COURSE CURRICULUM

B.Sc. (Hons.) Agriculture

(As per Sixth Dean's Committee)

FACULTY OF AGRICULTURE

AGRICULTURE UNIVERSITY, JODHPUR

Jodhpur-342304, Rajasthan

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RAJASTHAN-342304, INDIA

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Prof. Arun Kumar
Vice-Chancellor

FOREWORD

Agriculture University, Jodhpur was established under Act No. 21 of 2013 for the development of agricultural sciences with objective to achieve excellence in the field of teaching, research and extension. This University has its responsibility in the creation of best human resources having scientific visions to serve for the public and private sectors in the State and the Nation according to the University mandates. The **"Course Curriculum"** of Undergraduate Programme has been compiled and upgraded as per the recommendations of the 6th Dean's Committee formulated by ICAR, New Delhi for the result and skill-oriented quality agricultural education systems to meet the present needs of NEP 2020 and future challenges of Human Resource Development.

This Curriculum have been prepared semester wise distribution of subjects including course outlines of theory and practical, lecture schedules along with relevant books. Dr. Sita Ram Kumhar, Dean & Faculty Chairman with his team did splendid work in the compilation of Course Curriculum of UG Programme and I congratulate and appreciate for the publication of course content in the present shape on behalf of Agriculture University, Jodhpur. I also acknowledge the contribution of Heads of the Departments and all the Faculty members and supporting staff who helped in the publication of this booklet.

I am sure that booklet **"Course Curriculum"** has covered all the UG courses with syllabus. I believe that this **"Course Curriculum"** will be worthwhile to the students and faculty members of Agriculture faculty.

Dated : 24 January, 2025
Place : Jodhpur

(Arun Kumar)

Agriculture University, Jodhpur

Dean & Faculty Chairman

MESSAGE

I am delighted to write this message about Course Curriculum for Agriculture faculty of Agriculture University, Jodhpur. The **Course Curriculum** of UG Programme has been prepared as per recommendation of 6th Dean's Committee under the auspices of Indian Council of Agricultural Research, New Delhi. The present document contains syllabus with semester wise distribution of subjects, lecture schedules and suggested relevant reference books and being published as per the suggestions of Course Committee and approval of Academic Council and Board of Management of the University. This is upgraded version of Course Curricula, which includes some additional and important topics related to local requirement in Agriculture.

I express my deep sense of gratitude toProf. Arun Kumar, Hon'ble Vice-Chancellor, Agriculture University, Jodhpur for inspiration, guidance and encouragement to publish this document. I take this opportunity to express my sincere appreciation to all Heads of Departments for their valuable suggestions in the publication of the Course Curriculum. Further, I must appreciate the work of Academic cell to give this shape of the Course Curriculum.

I am sure that this publication would prove useful for the Teachers, Students and the entire faculty of Agriculture University, Jodhpur.

Dated : 24 January, 2025
Place: Jodhpur

(SR Kumhar)

CONTENT

SEMESTER WISE DISTRIBUTION OF COURSES WITH CREDIT HOURS

Note: Biology (PCB) and Agriculture (ABC) 10 + 2 streams Students should opt MATHS-111.

*****A student shall be required to opt any two of the SEC within year not between year from the bouquet (**SEC-111**, **SEC-112, SEC-113, SEC-114, SEC-121, SEC-122, SEC-123, SEC-124)** of Skill Enhancement Course (SEC) modules.

Second Year- Semester-I			
Course No.	**Course Title**	**Credit Hours**	**Page No.**
AGECON-211	Entrepreneurship Development and Business Communication	3 (2+1)	43-46
PEYPM-211	Physical Education, First Aid, Yoga Practices and Meditation	2 (0+2)	46-48
GPB-211	Principles of Genetics	3 (2+1)	48-50
AGRON-211	Crop Production Technology-I (*Kharif* crops)	3 (1+2)	50-52
HORT-211	Production Technology of Fruit and Plantation Crops	2 (1+1)	53-55
EXT-211	Fundamentals of Extension Education	2 (1+1)	55-58
NEMAT-211	Fundamentals of Nematology	2 (1+1)	58-60
AGRON-212	Principles and Practices of Natural Farming	2 (1+1)	60-63
SEC-211	Skill Enhancement course-V*	2 (0+2)	178-179
NSS-211/ NCC-211	National Cadet Corps -III/ National Service Scheme –III	1 (0+1) (NG	63-64
Total credit hours		**21 (9+12)**	-

NG = Non-gradial.

Second Year- Semester-II			
Course No.	**Course Title**	**Credit Hours**	**Page No.**
AIAI-221	Agricultural Informatics and Artificial Intelligence	3 (2+1)	64-67
HORT-221	Production Technology of Vegetables and Spices	2 (1+1)	67-69
AGECON-221	Principles of Agricultural Economics and Farm Management	2 (2+0)	69-71
AGRON-221	Crop Production Technology-II (*Rabi* Crops)	3 (1+2)	71-73
AGENGG-221	Farm Machinery and Power	2 (1+1)	74-75
AGRON-222	Water Management	2 (1+1)	75-77
SSAC-221	Problematic Soils and Their Management	2 (1+1)	77-79
GPB-221	Basics of Plant Breeding	3 (2+1)	79-82
SEC-221	Skill Enhancement Course-VI*	2 (0+2)	182-183
NSS-221/ NCC-221	National Cadet Corps -IV/ National Service Scheme –IV	1 (0+1) (NG)	82
Total credit hours		**21 (11+10)**	-

***Note:** A student shall be required to opt any two of the SEC within year not between year from the bouquet (**SEC-211**, **SEC-212, SEC-213, SEC-221, SEC-222, SEC-223**) of Skill Enhancement Course (SEC) modules. **NG =** Non-gradial**.**

Third Year- Semester-I			
Course No.	**Course Title**	**Credit Hours**	**Page No.**
AGECON-311	Agricultural Marketing and Trade	3 (2+1)	82-85
AGRON-311	Weed Management	2 (1+1)	85-87
AGMET-311	Introduction to Agro-meteorology	2 (1+1)	87-89
PPHY-311	Fundamentals of Crop Physiology	3 (2+1)	90-93
ENTO-311	Pest Management in Crops and Stored Grains	3 (2+1)	93-95
PPATH-311	Diseases of Field and Horticultural Crops and their Management	3 (2+1)	95-97
GPB-311	Crop Improvement (*kharif* crops) -I	2 (1+1)	97-100
HORT-311	Ornamental Crops, MAPs and Landscaping	2 (1+1)	101-102
AGRON-312	Introductory Agro Forestry	2 (1+1)	102-104
NCC-311*	National Cadet Corps -V	1 (0+1) (NG)	-
Total credit hours		**22 (13+9)**	-

* = Optional, NG = -Non-Gradial

Third Year- Semester-II			
Course No.	**Course Title**	**Credit Hours**	**Page No.**
PBT-321	Fundamentals of Agri Biotechnology	3 (2+1)	104-106
STAT-321	Basic and Applied Agricultural Statistics	3 (2+1)	107-109
GPB-321	Crop Improvement (*Rabi* crops) -II	2 (1+1)	110-112
AGENGG-321	Renewable Energy in Agriculture and Allied Sector	2 (1+1)	112-113
AGRON-321	Dryland Agriculture/ Rainfed Agriculture and Watershed Management	2 (1+1)	114-116
PPATH-321	Agricultural Microbiology and Phyto-remediation	2 (1+1)	116-118
AGECON-321	Agricultural Finance and Cooperation	2 (1+1)	118-120
BIOCHEM-321	Essentials of Plant Biochemistry	3 (2+1)	120-122
GPB-322	Fundamentals of Seed Science and Technology	2 (1+1)	122-124
NCC-321*	National Cadet Corps -VI	1 (0+1) (NG)	-
ST-321	Study Tour	2 (0+2) NG	124
Total credit hours		**21 (12+9)**	-

* = Optional, NG = -Non-Gradial

Fourth Year- Semester-I		
1.	Five Elective Courses (major or minor) each of 4 (3+1) credits for B.Sc. (Hons) Agriculture degree (Students shall opt only five courses from 20 listed courses at Page No. 4).	**20 (15+5)**
Fourth Year- Semester-II		
1.	Student READY: RAWE/ Industrial Attachment /Experiential Learning/ Hands-on Training/ Project Work/ Internship	**20 Credits**
	Total	**167**

	#Online courses (Page No. 189-190)	10	**10**
		Grand Total	**167+10#**

List of Elective Courses (Indicative)

S. No.	Course Name	Credit Hours	Page No.
1.	**AGECON-411:** Agri-Business Management	4 (3+1)	125-185
2.	**AGRON-411:** Management of Natural Resources	4 (3+1)	
3.	**ENTO-411:** Agrochemicals	4 (3+1)	
4.	**EXT-411:** Agricultural Journalism	4 (3+1)	
5.	**FSN-411:** Food Safety and Standards	4 (3+1)	
6.	**GPB-411:** Commercial Plant Breeding	4 (3+1)	
7.	**HORT-411:** Landscaping	4 (3+1)	
8.	**PBT-411:** Biotechnology of Crop Improvement	4 (3+1)	
9.	**PPATH-411:** Bioformulation and Nano Formulation	4 (3+1)	
10.	**SSAC-411:** Biopesticides and Biofertilizers	4 (3+1)	
11.	**AGRON-412:** System Simulation and Agro advisory	4 (3+1)	
12.	**FSN-412:** Food Science and Nutrition	4 (3+1)	
13.	**GPB-412:** Micro-Propagation Technologies	4 (3+1)	
14.	**HORT-412:** Hi-tech Horticulture	4 (3+1)	
15.	**HORT-413:** Protected Cultivation	4 (3+1)	
16.	**AGRON-413:** Climate Resilient Agriculture	4 (3+1)	
17.	**GPB-413:** Commercial Seed Production	4 (3+1)	
18.	**AGRON-414:** Geoinformatics and Remote Sensing, Precision Farming	4 (3+1)	
19.	**HORT-414:** Post-Harvest Technology and Value Addition	4 (3+1)	
20.	**AGRON-415:** Principles and Practices of Organic Farming/ Conservation Agriculture	4 (3+1)	
	Total Credits to be opted	**20 (15+5)**	-

Note: Any of the above five Elective Courses should be opted during 4th year, Semester-I.

READY 421: Student READY (RAWE/ Industrial Attachment/ Experiential Learning/ Hands-on Training/ Project Work/ Internship)

Rural Agricultural Work Experience and Agro-industrial Attachment (RAWE &AIA)				
S. No.	**Activities**	**No. of weeks**	**Credit Hours**	**Page No.**
1.	General Orientation & On Campus Training by different Faculties	1	10	186
2.	Unit Attachment in University/ College/ KVK/Research Station (Village Attachment)	5		
3.	Plant Clinic/ Agro-Industrial Attachment	4		
4.	Experiential Learning Programme	9	9	
5.	Project Report Preparation, Presentation and Evaluation	1	1	
	Total weeks for RAWE & AIA	**20**	**20**	-

Category Wise List of Courses

Course category	Course title	Credit Hours
Induction cum Foundation course	*Deekshaarambh*	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	1 (0+1) + 1 (0+1)
	Physical Education, First Aid and Yoga Practices	(0+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 and 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 and 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	2 (2+0)

	Management	
	Agricultural Finance and Cooperation	2 (1+1)
	Basic and Applied Agricultural 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)
	Fundamentals of Crop Physiology	3 (2+1)
	Essentials of Plant Biochemistry	3 (2+1)
	Livestock and Poultry Management	2 (1+1)
	Fundamentals of Agri Biotechnology	3 (2+1)
	TOTAL	**92**
Elective Courses	20 credits will be taken from list of choice-based course list or department wise courses to be decided by host institution	20
	TOTAL	**20**
Skill Enhancement Courses (indicative)	SEC-I	2 (0+2)
	SEC-II	2 (0+2)
	SEC-III	2 (0+2)
	SEC-IV	2 (0+2)
	SEC-V	2 (0+2)
	SEC-VI	2 (0+2)
	TOTAL	**12**
Students READY	RAWE/ Industrial Attachment /Experiential Learning/ Hands-on Training/ Project Work/ Internship	10+10
	TOTAL	**20**
Other/ Remedial course	Other Courses/ Remedial course on 1. Mathematics	1 Credit (Non-gradial)
	Study Tour (2 weeks in 3rd Year-Semester-I)	2 (0+2) (Non-gradial)
	Total credits for offline course	**167**
Online courses	*Online courses	**10**
	Grand Total	**167+10***

Department/Section Wise Courses

Course No.	Course title	Credit Hours	Total
Agronomy			
AGRON-111	Fundamentals of Agronomy	3 (2+1)	22 (11+11)
AGRON-112	Farming based livelihood systems	3 (2+1)	
AGRON-211	Crop Production Technology-I (*Kharif* Crops)	3 (1+2)	
AGRON-212	Principles and Practices of Natural Farming	2 (1+1)	
AGRON-221	Crop Production Technology-II (*Rabi* Crops))	3 (1+2	
AGRON-222	Water Management	2 (1+1)	
AGRON-311	Weed Management	2 (1+1)	
AGRON-312	Introductory Agro forestry	2 (1+1)	
AGRON-321	Dryland agriculture/ Rainfed Agriculture and Watershed Management	2 (1+1)	
Soil Science			
SSAC-111	Fundamentals of Soil Science	3 (2+1)	8 (5+3)
SSAC-121	Soil Fertility Management	3 (2+1)	
SSAC-221	Problematic Soils and their management	2 (1+1)	
Horticulture			
HORT-111	Fundamentals of Horticulture	3 (2+1)	9 (5+4)
HORT-211	Production Technology of Fruit and Plantation Crops	2 (1+1)	
HORT-221	Production Technology of Vegetables and Spices	2 (1+1)	
HORT-311	Ornamental Crops, MAPs, and Landscaping	2 (1+1)	
Genetics and Plant Breeding			
GPB-211	Principles of Genetics	3 (2+1)	12 (7+5)
GPB-221	Basics of Plant Breeding	3 (2+1)	
GPB-311	Crop Improvement (*Kharif* crops) - I	2 (1+1)	
GPB-321	Crop Improvement (*Rabi* crops)- II	2 (1+1)	
GPB-322	Fundamentals of Seed Science and Technology	2 (1+1)	
Entomology			
ENTO-121	Fundamentals of Entomology	3 (2+1)	6 (4+2)
ENTO-311	Pest management in Crops and Stored Grains	3 (2+1)	
Plant Pathology			
PPATH-121	Fundamentals of Plant Pathology	3 (2+1)	8 (5+3)
PPATH-311	Diseases of Field and Horticultural Crops and Their Management	3 (2+1)	
PPATH-321	Agricultural Microbiology and Phyto-remediation	2 (1+1)	
Extension Education			
EXT-111	Rural Sociology and Educational Psychology	2 (2+0)	8 (5+3)
EXT-112	Communication skills	2 (1+1)	
EXT-121	Personality development	2 (1+1)	
EXT-211	Fundamentals of Extension Education	2 (1+1)	
Agricultural Meteorology			
ESDM-121	Environmental Studies and Disaster Management	3 (2+1)	5 (3+2)

AGMET-311	Introduction to Agro-Meteorology	2 (1+1)	
Agricultural Economics			
AGECON-211	Entrepreneurship Development and Business Communication	3 (2+1)	9 (6+3)
AGECON-221	Principles of Agricultural Economics and Farm Management	2 (2+0)	
AGECON-311	Agricultural Marketing and Trade	2 (1+1)	
AGECON-321	Agricultural Finance and Cooperation	2 (1+1)	
Agricultural Statistics			
AIAI-221	Agricultural Informatics and Artificial Intelligence	3 (2+1)	6 (4+2)
STAT-321	Basic and Applied Agricultural Statistics	3 (2+1)	
MATHS-111	Introductory Mathematics	1 (1+0) NG	
Agricultural Engineering			
AGENGG-221	Farm Machinery and Power	2 (1+1)	4 (2+2)
AGENGG-321	Renewable energy in Agriculture and Allied Sector	2 (1+1)	
Nematology			
NEMAT-211	Fundamentals of Nematology	2 (1+1)	2 (1+1)
Biochemistry			
BIOCHEM-321	Essentials of Plant Biochemistry	3 (2+1)	3 (2+1)
Crop Physiology			
PPHY-311	Fundamentals of Crop Physiology	3 (2+1)	3 (2+1)
Animal Husbandry			
LPM-121	Livestock and Poultry Management	2 (1+1)	2 (1+1)
Agricultural Bio-Technology			
PBT-321	Fundamentals of Agri-Biotechnology	3 (2+1)	3 (2+1)
Students' Welfare			
NSS-111	NCC/NSS -I	1 (0+1)	1 (0+1)
NSS-121	NCC/NSS -II	1 (0+1)	1 (0+1)
NSS-211	NCC/NSS -III	1 (0+1) NG	1 (0+1) NG
NSS-221	NCC/NSS -IV	1 (0+1) NG	1 (0+1) NG
PEYPM-211	Physical Education, First Aid and Yoga Practices	2 (0+2)	2 (0+2)
ST-311	Study Tour	2 (0+2)	2 (0+2) NG

***Elective Courses (Indicative)**				
S.No.	**Credit No.**	**Courses Name**	**Credit hrs.**	**Discipline**
1.	**AGECON-411**	Agri-Business Management	4 (3+1)	Ag. Economics
2.	**AGRON-411**	Management of Natural Resources	4 (3+1)	Agronomy
3.	**AGRON-412**	System Simulation and Agro advisory	4 (3+1)	Agronomy
4.	**AGRON-413**	Climate Resilient Agriculture	4 (3+1)	Agronomy
5.	**AGRON-414**	Geoinformatics and Remote Sensing, Precision Farming	4 (3+1)	Agronomy
6.	**AGRON-415**	Principles and Practices of Organic Farming/ Conservation Agriculture	4 (3+1)	Agronomy
7.	**ENTO-411**	Agrochemicals	4 (3+1)	Entomology
8.	**EXT-411**	Agricultural Journalism	4 (3+1)	Ext. Education

9.	**FSN-411**	Food Safety and Standards	4 (3+1)	Food Science and Nutrition
10.	**FSN-412**	Food Science and Nutrition	4 (3+1)	Food Science and Nutrition
11.	**GPB-411**	Commercial Plant Breeding	4 (3+1)	GPB
12.	**GPB-412**	Micro-propagation Technologies	4 (3+1)	GPB
13.	**GPB-413**	Commercial Seed Production	4 (3+1)	GPB
14.	**HORT-411**	Landscaping	4 (3+1)	Horticulture
15.	**HORT-412**	Hi-tech Horticulture	4 (3+1)	Horticulture
16.	**HORT-413**	Protected Cultivation	4 (3+1)	Horticulture
17.	**HORT-414**	Post-Harvest Technology and Value Addition	4 (3+1)	Horticulture
18.	**PBT-411**	Biotechnology of Crop Improvement	4 (3+1)	Plant Biotechnology
19.	**PPATH-411**	Bioformulation and Nano Formulation	4 (3+1)	Plant Pathology
20.	**SSAC-411**	Biopesticides and Biofertilizers	4 (3+1)	Soil Science
***Out of the above 20 Elective courses, student has to choose 5 Courses**			**20 (15+5)**	**-**

List* - Skill Enhancement Courses (SECs)**				
S. No.	**Course No.**	**Course Title**	**Credit Hrs.**	**Discipline**
First Year				
1.	**SEC-111**	Vermicompost Production Technology	2 (0+2)	Soil Science
2.	**SEC-112**	Mushroom Production Technology	2 (0+2)	Plant Pathology
3.	**SEC-113**	Horticulture Nursery Management	2 (0+2)	Horticulture
4.	**SEC-114**	Food Processing	2 (0+2)	Food Science and Nutrtion
5.	**SEC-121**	Soil, Plant and Water Testing	2 (0+2)	Soil Science
6.	**SEC-122**	Production Technology of Bioagents	2 (0+2)	Plant Pathology
7.	**SEC-123**	Post-harvest Processing Technology	2 (0+2)	Horticulture
8.	**SEC-124**	Organic Production Technology	2 (0+2)	Agronomy
Second Year				
9.	**SEC-211**	Poultry Production Technology	2 (0+2)	Livestock Poultry Management
10.	**SEC-212**	Seed Production and Testing Technology	2 (0+2)	Genetics and Plant Breeding
11.	**SEC-213**	Floriculture and Landscaping	2 (0+2)	Horticulture
12.	**SEC-221**	Agriculture Waste Management	2 (0+2)	Soil Science
13.	**SEC-222**	Goat Farming	2 (0+2)	Livestock Poultry Management
14.	**SEC-223**	Beneficial Insect Farming	2 (0+2)	Entomology
		Total Credits	**12 (0+12)**	-

*Host institution may add more courses into this list.

** SEC will be decided by host institution depending on strength and choice of the student.

Summary of credit distributions among different categories of courses (Credit hrs)

Semester	Core Courses (Major and Minor)	Multi-Disciplinary Course (MDC)	Value Added Course (VAC)	Ability Enhancement Course (AEC)	Skill Enhancement Course (SEC)	Internship/ Project/ Student READY	Total Credits	Non-Gradial	Inter-nship	Online Courses / 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**	**-**	**10(13)**	
III	**14**	**----**	**---**	**2(9)**	**2**	**-**	**21**		**---**	
IV	**16**	**3(8)**	**3(10)**	**----**	**2**	**-**	**21**	**-**	**---**	
V	**19**	**3(11)**	**-**	**-**	**-**	**-**	**22**	**2(12)**	**10(14)**	
VI	**21**	**-**	**-**	**-**	**-**	**-**	**21**	**-**		
VII	**20**	**-**	**-**	**-**	**-**	**-**	**20**	**-**		
VIII	**-**	**-**	**-**	**-**	**-**	**20**	**20**	**-**		
Total	**112**	**9**	**6**	**8**	**12**	**20**	**167**	**4**	**20**	**10**

Note: The data in parenthesis denotes as per given below:

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

Summary of Credit Distributions

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

4.1 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.)/ B. F. Sc. (Hons.)/ B. Tech. NEP-NHEQF Level 6.0

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

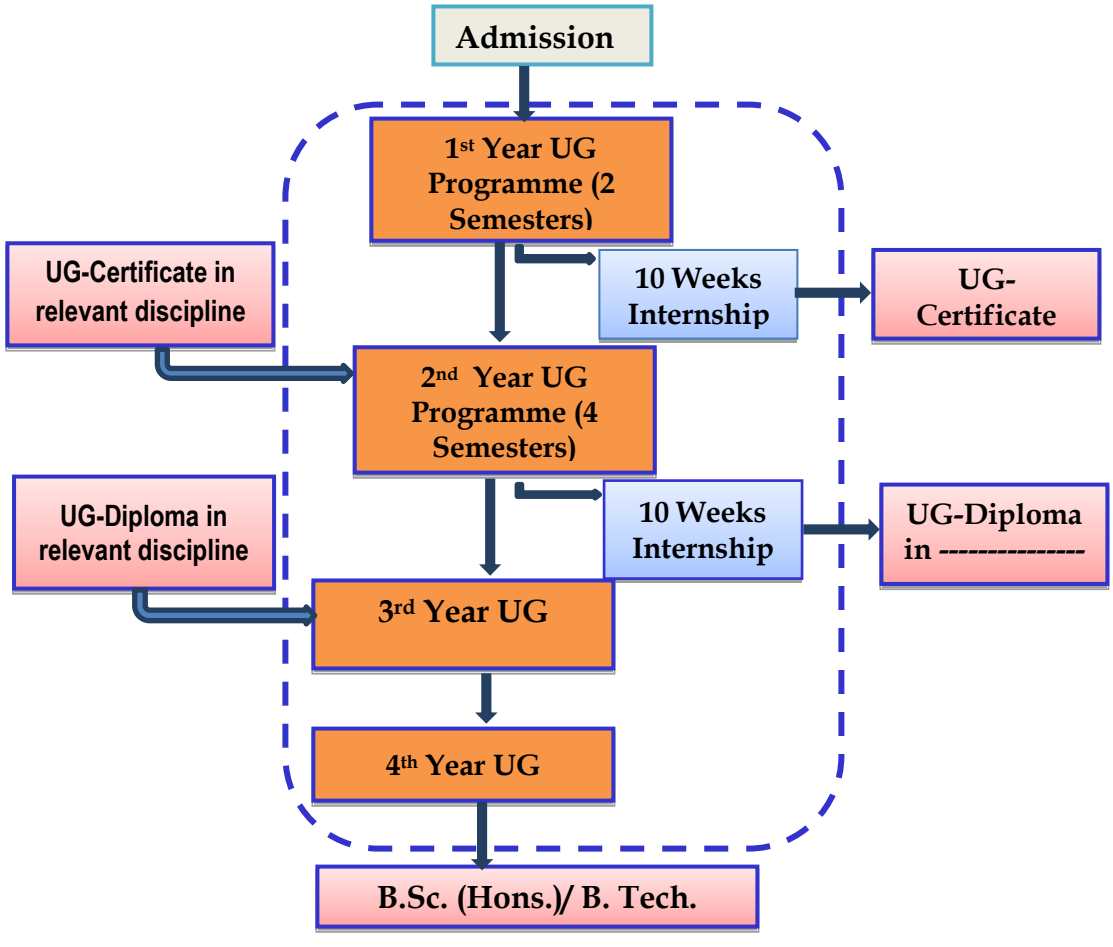

Fig. 1. Framework of Undergraduate Programmes

The eligibility for entry into the UG programs will be 10+2 Science; the students will be admitted as per norms of ICAR/ SAUs/CAUs. The 1st year of the programme will be having the foundation, introductory and skill enhancement courses. The 2nd year having basic core courses with some more options for skill enhancement. The 3rd year of the programme will have advanced core courses. The 4th year programme will emphasize more on the specialisation and elective courses as well as advanced skill enhancement through internship.

There will be exit options after 1st year and 2nd year for UG-Certificate and UG-Diploma, respectively. However, the students opting to exit with UG-Certificate or UG-Diploma will have to take up 10 weeks internship after the 1st year (2 semester) and 2nd year (4 semesters), respectively. The below Table shows the restructured undergraduate programs for the higher agricultural educational institutions (HAEIs).

Types of courses and Program outcomes for the restructured undergraduate programs

Year	Types of courses	Programme outcome (PO)	Exit option
YEAR 1 NHEQF Level 4.5	Foundation courses, Introductory courses and skills enhancement training/ training in the chosen area, ability enhancement courses.	Students will acquire the basic knowledge in respective disciplines and adequate skill in some selected areas, to enable them for employment /entrepreneurship.	A student must complete 10 weeks of internship (10 credits) after 1st year if exit with UG Certificate is opted.
YEAR-2 NHEQF Level 5	Basic core courses and additional skill enhancement in chosen areas/ courses.	Students will acquire the higher-level knowledge in respective disciplines and adequate skill in some selected areas, to enable them for employment at middle level/ supervisory level or for entrepreneurship.	A student must complete 10 weeks of internship (10 credits) after 2nd year if exit with UG-Diploma is opted i.e., Diploma in Agriculture.
YEAR-3	Advanced core subjects and their practical applications.	Students will have deeper understanding of the subjects and their major application areas.	No exit after 3rd year.
YEAR-4 NHEQF Level 6	Specialization/ Elective courses and advanced skill enhancement through project and internship.	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 the discipline of Agriculture i.e., B. Sc. (Hons.) Agriculture.

B. Sc. = Betchlor of Science.

Semester Wise Course Pogramme and Syllabus

Year-I (Part-I), Semester-I

ICF-111 *Deeksharambh* (Induction-cum-Foundation Programme) 2 (0+2)

Course Status : Foundation Course (Non-Gradial)

Contact Hours (L-T-P) : 0-0-16 (2 Weks duration)

Course Objective :
1. To give a broad view and application areas of the subject of study.
2. Helping students from different backgrounds for cultural Integration.
3. Knowing about the operational framework of academic process in the university.
4. Instilling life and social skills, leadership qualities, team working spirit.
5. Developing social awareness, ethics and values, creativity.
6. Helping students to identify the traditional values and indigenous cultures along with diverse potentialities both in indigenous and developed scenario.

Course Outcomes (CO) : This course will -
1. nurture students by blossoming their hidden potentials to pursue the academic and professional studies in a diligent, honest and responsible manner.
2. to develop a sense of integrity with diverse faculties and build linkages with peers, society and community as a whole and lastly be proficient in earning livelihood independently along with sustaining society and nature.

Course Description :

Activities:

The details of activities/ schedules will be decided by the universities/ college. The structure shall include, but not restricted to lecture schedule given below:

Theory Lecture Schedule:

S. No.	Name of Activity	No. of lecture
1.	Discussions on operational framework of academic process in the university, as well as interactions with academic and research managers of the University.	6
2.	Creating awareness on the subject of study and the traditional values, and indigenous cultures along with diverse potentialities both in indigenous and developed scenario.	8
3.	Interaction with alumni, business leaders, perspective employers, outstanding achievers in related fields and people with inspiring life experiences.	4
4.	Group activities to identify the strength and weakness of students (with expert advice for their improvement) as well as to create a platform for students to learn from each other's life experiences.	4
5.	Field visits to related fields/ establishments.	4
6.	Sessions on personality development (instilling life and social skills, social awareness, ethics and values, team work, leadership, etc.) and communication skills.	6

EXT-111 Rural Sociology and Educational Psychology 2 (2+0)

Course Status : Core
Contact Hours (L-T-P) : 2-0-0
Course Objective : To introduce the students to Rural Sociology and Educational Psychology so that students can communicate with farmer and easily implement the agricultural policies.
Course Outcomes (CO) : After the completion of this course, the student will be able to -
CO-1: Learn about rural sociology & extension education.
CO-2: Understand sociocultural dynamics.
CO-3: Learn about leadership.
CO-4: Understand psychological concepts.
CO-5: Apply teaching and learning process.

Course Description :

Theory:	**CO Mapping**
Unit 1: Foundations of Extension Education and Rural Sociology in Agricultural Extension Extension Education and Agricultural Extension: Meaning, definition, scope, and importance. Sociology and rural sociology: Meaning, definition, scope, importance of rural sociology in Agricultural Extension, and interrelationship between rural sociology and Agricultural Extension. Indian Rural Society: important characteristics, differences and relationship between rural and urban societies. Social Groups: Meaning, definition, classification, factors considered information and organization of groups, motivation in group formation, motivation in group formation and role of social groups in Agricultural Extension. Social Stratification: Meaning, definition, functions, basis for stratification, forms of social stratification, characteristics and differences between class and caste system.	CO-1
Unit 2: Sociocultural Dynamics in Agricultural Extension Cultural concepts: culture, customs, folkways, mores, taboos, rituals. Traditions: Meaning, definition and their role in Agricultural Extension. Social Values and Attitudes: Meaning, definition, types and role of social values and attitudes in agricultural Extension. Social Institutions: Meaning, definition, major institutions in rural society, functions, and their role in agricultural Extension. Social Organizations: Meaning, definition, types of organizations and role of social organizations in agricultural Extension. Social Control: Meaning, definition, need of social control and means of social control. Social change: Meaning, definition, nature of social change, dimensions of social change and factors of social change.	CO-2
Unit 3: Leadership Leadership: Meaning, definition, classification, roles of leader, different methods of selection of professional and lay leaders. Training of Leaders: Meaning, definition, methods of training, Advantages and limitations in use of local leaders in Agricultural Extension.	CO-3
Unit 4: Psychological Foundations in Agricultural Extension Psychology and educational psychology: Meaning, definition, scope, and importance of educational psychology in Agricultural Extension. Intelligence: Meaning, definition, types, factors affecting intelligence and importance of intelligence in Agricultural Extension. Personality: Meaning, definition, types, factors influencing the personality and role of personality in agricultural Extension.	CO-4
Unit 5: Teaching and Learning Process in Agricultural Education 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.	CO-5

Theory Lecture Schedule:

S. No.	Name of Topic	No. of lecture
1.	Extension Education and Agricultural Extension: Meaning, definition, scope, and importance.	1
2.	Sociology and rural sociology: Meaning, definition, scope, importance of rural sociology in Agricultural Extension, and interrelationship between rural sociology and Agricultural Extension	2
3.	Indian Rural Society: important characteristics, differences and relationship between rural and urban societies.	2
4.	Social Groups: Meaning, definition, classification, factors considered information and organization of groups, motivation in group formation, motivation in group formation and role of social groups in Agricultural Extension.	2
5.	Social Stratification: Meaning, definition, functions, basis for stratification, forms of social stratification, characteristics and differences between class and caste system.	2
6.	Cultural concepts: culture, customs, folkways, mores, taboos, rituals. Traditions: Meaning, definition and their role in Agricultural Extension.	2
7.	Social Values and Attitudes: Meaning, definition, types and role of social values and attitudes in agricultural Extension.	2
8.	Social Institutions: Meaning, definition, major institutions in rural society, functions, and their role in agricultural Extension.	2
9.	Social Organizations: Meaning, definition, types of organizations and role of social organizations in agricultural Extension.	2
10.	Social Control: Meaning, definition, need of social control and means of social control.	2
11.	Social change: Meaning, definition, nature of social change, dimensions of social change and factors of social change.	2
12.	Leadership: Meaning, definition, classification, roles of leader, different methods of selection of professional and lay leaders.	2
13.	Training of Leaders: Meaning, definition, methods of training, Advantages and limitations in use of local leaders in Agricultural Extension,	1
14.	Psychology and educational psychology: Meaning, definition, scope, and importance of educational psychology in Agricultural Extension.	2
15.	Intelligence: Meaning, definition, types, factors affecting intelligence and importance of intelligence in Agricultural Extension.	2
16.	Personality: Meaning, definition, types, factors influencing the personality and role of personality in agricultural Extension.	2
17.	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.	2

Suggested Readings*:*

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

EXT-112 Communication Skills 2 (1+1)

Course Status : Common Course
Contact Hours (L-T-P) : 1-0-2
Course Objective : To acquire competence in oral, written and non-verbal communication, develop strong personal and professional communication and demonstrate positive group communication.
Course Outcomes (CO) : After the completion of this course, the student will be able to -
CO-1: Understand effective communication.
CO-2: Develop communication skills.
CO-3: Apply grammar fundamentals.

Course Description :

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

Practical:

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

Theory Lecture Schedule:

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

	and articles.	
12.	Agreement of verb with the subject: tense, mood, voice; Writing effective sentences; Basic sentence faults.	2

Practical Schedule:

S. No.	Name of Topic	No. of practical
1.	Listening and note taking.	2
2.	Writing skills: precis writing, summarizing and abstracting.	2
3.	Reading and comprehension (written and oral) of general and technical articles.	2
4.	Micro-presentations and Impromptu Presentations: Feedback on presentations.	2
5.	Stage manners: grooming, body language, voice modulation, speed.	2
6.	Group discussions; Public speaking exercises; vocabulary building exercises.	2
7.	Interview Techniques.	2
8.	Organization of events.	2

Suggested Readings:

1. Allport, G. W. Personality: A Psychological Interpretation.
2. Brown Michele and Gyles Brandreth. How to Interview and be Interviewed.
3. Carnegie DaleThe Quick and Easy Way to Effective Speaking.
4. Francis Peter, S. J. Soft Skills and Professional Communication.
5. Kumar, S. and Pushpa Lata. Communication Skills.
6. Neuliep James, W. Intercultural Communication A Contextual Approach.
7. Pease, Allan. Body Language.
8. Raman, M. and Singh, P. Business Communication.
9. Seely, J. Oxford Guide to Effective Writing and Speaking.
10. Thomson, A. J. and Martinet, A. V. A Practical English Grammar.

AGRON-111 Fundamentals of Agronomy 3 (2+1)

Course Status : Core
Contact Hours (L-T-P) : 2-0-2
Course Objective : To impart the basic and fundamental knowledge of Agronomy.
Course Outcomes (CO) : After the completion of this course, the student will be able to learn about

CO-1: Explain the knowledge gained on the principle of agronomy with other disciplines of agriculture science.
CO-2: Recognize the various nutrients and their effects on plant health.
CO-3: To know about water budgeting and soil moisture constants.
CO-4: Identification of weeds and their management.
CO-5: Plan for sustainable agriculture production .

Course Description :

Theory:	CO Mapping
Unit 1: Introduction to Agronomy and its scope 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,	CO-1

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.	
Unit 2: Crop nutrition Definition of essential nutrients, criteria of essentiality, functional nutrients, classification of essential nutrients, role of macro and micro nutrients. Nutrient absorption, active and passive absorption of nutrients, forms of plant nutrients absorbed by plants, Combined /uncombined forms. Manures and fertilizers, nutrient use efficiency: Sources of nutrients: Inorganic (fertilizers), organic (manures) and bio-fertilizers; their classification and characteristics, method of preparation and role of organic manures in crop production. Integrated Nutrient Management (INM): Meaning, different approaches and advantages of INM. Green manure- role in crop production: Definition, objectives types of green manuring, desirable characteristics, advantages and limitations of green manuring.	CO-2
Unit 3: Water management Water resources of the world, India and the state; Soil Moisture constants: gravitational water, capillary water, hygroscopic water, Soil moisture constants	CO-3
Unit 4: Weed management Definition, Importance and basics of classification of weeds and their control. Agroclimatic zones of India and the state, cropping systems: Factors affecting cropping systems, major cropping patterns and systems in the country.	CO-4
Unit 5: 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.	CO-5

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, Seedgermination and viability test of seed, Practice on time and method of application of manures and fertilizers.

Theory Lecture Schedule:

S. No.	Name of Topic	No. of lecture
1.	Agronomy and its scope: Definition, meaning and scope of Agronomy; art, science and business of crop production.	1
2.	Relation of Agronomy with other disciplines of Agricultural Science.	1
3.	Fields crops and classification, importance, ecology and ecosystem.	1
4.	Seed; Definition of crops, variety and seed, Types of seeds, dormancy of seeds.	1
5.	Factors affecting crop stands establishment: good quality seed, proper tillage, time of sowing and seed rate.	1
6.	Viability of seeds, seed treatment.	1
7.	Sowing- Methods, depth, plant density.	1
8.	Tillage- Definition, objectives, types, advantages and disadvantages of tillage including conservation tillage.	1
9.	Tilth- Definition and characteristics of good tilth.	1
10.	Crop density and geometry; plant geometry and planting geometry, its	1

	effect on growth, yield.	
11.	Crop nutrition- Definition of essential nutrients, criteria of essentiality, functional elements, classification of essential nutrients.	2
12.	Role of macro and micro nutrients.	1
13.	Nutrient absorption, active and passive absorption of nutrients, forms of plant nutrients absorbed by plants, Combined /uncombined forms.	2
14.	Manures and fertilizers.	2
15.	Nutrient use efficiency and Sources of nutrients: Inorganic (fertilizers), organic (manures) and bio-fertilizers; their classification and characteristics.	2
16.	Method of preparation and role of organic manures in crop production	1
17.	Integrated Nutrient Management (INM): Meaning, different approaches and advantages of INM.	1
18.	Green manure- role in crop production: Definition, objectives types of green manuring, desirable characteristics, advantages and limitations of green manuring.	1
19.	Water management: Water resources of the world, India and the state.	1
20.	Soil Moisture constants: gravitational water, capillary water, hygroscopic water, Soil moisture constants.	1
21.	Weeds – Definition, importance and classification.	1
22.	Weed control methods.	1
23.	Agroclimatic zones of India and the state.	1
24.	cropping systems: Factors affecting cropping systems, major cropping patterns and systems in the country.	1
25.	Sustainable crop production: Definition, importance and practices.	1
26.	Natural resources and conservation pollution and pollutants.	1
27.	Allelopathy: Meaning and importance in crop production.	1
28.	Growth and development of crops: Definition, Meaning and factors affecting growth and development.	1

Practical Schedule:

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

Suggested Readings:

1. Rao V S. 1992. Principles of Weed Science. Oxford and IBH Publishing Co. Ltd. New Delhi.
2. Reddy Yellamanda T and Shankara Reddy G H. 2023 (6th Edition). Principles of Agronomy. Kalyani Publishers, Ludhiana.
3. Reddy, S. R. 2008. Principle of Crop Production, Kalyani Publisher, Ludhiana.
4. William L Donn. 1965. Meteorology. McGraw-Hill Book Co. New York.

5. Yawalkar K S and Agarwal J P. 1977. Manures and Fertilizers. Agricultural Horticultural Publishing House, NagpurRao, V. S. 1992. Principles of Weed Science. Oxford and IBH Publishing Co. Ltd. New Delhi.

AGRON-112 Farming Based Livelihood System 3 (2+1)

Course Status : Common Course
Contact Hours (L-T-P) : 2-0-2
Course Objective:
1. To make the students aware about farming-based livelihood systems in agriculture.
2. To disseminate the knowledge and skill how farming-based systems can be a source of livelihood.

Course Outcomes (CO) : After the completion of this course, the student will be able -
CO-1: To aware about agriculture status and farming systems in India.
CO-2: To know the components and enterprises of farming systems.
CO-3: To understand feasibility of different models through case studies.
CO-4: To know about innovative initiatives taken by public and private sector in 21st Century.

Course Description :

Theory:	**CO Mapping**
Unit 1: Introduction Status of agriculture in India and different states, Income of farmers and rural people in India, Livelihood-Definition, concept and livelihood pattern in urban and rural areas, Different indicators to study livelihood systems. Agricultural livelihood systems (ALS): Meaning, approach, approaches and framework, Definition of farming systems and farming based livelihood systems Prevalent Farming systems in India contributing to livelihood. Types of traditional and modern farming systems.	CO-1
Unit 2: Component and enterprises of farming system 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.	CO-2
Unit 3: Feasibility, models and case studies of farming system Feasibility of different farming systems for different agro-climatic zones, Commercial farming-based livelihood models by NABARD, ICAR and other organizations across the country, Case studies on different livelihood enterprises associated with the farming.	CO-3
Unit 4: Initiatives taken by public and private sector in 21st Century Risk and success factors in farming-based livelihood systems, Schemes and programs by Central and State Government, Public and Private organizations involved in promotion of farming-based livelihood opportunities. Role of farming-based livelihood enterprises in 21st Century in view of circular economy, green economy, climate change, digitalization and changing life style	CO-4

Practical:

Survey of farming systems and agricultural based livelihood enterprises, Study of components of important farming based livelihood models/ systems in different agro-climatic zones, Study of

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

Theory Lecture Schedule:

S. No.	Name of Topic	No. of lecture
1.	Status of agriculture in India and different states.	1
2.	Income of farmers and rural people in India.	1
3.	Livelihood-Definition, concept and livelihood pattern in urban and rural areas.	1
4.	Different indicators to study livelihood systems.	1
5.	Agricultural livelihood systems (ALS): Meaning, approaches and framework.	2
6.	Definition of farming systems and farming based livelihood systems.	1
7.	Prevalent Farming systems in India contributing to livelihood.	1
8.	Types of traditional and modern farming systems.	1
9.	Components of farming system/ farming-based livelihood systems- Crops and cropping systems, Livestock (Dairy, Piggery, Goatry, Poultry, Duckry etc.).	2
10.	Horticultural crops, Agro--forestry systems.	1
11.	Aqua culture Duck/Poultry cum Fish, Dairy cum Fish, Piggery cum Fish etc.	2
12.	Small-, medium- and large- enterprises including value chains and secondary enterprises as livelihood components for farmers.	2
13.	Factors affecting integration of various enterprises of farming for livelihood.	
14.	Feasibility of different farming systems for different agro-climatic zones.	1
15.	Commercial farming-based livelihood models by NABARD, ICAR and other organizations across the country.	2
16.	Case studies on different livelihood enterprises associated with the farming.	2
17.	Risk and success factors in farming-based livelihood systems.	1
18.	Schemes and programs by Central and State Government in promotion of farming-based livelihood opportunities.	2
19.	Schemes and programs by Public and Private organizations involved in promotion of farming-based livelihood opportunities.	2
20.	Role of farming-based livelihood enterprises in 21st Century in view of circular economy.	1
21.	Green economy.	1
22.	Climate change: Causes and its impact on agriculture.	1
23.	Digitalization and changing life style.	2

Practical Schedule:

S. No.	Name of Topic	No. of practical
1.	Survey of farming systems and agricultural based livelihood enterprises.	1
2.	To study the agro-climatic zones of India and Rajasthan.	1
3.	Study of components of important farming based livelihood models/ systems in different agro-climatic zones.	1
4.	Study of components of important farming based livelihood.	1
5.	Study of production and profitability of crop based system/models.	1

6.	Study of production and profitability of livestock based system/models.	1
7.	Study of production and profitability of processing based livelihood models.	1
8.	Study of production and profitability of integrated farming based livelihood models.	1
9.	Field visit of innovative farming system models.	1
10.	Visit of Agri-based enterprises and their functional aspects for integration of production, processing and distribution sectors.	1
11.	Study of agri-enterprises involved in industry and service sectors.	2
12.	Learning about concept of project formulation on farming-based livelihood systems.	1
13.	Cost and profit analysis of project formulation on farming-based livelihood systems.	1
14.	Case study of Start-Ups in agri-sectors.	2

Suggested Readings:

1. Ashley, C. and Carney, D. 1999. Sustainable Livelihoods: Lessons from Early Experience; Department for International Development: London, UK; Volume 7. [Google Scholar].
2. Agarwal, A. and Narain, S. 1989. Towards Green Villages: A strategy for Environmentally, Sound and Participatory Rural Development, Center for Science and Environment, New Delhi, India.
3. Carloni, A. 2001. Global Farming Systems Study: Challenges and Priorities to 2030 Regional Analysis: Sub-Saharan Africa, Consultation Document, FAO, Rome, Italy.
4. Dixon, J. and A. Gulliver with D. Gibbon. 2001. Farming Systems and Poverty: Improving Farmers' Livelihoods in a Changing World. FAO & World Bank, Rome, Italy & Washington, DC, USA.
5. Evenson, R.E. 2000. Agricultural Productivity and Production in Developing Countries'. In FAO, The State of Food and Agriculture, FAO, Rome, Italy.
6. Livelihood Improvement of Underprivileged Farming Community: Some Experiences from Vaishali, Samastipur, Darbhanga and Munger Districts of Bihar by B. P. Bhatt, Abhay Kumar, P.K. Thakur, AmitavaDeyUjjwal Kumar, Sanjeev Kumar, B.K. Jha, Lokendra Kumar, K. N. Pathak, A. Hassan, S. K. Singh, K. K. Singh and K. M. Singh ICAR Research Complex for Eastern Region ICAR Parisar, P.O. Bihar Veterinary College, Patna - 800 014, Bihar.
7. Panwar et al. 2020. Integrated Farming System models for Agricultural Diversification, Enhanced Income and employment, Indian Council of Agricultural Research, New Delhi.
8. Reddy, S.R. 2016. Farming System and Sustainable Agriculture, Kalyani Publishers, New Delhi.
9. Singh, J.P., et al. 2015. Region Specific Integrated Farming System Models, ICAR-Indian Institute of Farming Systems Research, Modipuram.
10. Walia, S. S. and Walia, U. S. 2020. Farming System and Sustainable Agriculture, Scientific Publishers, Jodhpur, Rajasthan.

SSAC-111 Fundamentals of Soil Science 3 (2+1)

Course Status : Core
Contact Hours (L-T-P) : 2-0-2
Course Objective : To impart knowledge on soil genesis, basic soil properties with respect to plant growth.
Course Outcomes (CO) : After the completion of this course the student will be able to learn-

CO-1: Comprehensive knowledge of soil genesis, formation processes, composition and properties.

CO-2: Knowledge of soil basic properties including physical and

chemical soil properties.

CO-3: Knowledge of classification and soil taxonomy.

Course Description :

Theory:	**CO Mapping**
Unit 1: Soil Fundamentals and Formation Soil-Pedological and edaphalogical concepts, rocks and minerals, Weathering, Soil formation, Pedogenic processes, Soil profile.	CO-1
Unit 2: Clay mineral and soil colloids Silicate clays: constitution and properties. Sources of charge, ion exchange, cation and anion exchange capacity. Soil colloids: inorganic and organic, Properties of soil colloids and Ion exchange in soils.	
Unit 3: Soil physical properties Soil texture, soil structure. Bulk density and particle density, soil consistency, soil temperature, soil air, soil water.	CO-2
Unit 4 Soil organic matter and chemical properties Soil organic matter, Soil reaction and buffering capacity.	
Unit 5 Soil taxonomy and classification Soil taxonomy, keys to soil orders. Soils of India.	CO-3

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 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, determination of pH and Electrical conductivity of soil.

Theory Lecture Schedule:

S. No.	Name of Topic	No. of Lecture
1.	Soil- Pedological and edaphalogical concepts.	1
2.	Soil forming rocks and minerals and their classification.	2
3.	Weathering: Physical, chemical and biological weathering of rocks	2
4.	Soil formation.	1
5.	Pedogenic processes/soil forming processes.	2
6.	Soil profile.	1
7.	Silicate clays: constitution and properties.	2
8.	Sources of charge.	1
9.	Ion exchange, cation and anion exchange capacity.	1
10.	Soil colloids: inorganic and organic, Properties of soil colloids.	2
11.	Ion exchange in soils.	1
12.	Soil texture.	1
13.	soil structure.	1
14.	Bulk density and particle density.	1
15.	soil consistency.	1
16.	Soil temperature.	2
17.	soil air	1
18.	Soil water	2
19.	Soil organic matter	2
20.	Soil reaction and buffering capacity.	1
21.	Soil taxonomy, keys to soil orders.	2
22.	Soils of India.	1

Practical Schedule:

S. No.	Name of Topic	No. of practical
1.	Study of general properties of minerals.	1
2.	Study of minerals-silicate and non-silicate minerals.	1
3.	Study of rocks-igneous, sedimentary and metamorphic rocks.	1
4.	Study of a soil profile.	1
5.	Study of collection and processing of soil for analysis.	1
6.	Study of soil texture-feel method and mechanical analysis.	1
7.	Determination of Bulk density of soil sample.	1
8.	Determination of particle density of soil and computation of porosity.	1
9.	Determination of soil colour by munsell colour chart.	1
10.	Study of soil structure and aggregate analysis.	1
11.	Determination of soil moisture by gravimetric method.	1
12.	Determination soil moisture content at 1/3 bars (field capacity) by pressure plate (membrane) apparatus.	1
13.	Determination of water holding capacity.	1
14.	Measurement of infiltration rate in soil by double ring infiltrometer.	1
15.	Determination of soil reaction (pH) of soil.	1
16.	Determination of electrical conductivity of soil.	1

Suggested Readings:

1. Brady, N. C. and Well, R. R. 2014. Nature and properties of soils. Pearson Education Inc., New Delhi.
2. Chopra, S. L., Kanwar, J. S. and Rakshit, A. 2013. Analytical Agricultural Chemistry, Kalyani Publishers Ludhiana.
3. Das, D. K. 2011. Introductory Soil Science (3rd Edition), Kalyani publisher, Ludhiana (India).
4. Gupta, P. K. 2009. Soil, Plant, Water and Fertilizer Analysis (2nd Edition), Agrobios, Jodhpur (India).
5. Indian Society of Soil Science (ISSS) 2002. Fundamentals of Soil Science, IARI, New Delhi.
6. Mehra, R. K. 2004. Text Book of Soil Science, ICAR, New Delhi.
7. Rakshit, A., Raha, P. and Bhadoria, P. B. S. 2015. Principles of Soil Science. Kalyani Publishers, Ludhiana.
8. Sehgal, J. A. 2005. Textbook of Pedology: Concepts and Applications. Kalyani Publishers, New Delhi.
9. Seema, Sodani R., Yadav S. 2019.Manual for Soil and Plant analysis, LAP Lambert Academic Publishing,U.K.
10. Indian Society of Soil Science (ISSS) 2015.Soil Science: An Introduction, Indian society of soil science, New Delhi.

HORT-111 Fundamentals of Horticulture 3 (2+1)

Course Status : Core
Contact Hours (L-T-P) : 2-0-1
Course Objective :
1. To provide knowledge on different branches of horticulture viz. pomology, olericulture, floriculture and landscaping, spices and medicinal plants.
2. To provide knowledge on orchard management, propagation methods, cultural operations and nutrient management of horticultural crops.
3. To provide knowledge on different physiological aspects of horticultural crops.

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

learn-

CO-1: Importance of horticulture and classification of horticultural crops.

CO-2: Principles and methods of plant propagation.

CO-3: Principles and methods of orchard establishment and management.

Course Description :

Theory:	**CO Mapping**
Unit 1: Introduction Horticulture: Its different branches, importance and scope, Horticultural and botanical classification, soil and climate for horticultural crops, Introduction to protected cultivation, Introduction to post-harvest management of fruits and vegetables.	CO-1
Unit 2: Plant propagation Plant propagation: methods and propagation structures, seed dormancy and seed germination, Merits and demerits of sexual and asexual propagation, Stock-scion relationship, Nursery raising and its importance.	CO-2
Unit 3: Orchard establishment and management 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, importance of bio regulators in horticultural crops, irrigation and its methods, Fertilizer application in horticultural crops.	CO-3

Practical:

Identification and nomenclature of fruits, 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.

Theory Lecture Schedule:

S. No.	Name of Topic	No. of Lecture
1.	Horticulture - Its definition and branches.	1
2.	Importance and scope of horticulture.	1
3.	Botanical and Horticultural classification of horticultural crops.	1
4.	Soil and climate for horticultural crops.	1
5.	Introduction to protected cultivation of horticultural crops.	1
6.	Introduction to post-harvest management of fruits and vegetables.	1
7.	Plant propagation methods- sexual propagation.	1
8.	Plant propagation methods- asexual propagation.	1
9.	Asexual propagation methods- cutting.	1
10.	Asexual propagation methods- layering.	1
11.	Asexual propagation methods- budding.	1
12.	Asexual propagation methods- grafting.	1
13.	Asexual propagation methods- specialized structures.	1
14.	Propagation structures.	1
15.	Seed dormancy- types and mechanisms.	1
16.	Seed dormancy- methods of breaking seed dormancy.	1
17.	Merits and demerits of sexual and asexual propagation	1
18.	Stock-scion relationship.	1
19.	Nursery raising and its importance- nursery types and affecting factors.	1

20.	Components of a model nursery.	1
21.	Principles of orchard establishment.	1
22.	Methods of orchard layout.	1
23.	Principles and methods of training and pruning of fruit crops.	1
24.	Juvenility and flower bud differentiation.	1
25.	Unfruitfulness in horticultural crops.	1
26.	Pollination, pollinizers and pollinators.	1
27.	Fertilization and parthenocarpy.	1
28.	Importance of plant bio-regulators in horticultural crops.	1
29.	Irrigation and its methods used in horticultural crops.	1
30.	Fertilizer application in horticultural crops.	1

Practical Schedule:

S. No.	Name of Topic	No. of practical
1.	Identification and nomenclature of fruits.	1
2.	Identification and brief description of garden tools.	1
3.	Layout of an orchard, pit making and system of planting.	1
4.	Nursery raising techniques of fruit crops.	1
5.	Understanding of plant propagation structures.	1
6.	Propagation of horticultural crops through seeds .	1
7.	Propagation of horticultural crops through specialized plant parts.	1
8.	Propagation techniques for horticultural crops- layering/cutting.	1
9.	Propagation techniques for horticultural crops- budding/grafting.	1
10.	Container, potting mixture, potting and repotting.	1
11.	Practice of training and pruning methods on fruit crops.	1
12.	Preparation of fertilizer mixture and application.	1
13.	Preparation and application of PGR.	1
14.	Layout of different irrigation systems.	1
15.	Studies on maturity, harvesting, grading, packaging and storage of fruits and vegetables.	1

Suggested Readings:

1. Chadha, K.L. 2019. Handbook of Horticulture (2 Vol., 2nd Rev. Edn.). ICAR.
2. Kumar, N. 2021. Introduction to Horticulture (9th Edn.). MedTech Science Publications.
3. R.L.Bhardwaj and D.K.Sarolia, 2011. Modern Nursery Management, Agrobios Publication – Jodhpur
4. Misra, K.K. and Kumar, R. 2014. Fundamentals of Horticulture. Biotech Books.
5. Peter, K.V. 2009. Basic Horticulture. NIPA.
6. Salunkhe, D.K. and Kadam, S.S. 2013. A Handbook of Fruit Science and Technology. CRC Press.
7. Singh, Jitendra. 2020. Basic Horticulture. Kalyani Publications.
8. Singh, N.P. 2005. Basic Concepts of Fruit Science. IBDC.

NSS-111 National Service Scheme -I 1 (0+1)

Course Status : Common Course
Contact Hours (L-T-P) : 0-0-4
Course Objective : To create a generation of well-informed, responsible citizens who are committed to contributing to the betterment of society through active engagement, volunteerism, and social mobilization.
Course Outcomes (CO) : After the completion of this course, the student will be able to -
CO-1: Understand about NSS, its organizational structure and the

significance of its symbols and badges.
CO-2: analyze and guide financial patterns of NSS schemes and effectively maintain activity diaries.
CO-3: understand the various definitions, profiles, and challenges faced by youth, recognizing their potential as agents of social change and exploring opportunities available through youth programs.
CO-4: develop skills in mapping community stakeholders, crafting culturally relevant messages, and utilizing effective methods for youth-adult partnership in mobilization efforts.
CO-5: to instill a sense of national identity by exploring the role of youth in nation-building, along with strategies for conflict resolution and peace-building within diverse communities.
CO-6: explore the significance of volunteerism and shramdan in Indian tradition.
CO-7: gain knowledge about the Constitution of India, including fundamental rights and duties, human rights, and consumer awareness, enhancing their sense of citizenship.
CO-8: analyze the concept of family, community structures like Panchayati Raj Institutions (PRIs), and their roles in societal development.

Course Description :

Practical:	**CO Mapping**
Unit-I: Introduction and organizational Structure of NSS: Introduction and basic components of NSS: Orientation: history, objectives, principles, symbol, badge; regular programmes under NSS. Organizational structure of NSS, code of conduct for NSS volunteers, points to be considered by NSS volunteers awareness about health.	CO-1
Unit-II: NSS programmes and activities: Concept of regular activities, special camping, day camps, basis of adoption of village/slums, conducting survey, analysing guiding financial patterns of scheme, youth programme/ schemes of GOI, coordination with different agencies and maintenance of diary.	CO-2
Unit-III: Understanding Youth: Definition, profile, categories, issues and challenges of youth; and opportunities for youth who is agent of the social change.	CO-3
Unit-IV: Community mobilization: Mapping of community stakeholders, designing the message as per problems and their culture; identifying methods of mobilisation involving youth-adult partnership; Social harmony and national integration.	CO-4
Unit-V: Social Harmony and National Integration: Indian history and culture, role of youth in nation building, conflict resolution and peace-building.	CO-5
Unit-VI: Volunteerism and shramdan: Indian tradition of volunteerism, its need, importance, motivation and constraints; shramdan as part of volunteerism.	CO-6
Unit-VII: Citizenship, constitution and human rights: Basic features of constitution of India, fundamental rights and duties, human rights, consumer awareness and rights to information.	CO-7
Unit-VIII: Family and society: Concept of family, community (PRIs and other community based organizations) and society.	CO-8

MATHS-111 Introductory Mathematics 1 (1+0)

Course Status : Remedial Course (Non-gradial)
Contact Hours (L-T-P) : (1-0-0)
Course Objective : The course objective of mathematics in a B.Sc. Agriculture program typically focuses on equipping students with essential mathematical skills and a preliminary understanding of mathematics.
Course Outcomes (CO) : **CO-1**: Students will grasp the definitions and characteristics of arithmetic, geometric, and harmonic progressions. Develop critical thinking and analytical skills to solve problems related to progressions in various contexts.
CO-2: Fundamental understanding of Matrices, their types, and basic operations. Familiarize students with key properties of determinants to enhance their understanding of matrix theory.
CO-3: Equip students with various techniques for finding derivatives. Explore practical applications of derivatives in real-world contexts, such as optimization problems (maximizing and minimizing). Introduce the concept of partial derivatives and their significance in functions of multiple variables. Students will develop a robust understanding of how differentiation applies to growth rates, costs, and revenues.
CO-4: Students will gain a comprehensive understanding of integral calculus and its applications to find the area of curve.
CO-5: Students will develop a comprehensive understanding of agricultural systems and the use of mathematical models, enabling them to apply these concepts effectively in research and practical applications in agriculture. Students will develop a solid understanding of how to fit linear, quadratic, and exponential models to experimental data.

Course Description :

Theory:	**CO Mapping**
Unit 1: Algebra Progressions- Arithmetic; Geometric and Harmonic Progressions	CO-1
Unit 2: Matrices Definition of Matrices, Addition, Subtraction, Multiplication, Transpose and Inverse up to 3rd order by adjoint method, Properties of determinants up to 3rd order and their evaluation	CO-2
Unit 3: Differential Calculus Definition - Differentiation of function using first principle, Derivatives of sum, difference, product and quotient of two functions, Methods, Increasing and Decreasing Functions. Application of Differentiation- Growth rate, Average Cost, and Marginal cost, Marginal Cost, Marginal Revenue. Maxima and Minima of the functions of the form y = f (x)).	CO-3
Unit 4: Integral Calculus Integration -Definite and Indefinite Integrals-Methods- Integration by substitution, Integration by parts, Area under simple well-known curves.	CO-4
Unit 5: Mathematical Models Agricultural systems - Mathematical models - classification of mathematical models, Fitting of Linear, quadratic and exponential models to experimental data.	CO-5

Theory Lecture Schedule:

S. No.	**Name of Topic**	**No. of lectures**
1.	Progressions- Arithmetic	1
2.	Geometric and Harmonic Progressions	1

3.	Definition of Matrices, Addition, Subtraction, Multiplication	1
4.	Transpose and Inverse up to 3rd order by adjoint method	1
5.	Properties of determinants up to 3rd order and their evaluation	1
6.	Definition - Differentiation of function using first principle	1
7.	Derivatives of sum, difference, product and quotient of two functions	1
8.	Methods, Increasing and Decreasing Functions	1
9.	Application of Differentiation- Growth rate, Average Cost, and Marginal cost, Marginal Cost, Marginal Revenue	1
10.	Maxima and Minima of the functions of the form y = f (x).	1
11.	Integration -Definite and Indefinite Integrals-Methods	1
12.	Integration by Substitution	1
13.	Integration by parts	1
14.	Definite Integration, Area under simple well-known curves	1
15.	Agricultural systems - Mathematical models - classification of mathematical models	1
16.	Fitting of Linear, quadratic and exponential models to experimental data.	1

Suggested Readings:

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

EXT-121 Personality Development 2 (1+1)

Course Status : Common Course
Contact Hours (L-T-P) : 1-0-2
Course Objective : Tto introduce the students about personality development by realizing their potential, strengths, cultivate their inter-personal skills and improve employability.
Course Outcomes (CO) : After the completion of this course, the student will be able to -
CO-1: Understand personality and analyze personality shaping factors.
CO-2: Understand behaviors and evaluate their impact on organizational behavior.
CO-3: Explore learning and intelligence and their role in individual and group performance.
CO-4: Apply motivation to enhance teamwork, group dynamics, and conflict management.
Course Description :

Theory:	**CO Mapping**
Unit 1: Personality Personality Definition, Nature of personality, theories of personality and its types. The humanistic approach - Maslow's self-actualization theory, shaping of personality, determinants of personality, Myers-Briggs Typology Indicator, Locus of control and performance.	CO-1
Unit 2: Behaviour Type A and Type B Behaviours, personality and Organizational Behaviour. Foundations of individual behavior and factors influencing individual behavior, Models of individual behavior, Perception and attributes and factors affecting perception, Attribution theory and case studies on Perception and Attribution.	CO-2
Unit 3: Learning and Intelligence	CO-3

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, measurements of intelligence, factors influencing intelligence, Intelligence and Organizational behavior, emotional intelligence.	
Unit 4: Motivation Motivation- theories and principles, Teamwork and group dynamics.	CO-4

Practical:

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

Theory Lecture Schedule:

S. No.	Name of Topic	No. of lecture
1.	Personality Definition, Nature of personality, theories of personality and its types.	2
2.	The humanistic approach - Maslow's self-actualization theory, shaping of personality, determinants of personality, Myers-Briggs Typology Indicator, Locus of control and performance.	2
3.	Type A and Type B Behaviours, personality and Organizational Behaviour. Foundations of individual behavior and factors influencing individual behaviour.	2
4.	Models of individual behavior, Perception and attributes and factors affecting perception, Attribution theory and case studies on Perception and Attribution.	2
5.	Learning: Meaning and definition, theories and principles of learning,	1
6.	Learning and organizational behavior, Learning and training, learning feedback. Attitude and values.	2
7.	Intelligence- types of Intelligence, theories of intelligence, measurements of intelligence, factors influencing intelligence.	2
8.	Intelligence and Organizational behavior, emotional intelligence.	1
9.	Motivation- theories and principles, Teamwork and group dynamics.	2

Practical Schedule:

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

Suggested Readings*:*

1. Andrews, Sudhir. How to Succeed at Interviews.
2. Heller, Robert. Effective Leadership. Essential Manager series.
3. Hindle, Tim. Reducing Stress. Essential Manager series.
4. Kumar, Pravesh. All about Self- Motivation.
5. Lucas, Stephen. Art of Public Speaking.

6. Mile, D.J. Power of Positive Thinking.
7. Smith, B. Body Language.
8. Shaffer, D. R. Social and Personality Development (6th Edition).

ESDM-121 Environmental Studies and Disaster Management 3 (2+1)

Course Status : Common Course
Contact Hours (L-T-P) : 2-0-2
Course Objective :
1. To develop an understanding of the natural environment, its components, and processes.
2. To foster awareness about current environmental issues such as pollution, climate change, biodiversity loss, deforestation, and resource depletion. Encourage responsible behavior and sustainable practices to mitigate environmental problems.
3. To familiarize students with national and international policies, treaties, and legal frameworks related to environmental protection and disaster management. Highlight the role of government, non-governmental organizations (NGOs), and international agencies in these domains Train students to analyze complex environmental and disaster-related challenges
4. To instil a sense of ethical responsibility towards the environment and society.
5. To encourage participation in community-based initiatives for environmental conservation and disaster risk reduction

Course Outcomes (CO) : After the completion of this course, the student will be able to-
CO-1: Introduction to basic concepts of Environment.
CO-2: Basics of Ecosystem and environmental pollution along with various laws of environment protection.
CO-3: Understanding the disaster, its types and management.

Course Descroption :

Theory:	**CO Mapping**
Unit 1: Introduction Introduction to Environment - Environmental studies - Definition, scope and importance - Multidisciplinary nature of environmental studies - Segments of Environment - Spheres of Earth - Lithosphere - Hydrosphere - Atmosphere - Different layers of atmosphere. Natural Resources: Classification - Forest resources. Water resources. Mineral resources. Introduction to Environment - Environmental studies-Definition, scope and importance -Multidisciplinary nature of environmental studies - Segments of Environment - Spheres of Earth - Lithosphere - Hydrosphere – Atmosphere - Different layers of atmosphere. Natural Resources: Classification - Forest resources. Water resources. Mineral resources Food resources. Energy resources. Land resources. Soil resources.	CO-1
Unit 2: Ecosystems Concept of an ecosystem - Structure and function of an ecosystem - Energy flow in the ecosystem. Types of ecosystem. Biodiversity and its conservation: Introduction, definition, types. Biogeographical classification of India. Importance and Value of biodiversity. Biodiversity hot spots. Threats and Conservation of biodiversity Environmental Pollution: Definition, cause, effects and control measures of: a. Air pollution. b. Water pollution. c. Soil pollution. d. Marine pollution. e. Noise pollution. f. Thermal pollution. h. light pollution. Solid Waste Management: Classification of solid wastes and management methods, Composting, Incineration, Pyrolysis, Biogas production, Causes, effects and control measures of urban and industrial wastes. Social issues and	CO-2

the Environment: Urban problems related to energy. Water conservation, rain water harvesting, watershed management. Environmental ethics: Issues and possible solutions, climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Environment Protection Act. Air (Prevention and Control of Pollution) Act. Water (Prevention and control of Pollution) Act. Wildlife Protection Act. Forest Conservation Act. Human Population and the Environment: Environment and human health: Human Rights, Value Education. Women and Child Welfare. Role of Information Technology in Environment and human health.	
Unit 3: Disaster management Disaster definition - Types - Natural Disasters - Floods, drought, cyclone, earthquakes, landslides, avalanches, volcanic eruptions, Heat and cold waves. Man Made Disasters - Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire, oil fire, road accidents, rail accidents, air accidents, sea accidents. International and National strategy for disaster reduction. Concept of disaster management, national disaster management framework; financial arrangements; role of NGOs, community-based organizations and media in disaster management. Central, state, district and local administration in disaster control; Armed forces in disaster response; Police and other organizations in disaster management.	CO-3

Practical:

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

Theory Lecture Schedule

S. No.	Name of Topic	No. of lecture
1.	Introduction to Environment - Environmental studies - Definition, scope and importance - Multidisciplinary nature of environmental studies - Segments of Environment	1
2.	Spheres of Earth - Lithosphere - Hydrosphere - Atmosphere - Different layers of atmosphere.	1
3.	Natural Resources: Classification - Forest resources. Water resources. Mineral resources Food resources. Energy resources. Land resources. Soil resources.	1
4.	Ecosystems - Concept of an ecosystem - Structure and function of an ecosystem - Energy flow in the ecosystem. Types of ecosystem.	1
5.	Biodiversity and its conservation: Introduction, definition, types	1
6.	Biogeographical classification of India. Importance and Value of biodiversity. Biodiversity hot spots.	2
7.	Threats and Conservation of biodiversity	1
8.	Environmental Pollution: Definition	1
9.	Cause, effects and control measures of: a. Air pollution	1
10.	Cause, effects and control measures of: b. Water pollution	1
11.	Cause, effects and control measures of : c. Soil pollution	1
12.	Cause, effects and control measures of : e. Noise pollution.	1
13.	Cause, effects and control measures of : d. Marine pollution.	1

14.	Cause, effects and control measures of : f. Thermal pollution. h. light pollution.	1
15.	Solid Waste Management: Classification of solid wastes and management methods	1
16.	Composting, Incineration, Pyrolysis, Biogas production	1
17.	Causes, effects and control measures of urban and industrial wastes.	1
18.	Social issues and the Environment:	1
19.	Urban problems related to energy.	1
20.	Water conservation, rain water harvesting, watershed management.	1
21.	Environmental ethics: Issues and possible solutions,	1
22.	Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust.	1
23.	Environment Protection Act. Air (Prevention and Control of Pollution) Act. Water (Prevention and control of Pollution) Act. Wildlife Protection Act Forest Conservation 1Act.	2
24.	Human Population and the Environment: Environment and human health: Human Rights, Value Education. Women and Child Welfare.	1
25.	Role of Information Technology in Environment and human health.	1
26.	Disaster management :Natural Disasters - Floods, drought, cyclone, earthquakes, landslides, avalanches, volcanic eruptions, Heat and cold waves.	2
27.	Man Made Disasters - Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire, oil fire, road accidents, rail accidents, air accidents, sea accidents	1
28.	International and National strategy for disaster reduction. Concept of disaster management, national disaster management framework; financial arrangements; role of NGOs, community-based organizations and media in disaster management.	1
29.	Central, state, district and local administration in disaster control; Armed forces in disaster response; Police and other organizations in disaster management.	1

Practical Schedule:

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

Suggested Readings:

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

SSAC-121 Soil Fertility Management 3 (2+1)

Course Status : Core
Contact Hours (L-T-P) : 2-0-2
Course Objective : To provide a comprehensive knowledge of soil fertility, plant nutrition, fertilizers, and nutrient management.
Course Outcomes (CO) : After the completion of this course, the student will be able to-
CO-1: Develop knowledge of soil fertility, plant nutrition, nutrient transport, and the chemistry of nutrients. Identify the roles, deficiencies, and toxicities of essential nutrients.
CO-2: Gain expertise in evaluating soil fertility, soil testing, plant analysis, and rapid tissue tests. Understand critical nutrient levels and forms in soil.
CO-3: Learn about manures, fertilizers, and nutrient management approaches. Study fertilizer classification, composition, properties, and methods to improve nutrient use efficiency.

Course Description :

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

conditions. STCR/RTNM/ IPNS, Carbon sequestration and Carbon Trading.	

Practical:

Introduction of analytical instruments and their principles, calibration and applications of Coloremetry 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.

Theory Lecture Schedule:

S. No.	Name of Topic	No. of lecture
1.	History of soil fertility and plant nutrition	1
2.	Criteria of essentiality. Forms of nutrients in soil	1
3.	Role, deficiency and toxicity symptoms of essential plant nutrients	2
4.	Mechanisms of nutrient transport to plants	1
5.	Factors affecting nutrient availability to plants	1
6.	Chemistry of macro and micronutrients	1
7.	Soil fertility evaluation; Soil testing, critical levels of different nutrients in soil	2
8.	Plant analysis, rapid plant tissue tests. Indicator plants	1
9.	Introduction and importance of manures and fertilizers.	1
10.	Preparation and properties of major manures (FYM, Compost, Vermicompost, Green manuring, Oilcakes.	3
11.	Chemical fertilizers: classification, composition and properties of major fertilizers, secondary and micronutrient fertilizers, Complex fertilizers, Customised fertilisers, water soluble fertilizers nano fertilizers	4
12.	Soil amendments	2
13.	Fertilizer Storage, Fertilizer Control Order	1
14.	Factor influencing nutrient use efficiency (NUE) methods of application under rainfed and irrigated conditions.	2
15.	Fertilizer recommendation approaches	1
16.	Integrated nutrient management	1
17.	Methods of fertilizer recommendations to crops	1
18.	Factor influencing nutrient use efficiency (NUE), methods of application under rainfed and irrigated conditions	2
19.	STCR/RTNM/IPNS.	2
20.	Carbon sequestration and Carbon Trading,	2

Practical Schedule:

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

13.	Study of characters of orders Diptera and its families	1
14.	Sampling techniques for estimation of insect population and damage	1

Suggested Readings:

1. Soil Fertility and Nutrient Management – By S. S. Singh, Kalyani Publishers
2. Soil Fertility and Fertilizers – By Samual L. Tisdale, Werner L. Nelson and James D. Beaton, Macmillan Publishing Company, New York
3. 3.Brady, N. C. and Well, R. R. 2014. Nature and properties of soils. Pearson Education Inc., New Delhi.
4. 4.. Chopra, S. L., Kanwar, J. S. and Rakshit, A. 2013. Analytical Agricultural Chemistry, Kalyani Publishers Ludhiana.
5. Das, D. K. 2011. Introductory Soil Science (3rd Edition), Kalyani publisher, Ludhiana (India).
6. 6.. Gupta, P. K. 2009. Soil, Plant, Water and Fertilizer Analysis (2nd Edition), Agrobios, Jodhpur (India).
7. Indian Society of Soil Science (ISSS) 2002. Fundamentals of Soil Science, IARI, New Delhi.
8. Seema, Sodani R., Yadav S. 2019. anual For Soil and plant analysis, LAP Lambert Academic Publishing, U.K.

ENTO-121 Fundamentals of Entomology 3 (2+1)

Course Status : Core
Contact Hours (L-T-P) : 2-0-2
Course Objective :
1. To know the history of entomology, classification of insects and their relationship with other arthropods.
2. To study the various morphological characters of class insect and their importance for classification of insects.
3. To get an idea about the different physiological systems of insects and their roles in growth and development and communications of insects.
4. To study the characteristics of commonly observed insect orders and their economically important families.

Course Outcomes (CO) : After the completion of this course, the student will be able to-
CO-1: Learn about phylum arthropoda.
CO-2: Understand morphology and anatomy of insect.
CO-3: Comprehend effect and functions of various biotic and abiotic factors.
CO-4: Identify agriculturally important insect's orders and families.

Course Description :

Theory:	**CO Mapping**
Unit 1: Introduction History of Entomology in India. Major points related to dominance of Insects in Animal kingdom. Classification of phylum Arthropoda up to classes. Relationship of class Insecta with other classes of Arthropoda.	CO-1
Unit 2: Insect Morphology and Anatomy Morphology: Structure and functions of insect cuticle and molting. Body segmentation. Structure of head, thorax and abdomen. Structure and modifications of insect antennae, mouth parts, legs, Wing venation, modifications and wing coupling apparatus. Metamorphosis and diapause in insects. Types of larvae and pupae. Structure and functions of digestive, circulatory, excretory, respiratory, nervous, secretary (Endocrine) and reproductive system in insects. Types of reproduction in insects. Major sensory organs.	CO-2
Unit 3: Ecology	CO-3

Insect Ecology: Introduction, Environment and its components. Effect of abiotic factors and biotic factors. Categories of pests.	
Unit 4: Systematics Systematics: Taxonomy – importance, history and development and binomial nomenclature. Definitions of Biotype, Sub-species, Species, Genus, Family and Order. Classification of class Insecta up to Orders, basic groups of present day insects with special emphasis to orders and families of Agricultural importance Orthoptera: Acrididae, Tettigoniidae, Gryllidae, Gryllotalpidae; Dictyoptera: Mantidae, Blattidae; Odonata; Isoptera: Termitidae; Thysanoptera: Thripidae; Hemiptera: Pentatomidae, Coreidae, Cimicidae, Pyrrhocoridae, Lygaeidae, Cicadellidae, Delphacidae, Aphididae, Coccidae, Lophophidae, Aleurodidae, Pseudococcidae; Neuroptera: Chrysopidae; Lepidoptera: Pieridae, Papiloinidae, Noctuidae, Sphingidae, Pyralidae, Gelechiidae, Arctiidae, Saturnidae, Bombycidae; Coleoptera: Coccinellidae, Chrysomelidae, Cerambycidae, Curculionidae, Bruchidae, Scarabaeidae; Hymenoptera: Tenthridinidae, Apidae. Trichogrammatidae, lchneumonidae, Braconidae, Chalcididae; Diptera: Cecidomyiidae, Tachinidae, Agromyziidae, Culicidae, Muscidae, Tephritidae.	CO-4

Practical:

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

Theory Lecture Schedule:

S. No.	Name of Topic	No. of lecture
1.	History of Entomology in India	1
2.	Major points related to dominance of Insecta in Animal kingdom	1
3.	Classification of phylum Arthropoda upto classes, Relationship of class Insecta with other classes of Arthropoda	1
4.	Morphology: Structure and functions of insect cuticle and molting	1
5.	Body segmentation. Structure of head, thorax and abdomen	1
6.	Structure and modifications of insect antennae	1
7.	Structure and modifications of insect mouth parts	1
8.	Structure and modifications of insect legs	1
9.	Wing venation, modifications and wing coupling apparatus	1
10.	Metamorphosis and diapause in insects	1
11.	Types of larvae and pupae	1
12.	Structure and functions of digestive system in insects	1
13.	Structure and functions of circulatory system in insects	1
14.	Structure and functions of excretory system in insects	1
15.	Structure and functions of respiratory system in insects	1
16.	Structure and functions of nervous system in insects	1
17.	Structure and functions of secretary (endocrine) system in insects	1
18.	Structure and functions of reproductive system in insects	1
19.	Types of reproduction in insects	1
20.	Major sensory organs	1
21.	Insect Ecology: Introduction, environment and its components	1
22.	Effect of abiotic factors–temperature, moisture, humidity, rainfall, light, atmospheric pressure and air currents	1
23.	Effect of biotic factors – food competition, natural and environmental	1

	resistance, agro ecosystem, categories of pests	
24.	Systematics: Taxonomy –importance, history and development and binomial nomenclature	1
25.	Definitions of Biotype, sub-species, species, genus, family and order	1
26.	Orthoptera: Acrididae, Tettigoniidae, Gryllidae, Gryllotalpidae; Dictyoptera: Mantidae, Blattidae;	1
27.	Odonata; Isoptera: Termitidae; Thysanoptera: Thripidae	1
28.	Hemiptera: Pentatomidae, Coreidae, Cimicidae, Pyrrhocoridae, Lygaeidae, Cicadellidae, Delphacidae, Aphididae, Coccidae, Lophophidae, Aleurodidae, Pseudococcidae;	1
29.	Neuroptera: Chrysopidae; Lepidoptera: Pieridae, Papiloinidae, Noctuidae, Sphingidae, Pyralidae, Gelechiidae, Arctiidae, Saturnidae, Bombycidae;	1
30.	Coleoptera: Coccinellidae, Chrysomelidae, Cerambycidae, Curculionidae, Bruchidae, Scarabaeidae;	1
31.	Hymenoptera: Tenthridinidae, Apidae. Trichogrammatidae, lchneumonidae, Braconidae, Chalcididae;	1
32.	Diptera: Cecidomyiidae, Tachinidae, Agromyziidae, Culicidae, Muscidae, Tephritidae.	1

Practical Schedule:

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

Suggested Readings:

1. Fundamentals of Ecology - Eugene. P. Odum and Gray W. Barrett
2. Imm's General Text book of Entomology— O.W. Rechards and R.G. Davies
3. Introduction to the study of Insects –D. J. Borror and DeLong's
4. The Insects: Structure and Function -Chapman, R. F.
5. Principles of Insect Morphology Snodgrass, R. E.

LPM-121 Livestock and Poultry Management 2 (1+1)

Course Status : Core
Contact Hours (L-T-P) : 1-0-2
Course Objective : 1. Provide basic knowledge to the students about scientific livestock and poultry rearing practices
2. Entrepreneurship development through Livestock/poultry and

Agriculture Integrated Farming System.

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

CO-1: Importance of livestock and poultry management.
CO-2: Breeds and breeding management of animals and poultry.
CO-3: Nutritional practices of animals and poultry.
CO-4: Health management practices of animals and poultry.

Course Description :

Theory:	**CO Mapping**
Unit 1: Outline of Animal husbandry Role of livestock in national economy, Reproduction in farm animals and their improvement, Reproduction in poultry and their improvement, Housing principles, space requirements for different species of livestock & poultry.	CO-1
Unit 2: Breed and Breeding Management Management of calf, Heifer and milch animals, Management of Sheep & Goats including their breeds, Management of Swine including of breeds, Breeds of dairy animals (Indigenous & Exotic), Breeds of poultry (Indigenous & Exotic), Incubation, Hatching & Brooding of chicks	CO-2
Unit 3: Animal Nutrition Management Proximate principles of feed, Nutrient and their functions, Classification of feed stuffs including Feed supplements & Feed additives and feed ingredients for ration, Feeding and digestion of livestock & poultry.	CO-3
Unit 4: Animal Health Management Important of livestock diseases and their and control, important diseases of poultry and their control, Prevention measurement of disease management of both livestock & poultry	CO-4

Practical:

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

Theory Lecture Schedule:

S. No.	Name of topic	No. of lecture
1.	Role of livestock in national economy.	1
2.	Reproduction in farm animals and their improvement.	1
3.	Reproduction in poultry and their improvement	1
4.	Housing principles,space requirements for different species of livestock & poultry.	1
5.	Management of calf, Heifer and milch animals.	1
6.	Management of Sheep & Goats including their breeds.	1
7.	Management of Swine including of breeds.	1
8.	Breeds of dairy animals (Indigenous & Exotic).	1
9.	Breeds of poultry (Indigenous & Exotic).	1
10.	Incubation, Hatching & Brooding of chicks.	1
11.	Proximate principles of feed, Nutrient and their functions.	1
12.	Classification of feed stuffs including Feed supplements & Feed additives and feed ingredients for ration.	1
13.	Feeding and digestion of livestock & poultry.	1

14.	Important of livestock diseases and their and control.	1
15.	important diseases of poultry and their control.	1
16.	Prevention measurement of disease management of both livestock & poultry.	1

Practical Schedule:

S. No.	Name of topic	No. of practical
1.	External body parts of cattle, Buffalo and Goat.	1
2.	External body parts of swine & poultry.	1
3.	Handling and restraining of livestock.	1
4.	Identification methods of farm animals and poultry.	1
5.	Daily routine farm operation and farm records.	1
6.	Judging of cattle, Goat and poultry.	1
7.	Culling of livestock and poultry.	1
8.	Planning and layout of housing for different species of livestck & poultry	1
9.	Computation of ration for livestock.	2
10.	Formulation of concentrate mixtures.	1
11.	Milking methods & Clean milk production.	1
12.	Incubation,hatchery operation & eqipments.	1
13.	Management of chick,grower and layers.	1
14.	Debeaking,Dusting and Vaccination.	1
15.	Economics of and livestock and poultry production.	1

Suggested Readings:

1. Banerjee, G. C. 2011. A Text Book of Animal Husbandry. VIII ed. Oxford and IBH Publications. New Delhi.
2. Choudhary, J. L. and Gupta L. 2016. A Text Book of Animal Husbandry. Somani Publication
3. D. N. Verma, A text Book of Livestock Production management in Tropic
4. Devendra, C. and Mecleroy, G. B. 1982. Goat and Sheep Production in Tropics.
5. Dimri, U., Sharma, M. C. and Tiwari, R. 2013. Swine Production and Health Management. New India Pub Agency.
6. Sastry, N. S. R. and Thomas, C. K. 2006. Livestock Production and Management. Kalyani
7. Singh, R. A. 1996. Poultry Production. 3rd ed. Kalyani Publications. New Delhi.
8. Thomas, C. K., Sastry, N. S. R. and Singh, R. A. 1982. Farm Animal Management and Poultry Production. Vikas Publications. New Delhi.

PPATH-121 Fundamentals of Plant Pathology 3 (2+1)

Course Status : Core Course
Contact Hours (L-T-P) : 2-0-2
Course Objective :
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, viruses, and other microorganisms causing plant diseases.
4. To acquaint the students with reproduction in fungi, and bacteria, causing plant diseases.
5. To get acquainted with various plant disease management principles and practices

Course Outcomes (CO) : After the completion of this course, the student will be able to –
CO-1: gain a clear understanding of the concept of disease in plants and the terminology commonly used in plant pathology.
CO-2: acquainted with the role of different microorganisms in the development of plant disease.

CO-3: understand the principles and practices of plant disease management including chemical, cultural, biological, and host resistance methods.

Course Description :

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

Practical:

Study of the microscope; Acquaintance with laboratory material and equipment; Study of different plant disease symptoms; Microscopic examination of general structure of fungi; Simple staining of bacteria: Direct and indirect staining, Gram staining of bacteria; Microscopic examination of fungal diseased specimen; Microscopic examination of bacterial diseased specimen; 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 on fungicides.

Theory Lecture Schedule:

S. No.	Name of Topic	No. of lecture
1.	Introduction to Plant Pathology: Concept of disease in plants.	1
2.	Different terms used in Plant Pathology.	2
3.	History of Plant Pathology with special references to India.	1
4.	Causes of plant disease: Inanimate and animate causes.	1
5.	Classification of plant disease.	2
6.	Parasitism and pathogenesis.	1
7.	Development of disease in plants.	1
8.	Disease Triangle, Disease cycle.	2
9.	Fungi and their morphology, reproduction and classification of fungi.	3
10.	Bacteria: Morphology, reproduction classification of phytopathogenic bacteria.	2
11.	Other plant pathogens: Mollicutes; Flagellant protozoa; FVB.	2
12.	Green algae and parasitic higher plants.	1
13.	Viruses and viroids, virus transmission.	3
14.	Principles of Plant disease management.	2
15.	Disease management with chemicals.	2
16.	Disease management through Host resistance.	2
17.	Disease management by cultural methods.	2
18.	Disease management by biological method.	2

Practical Schedule:

S. No.	Name of Topic	No. of practical
1.	Study of the microscope.	1

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

Suggested Readings*:*

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

NSS-121 National Service Scheme-II 1 (0+1)

Course Status : Commom Course
Contact Hours (L-T-P) : (0-0-4)
Course Objective : To empower youth with:

1. Leadership skills that promote social and community development.
2. Practical life competencies such as communication, problem-solving, and decision-making that are essential for personal success and social cohesion.
3. Health awareness and practices to support personal well-being and community health, including the promotion of hygiene, nutrition, sanitation, and preventive healthcare.
4. A deeper understanding of yoga as a tool for maintaining a balanced and healthy life.

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

CO-1: To identify leadership qualities in themselves and others, understand leadership roles in various contexts (community, political, organizational), and explore how youth can contribute to positive societal changes.
CO-2: To gain practical skills for addressing everyday challenges, enhance their communication abilities, and build confidence in making informed decisions. These competencies will aid in both personal and professional growth.
CO-3: To learn about national and regional initiatives aimed at empowering youth, the role of youth in development programs, and how to actively participate in or establish youth-led organizations.
CO-4: To identify the key factors affecting public health, understand the importance of proper sanitation, and recognize the role of personal hygiene in preventing diseases.
CO-5: To lead a healthy lifestyle, understand the social and medical implications of HIV/AIDS and substance abuse, and acquire basic first aid skills.
CO-6: To gain an understanding of yoga's health benefits, learn various practices, and appreciate how yoga can be integrated into daily routines for overall health improvement

Course Description :

Theory:	**CO Mapping**
Unit 1: Importance and role of youth leadership Meaning, types and traits of leadership, qualities of good leaders; importance and roles of youth leadership.	CO-1
Unit 2: Life competencies Definition and importance of life competencies, problem-solving and decision-making, inter personal communication.	CO-2
Unit 3: Youth development programmes Development of youth programmes and policy at the national level, state level and voluntary sector; youth-focused and youth-led organisations.	CO-3
Unit 4: Health, hygiene and sanitation Definition needs and scope of health education; role of food, nutrition, safe drinking water, water born diseases and sanitation (Swachh Bharat Abhiyan) for health; national health programmes and reproductive health.	CO-4
Unit 5: Youth health, lifestyle, HIV AIDS and first aid Healthy lifestyles, HIV AIDS, drugs and substance abuse, home nursing and first aid.	CO-5
Unit 6: Youth and yoga History, philosophy, concept, myths and misconceptions about yoga; yoga traditions and its impacts, yoga as a tool for healthy lifestyle, preventive and curative method.	CO-6

AGECON-211 Entrepreneurship Development and Business Communication 3 (2+1)

Course Status : Common Coure
Contact Hours (L-T-P) : 2-0-2
Course Objective :
1. To provide student an insight into the concept and scope of entrepreneurship
2. To expose the student to various aspects of establishment and management of a small business unit

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

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

CO-1: The basic concepts of entrepreneurship Development.

CO-2: Role of entrepreneurs in business development activities

CO-3: Basic concept about financial statement and project cycle and cost accounting.

Course Description :

Theory:	**CO Mapping**
Unit-I : Introduction to Entrepreneurship Development of entrepreneurship, motivational factors, social factors, environmental factors, characteristics of entrepreneurs, entrepreneurial attributes/competencies. Concept, need for and importance of entrepreneurial development. Evolution of entrepreneurship, objectives of entrepreneurial activities, types of entrepreneurs, functions of entrepreneurs, importance of entrepreneurial development, and process of entrepreneurship development.	CO-1
Unit-II: Entrepreneurial Finance and Financial Institutes Environment scanning and opportunity identification need for scanning: spotting of opportunity, scanning of environment identification of product / service: starting a project; factors influencing sensing the opportunities. Infrastructure and support systems: good policies, schemes for entrepreneurship development; role of financial institutions, and other agencies in entrepreneurship development. Steps involved in functioning of an enterprise. Selection of the product / services, selection of form of ownership; registration, selection of site, capital sources, acquisition of manufacturing know how, packaging and distribution.	CO-2
Unit-III: Project Cycle and Inventory Management Planning of an enterprise, project identification, selection, and formulation of project; project report preparation, Enterprise Management. Production management: product, levels of products, product mix, quality control, cost of production, production controls, and Material management. Production management: raw material costing, inventory control. Personal management: manpower planning, labour turn over, wages / salaries.	CO-3
Unit-IV: Financial Management and Cost Accounting Financial management /accounting: funds, fixed capital and working capital, costing and pricing, long term planning and short-term planning, book keeping, journal, ledger, subsidiary books, annual financial statement, and taxation. Marketing management: market, types, marketing assistance, market strategies. Crisis management: raw material, production, leadership, market, finance, natural etc.	

Practical:

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

Theory Lecture Schedule:

S. No.	Name of Topic	No. of lecture
1.	Concept, need for and importance of entrepreneurial development.	1
2.	Development of entrepreneurship.	1
3.	Motivational factors, social factors, environmental factors, characteristics of entrepreneurs.	1
4.	Entrepreneurial attributes/competencies.	1
5.	Evolution of entrepreneurship.	1

6.	Objectives of entrepreneurial activities, types of entrepreneurs, functions of entrepreneurs.	1
7.	Importance of entrepreneurial development, and process of entrepreneurship development.	1
8.	Environment scanning and opportunity identification need for scanning.	1
9.	Spotting of opportunity, scanning of environment identification of product / service.	1
10.	Starting a project; factors influencing sensing the opportunities.	1
11.	Infrastructure and support systems: good policies, schemes for entrepreneurship development.	1
12.	Role of financial institutions, and other agencies in entrepreneurship development.	1
13.	Steps involved in functioning of an enterprise.	1
14.	Selection of the product / services, selection of form of ownership;	1
15.	Registration, selection of site, capital sources, acquisition of manufacturing know how, packaging and distribution.	1
16.	Planning of an enterprise, project identification, selection, and formulation of project.	1
17.	Project report preparation, Enterprise Management.	1
18.	Production management: product, levels of products, product mix.	1
19.	Quality control, cost of production, production controls, and Material management.	1
20.	Personal management: manpower planning, labour turn over, wages / salaries.	1
21.	Funds, fixed capital and working capital, costing and pricing.	1
22.	Long term planning and short-term planning.	1
23.	Book keeping, journal, ledger, subsidiary books.	1
24.	Annual financial statement.	1
25.	Taxation	1
26.	Marketing management: market, types, marketing assistance, market strategies.	1
27.	Crisis management.	1
28.	Raw material.	1
29.	Production, leadership.	1
30.	Market Finance.	1
31.	Financial Management.	1
32.	Cost Accounting .	1

Practical Schedule:

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

Suggested Readings:

1. Charantimath, P.M. 2009, Entrepreneurship Development and Small Business Enterprises.
2. Pearson Publications, New Delhi.
3. Desai, V. 2015, Entrepreneurship: Development and Management, Himalaya Publishing House.

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

PEYPM-211 Physical Education, First Aid, Yoga Practices and Meditation 2 (0+2)

Course Status : Common Course
Contact Hours (L-T-P) : 0-0-4
Course Objective : To make the students aware about Physical Education, First Aid and Yoga Practices.
To disseminate the knowledge and skill how to perform physical training, perform first aid and increase stamina and general wellbeing through yoga.
Course Outcomes (CO) : After the completion of this course, the student will be able to learn about to -
CO-1: Get the different types of physical trainings.
CO-2: Understand the concept of balanced diet and nutrition.
CO-3: Acquaint with the knowledge about the effect of physical activities & yoga on our body metabolism and personality development.
Course Description :

Theory:	**CO Mapping**
Unit 1: Physical Training and Coaching Physical education; Training and Coaching - Meaning and Concept; Methods of Training; aerobic and anaerobic exercises; Calisthenics, weight training, circuit training, interval training, Fartlek training; Effects of Exercise on Muscular, Respiratory, Circulatory and Digestive systems;	CO-1
Unit 2: Balanced Diet and Nutrition Balanced Diet and Nutrition: Effects of Diet on Performance; Physiological changes due to ageing and role of regular exercise on ageing process; Personality, its dimensions and types; Role of sports in personality development; Motivation and Achievements in Sports; Learning and Theories of learning; Adolescent Problems and its Management; Posture; Postural Deformities; Exercises for good posture.	CO-2
Unit 3: Yoga Yoga; History of Yoga, Types of Yoga, Introduction to Yoga: **Asanas:** Definition and Importance, Padmasan, Gaumukhasan, Bhadrasan, Vajrajasan, Shashankasan, Pashchimotasan, Ushtrasan, Tadasan, Padhastasan, Ardhchandrasan, Bhujangasan, Utanpadasan, Sarvangasan, Parvatasan, Patangasan, Shishupalanasan– left leg right leg, Pavanmuktasan, Halasan, Sarpasan, Ardhdhanurasan, Sawasan. **Suryanamskar Pranayama** (Definition and Importance) Omkar, Suryabhedan, Chandrabhedan, AnulomVilom, Shitali, Shitkari, Bhastrika, Bhramari. **Meditation** (Definition and Importance), Yogic Kriyas (Kapalbhati), Tratak, Jalneti and Tribandh. **Mudras** (Definition and Importance) Gyanmudra, Dhyanmudra, Vayumudra,	CO-3

Akashmudra, Pruthvimudra, Shunyamudra, Suryamudra, Varunmudra, Pranmudra, Apanmudra, Vyanmudra, Uddanmudra. Role of yoga in sports. Teaching of Asanas – demonstration, practice, correction and practice.	
Unit 4: Sports and Games History of sports and ancient games, Governance of sports in India; Important national sporting events; Awards in Sports; History, latest rules, measurements of playfield, specifications of equipment, skill, technique, style and coaching of major games (Cricket, football, table Tennis, Badminton, Volleyball, Basketball, Kabaddi and Kho-Kho) and Athletics.	
Unit 5: First Aid Need and requirement of first aid. First Aid equipment and upkeep. First AID Techniques, First aid related with respiratory system. First aid related with Heart, Blood and Circulation. First aid related with Wounds and Injuries. First aid related with Bones, Joints Muscle related injuries. First aid related with Nervous system and Unconsciousness. First aid related with Gastrointestinal Tract. First aid related with Skin, Burns. First aid related with Poisoning. First aid related with Bites and Stings. First aid related with Sense organs, Handling and transport of injured traumatized persons. Sports injuries and their treatments.	

Practical Schedule:

S. No.	Name of Topic	No. of practical
1.	Physical education.	1
2.	Training and Coaching - Meaning and Concept; Methods of Training.	1
3.	Aerobic and anaerobic exercises.	1
4.	Calisthenics, weight training, circuit training, interval training, Fartlek training.	1
5.	Effects of Exercise on Muscular, Respiratory, Circulatory and Digestive systems.	1
6.	Balanced Diet and Nutrition: Effects of Diet on Performance.	1
7.	Physiological changes due to ageing and role of regular exercise on ageing process.	1
8.	Personality, its dimensions and types; Role of sports in personality development.	1
9.	Motivation and Achievements in Sports; Learning and Theories of learning.	1
10.	Adolescent Problems and its Management; Posture; Postural Deformities; Exercises for good posture.	1
11.	Yoga; History of Yoga, Types of Yoga, Introduction to Yoga.	1
12.	Asanas: Definition and Importance, Padmasan, Gaumukhasan, Bhadrasan, Vajrajasan, Shashankasan, Pashchimotasan, Ushtrasan, Tadasan, Padhastasan, Ardhchandrasan, Bhujangasan, Utanpadasan, Sarvangasan, Parvatasan, Patangasan, Shishupalanasan– left leg right leg, Pavanmuktasan, Halasan, Sarpasan, Ardhdhanurasan, Sawasan.	3
13.	Suryanamskar Pranayama (Definition and Importance) Omkar, Suryabhedan, Chandrabhedan, AnulomVilom, Shitali, Shitkari, Bhastrika, Bhramari.	2
14.	Meditation (Definition and Importance), Yogic Kriyas (Kapalbhati), Tratak, Jalneti and Tribandh.	2
15.	Mudras (Definition and Importance) Gyanmudra, Dhyanmudra, Vayumudra, Akashmudra, Pruthvimudra, Shunyamudra, Suryamudra, Varunmudra, Pranmudra, Apanmudra, Vyanmudra,	2

	Uddanmudra.	
16.	Role of yoga in sports.	1
17.	Teaching of Asanas – demonstration, practice, correction and practice.	3
18.	History of sports and ancient games, Governance of sports in India; Important national sporting events; Awards in Sports	1
19.	History, latest rules, measurements of playfield, specifications of equipment, skill, technique, style and coaching of major games (Cricket, football, table Tennis, Badminton, Volleyball, Basketball, Kabaddi and Kho-Kho) and Athletics.	2
20.	Need and requirement of first aid. First Aid equipment and upkeep	1
21.	First AID Techniques, first aid related with respiratory system. First aid related with Heart, Blood and Circulation. First aid related with Wounds and Injuries. First aid related with Bones, Joints Muscle related injuries.	1
22.	First aid related with Nervous system and Unconsciousness. First aid related with Gastrointestinal Tract. First aid related with Skin, Burns. First aid related with Poisoning. First aid related with Bites and Stings. First aid related with Sense organs.	1
23.	Handling and transport of injured traumatized persons.	1
24.	Sports injuries and their treatments.	1

GPB-211 Principles of Genetics 3 (2+1)

Course Status : Core
Contact Hours (L-T-P) : 2-0-2
Course Objective : To make the students acquainted with both principles and practices in the areas of classical genetics, modern genetics, quantitative genetics and cytogenetics.
Course Outcomes (CO) : After the completion of this course the student will be able to learn-
CO-1: The basic concepts of genetics.
CO-2: Role of genes in genetic manifestation of various characters.
CO-3: Basic concepts of molecular genetics.
Course Description :

Theory:	**CO Mapping**
Unit 1: Mendelian concepts and cell division Pre and post Mendelian concepts of heredity, Mendelian principles of heredity, Study of model organisms (*Drosophila*, *Arabidopsis*, Garden pea, *E. coli*, and mice), Architecture of chromosomes, chromonemata, chromosome matrix, chromomeres, centromere, secondary constriction and telomere, special types of chromosomes, Chromosomal theory of inheritance- cell cycle and cell division-mitosis and meiosis. Probability and Chi-square. Types of DNA and RNA.	CO-1
Unit 2: Gene interaction & cytogenetics Dominance relationships, Epistatic interactions with example, Introduction and definition of cytology, genetics and cytogenetics and their interrelation. Multiple alleles, pleiotropism and pseudo alleles and blood group genetics.	
Unit 3: Sex determination, Linkage and crossing over Sex determination and sex linkage, sex limited and sex influenced traits, Blood group genetics, Linkage and its estimation, crossing over mechanism, chromosome mapping.	CO-2
Unit 4: Structural and numerical variations in chromosome and their implications	

Structural and numerical variations in chromosomes and their implications, Use of haploids, dihaploids and double haploids in Genetics, Mutation, classification, Methods of inducing mutations, mutagenic agents and induction of mutation. Qualitative and quantitative traits, Polygenes and continuous variations, multiple factor hypothesis, Cytoplasmic inheritance,	
Unit 5: Nature, structure and replication of genetic material Nature, structure and replication of genetic material, Protein synthesis, Transcription and translational mechanism of genetic material, Gene concept: Gene structure, function and regulation.	CO-3

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 croo-over analysis (through two point test cross data), Study on sex linked inheritance in Drosophila. Study on models on DNA and RNA structures

Theory Lecture Schedule:

S. No.	Name of Topic	No. of lecture
1.	Pre and post mendelian concepts of heredity.	1
2.	Mendelian principles of heredity.	1
3.	Mendelian principles of heredity, Study of model organisms (Drosophila, Arabidopsis, Garden pea, E. coli, and mice).	1
4.	Architecture of chromosomes, chromonemata, chromosome matrix, chromomeres, centromere, secondary constriction and telomere.	1
5.	Special types of chromosomes.	1
6.	Chromosomal theory of inheritance- cell cycle.	1
7.	Cell division-mitosis.	1
8.	Cell division- meiosis.	1
9.	Probability and Chi-square.	1
10.	Types of DNA and RNA.	1
11.	Dominance relationships, Epistatic interactions with example.	1
12.	Introduction and definition of cytology, genetics and cytogenetics and their interrelation.	1
13.	Multiple alleles, pleiotropism and pseudoalleles.	1
14.	Sex determination and sex linkage.	1
15.	Sex limited and sex influenced traits.	1
16.	Blood group genetics.	1
17.	Linkage and its estimation.	1
18.	Crossing over mechanism.	1
19.	Chromosome mapping.	1
20.	Structural and numerical variations in chromosomes and their implications.	1
21.	Numerical variations in chromosomes and their implications.	1
22.	Use of haploids, dihaploids and double haploids in Genetics.	1
23.	Mutation, classification, Methods of inducing mutations.	1
24.	Mutagenic agents and induction of mutation	1
25.	Qualitative and quantitative traits, Polygenes and continuous variations.	1
26.	Multiple factor hypothesis.	1
27.	Cytoplasmic inheritance.	1
28.	Nature, structure and replication of genetic material.	1
29.	Protein synthesis.	1

30.	Transcription and translational mechanism of genetic material.	1
31.	Gene concept: Gene structure and function.	1
32.	Gene regulation.	1

Practical Schedule:

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

Suggested Readings

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

AGRON-211 Crop Production Technology-I (*Kharif* crops) 3 (1+2)

Course Status : Core

Contact Hours (L-T-P) : 1-0-4

Course Objective : This course intends to impart knowledge on various cultivation practices of different Kharif crops.

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

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

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

CO-3: To know the suitable crop production technology of *Kharif* fibre and forage including origin, geographical distribution and economic importance.

Course Description :

Theory:	CO Mapping
Unit 1: Cereals Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of Rice, Maize, Sorghum, Pearlmillet, finger millet and other millets	CO-1
Unit 2: Pulses Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of Pigeon pea, Mungbean, Urdbean and Mothbean	CO-2
Unit 3: Oilseeds Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of Groundnut, Soybean, Sesame and Castor	
Unit 4: Fibre crops Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of Cotton and jute	CO-3
Unit 5: Forage crops Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of Sorghum, Cowpea, Clusterbean, maize, guinea and Napier.	

Practical:

Rice nursery preparation, transplanting of rice, sowing of soybean, pigeon pea and mungbean, maize, groundnut and cotton, effect of seed size on germination and seedling vigour of Kharif crops, effect of sowing depth on germination of Kharif crops, identification of weeds in Kharif crops, top dressing and foliar feeding of nutrients, study of yield contributing characters and yield calculation of Kharif crops, study of crop varieties and important agronomic experiments at experiential farm, recording biometric observations, Study of forage experiments, morphological description of Kharif crops, silage and hay making, visit to research centres of related crops.

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

Theory Lecture Schedule:

S. No.	Name of Topic	No. of lecture
1.	Rice- origin, distribution, importance, production, soil and climatic requirement, improved varieties, nursery raising, seed and sowing, intercultural operations/ weed management, fertilizer and water management, protection measures, harvesting, processing and yield.	2
2.	Crop production technology for maize.	1
3.	Crop production technology for sorghum.	1
4.	Crop production technology for pearl millet.	1
5.	Crop production technology for Finger millet and other minor millets	1
6.	Crop production technology for pigeon pea.	1
7.	Crop production technology for mungbean .	1
8.	Crop production technology for urdbean and mothbean.	1
9.	Crop production technology for groundnut.	1
10.	Crop production technology for soybean.	1
11.	Crop production technology for sesame and castor.	1
12.	Crop production technology for cotton.	1
13.	Crop production technology for Jute.	1
14.	Crop production technology for cowpea and clusterbean.	1
15.	Crop production technology for guinea and napier.	1

Practical schedule:

S. No.	Name of Topic	No. of practical
1.	Rice nursery preparation.	1
2.	Transplanting of rice	1
3.	Sowing methods of different *kharif* crops.	2
4.	To study the effect of seed size on germination and seedling vigour of *Kharif* crops.	1
5.	To study the effect of sowing depth on germination of *Kharif* crops.	1
6.	Identification of weeds in *Kharif* crops.	1
7.	Fertilizer application in crops, including top dressing and foliar feeding	1
8.	Study of yield contributing characters and yield calculation of *Kharif* crops.	1
9.	Study of crops and their varieties.	1
10.	Study of important agronomic experiments at experiential farm, recording biometric observations.	
11.	Study of forage experiments.	1
12.	To study the morphological description of *Kharif* crops.	1
13.	Preparation of silage and hay.	2
14.	Visit to research centres of related crops.	1

Practical Schedule: Crop Production

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

Suggested Readings:

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

HORT-211 Production Technology of Fruit and Plantation Crops 2 (1+1)

Course Status : Core
Contact Hours (L-T-P) : 1-0-2
Course Objective :
1. To educate about the different forms of classification of fruit crops.
2. To educate about the origin, area, climate, soil, improved varieties and cultivation practices of fruit and plantation crops.
3. To educate about the physiological disorders of fruit crops, palms and plantation crops.

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

CO-1: Importance and scope of fruit and plantation crops and their classification.
CO-2: Production technology of fruit crops.
CO-3: Production technology of palms and plantation crops.

Course Description :

Theory:	**CO Mapping**
Unit 1: Introduction Production status of fruit and plantation crops: Importance and scope of fruit and plantation crop industry in India; nutritional value of fruit crops; classification of fruit crops; area, production, productivity and export potential of fruit and plantation crops.	CO-1
Unit 2: Production technology of fruit crops Crop production techniques in tropical, sub-tropical and temperate fruit crops: Climate and soil requirements, varieties, propagation and use of rootstocks, planting density and systems of planting: High density and ultra-high density planting, cropping systems, after care– training and pruning; water, nutrient and weed management, fertigation, special horticultural techniques, plant growth regulation, important disorders, maturity indices, harvesting and yield, pests and diseases, value addition: Fruit crops: mango, banana, papaya, guava, sapota, citrus, grape, litchi, pineapple, pomegranate, apple, pear, peach, strawberry, nut crops (walnut and almond), jackfruit, and minor fruits (date, ber, kair, lasora, aonla and bael).	CO-2
Unit 3: Production technology of palms and plantation crops Crop production techniques in palms and plantation crops: Climate and soil requirements, varieties, propagation, nursery management, planting and planting systems, cropping systems, after care, training and pruning for plantation crops, water, nutrient and weed management, intercropping, multi-tier cropping system, mulching, special horticultural practices, maturity indices, harvesting and yield, pests and diseases, processing- value addition: Palms: Coconut, Arecanut, Oil palm and Palmyrah. Plantation crops: Tea, Coffee, Cocoa, Cashewnut and Rubber.	CO-3

Practical:

Propagation techniques, selection of planting material, varieties, important cultural practices for mango, banana, papaya, guava, sapota, grapes, Citrus (mandarin and acid lime), pomegranate, jackfruit, preparation and application of PGR's for propagation, Micro propagation, protocol for mass multiplication and hardening of fruit crops, Identification and description of varieties, mother palm and seed nut selection, nursery practices, seedling selection, fertilizers application, nutritional disorders, pests and diseases of coconut, arecanut and cocoa, tea and coffee, rubber and cashew, Visit to commercial orchard and plantation industries.

Theory Lecture Schedule:

S. No.	Name of Topic	No. of lecture
1.	Importance and scope of fruit and plantation crop industry in India; Area, production and productivity status of fruit and plantation crops, and export potential of fruit and plantation crops.	1
2.	Nutritional value of fruit crops, Classification of fruit crops.	1
3.	Crop production techniques in tropical, sub-tropical and temperate fruit crops (climate and soil requirements, varieties, propagation and use of rootstocks, planting density and systems of planting: High density and ultra-high density planting, cropping systems, after care – training and pruning; water, nutrient and weed management, fertigation, special horticultural techniques, plant growth regulation, important disorders, maturity indices, harvesting and yield, pests and diseases, value addition): Fruit crops: Mango and Sapota.	1
4.	Fruit crops: Banana and Papaya.	1
5.	Fruit crops: Citrus.	1
6.	Fruit crops: Guava and Pomegranate.	1
7.	Fruit crops: Grape, Litchi and Pineapple.	1
8.	Fruit crops: Apple, Pear and Peach.	1
9.	Fruit crops: Strawberry and Jackfruit.	1
10.	Nut crops: Almond and Walnut.	1
11.	Minor fruits: Date and Ber.	1
12.	Minor fruits: Aonla, Bael, Lasora and Kair.	1
13.	Crop production techniques in palms and plantation crops: Climate and soil requirements, varieties, propagation, nursery management, planting and planting systems, cropping systems, after care, training and pruning for plantation crops, water, nutrient and weed management, intercropping, multi-tier cropping system, mulching, special horticultural practices, maturity indices, harvesting and yield, pests and diseases, processing- value addition: Palms: Coconut and Arecanut.	1
14.	Palms: Oil palm and Palmyrah.	1
15.	Plantation crops: Tea and Coffee.	1
16.	Plantation crops: Cashewnut, Cocoa and Rubber.	1

Practical Schedule:

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

14.	Pests and diseases of Coconut, Arecanut, Cocoa, Tea, Coffee, Rubber and Cashew.	1
15.	Visit to commercial orchard and plantation industries.	1

Suggested Readings

1. Bal, J.S. 2013. Fruit Growing. Kalyani Publishers.
2. Banday, F.A. and M.K. Sharma. 2010 Advances in temperate fruit production. Kalyani Publishers.
3. Bose, T.K., S.K. Mitra and D. Sanyal. 2001. Fruits: Tropical and Subtropical (2 volumes) Naya Udyog, Calcutta.
4. Chadha, K.L. 2019. Handbook of Horticulture (2 Vol., 2nd Rev. Edn.). ICAR.
5. Chadha, T.R. 2001. Textbook of Temperate Fruits. ICAR.
6. Chattopadhyay, T.K. 2001. A Text Book on Pomology (4 volumes). Kalyani Publishers.
7. Chudawat, B.S.1990. Arid fruit culture. Oxford &IBH.
8. Das, B.C. and S.N. Das. 2003. Cultivation of Minor Fruits. Kalyani Publishers.
9. David Jackson and N.E. Laone. 1999. Subtropical and Temperate Fruit Production. CABI.
10. Dhillon, W.S. 2013. Fruit Production in India. Narendra Publishing House.
11. Kavino, M.V., R.M. Jegadeeswari, Vijayakumar and S. Balkrishnan. 2018. Production Technology of Fruits and Plantation Crops. Narendra Publishing House.
12. Ponnuswami, V., M. Kumar, S.R. Kumar and C. Krishnamoorthy. 2015. Fruit and Plantation Crops. Narendra Publishing House.
13. Radha, T. and L. Mathew. 2007. Fruit Crops. NIPA.
14. Sadhu, M.K. and P.K. Chattopadhyay. 2001. Introductory Fruit Crops. Naya Prokash.
15. Sharma, A., P. Kumar, and V.K. Tripathi. 2024. Production Technology of Fruits and Plantation Crops. Elite Publishing House.
16. Singh, A. 1986. Fruit Physiology and Production. Kalyani Publishers.
17. Singh, S.P. 2004. Commercial Fruits. Kalyani Publishers.
18. Veeraragavathatham, D., M. Jawaharlal, S. Jeeva, R. Rabindran, and G. Umapathy. 2004. Scientific Fruit Culture (2nd Edn.). Suri Associates, Coimbatore.

EXT-211 Fundamentals of Extension Education 2 (1+1)

Course Status : Core
Contact Hours (L-T-P) : 2-0-2
Course Objective : The course is intended to orient the students with the concept of extension education and its importance in Agriculture development and also to expose the students with various Rural development programmes aimed at poverty alleviation and to increase employment opportunities and their analysis. Besides, the students will be learning about the new innovations being brought into the Agricultural Extension in India.
Course Outcomes (CO) : After the completion of this course, the student will be able to -

CO-1: Understand key concepts, objectives, and principles of education and extension education, including program planning and development.

CO-2: Analyze the evolution of agricultural extension systems and explore various Rural development programmes .

CO-3: Understand key concepts of rural development, leadership, and extension administration.

CO-4: Implement monitoring, evaluation, and technology transfer techniques, using ICT and communication strategies for extension outreach.

CO-5: Understand Communication Strategies and ICT in Technology Transfer.

Course Description :

Theory:	**CO Mapping**
Unit 1: Foundations of Education and Extension Education Education: Meaning, definition and Types; Extension Education: meaning, definition, scope and process; objectives and principles of Extension Education; Extension Programme planning: Meaning, Process, Principles and Steps in Programme Development.	CO-1
Unit 2: Evolution and Emerging Trends in Agricultural Extension Systems in India Extension systems in India: extension efforts in pre-independence era (Sriniketan, Marthandam, Firka Development Scheme, Gurgaon Experiment, etc.) and post-independence era (Etawah Pilot Project, Nilokheri Experiment, etc.). Reorganised Extension System (T&V system) various extension/ agriculture development programs launched by ICAR/ Govt. of India (IADP, IAAP, HYVP, KVK, IVLP, ORP, ND, NATP, NAIP, etc.). Social Justice and poverty alleviation programme: ITDA, IRDP/SGSY/NRLM. Women Development Programme: RMK, MSY etc. New trends in agriculture extension: privatization extension, cyber extension/ e-extension, market-led extension, farmer-led extension, expert systems, etc. Attributes of Innovation, DWCRA, Commodity Interest Groups (CIGs)., Farmers Producer Group (FPG).	CO-2
Unit 3: Rural Development and Leadership in Agricultural Extension Rural Development: concept, meaning, definition; various rural development programs launched by Govt. of India. Community Development: meaning, definition, concept and principles, Philosophy of C.D. Rural Leadership: concept and definition, types of leaders in rural context; Method of identification of Rural Leader. Extension administration: meaning and concept, principles and functions.	CO-3
Unit 4: Monitoring, Evaluation, and Technology Transfer in Extension Monitoring and evaluation: concept and definition, monitoring and evaluation of extension programs; Transfer of technology: concept and models, capacity building of extension personnel Extension teaching methods: meaning, classification, individual, group and mass contact methods.	CO-4
Unit 5: Communication Strategies and ICT in Technology Transfer ICT Applications in TOT (New and Social Media), media mix strategies; Communication: meaning and definition; Principles and Functions of Communication, models and barriers to communication. Agriculture journalism. Diffusion and adoption of innovation: concept and meaning, process and stages of adoption, adopter categories.	CO-5

Practical:

To get acquainted with 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.

Theory Lecture Schedule:

S. No.	**Name of Topic**	**No. of lecture**
1.	Education: Meaning, definition and Types, Extension Education:	1

	meaning, definition, scope and process; objectives and principles of Extension Education.	
2.	Extension Programme planning: Meaning, Process, Principles and Steps in Programme Development.	1
3.	Extension systems in India: extension efforts in pre-independence era (Sriniketan, Marthandam, Firka Development Scheme, Gurgaon Experiment, etc.) and post-independence era (Etawah Pilot Project, Nilokheri Experiment, etc.)	1
4.	Reorganised Extension System (T&V system) various extension/ agriculture development programs launched by ICAR/ Govt. of India (IADP, IAAP, HYVP, KVK, IVLP, ORP, ND, NATP, NAIP, etc.).	1
5.	Social Justice and poverty alleviation programme: ITDA, IRDP/SGSY/NRLM, Women Development Programme: RMK, MSY etc.	1
6.	New trends in agriculture extension: privatization extension, cyber extension/ e-extension, market-led extension, farmer-led extension, expert systems, etc.	1
7.	Attributes of Innovation, DWCRA, Commodity Interest Groups (CIGs)., Farmers Producer Group (FPG).	1
8.	Rural Development: concept, meaning, definition; various rural development programs launched by Govt. of India.	1
9.	Community Development: meaning, definition, concept and principles, Philosophy of C.D.	1
10.	Rural Leadership: concept and definition, types of leaders in rural context; Method of identification of Rural Leader, Extension administration: meaning and concept, principles and functions.	1
11.	Monitoring and evaluation: concept and definition, monitoring and evaluation of extension programs.	1
12.	Transfer of technology: concept and models, capacity building of extension personnel.	1
13.	Extension teaching methods: meaning, classification, individual, group and mass contact methods, ICT Applications in TOT (New and Social Media), media mix strategies.	1
14.	Communication: meaning and definition; Principles and Functions of Communication, models and barriers to communication.	1
15.	Agriculture journalism.	1
16.	Diffusion and adoption of innovation: concept and meaning, process and stages of adoption, adopter categories.	1

Practical Schedule:

S. No.	Name of Topic	No. of practical
1.	To get acquainted with university extension system.	1
2.	Group discussion- exercise.	1
3.	Identification of rural leaders in village situation	1
4.	preparation and use of AV aids, preparation of extension literature (leaflet, booklet, folder, pamphlet news stories and success stories).	1
5.	Presentation skills exercise; micro teaching exercise.	1
6.	A visit to village to understand the problems being encountered by the villagers/ farmers.	2
7.	To study organization and functioning of DRDA/PRI and other development departments at district level.	1
8.	Visit to NGO/FO/FPO and learning from their experience in rural development.	2
9.	Understanding PRA techniques and their application in village development planning.	2

10.	Exposure to mass media: visit to community radio and television studio for understanding the process of programme production.	2
11.	Script writing, writing for print and electronic media, developing script for radio and television.	2

Suggested Readings*:*

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

NEMAT-211 Fundamentals of Nematology 2 (1+1)

Course Status : Core
Contact Hours (L-T-P) : 1-0-2
Course Objective :
1. To impart knowledge on the history, and economic importance of plant parasitic nematodes, morphology, biology, and host parasitic relationship of nematodes.
2. To impart knowledge on nematode pests of different crops of national and local importance and their management.

Course Outcomes (CO) : After the completion of this course, the student will be able to –
CO-1: Basic knowledge and importance of nematodes in Agriculture.
CO-2: Study about morphology, biology, and taxonomy of nematodes.
CO-3: Interaction and synergetic impact of nematodes.
CO-4: Role of plant parasitic nematodes in crop protection.
CO-5: Improve knowledge about management practices against plant parasitic nematodes.

Course Description :

Theory:	**CO Mapping**
Unit 1: Introduction – History of phytonematodes. Habitat and diversity of nematodes. Economic importance of nematodes. General characteristics of plant parasitic nematodes	CO-1
Unit 2: General morphology and Biology- General morphology (Inner-outer body tubes and systems). General biology (Embryogenesis and life cycle).	CO-2
Unit 3: Taxonomy- Classification of nematodes. Economically important genera. Classification of nematodes on the basis of feeding/ parasitic habit	
Unit 4: Symptomatology and Interaction- Symptoms caused by plant parasitic nematodes. Role of nematodes in disease development. Interaction between plant parasitic nematodes and disease-causing fungi, bacteria and viruses	CO-3
Unit 5: Nematode pests of crops- Rice, wheat & barley, and vegetables. Pulses, oilseed and fiber crops. Orchards and plantation crops. Protected cultivation	CO-4
Unit 6: Nematode management- Cultural and physical methods. Biological methods. Chemical methods. Plant Quarantine and Plant resistance. Integrated Nematode Management (Principles, elements and components)	CO-5

Practical:

Sampling methods, collection of soil and plant samples; Extraction of nematodes from soil and plant tissues following Cobb's sieving and decanting technique, Baermann funnel technique, Picking and counting of plant parasitic nematode. Identification of economically important plant nematodes up to generic level with the help of keys and description: *Meloidogyne, Pratylenchus*, *Rotylechulus Heterodera, Tylenchulus, Xiphinema* and *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.

Theory Lecture Schedule:

S. No.	Name of Topic	No. of lecture
1.	History and economic importance of nematodes.	1
2.	Habitat and diversity of nematodes.	1
3.	General characteristics of plant parasitic nematodes.	1
4.	General morphology (Inner and outer body tubes).	1
5.	Reproduction system, circulatory and excretory systems.	1
6.	General biology (Embryogenesis and life cycle).	1
7.	Classification of nematodes up to economically important genera and on the basis of feeding/ parasitic habit.	1
8.	Symptoms caused by plant parasitic nematodes and role of nematodes in disease development.	1
9.	Interaction between plant parasitic nematodes and disease-causing fungi, bacteria and viruses.	1
10.	Nematode pest of rice, wheat & barley, cumin and vegetables.	1
11.	Nematode pest of pulses, oilseed and fiber crops.	1
12.	Nematode pest of orchards (citrus, banana, pomegranate and guava), protected cultivation and plantation crops (tea, coffee and coconut).	1
13.	Cultural and physical methods.	1
14.	Biological methods and chemical methods.	1
15.	Plant Quarantine and Plant resistance.	1
16.	Integrated Nematode Management (Principles, elements and components).	1

Practical Schedule:

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

Suggested Readings*:*

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

AGRON-212 Principles and Practices of Natural Farming 2 (1+1)

Course Status : Core

Contact Hours (L-T-P) : 1-0-2

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

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

: know the basic knowledge on natural farming.

CO-2: acquire comprehensive knowledge on different management options available under natural farming.

CO-3: familiar with the mechanization, processing, certification and marketing aspects, in natural farming.

CO-4: acquaint with initiatives taken by public and private sector for promotion of natural farming.

Course Description :

Theory:	**CO Mapping**
Unit 1: Introduction and History Indian Heritage of Ancient Agriculture, History of Natural Farming, Importance of natural farming in view of climate change, soil health, water use carbon sequestration, biodiversity conservation, food security and nutritional security, and sustainable development goals (SDGs).	CO-1
Unit 2: Concept, Priniciples, Scope and Pillars Concept of natural farming; Definition of natural farming; Objective of natural farming, Essential characteristics and Principles of natural farming; Scope and importance of natural farming. Main Pillars of natural farming; Methods/ types/schools of natural farming.	
Unit 3: Management of natural ecosystem Characteristics and design of a natural farm, Concept of ecological balance, ecological engineering and community responsibility in natural versus other farming systems, Introduction to concept of ecological, water, carbon and nitrogen foot prints, Concept and evaluation of ecosystem services, integration of crops, trees and animals, cropping system approaches, Biodiversity, indigenous seed production, farm waste recycling, water conservation and renewable energy use approaches on a natural farm, Rearing practices for animals under natural farming.	CO-2
Unit 4: Cultivation, mechanization, processing, certification and marketing 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,	CO-3

certification and standards in natural farming, marketing and export potential of natural farming produce and products.	
Unit 5: Initiatives taken by public and private sector for promotion Initiatives taken by Government (central/state), NGOs and other organizations for promotion of natural farming and chemical free agriculture, Case studies and success stories in natural farming and chemical free traditional farming, Entrepreneurship opportunities in natural farming.	CO-4

Practical:

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

Theory Lecture Schedule:

S. No.	Name of Topic	No. of lecture
1.	Indian Heritage of Ancient Agriculture, History of Natural Farming	1
2.	Importance of natural farming in view of climate change, soil health, water use carbon sequestration, biodiversity conservation, food security and nutritional security and sustainable development goals (SDGs).	2
3.	Concept of natural farming; Definition of natural farming; Objective of natural farming.	1
4.	Essential characteristics and Principles of natural farming; Scope and importance of natural farming.	1
5.	Main Pillars of natural farming; Methods/ types/ schools of natural farming.	1
6.	Characteristics and design of a natural farm.	1
7.	Concept of ecological balance, ecological engineering and community responsibility in natural versus other farming systems.	1
8.	Introduction to concept of ecological, water, carbon and nitrogen foot prints.	1
9.	Concept and evaluation of ecosystem services, integration of crops, trees and animals.	1
10.	Cropping system approaches, Biodiversity, indigenous seed production.	1
11.	Farm waste recycling, water conservation and renewable energy use approaches on a natural farm.	1
12.	Rearing practices for animals under natural farming.	1
13.	Nutrient management in natural farming and their sources, Insect, pest, disease and weed management under natural farming.	2
14.	Mechanization in natural farming, Processing,labelling, economic considerations and viability.	1
15.	Certification and standards in natural farming.	1
16.	Marketing and export potential of natural farming produce and products.	1
17.	Initiatives taken by Government (central/state), NGOs and other organizations for promotion of natural farming and chemical free agriculture.	1
18.	Case studies and success stories in natural farming and chemical free traditional farming.	1

19.	Entrepreneurship opportunities in natural farming.	1

Practical Schedule:

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

Suggested Readings:

1. Ayachit, S.M. 2002. Kashyapi Krishi Sukti (A Treatise on Agriculture by Kashyapa). Brig Sayeed Road, Secunderabad, Telangana: Asian Agri-History Foundation 4: 205.
2. Boeringa, R. (Eed.). 1980. Alternative Methods of Agriculture. Elsevier, Amsterdam, 199 pp.
3. Das, P., Das, S.K., Arya, H.P.S., Reddy, G. Subba, Mishra, A. and others: Inventory of Indigenous Technical Knowledge in Agriculture: Mission mode Project on Collection, Documentation and Validation of Indigenous Technical Knowledge, Document 1 To 7, Indian Council of Agricultural Research, New Delhi.
4. Ecological Farming -The seven principles of a food system that has people at its heart. May 2015, Greenpeace.
5. Ecological Farming, The Seven principles of a food system that has people at its heart. May 2015, Greenpeace.
6. FAO. 2018. The 10 elements of agro-ecology: guiding the transition to sustainable food and agricultural system.https://www.fao.org/3/i9037en/i9037en.pdf Agro ecosystem Analysis for Research and Development Gordon R. Conway.1985.
7. Fukuoka, M. 1978. The One-Straw Revolution: An Introduction to Natural Farming. Rodale Press, Emmaus, PA. pp 181.
8. Fukuoka, M. 1985. The Natural Way of Farming: The Theory and Practice of Green Philosophy. Japan Publications, Tokyo, 280 pp.
9. Hill S.B and Ott. P. (Eeds.). 1982. Basic Techniques in Ecological Farming Berkhauser Verlag, Basel, Germany, 366 pp.
10. Hill, S.B. and Ott, P. (Eeds.). 1982. Basic Techniques in Ecological Farming. Berkhauser Verlag, Basel, Germany, 366 pp.
11. HLPE. 2019. Agroeeological and other innovative approaches for sustainable agriculture and food systems that enhance food security and nutrition. A report by the High Level Panel of Experts on Food Security and nutrition of the Committee on World Food Security, Rome. https://fao.org/3/ea5602en/ea5602en.pdf.
12. INFRC. 1988. Guidelines for Nature Farming Techniques. Atami, Japan. pp 38.
13. Khurana, A. and Kumar, V. 2020. State of Organic and Natural Farming: Challenges and Possibilities, Centre for Science and Environment, New Delhi.
14. Malhotra R. and S.D. Babaji. 2020. Sanskrit Non Translatable- The importance of Sanskritizing English. Amaryllis, New Delhi India.

15. Nalini, S. 1996. Vrikshayurveda (The Science of Plant Life) by Surapala. AAHF Classic Bulletin 1. Asian Agri-History Foundation, Brig Sayeed Road, Secunderabad, AP (now Telengana), India. pp 94.
16. Nalini, S. 1999. Krishi-Parashara (Agriculture by Parashara) by Parashara. Brig Sayeed Road, Secunderabad, Telangana: AAHF Classic Bulletin, Asian Agri-History Foundation. pp 104.
17. Nalini, S. 2011. Upavana Vinoda (Woodland Garden for Enjoyment) by Sarangdhara (13th century CE): AAHF Classic Bulletin 8. Asian Agri-History Foundation, Brig Sayeed Road, Secunderabad, AP (now Telangana), India. pp 64.
18. Natural Asset Farming: Creating Productive and Biodiverse Farms by David B. Lindenmayer, Suzannah M. Macbeth, et al. (2022).
19. Natural Farming Techniques: Farming without tilling by Prathapan Paramu (2021).
20. Plenty for All: Natural Farming A to Z Prayog Pariwar Methodology by Prof. Shripad A. Dabholkar and Prayog Pariwar Prayog Pariwar (2021).
21. Reyes Tirado. 2015. Ecological Farming- The seven principles of a food system that has people at its heart. Greenpeace Research laboratories. University of Exeter, Ottho Heldringstraat.
22. Shamasastry, R. 1915. Kautilya's Arthashastra.
23. The Ultimate Guide to Natural Farming and Sustainable Living: Permaculture for Beginners (Ultimate Guides) by Nicole Faires (2016).
24. U. K. Behera. 2013. A text Book of Farming System. Agrotech Publishing House, Udaipur.
25. कम लागत प्राकृत कृतिः आचार्य देवव्रत, pp 1-166.

NSS-211 National Service Scheme-III 1 (0+1)

Course Status : Commom Course
Contact Hours (L-T-P) : 0-0-4 (Non-Gradial)
Course Objective : To equip NSS volunteers with practical vocational skills, environmental awareness, disaster management capabilities, and entrepreneurial knowledge.
Course Outcomes (CO) : After the completion of this course, the student will be able-

CO-1: To gain expertise in two vocational skills from a selected list to enhance employability or support small business ventures.

CO-2: To learn the importance of environmental conservation (e.g., forestation, water and soil conservation), energy conservation, waste management, and sustainable resource practices.

CO-3: To understand disaster types (natural and man-made), the importance of disaster management, and the role of NSS volunteers in relief and recovery, including rehabilitation, safety, and coordination efforts.

CO-4: To understand key entrepreneurial qualities (e.g., leadership, innovation), learn the steps to start a business (idea development, market research, planning), and explore financial support options (capital, loans, mentorship).

CO-5: To learn project formulation from planning to execution, develop management skills, and assess the social, economic, and environmental impact on local communities.

CO-6: To learn to collect and analyze project data (e.g., surveys, observations, statistics), document activities through reports and presentations, and effectively communicate results to stakeholders, communities, and government agencies to drive positive change.

Course Description :

Practical:	**CO Mapping**
Unit 1: Vocational skill development To enhance the employment potential and to set up small business enterprises skills of volunteers, a list of 12 to 15 vocational skills will be drawn up based on the local conditions and opportunities; Each volunteer will have the option to select two skill-areas out of this list.	CO-1
Unit 2: Issues related environment Environmental conservation, enrichment and sustainability, climatic change, natural resource management (rain water harvesting, energy conservation, forestation, waste land development and soil conservations) and waste management.	CO-2
Unit 3: Disaster management Introduction and classification of disaster, rehabilitation and management after disaster; role of NSS volunteers in disaster management.	CO-3
Unit 4: Entrepreneurship development Definition, meaning and quality of entrepreneur; steps in opening of an enterprise and role of financial and support service institution.	CO-4
Unit 5: Formulation of production oriented project Planning, implementation, management and impact assessment of project; Documentation and data reporting: Collection and analysis of data, documentation and dissemination of project reports.	CO-5
Unit 6: Documentation and data reporting Collection and analysis of data, documentation and dissemination of project reports.	CO-6

AIAI-221 Agricultural Informatics and Artificial Intelligence 3 (2+1)

Course Status : Common Course
Contact Hours (L-T-P) : 2-0-2
Course Objective :
1. To acquaint students with the basics of computer applications in agriculture, multimedia, database management, application of mobile app and decision- making processes, etc.
2. To provide basic knowledge of computer with applications in agriculture
3. To make the students familiar with agricultural-informatics, its components and applications in agriculture and Artificial intelligence

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

CO-1: The basic concepts of Computers knowledge and its programming.

CO-2: The basic concepts of Computers application in Agricultural Sciences.

CO-3: The knowledge of Agriculture Informatics and its application in Agriculture and Artificial intelligence.

Course Description :

Theory:	**CO Mapping**
Unit 1: Introduction to Computers and its operating system Introduction to Computers, Anatomy of Computers, Memory Concepts, Units of Memory, Operating System: Definition and types, Applications of MS-Office for creating, Editing and Formatting a document, Data presentation, Tabulation and graph creation, Statistical analysis, Mathematical expressions.	CO-1
Unit 2: Data base management and programming	

Database, concepts and types, creating database, Uses of DBMS in Agriculture, Internet and World Wide Web (WWW): Concepts and components. Computer programming: General concepts, Introduction to Visual Basic, Java, Fortran, C/ C++, etc. concepts and standard input/output operations.	
Unit 3: e-Agriculture e-Agriculture, Concepts, design and development, Application of innovative ways to use information and communication technologies (IT) in Agriculture, Computer Models in Agriculture: Statistical, weather analysis and crop simulation models, concepts, structure, inputsoutputs files, limitation, advantages and application of models for understanding plant processes, sensitivity, verification, calibration and validation.	CO-2
Unit 4: Information Technology in Agriculture IT applications for computation of water and nutrient requirement of crops, Computer-controlled devices (automated systems) for Agri-input management, Smartphone mobile apps in agriculture for farm advice: Market price, postharvest management etc., Geospatial technology: Concepts, techniques, components and uses for generating valuable agri-information, Decision support systems: Concepts, components and applications in Agriculture, Agriculture Expert System, Soil Information Systems etc. for supporting farm decisions. Preparation of contingent crop planning and crop calendars using IT tools, Digital India and schemes to promote digitalization of agriculture in India.	
Unit 5: Artificial intelligence in Agricultural Sciences Introduction to artificial intelligence, background and applications, Turing test. Control strategies, Breadth-first search, Depth-first search, Heuristics search techniques: Best-first search, A* algorithm, IoT and Big Data; Use of AI in agriculture for autonomous crop management, and health, monitoring livestock health, intelligent pesticide application, yield mapping and predictive analysis, automatic weeding and harvesting, sorting of produce, and other food processing applications; Concepts of smart agriculture, use of AI in food and nutrition science etc.	CO-3

Practical:

Study of computer components, accessories, practice of important DoS Commands, Introduction of different operating systems such as Windows, Unix/ Linux, creating files and folders, File Management. Use of MS-WoRD and MS Power-point for creating, editing and presenting a scientific documents, MS-EXCEL - Creating a spreadsheet, Use of statistical tools, Writing expressions, Creating graphs, Analysis of scientific data, Handling macros. MS-ACCESS: Creating Database, preparing queries and reports, Demonstration of Agri- information system, Introduction to World Wide Web (WWW) and its components, Introduction of programming languages such as Visual Basic, Java, Fortran, C, C++, Hands on practice on Crop Simulation Models (CSM), DSSAT/Crop-Info/Crop Syst/ Wofost, Preparation of inputs file for CSM and study of model outputs, computation of water and nutrient requirements of crop using CSM and IT tools, Use of smart phones and other devices in agro-advisory and dissemination of market information, Introduction of Geospatial Technology, Hands on practice on preparation of Decision Support System, Preparation of contingent crop planning, India Digital Ecosystem of Agriculture (IDEA).

Theory Lecture Schedule:

S.No.	Name of Topic	No. of lecture
1.	Introduction to Computers, Anatomy of Computers, Memory Concepts, Units of Memory.	1
2.	Operating System: Definition and types.	1
3.	Applications of MS-Office for creating, Editing and Formatting a document.	1
4.	Data presentation, Tabulation and graph creation.	1

5.	Statistical analysis, Mathematical expressions.	2
6.	Database: concepts and types, creating database, Uses of DBMS in Agriculture.	1
7.	Internet and World Wide Web (WWW): Concepts and components.	1
8.	Computer programming: General concepts, Introduction to Visual Basic, Java, Fortran, C/. C++, etc. concepts and standard input/output operations.	2
9.	e-Agriculture, Concepts, design and development.	1
10.	Application of innovative ways to use information and communication technologies (IT) in Agriculture.	1
11.	Computer Models in Agriculture: Statistical, weather analysis and crop simulation models.	2
12.	Concepts, structure, inputs-outputs files, limitation, advantages and application of models for understanding plant processes, sensitivity, verification, calibration and validation.	2
13.	IT applications for computation of water and nutrient requirement of crops.	1
14.	Computer-controlled devices (automated systems) for Agri-input management.	1
15.	Smartphone mobile apps in agriculture for farm advice: Market price, postharvest management etc.	1
16.	Geospatial technology: Concepts, techniques, components and uses for generating valuable agri-information.	1
17.	Decision support systems: Concepts, components and applications in Agriculture.	1
18.	Agriculture Expert System, Soil Information Systems etc. for supporting farm decisions.	1
19.	Preparation of contingent crop planning and crop calendars using IT tools.	1
20.	Digital India and schemes to promote digitalization of agriculture in India.	1
21.	Introduction to artificial intelligence, background and applications, Turing test.	1
22.	Control strategies, Breadth-first search, Depth-first search, Heuristics search techniques: Best-first search, A* algorithm, IoT and Big Data.	2
23.	Use of AI in agriculture for autonomous crop management, and health, monitoring livestock health, intelligent pesticide application, yield mapping and predictive analysis.	2
24.	Use of AI in agriculture for automatic weeding and harvesting, sorting of produce, and other food processing applications.	2
25.	Concepts of smart agriculture, use of AI in food and nutrition science etc.	1

Practical Schedule:

S. No.	Name of Topic	No. of practical
1.	Study of computer components, accessories, practice of important DoS Commands.	1
2.	Introduction of different operating systems such as Windows, Unix/ Linux, creating files and folders, File Management.	1
3.	Use of MS-WoRD and MS Power-point for creating, editing and presenting a scientific documents.	1
4.	MS-EXCEL - Creating a spreadsheet, Use of statistical tools, Writing expressions, Creating graphs, Analysis of scientific data, Handling macros.	1

5.	MS-ACCESS: Creating Database, preparing queries and reports.	1
6.	Demonstration of Agri- information system.	1
7.	Introduction to World Wide Web (WWW) and its components.	1
8.	Introduction of programming languages such as Visual Basic, Java, Fortran, C, C++	1
9.	Hands on practice on Crop Simulation Models (CSM), DSSAT/Crop-Info/Crop Syst/ Wofost.	1
10.	Preparation of inputs file for CSM and study of model outputs.	1
11.	computation of water and nutrient requirements of crop using CSM and IT tools.	1
12.	Use of smart phones and other devices in agro-advisory and dissemination of market information.	1
13.	Introduction of Geospatial Technology.	1
14.	Hands on practice on preparation of Decision Support System.	1
15.	Preparation of contingent crop planning.	1
16.	India Digital Ecosystem of Agriculture (IDEA).	1

Suggested Readings:

1. Fundamentals of Computer by V. Rajaroman.
2. Introduction to Information Technology by Pearson.
3. Introduction to Database Management System by C. J. Date.
4. Concepts and Techniques of Programming in C by Dhabal Prasad Sethi and Manoranjan, Wiley India.
5. Introductory Agri Informatics by Mahapatra, Subrat K et al, Jain Brothers Publication.
6. Russell, Stuart. Artificial Intelligence: A Modern Approach, Pearson Edition 2013.
7. Nilson N.J. 2001. Principles of Artificial Intelligence. Narosa.
8. Allport, G. W. Personality: A Psychological Interpretation.

HORT-221 Production Technology of Vegetables and Spices 2 (1+1)

Course Status : Core
Contact Hours (L-T-P) : 1-0-2
Course Objective :
1. To educate about the different forms of classification of vegetables.
2. To educate about the origin, area, climate, soil, improved varieties and cultivation practices of vegetables and spices.
3. To educate about the physiological disorders of vegetables and spices.

Course Outcomes (CO) : After the completion of this course the student will be able to learn-
CO-1: Importance of vegetables and spices in human nutrition and national economy.
CO-2: Production technology of vegetables.
CO-3: Production technology of spices.

Course Description :

Theory:	**CO Mapping**
Unit 1: Introduction Importance of vegetables and spices in human nutrition and national economy, Kitchen gardening.	CO-1
Unit 2: Production technology of vegetables Brief description about origin, area, climate, soil, improved varieties and cultivation practices such as time and method of sowing, transplanting techniques, planting distance, fertilizer requirements, irrigation, weed	CO-2

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

Practical:

Identification of vegetables and spice crops and their seeds. Description of varieties. Propagation methods - rapid multiplication techniques - seed collection and extraction. Nursery raising. Direct seed sowing and transplanting. Study of morphological characters of different vegetables and spices. Fertilizers applications. Harvesting and post-harvest practices, Economics of vegetables and spices cultivation, visit to spice gardens.

Theory Lecture Schedule:

S. No.	Name of Topic	No. of lecture
1.	Importance of vegetables and spices in human nutrition and national economy.	1
2.	Kitchen gardening.	1
3.	Production technology of important vegetables including brief description about origin, area, climate, soil, improved varieties and cultivation practices such as time and method of sowing, transplanting techniques, planting distance, fertilizer requirements, irrigation, weed management, harvesting and yield, and physiological disorders: Vegetable crops: Tomato and Brinjal.	1
4.	Vegetable crops: Chilli and Capsicum, and Okra.	1
5.	Vegetable crops: Cucumber, Bottle gourd, Bitter gourd and Pumpkin.	1
6.	Vegetable crops: Sweet potato, Cassava and Moringa.	1
7.	Vegetable crops: Peas and French bean.	1
8.	Vegetable crops: Cole crops (Cabbage, Cauliflower and Knol-khol).	1
9.	Vegetable crops: Bulb crops (Onion and Garlic).	1
10.	Vegetable crops: Root crops (Carrot, Radish and Beetroot).	1
11.	Vegetable crops: Tuber crop (Potato), Leafy vegetables (Amaranth and Palak), and Perennial vegetable- Pointed gourd.	1
12.	Production technology of important spice including brief description about origin, area, climate, soil, improved varieties and cultivation practices such as time and method of sowing, transplanting techniques, planting distance, fertilizer requirements, irrigation, weed management, harvesting and yield, and physiological disorders: Spice crops: Ginger and Turmeric.	1
13.	Spice crops: Black pepper and Cardamom.	1
14.	Spice crops: Cumin, Coriander and Fennel.	1
15.	Spice crops: Fenugreek, Curry leaf and Herbal spices.	1
16.	Spice crops: Clove, Nutmeg, Cinnamon and Tamarind.	1

Practical Schedule:

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

Suggested Readings:

1. Chadha, K.L. 2019. Handbook of Horticulture (2 Vol., 2nd Rev. Edn.). ICAR, New Delhi.
2. Dashora, L. K., A. Dashora, S. S. Lakhawat, and L.L. Somani. 2013. Production Technology of Plantation Crops, Spices, Aromatic & Medicinal Plants. Agrotech.
3. Fagaria, M.S., B.R. Choudhury and R.S. Dhaka. 2016. Vegetable Crops Production Technology Text Book (Vol.-II). Kalyani Publishers.
4. Kumar, N. 2017. Introduction to Spices, Plantation Crops, Medicinal & Aromatic Plants (3rd Edn.). MedTech.
5. Singh, K.P. and Anant Bahadur. Olericulture: Fundamentals of Vegetable Production (Vol.1). Kalyani Publishers.
6. Som, M.G., T.K. Bose, J. Kabir. 2021. Vegetable Crops (Vol.3, 4th Rev. Edn.). Astral Publishing.

AGECON-221 Principles of Agricultural Economics and Farm Management 2 (2+0)

Course Status : Core
Contact Hours (L-T-P) : 2-0-0
Course Objective :
1. To aware the students about broad areas covered under agricultural Economics and farm Management
2. To impart knowledge on judicious use of resources for optimum production.

Course Outcomes (CO) : After the completion of this course, the student will be able to learn about -
CO-1: The basic concepts of Fundamental economics
CO-2: Role of Farm manager in business development activities
CO-3: Basic concept about Farm management tools and International Trade.
CO-4: To understand different type of insurance scheme.

Course Description :

Theory:	CO Mapping
Unit-I Basics Concepts of Economics Economics: Meaning, scope and subject matter, definitions, activities, approaches to economic analysis; micro- and macro-economics, positive and normative analysis. Nature of economic theory; rationality assumption, concept of equilibrium, economic laws as generalization of human behavior. Basic	CO-1

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.	
Unit-II: Consumers Theory Consumer's equilibrium and derivation of demand curve, concept of consumer surplus. Elasticity of demand: concept and measurement of price elasticity, income elasticity and cross elasticity.	CO-2
Unit-III: Farm Production Economics Production: process, creation of utility, factors of production, input output relationship. Laws of returns: Law of variable proportions and law of returns to scale. Cost: Cost concepts, short run and long run cost curves. Supply: Stock v/s supply, law of supply, supply schedule, supply curve, determinants of supply, elasticity of supply. Distribution theory: meaning, factor market and pricing of factors of production	CO-3
UNIT-IV: Rent, Wages, Interest and Theory of Profit Concepts of rent, wage, interest and profit. National income: Meaning and importance, circular flow, concepts of national income accounting and approaches to measurement, difficulties in measurement. Population: Importance, Malthusian and Optimum population theories, natural and socio-economic determinants, current policies and programs on population control.	
Unit-V: Economic Systems Money: Barter system of exchange and its problems, evolution, meaning and functions of money, classification of money, money supply, general price index, inflation and deflation. Economic systems: Concepts of economy and its functions, important features of capitalistic, socialistic and mixed economies, elements of economic planning. Forms of business organizations, international trade and balance of payments. GST and its implication on Indian economy.	CO-4

Theory Lecture Schedule:

S. No.	Name of Topic	No. of lecture
1.	Economics: Meaning, scope and subject matter, definitions, activities, approaches to economic analysis.	1
2.	Micro- and macro-economics, positive and normative analysis.	1
3.	Nature of economic theory; rationality assumption, concept of equilibrium, economic laws as generalization of human behavior.	1
4.	Basic concepts: Goods and services, desire, want, demand, utility, cost and price, wealth, capital, income and welfare.	1
5.	Agricultural economics: meaning, definition, characteristics of agriculture, importance and its role in economic development.	2
6.	Agricultural planning and development in the country. Demand: meaning, law of demand, demand schedule and demand curve, determinants.	1
7.	Utility theory; law of diminishing marginal utility, equi-marginal utility principle.	1
8.	Consumer's equilibrium and derivation of demand curve, concept of consumer surplus.	1
9.	Elasticity of demand: concept and measurement of price elasticity, income elasticity and cross elasticity.	1
10.	Production: process, creation of utility, factors of production, input output relationship.	1
11.	Laws of returns: Law of variable proportions and law of returns to scale.	2

12.	Cost: Cost concepts, short run and long run cost curves.	1
13.	Supply: Stock v/s supply, law of supply, supply schedule, supply curve, determinants of supply, elasticity of supply.	1
14.	Distribution theory: meaning, factor market and pricing of factors of production.	1
15.	Concepts of rent, wage, interest and profit.	2
16.	National income: Meaning and importance, circular flow, concepts of national income accounting and approaches to measurement, difficulties in measurement.	2
17.	Population: Importance, Malthusian and Optimum population theories.	1
18.	Natural and socio-economic determinants, current policies and programs on population control.	2
19.	Money: Barter system of exchange and its problems, evolution, meaning and functions of money.	1
20.	Classification of money, money supply	1
21.	General price index, inflation and deflation.	1
22.	Economic systems: Concepts of economy and its functions, important features of capitalistic, socialistic and mixed economies, elements of economic planning.	3
23.	Forms of business organizations.	1
24.	International trade and balance of payments.	1
25.	Taxation GST and its implication on Indian economy.	1

Suggested Readings:

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

AGRON-221 Crop Production Technology-II (*Rabi* Crops) 3 (1+2*)

Course Status : Core
Contact Hours (L-T-P) : 1-0-4
Course Objective : This course intends to impart knowledge on various cultivation practices of different Rabi crops.
Course Outcomes (CO) : After the completion of this course, the student will be able -

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

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

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

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

Course Description :

Theory:	**CO Mapping**
Unit 1: Cereals: Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of Wheat and Barley.	CO-1

Unit 2: Pulses: Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of Chickpea, Lentil, Peas, *Rabi* Redgram and Rajmash.	CO-2
Unit 3: Oilseeds: Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of Rapeseed, Mustard, Sunflower and Safflower.	
Unit 4: Sugar crops: Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of Sugarcane and Sugarbeat.	CO-3
Unit 5: **Medicinal and aromatic crops:** Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of Mentha, Lemon grass, Citronella and isabgoal.	CO-4
Unit 6: Forage crops: Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of Barseem, Lucerne and Oat.	
Unit 7: Cash crops: Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of potato, quinoa, tobacco.	

Practical:

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

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

Theory Lecture Schedule:

S. No.	Name of Topic	No. of lecture
1.	Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of cereals – wheat and barley.	2
2.	Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of pulses- chickpea, lentil, peas, Rabi redgram and Rajmash.	2
3.	Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of oilseeds- rapeseed-mustard, sunflower, safflower and linseed.	4
4.	Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of sugar crops-sugarcane and sugar beet.	2
5.	Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of medicinal and aromatic crop- mentha, lemon grass and citronella.	1
6.	Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of Forage crops- berseem, lucerne and oat.	2
7.	Origin, geographical distribution, economic importance, soil and	3

	climatic requirements, varieties, cultural practices and yield of cash crops-; potato, quinoa, tobacco.	

Practical Schedule:

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

Practical schedule: Practical Crop Oroduction

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

Suggested Readings:

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

AGENGG-221 Farm Machinery and Power 2 (1+1)

Course Status : Core
Contact Hours (L-T-P) : 1-0-1
Course Objective : To enable the students to understand the need of farm power, basic principles and parts of IC engine, different tillage, sowing, intercultural, plant protection equipment, working principles of threshers, harvesting of field and horticultural crops.
Course Outcomes (CO) : After the completion of this course, the student will be able to learn about -
CO-1: Status of Farm Power in India and Familiarization with different systems of I.C. engines and maintenance of tractor.
CO-2: Familiarization with Primary and Secondary Tillage implement ans use in Agriculture.

Course Description :

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

Practical:

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

Theory Lecture Schedule:

S. No.	Name of Topic	No. of lecture
1.	Sources of farm power and its status in India and Rajasthan.	1
2.	I.C. engines, working principles of I. C. engines, comparison of two stroke and four stroke cycle engines.	1
3.	Study of different components of I. C. engine, I. C. engine terminology and numerical.	2
4.	Air supply and exhaust system- Pre cleaners, oil-soaked element type	1

	and oil bath type air cleaners; fuel supply system.	
5.	Lubricating system- splash system and forced feed system; cooling system-thermo siphon system and forced circulation system.	1
6.	Transmission system- clutch, gear box, differential, final drive, P.T.O. shaft and hydraulic control system.	1
7.	Tractor types, Estimation of operational cost of a tractor.	1
8.	Familiarization with primary and secondary tillage implement.	2
9.	Numerical on field capacity and power requirement of implements.	2
10.	Familiarization with implement with intercultural operations.	1
11.	Familiarization with sowing and planting equipment.	1
12.	Familiarization with plant protection equipment.	1
13.	Familiarization with harvesting and threshing equipment.	1

Practical Schedule:

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

Suggested Readings:

1. Jagdiswar Sahay – Elements of Agricultural Engineering Jain, S.C. and C.R. Rai-Farm Tractor and maintenance and repair. Standard Publishers, 1705-B, Naisarak. Delhi- 110006.
2. Ojha, T.P. and A.M. Michael, A.M. Principles of Agricultural Engineering. Vol.-I. Jain brothers, 16/893, East Park Road, Karol Bagh, New Delhi -110005.
3. Surendra Singh- Farm machinery –Principles and applications, ICAR, New Delhi.

AGRON-222 Water Management 2 (1+1)

Course Status : Core
Contact Hours (L-T-P) : 1-0-2
Course Objective :
1. To study the important properties of soil affecting water availability to crops and water requirement for optimum growth and development.
2. To study different methods of irrigation and water management practices of both field and horticultural crops and drainage.
3. To study the soil moisture conservation practices including management of rain water, watershed and command areas.

Course Outcomes (CO) : After the completion of this course, the student will be able -
CO-1: to know basic knowledge on water resources.

CO-2: to acquaint with soil plant water relationship.
CO-3: to familiarisation with the irrigation methods.
CO-4: to analyse the irrigation efficiency and quality of irrigation water.
CO-5: to construct ideologies pertaining to water management for different soils and crops.

Course Description :

Theory:	**CO Mapping**
Unit 1: Water resources, utilization and irrigation development Irrigation: definition and objectives; Importance: Function of water for plant growth, Water resources and irrigation development for different crops in India	CO-1
Unit 2: Soil-plant-water relationships and Irrigation Scheduling Soil plant water relationships; Available and unavailable soil moisture, distribution of soil moisture, water budgeting, rooting characteristics, moisture extraction pattern, effect of moisture stress on crop growth. Methods of soil moisture estimation, evapotranspiration and crop water requirement; effective rainfall, different approaches of scheduling of irrigation.	CO-2
Unit 3: Methods of Irrigation and fertigation Methods of irrigation: surface and sub-surface, pressurized methods, viz., sprinkler and drip irrigation, their suitability, merits and limitations, fertigation, economic use of irrigation water; Layout of different irrigation systems	CO-3
Unit 4: Irrigation efficiency, water quality management Irrigation efficiency and water use efficiency, Conjunctive use of water, irrigation water quality and its management.	CO-4
Unit 5: Water management information Water management of different crops (rice, wheat, maize, groundnut, sugarcane, mango, banana and tomato); irrigation management practices for different soils and crops, drip, sprinkler. Layout of underground pipeline system, Irrigation automation, Artificial Intelligence and climate-based irrigation practices and its management.	CO-5

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, weirs, notches, orifices; 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; Visit to irrigation research centre/ station and visit to command area.

Theory Lecture Schedule:

S. No.	Name of Topic	No. of lecture
1.	Irrigation: definition and objectives; Importance.	1
2.	Function of water for plant growth and water resources and irrigation development for different crops in India.	1
3.	Soil plant water relationships and Available and unavailable soil moisture, distribution of soil moisture.	1
4.	Water budgeting.	1
5.	Rooting characteristics, moisture extraction pattern, effect of moisture stress on crop growth.	1
6.	Methods of soil moisture estimation, evapotranspiration and crop	1

	water requirement.	
7.	Effective rainfall, different approaches of scheduling of irrigation.	1
8.	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.	2
9.	Layout of different irrigation systems.	1
10.	Irrigation efficiency and water use efficiency, conjunctive use of water.	1
11.	Irrigation water quality and its management.	1
12.	Water management of different crops.	1
13.	Irrigation management practices for different soils and crops, drip, sprinkler.	1
14.	Layout of underground pipeline system, Irrigation automation.	1
15.	Artificial Intelligence and climate-based irrigation practices and its management.	1

Practical Schedule:

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

Suggested Readings:

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

SSAC-221 Problematic Soils and Their Management 2 (1+1)

Course Status : Core
Contact Hours (L-T-P) : 1-0-2
Course Objective : 1. To acquaint the students about various problem soils like

degraded soils, acid soils, saline soils, alkali soils, eroded soils, submerged soils, polluted soils. Also to impart knowledge about remote sensing, GIS, Multipurpose tree and Land capability classification.

2. To give hands on training about estimation of various soil and water quality parameters associated with problem soils..

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

CO-1: about various types of problematic soils.

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

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

Course Description :

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

Practical:

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

Theory Lecture Schedule:

S. No.	Name of Topic	No. of lecture
1.	Soil heath – indicators, characteristics and major factors affecting soil quality, soil heath.	1
2.	Distribution of Waste land and problem soils in India.	1
3.	Categorization of Problem soils based on properties.	1
4.	Reclamation and management of salt affected soils.	2
5.	Reclamation and management of acid soils.	1
6.	Management of Eroded and Compacted soils.	1
7.	Reclamation and management of polluted soils.	1
8.	Reclamation and management of Contaminated and mined soils.	1
9.	Management of Riverine and Waterlogged soils.	1
10.	Irrigation water – quality and standards.	1
11.	Utilization of saline water in agriculture.	1

12.	Use of Remote sensing and GIS in diagnosis and management of problem soils.	1
13.	Bio- remediation of soils through Multipurpose tree (MPT) species.	1
14.	Land capability classification and Land suitability classification.	2

Practical Schedule:

S. No.	Name of Topic	No. of practical
1.	Determination of pHs and EC of saturation extract of problematic soil.	1
2.	Determination of redox potential in soil.	1
3.	Determination of Ca++ and Mg++ in saturation extract of soil.	1
4.	Determination Na+ in saturation extract of soil.	1
5.	Determination K+ in saturation extract of soil.	1
6.	Computation of SAR and ESP.	1
7.	Determination of Gypsum requirement of alkali/ sodic soil.	1
8.	Determination of lime requirement of acidic soil.	1
9.	Determination of pH and EC in irrigation water.	1
10.	Determination of Ca++ and Mg++ in irrigation water.	1
11.	Determination of Na+ and Cl in irrigation water.	1
12.	Determination of CO_3 and HCO_3 in irrigation water.	1
13.	Computation of SAR and RSC in irrigation water.	1
14.	Determination of nitrate (NO_3-) from irrigation water.	1
15.	Determination of dissolved oxygen in water samples.	1
16.	Determination of free carbon dioxide levels in water samples.	1

Suggested Readings:

1. Brady, N. C. and Well, R. R. 2014. Nature and properties of soils. Pearson Education Inc., New Delhi.
2. Das, D. K. 2011. Introductory Soil Science (3rd Edition), Kalyani publisher, Ludhiana (India).
3. Gupta, P. K. 2009. Soil, Plant, Water and Fertilizer Analysis (2nd Edition), Agrobios, Jodhpur (India).
4. Indian Society of Soil Science (ISSS) 2002. Fundamentals of Soil Science, IARI, New Delhi.
5. Mehra, R. K. 2004. Text Book of Soil Science, ICAR, New Delhi.
6. Rakshit, A., Raha, P. and Bhadoria, P. B. S. 2015. Principles of Soil Science. Kalyani Publishers, Ludhiana.
7. Agarwal, R.R., Yadav, J.S.P. and Gupta, R.N. (1982). Saline Alkali soils of India, ICAR,
8. Cirsan J. Paul., 1985,. Principles of Remote Sensing. Longman, New York
9. Osman, Khan Towhid., 2018., Management of Soil Problems. Springer publication.
10. Srivastava, V. C., 2002. Management of Problem Soils -Principles and Practices New Delhi.

GPB-221 Basics of Plant Breeding 3 (2+1)

Course Status : Core
Contact Hours (L-T-P) : 2-0-2
Course Objective : To acquaint with different techniques ranging from simply selecting plants with desirable characteristics for propagation, to more complex molecular techniques for breeding new varieties, which are higher yielding, resistant to biotic and abiotic stresses for ensuring food security.
Course Outcomes (CO) : After the completion of this course, the student will be able to learn-
CO-1: History, nature and role of Plant breeding.
CO-2: Breeding methods for self-pollinated, cross-pollinated and

clonally propagated crops.

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

Course Description :

Theory:	**CO Mapping**
Unit 1: Introduction to Plant Breeding Historical development, concept, nature and role of plant breeding, major achievements and future prospects; Genetics in relation to plant breeding, modes of reproduction and apomixes, self-incompatibility and male-sterility-genetic consequences, cultivar options, Plant genetic resources, its utilization and conservation Domestication, Acclimatization and Introduction. Centres of origin/ diversity, Components of Genetic variation. Heritability and genetic advance.	CO-1
Unit 2: Breeding methods for self- and cross-pollinated crops Pre-breeding and Universal Plant Breeder's equation. Genetic basis and breeding methods in self-pollinated crops-mass and pure line selection, hybridization techniques and handling of segregating population. Multiline concept, Concepts of population genetics and Hardy-Weinberg Law, Genetic basis and methods of breeding cross-pollinated crops, modes of selection. Population movement schemes- Ear to Row method, Modified Ear to Row, recurrent selection schemes. Heterosis and inbreeding depression, development of inbred lines and hybrids, composite and synthetic varieties.	CO-2
Unit 3: Breeding methods for clonally propagated crops Breeding methods in asexually propagated crops, clonal selection and hybridization.	
Unit 4: Distant Hybridization and Breeding for Stress Wide hybridization and pre-breeding. Polyploidy in relation to plant breeding, mutation breeding- methods and uses. Breeding for important biotic and abiotic stresses.	CO-3
Unit 5: Variety Release and Intellectual property rights Participatory plant breeding. Variety Release and notification. Intellectual Property Rights, Patenting, Plant Breeders and Farmer's Rights.	

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 genetic structure of resulting populations, Study of male sterility system, Handling of segregating populations, Methods of calculating mean, range, variance, standard deviation, heritability, Designs used in plant breeding experiments, analysis of Randomized Block Design, To work out the mode of pollination in a given crop and extent of natural out-crossing, Prediction of performance of double cross hybrids, Maintenance of breeding records and data collection, Screening tests for biotic and abiotic stresses.

Theory Lecture Schedule:

S. No.	Name of Topic	No. of lecture
1.	Historical development of Plant Breeding.	1
2.	Plant breeding: concept, nature, objectives and role of Plant Breeding.	1
3.	Major achievements and future prospects of Plant Breeding.	1
4.	Genetics in relation to Plant Breeding.	1
5.	Modes of reproduction and pollination, apomixes.	1
6.	Self – incompatibility.	1
7.	Male sterility- genetic consequences, cultivar options.	1
8.	Plant genetic resources, its utilization and conservation.	1
9.	Domestication, Acclimatization, introduction, centre of origin/diversity.	1
10.	Component of genetic variation; heritability and genetic advance.	1

11.	Pre-breeding and Universal Plant Breeder's equation.	1
12.	Genetic basis and breeding methods of self- pollinated crops- mass and pure line selection.	1
13.	Hybridization techniques.	1
14.	Handling of segregating population.	1
15.	Multiline concept.	1
16.	Concepts of population genetics and Hardy-Weinberg Law.	1
17.	Genetic basis and methods of breeding cross pollinated crops.	1
18.	Modes of selection, Population improvement - Ear to Row method, Modified Ear to Row, recurrent selection schemes.	1
19.	Heterosis and inbreeding depression.	1
20.	Development of inbred lines and hybrids.	1
21.	Composite and synthetic varieties.	1
22.	Breeding methods in asexually propagated crops.	1
23.	Clonal selection and hybridization.	1
24.	Wide hybridization and pre-breeding.	1
25.	Polyploidy in relation to Plant Breeding.	1
26.	Mutation breeding- methods and uses.	1
27.	Breeding for important biotic stresses.	1
28.	Breeding for important abiotic stresses.	1
29.	Participatory plant breeding.	1
30.	Variety Release and notification.	1
31.	Intellectual Property Rights and Patenting.	1
32.	Plant Breeders and & Farmer's Rights.	1

Practical Schedule:

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

Suggested Readings:

1. Allard, R. W. 2000. Principles of Plant Breeding. John Willey & Sons, New York.
2. Chahel, G.S. and Ghosal, S.S. 2002. Principles and Procedures of Plant Breeding, Biotechnological and Conventional Approaches. Narosa Publishing House, New Delhi.

3. Chopra, V. L. 2012. Plant breeding: Theory and Practice. Oxford & IBH Publishing CO. Pvt. Ltd., New Delhi.
4. Jain, H. K. and Kharsckwal, M. C. 2004. Plant Breeding- Mendelian to Molecular Approach. Narosa Publishing House, New Delhi.
5. Ramchandra, R. K. 2015. Princilpes of Plant Breeding. Jaya Publishing House, Delhi.
6. Sharma, J. R. 1994. Principles and Practices of Plant Breeding. Tata McGraw Publishing Company Ltd., New Delhi.
7. Singh, B. D. 2006. Plant Breeding. Kalyani Publishing House, New Delhi.
8. Principles of Plant Genetics and Breeding by George Acquaah.

NSS-221 National Service Scheme –IV 1 (0+1)

Course Status : Commom Course
Contact Hours (L-T-P) : 0-0-4 (Non-Gradial)
Course Objective : To empower youth by developing their ability to prevent and address crime, defend themselves, mobilize resources, and improve their personal and professional lives.
Course Outcomes (CO) : After the completion of this course, the student will be able-
CO-1: To understand the root causes of youth crime and the impact on individuals and communities. Promote awareness of peer mentoring as a strategy to prevent crime and educate youth about the juvenile justice system and legal rights.
CO-2: To equip with the knowledge and practical skills required for self-defence and emergency preparedness in various situations, including understanding civil defence services and their role in national safety.
CO-3: To enable youth to mobilize resources, write effective proposals, and establish sustainable self-funding ventures, promoting entrepreneurial thinking and community development.
CO-4: To build a positive mindset, develop strong personal leadership, improve self-esteem, and learn how to set and achieve life goals while managing stress and maintaining work-life balance.

Course Description :

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

AGECON-311 Agricultural Marketing and Trade 3 (2+1)

Course Status : Common course
Contact Hours (L-T-P) : 2-0-2
Course Objective : 1. To understand the fundamentals of agricultural marketing and

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

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

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

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

CO-3: understand role of government agencies and international tarde.

Course Description :

Theory:	**CO Mapping**
Unit 1: Agricultural Marketing Agricultural Marketing: Concepts and definitions of market, marketing, agricultural marketing, market structure, marketing mix and market segmentation, classification and characteristics of agricultural markets.	CO-1
Unit 2: Supply, Demand and Producers Surplus Demand, supply and producer's surplus of agri commodities: nature and determinants of demand and supply of farm products, producer's surplus – meaning and its types, marketable and marketed surplus, factors affecting marketable surplus of agri-commodities.	
Unit 3: Pricing and promotional strategies Pricing and promotion strategies: pricing considerations and approaches – cost based and competition based pricing; market promotion – advertising, personal selling, sales promotion and publicity – meaning, merits and demerits.	CO-2
Unit 4: Marketing process and functions Marketing process and functions: Marketing process concentration, dispersion and equalization; exchange functions – buying and selling; physical functions – storage, transport and processing; facilitating functions – packaging, branding, grading, quality control and labelling (Agmark); Market functionaries and marketing channels: Types and importance of agencies involved in agricultural marketing; meaning and definition of marketing channel; number of channel levels; marketing channels for different farm products.	
Unit 5: Market Intigration,Marketing Margin and Price Spread Integration, efficiency, costs and price spread: Meaning, definition and types of market integration; marketing efficiency; marketing costs, margins and price spread; factors affecting cost of marketing; reasons for higher marketing costs of farm commodities; ways of reducing marketing costs.	CO-3
Unit 6: Role of Govt. Agencies in agricultural marketing Role of Govt. in agricultural marketing: Public sector institutions- CWC, SWC, FCI, CACP and DMI – their objectives and functions; cooperative marketing in India; Risk in marketing: Types of risk in marketing; speculation and hedging; an overview of futures trading; Agricultural prices and policy: Meaning and functions of price; administered prices; need for innovations in agricultural price policy	
Unit 7: Trade Trade: Concept of International Trade and its need, theories of absolute and comparative advantage. Present status and prospects of international trade in agri-commodities; WTO; Agreement on Agriculture (AoA) and its implications on	

Indian agriculture; IPR; Role of government in agricultural marketing; Role of APMC and its relevance in the present day context.	

Practicals:

Plotting and study of demand and supply curves and calculation of elasticities; Study of relationship between market arrivals and prices of some selected commodities; Computation of marketable and marketed surplus of important commodities; Study of price behaviour over time for some 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 selected commodity, collection of data regarding marketing costs, margins andprice spread and presentation of report in the class; Visit to market institutions– NAFED, SWC, CWC, cooperative marketing society, etc. to study their organization and functioning. Application of principles of comparative advantage of international trade.

Theory Lecture Schedule:

S. No.	Name of Topic	No. of lecture
1.	Agricultural Marketing: Concepts and definitions of market, marketing, agricultural marketing.	1
2.	Market structure, marketing mix and market segmentation.	1
3.	Classification and characteristics of agricultural markets.	1
4.	Demand, supply and producer's surplus of agri-commodities: nature and determinants of demand and supply of farm products.	2
5.	Producer's surplus – meaning and its types, marketable and marketed surplus, factors affecting marketable surplus of agri-commodities.	1
6.	Pricing and promotion strategies: pricing considerations and approaches – cost based and competition based pricing.	2
7.	Market promotion – advertising, personal selling, sales promotion and publicity – their meaning and merits & demerits.	2
8.	Marketing process and functions: exchange functions – buying and selling; physical functions – storage, transport and processing; facilitating functions – packaging, branding, grading, quality control and labeling (Agmark).	3
9.	Market functionaries and marketing channels: Types and importance of agencies involved in agricultural marketing.	2
10.	Meaning and definition of marketing channel.	1
11.	Marketing channels for different farm products.	1
12.	Integration, efficiency, costs and price spread: Meaning, definition and types of market integration.	1
13.	Marketing efficiency.	1
14.	Marketing costs, margins and price spread, factors affecting cost of marketing.	1
15.	Reasons for higher marketing costs of farm commodities; ways of reducing marketing costs.	1
16.	Role of Government in agricultural marketing, Introduction to Public sector institutions- CWC, SWC, FCI, CACP and DIMI- their objectives and functions.	2
17.	Cooperative marketing in India.	1
18.	Risk in marketing: Types of risk in marketing; speculation & hedging; an overview of futures trading.	2
19.	Agricultural prices and policy: Meaning and functions of price; administered prices; need for agricultural price policy.	1
20.	Trade: Concept of International Trade and its need, theories of absolute and comparative advantage. Present status and prospects of international trade in agri-commodities.	2

21.	GATT and WTO.	1
22.	Agreement on Agriculture (AoA) and its implications on Indian agriculture.	1
23.	Role of APMC and its relevance in the present day context.	1

Practical Schedule:

S. No.	Name of Topic	No. of practical
1.	Plotting and study of demand and supply curves.	1
2.	Analysis of the problems on elasticities.	2
3.	Identification of marketing channels for selected commodity.	1
4.	Computation of marketable and marketed surplus of important commodities.	2
5.	Study of price behaviour over time for some selected commodities, based on secondary data.	1
6.	Visit to a local market to study various marketing functions performed by different agencies.	1
7.	Study of relationship between market arrivals and prices of some selected commodities.	1
8.	Construction of index numbers- simple and weighted using different methods.	1
9.	Visit/assignment to market institutions – NAFED, SWC, CWC, cooperative marketing society and evaluation of the functioning	4
10.	To study their organization and functioning.	1
11.	Collection of data regarding marketing costs, margins and price spread and presentation of report in the class.	1

Suggested Readings:

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

AGRON-311 Weed Management 2 (1+1)

Course Status : Core
Contact Hours (L-T-P) : 1-0-2
Course Objective :
1. To teach students about principles of weed science
2. To impart practical knowledge of weed management in field and horticultural crop

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

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

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

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

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

Course Description :

Theory:	**CO Mapping**
Unit 1: Introduction to Weeds and Their Nature Introduction to weeds, characteristics of weeds, their harmful and beneficial effects on ecosystem. Classification, reproduction and dissemination of weeds. Crop-weed competition, factors of competition. Factors affecting growth and development. Studies on weed seed bank, weed shifts.	CO-1
Unit 2: Methods of weed management Concepts of weed management, principles and methods, physical, cultural, chemical and biological methods of weed management. Weed management in organic/ natural farming. Integrated weed management & implements for weed control, Robotic weed control & precision weed management.	CO-2
Unit 3: Herbicides Herbicide classification and properties of important herbicides. Concept of adjuvants and surfactants. Herbicide formulation and their use. Mode of action of herbicides and selectivity phenomenon. Nano herbicides.	CO-3
Unit 4: Herbicides mixture and interaction with agro-chemicals Concept of herbicide mixture and utility in agriculture. Herbicide compatibility with agro-chemicals and their application.	CO-4
Unit 5: Herbicide resistance and weed management in crops Herbicide resistance and its management. Weed management in different field and horticultural crops.Aquatic weed management. Weed management in cropping systems.	CO-2

Practical:

Techniques of weed preservation, weed identification and losses caused by weeds. Biology of important weeds. Study weeds in different situations, Study of herbicide formulations and mixture of herbicide. Study methods of herbicide application, Herbicide application equipmenttheir parts, use, maintenance and calibration. Weed control implements, Calculation of herbicide doses and requirement, weed control efficiency and weed index, Phytotoxicity of herbicides, Weed management in fallow lands, Management of problem and parasitic weeds.

Theory Lecture Schedule:

S. No.	**Name of Topic**	**No. of lecture**
1.	Introduction to weeds, characteristics of weeds their harmful and beneficial effects on ecosystem.	1
2.	Classification, reproduction and dissemination of weeds.	1
3.	Crop-weed comptetion, factors of competition, factors affecting growth and development.	1
4.	Studies on weed seed bank, weed shifts.	1
5.	Concepts of weed management: physical, cultural, chemical and biological.	1
6.	Priciples and methods of weed control: physical, chemical and biological, Integrated weed management.	1
7.	Implements for weed control and robotic weed control.	1
8.	Weed management in organic/ natural farming.	1
9.	Herbicide classification and properties of important herbicides.	1
10.	Concept of adjuvant, surfactant, herbicide formulation and their use	1
11.	Nano herbicides, precision weed management.	1
12.	Mode of action of herbicides and selectivity phenomenon.	1
13.	Concept of herbicide mixture and utility in agriculture.	1
14.	Herbicide compatibility with agro-chemicals and their application.	1
15.	Herbicide resistance and its management.	1

16.	Weed management in different field and horticultural crops; aquatic weed management, weed management in cropping systems.	1

Practical Schedule:

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

Suggested Readings:

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

AGMET-312 Introduction to Agro-meteorology 2 (1+1)

Course Status : Core
Contact Hours (L-T-P) : 2-0-2
Course Objective :
1. To introduce the fundamental principles of meteorology and their applications to agriculture.
2. To explore the relationship between weather, climate, and agricultural production.
3. To impart the theoretical and practical knowledge of instruments/equipment used for measurement of different weather variables in an agrometeorological observatory.
4. To learn about tools and techniques used for weather forecasting and monitoring. Understand how to interpret agro-meteorological data for decision-making in agriculture.
5. To study the meteorological aspects of climate change in agriculture and allied activities.

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

about -

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

CO-2: weather hazards in relation to Agriculture

CO-3: Weather forecasting and modification of crop microclimate

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

Course Description :

Theory:	**CO Mapping**
Unit 1: Introduction to Meteorology Meaning and scope of agricultural meteorology; Earth atmosphere: its composition, extent and structure; Atmospheric weather variables; Atmospheric pressure, its variation with height; Wind, types of wind, daily and seasonal variation of wind speed, cyclone, anticyclone, land breeze and sea breeze; Nature and properties of solar radiation, solar constant, depletion of solar radiation, short wave, long wave and thermal radiation, net radiation, albedo; Atmospheric temperature, temperature inversion, lapse rate, daily and seasonal variations of temperature, vertical profile of temperature, Application of Thermal time concept and Atmospheric humidity, concept of saturation, vapour pressure, process of condensation, formation of dew, fog, mist, frost, cloud; Precipitation, process of precipitation, types of precipitation such as rain, snow, sleet, and hail, cloud formation and classification; Artificial rainmaking. Monsoon- mechanism and importance in Indian agriculture; Crop/Pest weather calendar; Energy balance of earth.	CO-1
Unit 2: Weather hazards in relation to Agriculture Weather hazards - drought, floods, frost, tropical cyclones and extreme weather conditions such as heat-wave and cold-wave; Agriculture and weather relations;	CO-2
Unit 3: Weather forecasting Modifications of crop microclimate, climatic normal for crop and livestock production. Weather forecasting- types of weather forecast and their uses.	CO-3
Unit 4: Basics of Climate change Climate change, climatic variability, global warming, causes of climate change and its impact on regional and national agriculture.	CO-4

Theory Lecture Schedule:

S. No.	**Name of topic**	**No. of lecture**
1.	Meaning and scope of agricultural meteorology.	1
2.	Atmosphere: its composition, extent and structure.	1
3.	Atmospheric pressure, its variation with height.	1
4.	Types of wind, daily and seasonal variation of wind speed, cyclone, anticyclone, land breeze and sea breeze.	1
5.	Nature and properties of solar radiation, solar constant, depletion of solar radiation, short wave, longwave and thermal radiation, net radiation, albedo.	1
6.	Atmospheric temperature, temperature inversion, lapse rate, daily and seasonal variations of temperature, vertical profile of temperature, Application of Thermal time concept and Crop/Pest weather calendar.	1
7.	Energy balance of earth.	1
8.	Atmospheric humidity, concept of saturation, vapour pressure, process of condensation, formation of dew, fog, mist, frost, cloud.	1
9.	Precipitation, process of precipitation, types of precipitation such as rain, snow, sleet, and hail, cloud formation and classification; Artificial rainmaking.	1

10.	Monsoon- mechanism and importance in Indian agriculture.	1
11.	Weather hazards - drought, floods, frost, tropical cyclones and extreme weather conditions such as heat-wave and cold-wave; Agriculture and weather relations.	1
12.	Modifications of crop microclimate.	1
13.	climatic normal for crop and livestock production.	1
14.	Weather forecasting- types of weather forecast and their uses.	1
15.	Climate change, climatic variability, global warming.	1
16.	Causes of climate change and its impact on regional and national agriculture.	1

Practical:

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

Practical Schedule:

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

Suggested Readings:

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

PPHY-311 Fundamentals of Crop Physiology 3 (2+1)

Course Status : Core
Contact Hours (L-T-P) : 2-0-2
Course Objective : This course intends to provide a basic knowledge about physiological concepts for crop growth and development.
Course Outcomes (CO) : After the completion of this course, the student will be able to learn about -
CO-1: The basic concepts of Plant Physiology, water and nutrient mechanism in plants.
CO-2: Role of photosynthesis and respiration in plant growth and development.
CO-3: Use of plant growth regulators in agriculture.

Course Description :

Theory:	**CO Mapping**
Unit 1: Plant Physiology, water mechanism and stomatal physiology in plants Definitions of plant physiology and crop physiology; Importance of crop physiology; Relationship of crop physiology with other branches of crop science. Diffusion and osmosis; Physiological roles of water to crop plants, Definition of water potential and components of water potential. Water absorption by plants: Concept of active and passive absorption; Water loss by plants: Types of water loss: transpiration, stomatal physiology and guttation; Water use efficiency; Significance of transpiration. Stomatal opening and closing mechanisms. Definition of Cavitation and embolism. Anti-transpirants - types and examples. Hydroponics and sand culture. Imbibition; Field capacity, permanent wilting point and available soil moisture; Apoplast, symplast and transmembrane, Ascent of sap – theories and mechanism; Soil-plant-atmospheric continuum.	CO-1
Unit 2: Nutrient mechanism and Plant cell Essential and beneficial elements; Passive and active transport of mineral element; Functions of essential elements; Criteria of essentiality of nutrients; Correction measures for nutrient deficiency symptoms. Foliar nutrition and root feeding – significance; Aeroponics, Hydroponics and sand culture. Overview of plant cell - organelle and their functions.	
Unit 3: Photosynthesis and Respiration Brief outline of: Photosynthetic apparatus, pigment system, quantum requirement and quantum yield; Structure of chloroplast, Examples of different photosynthetic pigments (chlorophyll, carotenoids, phycobilins etc.). Difference between chlorophyll a and chlorophyll b, Structure of chlorophyll a and chlorophyll b, Short discussion on quantum requirement and quantum yield, Red drop and Emerson enhancement effect, Pigment system I and II. Introduction to light reaction of photosynthesis, Light absorption by photosynthetic pigments and transfer of energy. Source of O2 during photosynthesis: Hill reaction; Brief introduction to cyclic and non-cyclic photo-phosphorylation: production of assimilatory powers. Introduction to C3, C4 and CAM pathways: Calvin Cycle, Hatch and Slack Cycle, CAM Cycle; Significance of these pathways (concept of photorespiration, absence of photorespiration in C4 plant: Productivity of C4 plant, CAM: an adaptive mechanism); Factors affecting photosynthesis (light, temperature, CO2, O2 etc.). Outline of the process of respiration: Definition and importance, Glycolysis, Kreb Cycle and ETC, Factors affecting respiration (O2, temperature, CO2 etc.).	CO-2
Unit 4: Growth and development in plants Growth, Development and Differentiation. Measurement of plant growth (fresh	

weight, dry weight, linear dimension, area etc.). Introduction to CGR, RGR, NAR etc. Photoperiodism: Photoperiodic Classification of plants: Short Day Plant, Long Day Plant, Day Neutral plant etc. Introduction to Photoperiodic induction site of photo-inductive perception, Role of Phytochrome Introduction to Vernalization (What is vernalization, devernalization etc.). Meaning, classification (seasonal, sequential etc), relation with abscission. Physiological and biochemical changes during senescence, Abscission and its significance, Concept of stay green, Hormonal regulation of senescence	
Unit 5: Plant growth regulators Terminologies / Definitions: Plant hormone, Plant growth regulators (PGR), Plant growth inhibitor. Recognized classes of PGR (Auxins, Gibberellins, Cytokinins, Ethylene and Abscisic acid) and their major physiological roles. Agricultural uses of PGRs (IBA, NAA, 2,4-D, GAs, Kinetin etc).	CO-3

Practical:

Study on structure and distribution of stomata; Demonstration of imbibition, osmosis, plasmolysis, estimation of water potential, relative water content; Tissue test for mineral nutrients, identification of nutrient deficiency and toxicity symptoms in plant; Identification of nutrients by hydroponics; Estimation of photosynthetic pigments, rate of photosynthesis, respiration and transpiration; Plant growth analysis; Study on senescence and abscission, hormonal regulation of senescence; Demonstration of the effects of different PGRs on plants, Leaf anatomy of C_3 and C_4 plants.

Theory Lecture Schedule:

S. No.	Name of Topic	No. of lecture
1.	Definitions of plant physiology and crop physiology; Importance of crop physiology; Relationship of crop physiology with other branches of crop science.	1
2.	Diffusion and osmosis; Physiological roles of water to crop plants.	1
3.	Definition of water potential and its components.	1
4.	Water absorption by plants: Concept of active and passive absorption; Apoplast, symplast and transmembrane pathway.	1
5.	Water loss by plants: Types of water loss: transpiration, Significance of transpiration.	1
6.	Stomatal physiology: Stomatal opening and closing mechanisms and guttation.	
7.	Definition of Cavitation and embolism. Anti-transpirants - types and examples, Water use efficiency.	1
8.	Essential and beneficial elements; Passive and active transport of mineral element.	1
9.	Functions of essential elements; Criteria of essentiality of nutrients; Correction measures for nutrient deficiency symptoms.	1
10.	Foliar nutrition and root feeding – significance; Aeroponics, Hydroponics and sand culture.	1
11.	Imbibition; Field capacity, permanent wilting point and available soil moisture.	1
12.	Ascent of sap – theories and mechanism; Soil-plant-atmospheric continuum.	1
13.	Overview of plant cell - organelle and their functions.	1
14.	Brief outline of: Photosynthetic apparatus, pigment system, quantum requirement and quantum yield; Structure of chloroplast, Examples of different photosynthetic pigments (chlorophyll, carotenoids, phycobilins etc.).	1
15.	Difference between chlorophyll a and chlorophyll b, Structure of	1

	chlorophyll a and chlorophyll b, Short discussion on quantum requirement and quantum yield, Red drop and Emerson enhancement effect, Pigment system I and II.	
16.	Introduction to light reaction of photosynthesis, Light absorption by photosynthetic pigments and transfer of energy.	1
17.	Source of O_2 during photosynthesis: Hill reaction; Brief introduction to cyclic and non-cyclic photo-phosphorylation: production of assimilatory powers.	1
18.	Introduction to C_3, C_4 and CAM pathways: Calvin Cycle, Hatch and Slack Cycle, CAM Cycle.	1
19.	Significance of these pathways (concept of photorespiration, absence of photorespiration in C4 plant: Productivity of C4 plant, CAM: an adaptive mechanism).	1
20.	Factors affecting photosynthesis (light, temperature, CO_2, O_2 etc.).	
21.	Outline of the process of respiration: Definition and importance.	1
22.	Glycolysis, Kreb Cycle and ETC.	1
23.	Factors affecting respiration (O_2, temperature, CO_2 etc.).	
24.	Terminologies / Definitions: Growth, Development and Differentiation.	1
25.	Measurement of plant growth (fresh weight, dry weight, linear dimension, area etc.). Introduction to CGR, RGR, NAR etc.	1
26.	Photoperiodism: Photoperiodic Classification of plants: Short Day Plant, Long Day Plant, Day Neutral plant etc.	1
27.	Introduction to Photoperiodic induction site of photo-inductive perception, Role of Phytochrome.	1
28.	Introduction to Vernalization (What is vernalization, devernalization etc.), Meaning, classification (seasonal, sequential etc), relation with abscission.	1
29.	Physiological and biochemical changes during senescence.	1
30.	Abscission and its significance, Concept of stay green, Hormonal regulation of senescence.	1
31.	Terminologies / Definitions: Plant hormone, Plant growth regulators (PGR), Plant growth inhibitor.	1
32.	Recognized classes of PGR (Auxins, Gibberellins, Cytokinins, Ethylene and Abscisic acid) and their major physiological roles, Agricultural uses of PGRs (IBA, NAA, 2,4–D, GAs, Kinetin etc).	1

Practical Schedule:

S. No.	Name of Topic	No. of practical
1.	Study of structure and distribution of stomata.	1
2.	Demonstration of imbibition.	1
3.	Demonstration of osmosis and plasmolysis.	1
4.	Estimation of water potential and relative water content.	1
5.	Tissue test for mineral nutrients.	1
6.	Identification of nutrient deficiency and toxicity symptoms in plant.	1
7.	Identification of nutrients by hydroponics.	2
8.	Estimation of photosynthetic pigments.	1
9.	Measurement of rate of photosynthesis.	1
10.	Measurement of respiration.	1
11.	Measurement of transpiration.	1
12.	Estimation of Plant growth analysis parameters.	1
13.	Study on senescence and abscission.	1
14.	Hormonal regulation of senescence.	1
15.	Demonstration of the effects of different PGRs on plants.	1

16.	Study Leaf anatomy of C_3 and C_4 plants.	1

Suggested Readings:

1. Devlin's Exercises in Plant Physiology by Robert Devlin, Francis H. Witham and David F. Blaydes
2. Fundamentals of Plant Physiology by Lincoln Taiz, Eduardo Zeiger, Ian Max Molle and Angus Murphy
3. Plant Physiology by Robert M. Devlin and Francis H. Witham
4. Plant Physiology by Lincoln Taiz and Eduardo Zeiger
5. Plant Physiology by Frank B. Salisbury and Cleon W. Ross.
6. Fundamentals of Plant Physiology, Jain, V. K. 2017. S. Chand Publisher, New Delhi

ENTO-311 Pest Management in Crops and Stored Grains 3 (2+1)

Course Status : Core
Contact Hours (L-T-P) : 2-0-2
Course Objective : To provide the knowledge of diagnosis and management of major insect and non- insect pests of crops in field and storage.
Course Outcomes (CO) : After the completion of this course, the student will be able to -
CO-1: Identify the various insect-pests their Life cycle, symptoms of damage and their management practices.
CO-2: Understand various pest infesting during storage and their management.
CO-3: Apply integrated pest management techniques for pest management.

Course Description :

Theory:	CO Mapping
Unit 1: Major insect pests 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 Field crops, Vegetable crops and fruit crops, Plantation crops, ornamental crops, spices and condiments, Structural entomology and important household pests, their nature of damage and management	CO-1
Unit 2: Storage Entomology Factors affecting loss of stored grains. Insect pests, mites, rodents, birds and microorganisms associated with stored grains and their management. Storage structures and methods of grain storage and fundamental principles of stored grains management. Management of non insect pest of mites, snails and slugs.	CO-2
Unit 3: Integrated Pest Management Concept of IPM, Practices, scope and limitations of IPM. Classification of insecticides. Toxicity of insecticides and formulations of insecticides. Biorational pesticides including insect repellents, antifeedants. Use of drones and AI in pest management.	CO-3

Practical:

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

Theory Lecture Schedule:

S. No.	Name of Topic	No. of lecture
1.	Study of identification, host range and nature of damage, biology and bionomics, and management of important arthropod pests of Polyphagous insect pests: Locust, grasshopper, whitegrub, termite and red hairy caterpillar	3
2.	Major insects pests of cereals and their management.	3
3.	Major insects pests of Pulses and their management.	2
4.	Major insects pests of Oilseeds and their management.	3
5.	Major insects pests of cash crops and their management	2
6.	Major insects pests of vegetables crops and their management.	3
7.	Major insects pests of fruit crops and their management.	3
8.	Major insects pests of Plantation crops and their management.	3
9.	Major insects pests of ornamental crops and their management.	2
10.	Major insects pests of spices and condiments and their management.	2
11.	Structural entomology and important household pests, their nature of damage and management.	1
12.	Factors affecting loss of stored grains, Insect pests, mites, rodents, birds and microorganisms associated with stored grains and their management.	1
13.	Storage structures and methods of grain storage and fundamental principles of stored grains management.	1
14.	Management of non-insect pest of mites, snails and slugs.	1
15.	Concept of IPM, Practices, scope and limitations of IPM. Classification of insecticides.	1
16.	Toxicity of insecticides and formulations of insecticides, Biorational pesticides including insect repellents, antifeedants, Use of drones and AI in pest management.	1

Practical Schedule:

S. No.	Name of Topic	No. of practical
1.	Field visit.	2
2.	Identification of major insect pests and their damage symptoms.	1
3.	Collection and preservation of major insect pests.	2
4.	Collection of damage samples, their identification and herbarium preparation.	1
5.	Methods of monitoring of pest incidence in situ.	1
6.	Management strategies of insect pests of different crops.	1
7.	Study on structural entomology and household pests.	1
8.	Storage structures and methods of grain storage.	1
9.	Spraying techniques for selected field and horticultural crops.	1
10.	Vertebrate pest management.	1
11.	Mass multiplication of NPV.	1
12.	Mass multiplication of entomopathogenic nematodes.	1
13.	Insecticides and their formulations.	1
14.	Pesticide appliances and their maintenance.	1

Suggested Readings:

1. A Textbook of Insect Pest and Disease Management, 2021. Somnath Sen, and Mohd. Sameer, S. Kataria & Sons publish.
2. Agricultural Pests of India and South east Asia, A.S. Athwal, Kalyani Publishers.
3. A Textbook of Applied Entomology, K.P. Srivastava and G. S. Dhaliwal, Kalyani Publish.
4. Essentials of Pest Management: Key Information on Pest Identification and its Management, 2022. Prakash Rambhat Thalya and Ravi Chandra
5. Integrated pest Management Concept and Approaches- G.S. Dhaliwal and Ramesh Arora

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

PPATH-311 Diseases of Field and Horticultural Crops and their Management 3 (2+1)

Course Status : Core Course
Contact Hours (L-T-P) : 2-0-2
Course Objective :
1. To study the symptoms produced on the host.
2. To study the etiology of the diseases.
3. To know about the disease cycle of the pathogens during pathogenesis.
4. To study the epidemiological factors responsible for disease development.
5. To study the management techniques for curbing the major diseases of field and horticultural crops.

Course Outcomes (CO) : After the completion of this course, the student will be able to -
CO-1: acquaint with symptoms, etiology, disease cycle, and management of cereal, pulse oilseed, and Sugar and Cash crops diseases.
CO-2: acquaint with symptoms, etiology, disease cycle, and management of fruit and vegetable crop diseases.
CO-3: acquaint with symptoms, etiology, disease cycle, and management of ornamental and plantation crops diseases.

Course Description :

Theory:	**CO Mapping**
Symptoms, etiology, disease cycle, epidemiology, and management of major diseases of the following field and horticultural crops:	
Unit-I: Cereals- Rice: blast, brown spot, sheath blight, false smut, bacterial leaf blight, bacterial leaf streak, tungro, khaira. **Wheat:** rusts, loose smut, Karnal bunt **Maize:** banded leaf and sheath blight, southern and northern blight, downy mildew. **Sorghum:** smuts, grain mold, anthracnose. **Bajra:** downy mildew, ergot, and **Finger millet:** blast, leaf spot.	CO-1
Unit-II: Pulses- Gram: Ascochyta blight, wilt, grey mold **Pea:** downy mildew, powdery mildew, rust **Black gram and Green gram:** web blight, Cercospora leaf spot, anthracnose, yellow mosaic.	
Unit-III: Oilseeds- Groundnut: early and late leaf spots, rust, wilt **Soybean:** Rhizoctonia blight, bacterial spot, seed and seedling rot, mosaic **Mustard:** Alternaria blight, white rust, downy mildew, sclerotinia stem rot and **Sunflower**: sclerotinia stem rot, Alternaria blight.	
Unit-IV: Sugar and Cash crops- Sugarcane: red rot, smut, grassy shoot, ratoon stunting, PokahBoeng. **Cotton**: anthracnose, vascular wilts, black arm.	
Unit-V: Fruit 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. **Mango:** anthracnose, malformation, bacterial blight, powdery mildew**.**	CO-2
Unit-VI: Vegetable crops- 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, and **Okra:** yellow vein mosaic. **Ginger**: soft rot. **Turmeric:** leaf Spot and **Coriander:** stem gall.	
Unit-VII: Ornamental crops- Rose: dieback, powdery mildew, black leaf spot, and **Marigold**: botrytis blight, leaf spots.	CO-3
Unit-VIII: Plantation crops- Coconut: bud rot, Ganoderma wilt. **Tea**: Blister blight. **Coffee**: Rust.	

Practical:

To study the symptoms of different diseases of field and horticultural crops: Blast and brown spot of rice, sheath blight and bacterial leaf blight of rice, downy mildew and powdery of cucurbits, Rhizoctonia and Cercospora leaf spot of green gram / black gram, Alternaria blight and downy mildew of mustard, early blight of late blight of potato and tomato, Phomopsis blight of brinjal, powdery mildew and rust of pea, stem gall of coriander, anthracnose and fruit rot of chili, 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 visit for the diagnosis of field problems, Collection, and preservation of plant-diseased specimens for herbarium.

Theory Lecture Schedule:

S. No.	Name of Topic	No. of lecture
Symptoms, etiology, disease cycle, and management of major diseases of the following crops:		
1.	**Rice**: blast, brown spot, sheath blight, false smut, bacterial leaf blight, bacterial leaf streak, tungro, khaira.	2
2.	**Wheat:** rusts, loose smut, Karnal bunt	2
3.	**Maize:** banded leaf and sheath blight, southern and northern blight, downy mildew.	2
4.	**Bajra:** downy mildew, ergot. **Finger millet**: blast, leaf spot, and **Sorghum:** smuts, grain mold, anthracnose.	2
5.	**Gram:** Ascochyta blight, wilt, grey mold, and **Pea:** downy mildew, powdery mildew, rust.	1
6.	**Black gram and Green gram:** web blight, Cercospora leaf spot, anthracnose, yellow mosaic.	1
7.	**Groundnut:** early and late leaf spots, rust, wilt.	1
8.	**Soybean:** Rhizoctonia blight, bacterial spot, seed, and seedling rot, mosaic.	1
9.	**Mustard:** Alternaria blight, white rust, downy mildew, sclerotinia stem rot and **Sunflower**: sclerotinia stem rot, Alternaria blight.	2
10.	**Sugarcane:** red rot, smut, grassy shoot, ratoon stunting, PokahBoeng. **Cotton**: anthracnose, vascular wilts, black arm.	2
11.	**Citrus:** canker, gummosis. **Guava:** wilt, anthracnose.	1
12.	**Banana:** Sigatoka, Panama wilt, bacterial wilt, bunchy top. **Papaya:** foot rot, leaf curl, mosaic.	1
13.	**Pomegranate:** bacterial blight. **Apple:** scab, powdery mildew, fire blight, crown gall. **Peach:** leaf curl**.**	1
14.	**Mango:** anthracnose, malformation, bacterial blight, powdery mildew**.**	1
15.	**Grapevine:** downy mildew, powdery mildew, anthracnose**. Strawberry:** leaf spot.	2
16.	**Potato:** early and late blight, black scurf, leaf roll, mosaic. **Tomato:** damping off, wilt, early and late blight, leaf curl, mosaic.	2
17.	**Brinjal:** Phomopsis blight and fruit rot, sclerotinia blight**. Chilli:** anthracnose and fruit rot, wilt, leaf curl.	2

18.	**Cucurbits:** powdery and downy mildew, wilts**. Cruciferous vegetables:** Alternaria leaf spot, black rot, cauliflower mosaic.	2
19.	**Beans:** anthracnose, bacterial blight, **and Okra:** yellow vein mosaic. **Ginger**: soft rot. **Turmeric:** leaf Spot and **Coriander:** stem gall.	2
20.	**Rose**: dieback, powdery mildew, black leaf spot, and **Marigold**: botrytis blight, leaf spots.	1
21.	**Coconut**: Bud rot, Ganoderma wilt. **Tea**: Blister blight. **Coffee**: Rust.	1

Practical Schedule:

S. No.	Name of Topic	No. of practical
To study the symptoms of different diseases of field and horticultural crops-		
1.	Blast and brown spot of rice, sheath blight and bacterial leaf blight of rice.	1
2.	Downy mildew and powdery of cucurbits.	1
3.	Rhizoctonia and Cercospora leaf spot of green gram / black gram.	1
4.	Alternaria blight and downy mildew of mustard.	1
5.	Early blight of late blight of potato and tomato.	1
6.	Phomopsis blight of brinjal.	1
7.	Powdery mildew and rust of pea.	1
8.	Stem gall of coriander.	1
9.	Anthracnose and fruit rot of chilli.	1
10.	Taphrina leaf spot of turmeric.	1
11.	Red rot of sugarcane.	1
12.	Acquaintance with fungicides, antibiotics and biopesticides and their use in management of diseases of horticultural crops.	1
13.	Identification and histopathological studies of selected diseases of field crops.	1
14.	Identification and histopathological studies of selected diseases of horticultural crops.	1
15.	Field visit for the diagnosis of field problems.	1
16.	Collection and preservation of plant diseased specimens for herbarium.	1

Suggested Readings:

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

GPB-311 Crop Improvement (*kharif* crops) -I 2 (1+1)

Course Status : Core
Contact Hours (L-T-P) : 1-0-2
Course Objective :
1. To provide knowledge about Self-pollinated and cross pollinated *Kharif* crops.
2. To learn about origin and distribution of *Kharif* crops.
3. To design breeding objectives of major *kharif* crops.
4. To impart information on different crop varieties for *Kharif* season.

Course Outcomes (CO) : After the completion of this course, the student will be able to learn-
CO-1: Origin and distribution of various *Kharif* crop species,
CO-2: Major breeding objectives and procedures in development of varieties and hybrids of various field and vegetable *Kharif* season

crops.

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

Course Description :

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

Practical:

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

Theory Lecture schedule:

S. No.	Name of Topic	No. of lecture
1.	Crop improvement in **Rice;** Centers of origin, distribution of species. Floral biology breeding objectives and procedures etc. & hybrid seed production.	1
2.	Crop improvement in **Maize;** Centers of origin, distribution of species. Floral biology breeding objectives and procedures etc. & hybrid seed production.	1
3.	Crop improvement in **Sorghum;** Centers of origin, distribution of species. Floral biology breeding objectives and procedures etc. & hybrid seed production.	1
4.	Crop improvement in **Pearl millet;** Centers of origin, distribution of species. Floral biology breeding objectives and procedures etc. & hybrid seed production	1
5.	Crop improvement in **Urdbean, Mungbean, Mothbean and Cowpea;** Centers of origin, distribution of species. Floral biology breeding objectives and procedures etc.	1
6.	Crop improvement in **Pigeonpea and Clusterbean;** Centers of origin, distribution of species. Floral biology breeding objectives and	1

	procedures etc. & hybrid seed production	
7.	Crop improvement in **Soybean** and **Groundnut;** Centers of origin, distribution of species. Floral biology breeding objectives and procedures etc.	1
8.	Crop improvement in **Sesame;** Centers of origin, distribution of species. Floral biology breeding objectives and procedures etc.	1
9.	Crop improvement in **Castor;** Centers of origin, distribution of species. Floral biology breeding objectives and procedures etc.	1
10.	Crop improvement in **Cotton** and **Chilli;** Centers of origin, distribution of species. Floral biology breeding objectives and procedures etc.	1
11.	Crop improvement in **Sugarcane;** Centers of origin, distribution of species. Floral biology breeding objectives and procedures etc.	1
12.	Crop improvement aspects in **Tomato** as mentioned in the syllabus such as Centers of origin, distribution of species. Floral biology breeding objectives and procedures etc.	1
13.	Modern innovative approaches for development of hybrids and varieties for yield, adaptability, stability, abiotic and biotic stress tolerance and quality (physical, chemical, nutritional).	1
14.	Seed production technology in self-pollinated, cross pollinated and vegetatively propagated crops.	1
15.	Ideotype concept.	1
16.	Climate resilient crop varieties for future.	1

Practical Schedule:

S. No.	Name of Topic	No. of practical
1.	Emasculation and hybridization techniques in rice and maize.	1
2.	Emasculation and hybridization techniques in sorghum and pearl millet.	1
3.	Emasculation and hybridization techniques in urdbean, mungbean, mothbean, cowpea and pigeonpea.	1
4.	Emasculation and hybridization techniques in soybean and sesame.	1
5.	Emasculation and hybridization techniques in groundnut and clusterbean.	1
6.	Emasculation and hybridization techniques in caster and chilli.	1
7.	Maintenance breeding of different *kharif* crops.	1
8.	Handling of germplasm and segregating populations by different methods like pedigree, bulk and single seed decent methods.	1
9.	Study of field techniques for seed production and hybrid seeds production in *kharif* crops.	1
10.	Estimation of heterosis, inbreeding depression and heritability.	1
11.	Layout of field experiments.	1
12.	Study of quality characters.	1
13.	Donor parents for different characters.	1
14.	Visit to seed production plots.	2
15.	Visit to AICRP plots of different field crops.	1

Suggested Readings:

1. Chaddha, K. L. and Gupta, R. 1995. Advances in Horticulture Vol. II Medicinal and Aromatic Plant. Malhotra Publishing House, New Delhi.
2. Chopra, V. L. 2000. Breeding of Field Crops (Edt.). Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
3. Mandal, A. K., Ganguli, P. K. and Banerjee, S. P. 1991. Advances in Plant Breeding Vol. I and II. CBS Publishers and Distributors, New Delhi.

4. Manjit, S. Kang. 2004. Crop Improvement: Challenges in the Twenti-First Century (Edt). International Book Distributing Co. Lucknow.
5. Poehlman, J. M. 1987. Breeding of Field Crops. AVI Publishing Co.. INC, East Port, Conneacticut, USA.
6. Ram, H. H. and Singh, H. G. 1994. Crop Breeding and Genetics. Kalyani Publishers, New Delhi.
7. Ram. H. H. 2005. Vegetable Breeding - Principles and Practices. Kalyani Publishers, New Delhi.
8. Sharma, A. K. 2005. Breeding Technology of Crop Plants (Edt.). Yash Publishing House, Bikaner.

HORT-311 Ornamental Crops, MAPs and Landscaping 2 (1+1)

Course Status : Core
Contact Hours (L-T-P) : 1-0-2
Course Objective :
1. To educate in detail about origin, area, climate, soil, improved varieties production technology of flowers and MAPs.
2. To educate about concept, designing principles and components of landscaping.
3. To educate about the physiological disorders of commercial flowers.
4. To educate about the post-harvest management and value addition in flower crops and MAPs.

Course Outcomes (CO) : After the completion of this course the student will be able to learn-
CO-1: Importance of ornamental crops, MAPs and landscaping.
CO-2: Principles of landscaping, features of gardens, and landscape uses of plants.
CO-3: Production technology of ornamental crops and value addition.
CO-4: Production technology of medicinal & aromatic plants and value addition.

Course Description :

Theory	**CO Mapping**
Unit 1: Introduction Importance and scope of ornamental crops, medicinal and aromatic plants, and landscaping	CO-1
Unit 2: Landscaping Principles of landscaping; Landscape uses of trees, shrubs and climbers, Brief concept of home landscaping, carpet bedding, topiary, bonsai, lawn, flower arrangement, herbaceous border, hedge, edge *etc.*	CO-2
Unit 3: Production Technology of ornamental crops and value addition Production technology of important cut flowers like rose, gerbera, chrysanthemum, carnation, anthurium, orchids, gladiolus, tuberose and lilium; Package of practices for loose flowers like marigold and jasmine under open conditions; Processing and value addition in important ornamental crops	CO-3
Unit 4: Production technology of medicinal and aromatic plants and value addition Production technology of ashwagandha, costus, isabgol, aloe, coleus, glory lily, periwinkle, asparagus, senna, guggul, mint, ocimum, geranium, lemongrass, citronella, vetiver and palmarosa, Processing and value addition of MAPs produce.	CO-4

Practical

Identification MAPs and Ornamental plants (trees, shrubs, climbers, seasonal flower and house plants). Propagation of MAP, Bed preparation and planting of MAP; Nursery bed preparation and

sowing of seasonal flower seeds; Propagation of ornamental plants by terminal/herbaceous cuttings; Propagation of Anthurium and orchids; Propagation of bougainvillea; Planting of gerbera suckers; Gladiolus corms; Establishment and maintenance of lawn; Preparation of flower preservatives and their use in extending the vase life of cut flowers; Training and pruning of ornamental plants and raising of hedge and edge; Planning and layout of garden. Processing of MAPs.

Theory Lecture Schedule:

S. No.	Name of Topic	No. of lecture
1.	Importance and scope of ornamental crops, medicinal and aromatic plants, and landscaping.	1
2.	Principles of landscaping and brief concept of home landscaping.	1
3.	Landscape uses of trees, shrubs and climbers.	1
4.	Features of gardens such as carpet bedding, topiary, bonsai, lawn, flower arrangement, herbaceous border, hedge, edge *etc.*	1
5.	Production technology of cut flowers: Rose and Gerbera.	1
6.	Production technology of cut flowers: Chrysanthemum and Carnation.	1
7.	Production technology of cut flowers: Anthurium, Lilium and Orchids.	1
8.	Production technology of cut flowers: Gladiolus and Tuberose .	1
9.	Package of practices for loose flower cultivation under open conditions: Marigold and Jasmine.	1
10.	Processing and value addition in important ornamental crops.	1
11.	Production technology of medicinal plants: Ashwagandha and Isabgol.	1
12.	Production technology of medicinal plants: Aloe, Coleus, Glory lily and Periwinkle.	1
13.	Production technology of medicinal plants: Asparagus, Senna, Guggul and Costus.	1
14.	Production technology of aromatic plants: Lemongrass, Citronella, Palmarosa and Vetiver.	1
15.	Production technology of aromatic plants: Mint, Ocimum and Geranium.	1
16.	Processing and value addition of MAPs produce.	1

Practical Schedule:

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

Suggested Readings:

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

2. Aswath, C., T.K. Bose, R. Bhatia, K. Dutta, R. Kumar and S.N. Saha. 2021. Commercial Flowers (Vol.1 & 2, 3rd Rev. Edn.). Astral Publishing.
3. Bose, T. K., Malti, R. G., Dhua, R. S. and Das, P. 2012. Floriculture and Landscaping (Vol. 1 &2, 2nd Rev. Edn.). Nayaprakash.
4. Chadha, K.L. 2019. Handbook of Horticulture (2 Vol., 2nd Rev. Edn.). ICAR, New Delhi.
5. Kumar, N. 2017. Introduction to Spices, Plantation Crops, Medicinal & Aromatic Plants (3rd Edn.). MedTech.
6. Randhawa, G. S. and A. Mukhopadhyay. 2004. Floriculture in India. Allied Publishers.
7. Singh, A.K. and Anjana Sisodia. 2017. Textbook of Floriculture and Landscaping. NIPA.

AGRON-312 Introductry Agro-Forestry 2 (1+1)

Course Status : Core
Contact Hours (L-T-P) : 1-0-2
Course Objective :
1. To study Agro forestry as an alternate system of land use.
2. To study different types of Agro forestry for soil and water conservation.
3. To study the characteristics of Agroforestry in terms its potential for soil moisture conservation practices.

Course Outcomes (CO) : After the completion of this course, the student will be able to
CO-1: CO-1- Understand basic concepts of agroforestry, Identification of Trees.
CO-2: Knowledge on Traditional agroforestry, basic knowledge for management of agroforestry.
CO-3: Management, socieo-economic aspect of agroforestry.
CO-4: Silviculture aspect of important agroforestry tree species.
CO-5: Important AF models.

Course Description :

Theory:	**CO Mapping**
Unit 1: Introduction Agro-forestry: Definition and scope of Agroforestry system. Type of Agroforestry system, potential of Agroforestry in India. Prevailing agroforestry system in India.	CO-1
Unit 2: Multi purpose Tress Species (MPTS) Definition, role of MPTS in agroforestry system. Selection of MPTS for different agroforestry system. MPTS of India.	
Unit 3: Ecological aspects of Agroforestry system Ecological aspects of Agroforestry system, Tree -crop interaction – competition, nutrient recycling.	
Unit 4: Traditional Agroforestry System Traditional Agroforestry as a viable choice to conserve Agro biodiversity of India.	CO-2
Unit 5: Management of Agro-forestry system Management of Agro-forestry system. Role of agroforestry in soil and water conservation, Windbreak; Shelterbelt– definition, objectives.	CO-3
Unit 6: Socio- economic aspects of Agroforestry system Socio- economic aspects of Agroforestry system. Design and Diagnostic study of agroforestry system.	
Unit 7: Silviculture Silviculture: Definition and scope, Propagation of tree species, Regeneration by seed, coppice, root suckers, Transplanting, stump, branch cutting, rhizomes. Nursery bed preparation and management, Cultural practices for bare root and seedling, field handling of nursery stock.	CO-4
Unit 8: Management of tree species	

Silviculture of important tree species, choice of species- site factors, root, crown and bole characteristics, phenology, nutritional and water requirement, ground operation, tending, harvesting utility etc.	
Unit 9: Agroforestry models Horticulture and forage crops-based agroforestry models developed by ICAR-IGFRI. Agroforestry models developed by Indian council of Forestry Research and Education.	CO-5

Practical:

Identification of tree species in agro-forestry, Study of tree growth measurement, Study of environmental parameters affecting AF System, Plant propagation methods, Pre-sowing seed treatment, Preparation of nursery bed exercise, practicing propagation techniques for trees, Afforestation method, practical training, pruning, coppicing, pollarding etc. Planting pattern and designs for plantation, natural and artificial regeneration, Design and diagnostic survey of agroforestry system, Evaluation of agro-forestry system in different agro climatic zones, Exposure Visit to prevailing agroforestry systems of the state and related important institutions, Virtual visit of agroforestry models developed by ICAR-IGFRI, ICFRE.

Theory Lecture Schedule:

S. No.	Name of Topic	No. of lecture
1.	Agro-forestry: Definition and scope of Agroforestry system. Type of Agroforestry system, potential of Agroforestry in India, Prevailing agroforestry system in India.	2
2.	Definition, MPTS of India, role of MPTS in agroforestry system. Selection of MPTS for different agroforestry system.	2
3.	Ecological aspects of Agroforestry system and Tree-crop interaction – competition, nutrient recycling.	1
4.	Traditional Agroforestry as a viable choice to conserve Agro biodiversity of India.	1
5.	Management of Agro-forestry system, Role of agroforestry in soil and water conservation.	1
6.	Windbreak; Shelterbelt– definition, objectives.	1
7.	Socio- economic aspects of Agroforestry system, Design and Diagnostic study of agroforestry system.	1
8.	Silviculture: Definition and scope, Propagation of tree species, Regeneration by seed, coppice, root suckers, Transplanting, stump, branch cutting, rhizomes.	1
9.	Nursery bed preparation and management, Cultural practices for bare root and seedling, field handling of nursery stock.	2
10.	Silviculture of important tree species, choice of species- site factors, root, crown and bole characteristics, phenology, nutritional and water requirement, ground operation, tending, harvesting utility etc.	2
11.	Horticulture and forage crops-based agroforestry models developed by ICAR-IGFRI.	1
12.	Agroforestry models developed by Indian council of Forestry Research and Education.	1

Practical Schedule:

S. No.	Name of Topic	No. of practical
1.	Identification of tree species in agro-forestry.	1
2.	Study of tree growth measurement.	1
3.	Study of environmental parameters affecting AF System.	1
4.	Plant propagation methods, Pre-sowing seed treatment.	1
5.	Preparation of nursery bed exercise.	1
6.	Practicing propagation techniques for trees.	2

7.	Afforestation method.	1
8.	Practical training pruning, coppicing, pollarding etc.	1
9.	Planting pattern and designs for plantation.	1
10.	Natural and artificial regeneration.	1
11.	Design and diagnostic survey of agroforestry system.	2
12.	Evaluation of agro-forestry system in different agro climatic zones.	1
13.	Exposure Visit to prevailing agroforestry systems of the state and related important institutions.	1
14.	Virtual visit of agroforestry models developed by ICAR-IGFRI, ICFRE.	1

Suggested Readings:

1. Nair, P.K. R. 1993. An Introduction to Agroforestry, Kluar Academic Publisher
2. Chundawat D. S. and S.K. Gautham. 2017. Textbook of Agroforestry. Oxford & IBH Publishing, (ISBN: 9788120408326)
3. Parthiban, K. T, N. Krishnakumar and M. Karthick. 2018. Introduction to Forestry, Scientific Publisher, Jodhpur. 350p
4. Divya M. P. and K. T. Parthiban. 2005. A Textbook on Social Forestry and Agroforestry. Satish Serial Publishing, New Delhi (ISBN: 9384988952).
5. Tejwani, K.G. 1994. Agroforestry in India. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
6. Abrol IP and Dhuruva Narayana VV. 1990. *Technologies for Wasteland Development*. ICAR, New Delhi.
7. Dwivedi AP. 1992. *Agroforestry Principles and Practices*. Oxford and IBH Publication Co., New Delhi.
8. Huxley P. 1999. *Tropical Agroforestry*. Blackwell Science, Oxford.
9. Khosla PK and Khurana DK. 1987. *Agroforestry for Rural needs*. Vol.-1 & II, ISTS, Solan, H.P.
10. Luna RK. 2006. *Plantation Forestry in India*. International Book Distributors.9/3, Rajpur Road, Dehradun.
11. Nair PKR. 1993. *An Introduction to Agroforestry*. Kluwer Academic Publishers.
12. Ong CK and Huxley PK. 1996. *Tree crop Interactions – A Physiological Approach*. ICRAF, Kenya.
13. Khanna L. S and Chaturvedi A. N. 2015. Hand book of forestry. Khanna Publishers, Delhi. India.
14. Khanna L. S.1989. Principles and Practice of Silviculture. Khanna Bandhu, New Delhi.

Manikandan M and Prabhu S. 2018. Indian Forestry: A Breakthrough Approach to Forest Service. Jain Publications, New Delhi.

PBT-321 Fundamentals of Agri Biotechnology 3 (2+1)

Course Status : Core
Contact Hours (L-T-P) : 2-0-2
Course Objective : This course intends to provide knowledge about the basic concepts of plant tissue culture and its application, to understand the fundamentals of molecular biology with modern techniques including transgenic and marker assisted selection in crop improvement.
Course Outcomes (CO) : After the completion of this course, the student will be able to learn about -
CO-1: The basic concepts of plant tissue culture and its application.
CO-2: Fundamentals of molecular biology with modern techniques.
CO-3: R-DNA technology, transgenic and MAS for crop improvements.
Course Description :

Theory:	CO Mapping
Unit 1: Plant tissue culture and its application History; Cellular totpotency 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 technique for the generation of quality planting material; Synthetic seeds and its applications; National certification and Quality management of TC plants-secondary metabolite production- *In vitro* germplasm conservation.	CO-1
Unit 2: Fundamentals of molecular biology with modern techniques DNA structure and function; DNA replication, transcription and translation, RNA, types and function; Structure of prokaryotic and eukaryotic gene; Central dogma of life - DNA replication, transcription, genetic codes, translation and protein synthesis; Lac Operon concept Nucleic acid hybridization; Polymerase chain reaction- DNA sequencing – Sanger method; PCR and its applications.	CO-2
Unit 3: Recombinant-DNA technology Introduction to recombinant DNA technology; DNA modifying enzymes; Vectors. Plant genetic transformation – physical (Gene gun method), chemical (PEG mediated); *Agrobacterium*-mediated gene transfer methods.	CO-3
Unit 4: Transgenics and Marker Assisted Selection Transgenic and its importance in crop improvement with successful stories; Biosafety; Introduction to various molecular markers: RFLP, RAPD, SSR, SNP etc.; Marker-assisted breeding in crop improvement.	

Practical:

Introduction to Plant Tissue Culture Laboratory; 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; Visit to tissue culture units /biotech labs.

Theory Lecture Schedule:

S. No.	Name of Topic	No. of lecture
1.	Introduction to Plant Tissue Culture and Genetic Engineering: history, cellular totipotency and cyto-differentiation.	1
2.	Callus culture, single-cell/suspension culture and their applications.	1
3.	Organogenesis and somatic embryogenesis.	1
4.	Soma-clonal variation and its use in crop improvement.	1
5.	Embryo rescue technique and its significance in hybrid development.	1
6.	*In vitro* fertilization, ovule culture and its significance in hybrid development.	1
7.	Protoplast isolation, culture and regeneration.	1
8.	Somatic hybridization (somatic hybrids and cybrids) and its application in crop improvement.	1
9.	Anther and pollen culture for haploid production.	1
10.	Development of disease-free (virus free) plants through apical meristem culture.	1

11.	Micro-propagation technique for the generation of quality planting material.	1
12.	Synthetic seeds and its applications.	1
13.	National certification and Quality management of TC plants-secondary metabolite production- *in vitro* germplasm conservation.	1
14.	DNA structure and function.	1
15.	DNA replication, transcription and translation.	1
16.	RNA, types and function.	1
17.	Structure of prokaryotic and eukaryotic gene.	1
18.	Central dogma of life - DNA replication, transcription, genetic codes translation and protein synthesis.	1
19.	Lac Operon concept.	1
20.	Nucleic acid hybridization.	1
21.	Polymerase chain reaction and its applications.	1
22.	DNA sequencing – Sanger method.	1
23.	Introduction to recombinant DNA technology.	1
24.	DNA modifying enzymes.	1
25.	Vectors	1
26.	Plant genetic transformation.	1
27.	Physical (Gene gun method), chemical (PEG mediated).	1
28.	*Agrobacterium*-mediated gene transfer methods.	1
29.	Transgenic and its importance in crop improvement with successful stories.	1
30.	Biosafety.	1
31.	Introduction to various molecular markers: RFLP, RAPD, SSR, SNP etc.	1
32.	Marker-assisted breeding in crop improvement.	1

Practical Schedule:

S. No.	Name of Topic	No. of practical
1.	Introduction to plant tissue culture laboratory.	1
2.	Good laboratory practices.	1
3.	Media preparation.	1
4.	Techniques of sterilization.	1
5.	Micro-propagation- callus induction and regeneration.	2
6.	Studies of anther culture.	1
7.	Apical meristem culture.	1
8.	Preparation of synthetic seeds.	1
9.	Isolation and quantification of plasmid DNA.	1
10.	Agarose gel electrophoresis and visualization of plasmid DNA.	1
11.	Restriction digestion of plasmid DNA and agarose gel electrophoresis.	1
12.	Isolation of plant genomic DNA.	1
13.	PCR amplification of DNA and gel electrophoresis of amplified DNA	2
14.	Visit to tissue culture units /biotech labs.	1

Suggested Readings:

1. Bhojwani SS. 1983. Plant Tissue Culture: Theory and Practice. Elsevier.
2. Singh BD. 2007. Biotechnology: Expanding Horiozon. Kalyani
3. Christou P and Klee H. 2004. Handbook of Plant Biotechnology. John Wiley & Sons.
4. Lewin B. 2008. Gene IX. Peterson Publications/ Panima. W.H. Freeman & Co.
5. Primrose SB. 2001. Molecular Biotechnology. Panima.
6. Lal, Dalpat. 2022. Fundamentals of Plant Biochemistry and Biotechnology. Kalyani Publishers. New Delhi.

STAT-321 Basic and Applied Agricultural Statistics 3 (2+1)

Course Status : Core
Contact Hours (L-T-P) : 2-0-2
Course Objective : To provide an idea on statistical concepts of both descriptive and inference Statistics which will be useful to do statistical analysis.
Course Outcomes (CO) : After the completion of this course, the student will be able to learn about -
CO-1: the fundamental of statistical concepts and their relevance in agricultural research.
CO-2: use of statistical methods in in agricultural data and interpret results.
CO-3: basics of experiment design and sampling in agricultural research.

Course Description :

Theory:	**CO Mapping**
Unit 1: Introduction to Statistics and its Applications in Agriculture Introduction to Statistics and its Applications in Agriculture. Types of Data. Scales of measurements of Data. Summarization of Data. Classification of Data. Frequency Distribution. Methods of Classification. Definition of Grouped and Ungrouped Data. Definition of Class Interval (formula for determining the no. of class interval), Width of CI, Class Limits (Boundaries), Mid Points. Types of Frequency Distribution. Diagrammatic Presentation of Data. Bar Diagrams – Simple, Multiple, Sub-divided and Percentage Bar Diagrams. Pie-diagram. Graphical Presentation of Data – Histogram, Frequency Polygon and Ogives.	CO-1
Unit 2: Measures of Central Tendency Measures of Central Tendency. Requisites for an Ideal Measure of Central Tendency. Different Types of Measure. Arithmetic Mean– Definition, Properties, Merits, Demerits and Uses. A.M. (examples) for Grouped and Ungrouped Data. Step-deviation Method. Weighted Mean. Definition of Geometric Mean and Harmonic Mean. Relationship between A.M., G.M. and H.M. MedianDefinition, Merits, Demerits and Uses. Graphical Location of Median. Mode- Definition, Merits, Demerits and Uses. Graphical Location of Mode. Relationship between Mean, Median and Mode.	
Unit 3: Measures of Dispersion and Skewness & Kurtosis Measures of Dispersion. Characteristics for an Ideal Measure of Dispersion. Different Types of Measures of Dispersions. Definition of Range, Interquartile Range, Quartile Deviation and Mean Deviation. Standard Deviation- Definition, Properties. S.D. and Variance for Grouped and Ungrouped Data. Variance of Combined Series. Co-efficients of Dispersions. Co-efficient of Variation. Measures of Skewness and Kurtosis. Definition of Symmetrical Distribution. Definition of Skewness, Measures of Skewness. Definition of Kurtosis. Measure of Kurtosis. Relationship between Mean, Median and Mode for Symmetrical and Skewed Distribution.	
Unit 4: Probability Theory and Normal Distribution Probability Theory and Normal Distribution. Introduction to Probability. Basic Terminologies. Classical Probability-Definition and Limitations. Empirical Probability- Definition and Limitations. Axiomatic Probability. Addition and Multiplication Theorem (without proof). Conditional Probability. Independent Events. Simple Problems based on Probability. Definition of Random Variable. Discrete and Continuous Random Variable. Normal Distribution- Definition, Prob. Distribution, Mean and Variance. Assumptions of Normal Distribution. Normal Probability Curve.	CO-2
Unit 5: Correlation and Regression	

Correlation and Regression. Definition of Correlation. Scatter Diagram. Karl Pearson's Coefficient of Correlation. Types of Correlation Coefficient. Properties of Correlation Coefficient. Definition of Linear Regression. Regression Equations. Regression Coefficients. Properties of Regression Coefficients.	
Unit 6: Tests of Significance Definition. Null and Alternative Hypothesis. Type I and Type II Error. Critical Region and Level of Significance. One Tailed and Two Tailed Tests. Test Statistic. One Sample, Two Sample and Paired t-test with Examples. F-test for Variance.	
Unit 7: Basic Experimental Designs and Sampling Theory ANOVA and Experimental Designs. Definition of ANOVA. Assignable and Non assignable Factors. Analysis of One-way Classified Data. Basic Examples of Experimental Designs. Terminologies. Completely Randomized Design (CRD). Sampling Theory. Introduction. Definition of Population, Sample, Parameter and Statistic. Sampling Vs Complete Enumeration. Sampling Methods. Simple Random Sampling with Replacement and without Replacement. Use of Random Number Table.	CO-3

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 random sample using simple random sampling.

Theory Lecture schedule:

S. No.	Name of Topic	No. of lecture
1.	Introduction to Statistics and its Applications in Agriculture.	1
2.	Types of Data. Scales of measurements of Data. Summarization of Data. Classification of Data.	1
3.	Frequency Distribution. Methods of Classification. Definition of Grouped and Ungrouped Data. Definition of Class Interval (formula fordetermining the no. of class interval), Width of CI, Class Limits (Boundaries), Mid Points. Types of Frequency Distribution.	2
4.	Diagrammatic Presentation of Data. Bar Diagrams – Simple, Multiple, Sub-divided and Percentage Bar Diagrams. Pie-diagram.	1
5.	Graphical Presentation of Data – Histogram, Frequency Polygon and Ogives.	1
6.	Measures of Central Tendency. Requisites for an Ideal Measure of Central Tendency. Different Types of Measure. Arithmetic Mean– Definition, Properties, Merits, Demerits and Uses. A.M. (examples) for Grouped and Ungrouped Data. Step-deviation Method. Weighted Mean.	2
7.	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.	2
8.	Measures of Dispersion. Characteristics for an Ideal Measure of Dispersion. Different Types of Measures of Dispersions.	2
9.	Definition of Range, Interquartile Range, Quartile Deviation and Mean Deviation. Standard Deviation- Definition, Properties. S.D. and Variance for Grouped and Ungrouped Data. Variance of Combined Series. Co-efficients of Dispersions. Co-efficient of Variation.	2
10.	Measures of Skewness and Kurtosis. Definition of Symmetrical Distribution. Definition of Skewness, Measures of Skewness.	1
11.	Definition of Kurtosis. Measure of Kurtosis. Relationship between Mean,	1

	Median and Mode for Symmetrical and Skewed Distribution.	
12.	Probability Theory and Normal Distribution. Introduction to Probability. Basic Terminologies. Classical Probability-Definition and Limitations. Empirical Probability- Definition and Limitations. Axiomatic Probability.	2
13.	Addition and Multiplication Theorem (without proof). Conditional Probability. Independent Events. Simple Problems based on Probability.	1
14.	Definition of Random Variable. Discrete and Continuous Random Variable.	1
15.	Normal Distribution- Definition, Prob. Distribution, Mean and Variance. Assumptions of Normal Distribution. Normal Probability curve.	1
16.	Correlation and Regression. Definition of Correlation. Scatter Diagram. Karl Pearson's Coefficient of Correlation. Types of Correlation Coefficient. Properties of Correlation Coefficient.	2
17.	Definition of Linear Regression. Regression Equations. Regression Coefficients. Properties of Regression Coefficients.	1
18.	Tests of Significance. Definition. Null and Alternative Hypothesis. Type I and Type II Error. Critical Region and Level of Significance. One Tailed and Two Tailed Tests. Test Statistic.	1
19.	One Sample, Two Sample and Paired t-test with Examples. F-test for Variance.	2
20.	ANOVA and Experimental Designs. Definition of ANOVA. Assignable and Non assignable Factors. Analysis of One-way Classified Data.	2
21.	Basic Examples of Experimental Designs. Terminologies. Completely Randomized Design (CRD).	1
22.	Sampling Theory. Introduction. Definition of Population, Sample, Parameter and Statistic. Sampling Vs Complete Enumeration.	1
23.	Sampling Methods. Simple Random Sampling with Replacement and without Replacement. Use of Random Number Table.	1

Practical Schedule:

S. No.	Name of Topic	No. of practical
1.	Diagrammatic and Graphical representation of data.	2
2.	Calculation of A.M., Median and Mode (Ungrouped and Grouped data).	2
3.	Calculation of S.D. and C.V. (Ungrouped and Grouped data).	2
4.	Correlation analysis.	2
5.	Regression analysis.	2
6.	Application of t-test (one sample, two sample independent.	
7.	Application of t-test (one sample, two sample dependent).	2
8.	Analysis of variance one-way classification. CRD.	2

Suggested Readings:

1. Fundamentals of Statistics by D. N. Elhance, Kitab Mahal Publishers.
2. Fundamentals of Applied Statistics by S.C. Gupta and V. K. Kapoor, Sultan Chand and Sons.
3. Basic Statistics by B. L. Agarwal, New Age International Publishers.
4. Agricultural Statistics by S.P. Singh and R.P.S. Verma, Rama Publishing House.
5. Agriculture and Applied Statistics-I by P.K. Sahu, Kalyani Publishers.
6. Agriculture and Applied Statistics-II by P. K. Sahu and A. K. Das, Kalyani Publishers.

GPB-321 Crop Improvement (*Rabi* crops) -II 2 (1+1)

Course Status : Core
Contact Hours (L-T-P) : 1-0-2
Course Objective :
1. To provide knowledge about self-pollinated and cross-pollinated *rabi* crops.
2. To learn about origin and distribution of *rabi* crops.
3. To design breeding objectives of major *rabi* crops.
4. To impart information on different crop varieties for *rabi* season.

Course Outcomes (CO) : After the completion of this course, the student will be able to learn about -
CO-1: Origin and distribution of various *Rabi* crop species,
CO-2: Major breeding objectives and procedures in development of varieties and hybrids of field and vegetable crops of *Rabi* season.
CO-3: Conventional and modern breeding approaches for improving yield, adaptability, stability, abiotic and biotic stress tolerance and quality.

Course Description :

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

Practical:

Botany of crops, Floral biology, emasculation and hybridization techniques in different crop species, viz. wheat, oat, rapeseed and mustard, pulses, potato, sugarcane, tomato, chilli, onion, cumin, isabgol 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; Visit to seed production plots; Visit to AICRP breeding plots of different crops.

Theory Lecture Schedule:

S. No.	Name of Topic	No. of lecture
1.	Crop improvement in **Wheat;** Centers of origin, distribution of species. Floral biology, breeding objectives and procedures etc.	1
2.	Crop improvement in **Oat;** Centers of origin, distribution of species. Floral biology, breeding objectives and procedures etc.	1
3.	Crop improvement in **Barley;** Centers of origin, distribution of species. Floral biology, breeding objectives and procedures etc.	1

4.	Crop improvement in **Chickpea;** Centers of origin, distribution of species. Floral biology, breeding objectives and procedures etc.	1
5.	Crop improvement in **Lentil;** Centers of origin, distribution of species. Floral biology, breeding objectives and procedures etc.	1
6.	Crop improvement in **Pigeonpea;** Centers of origin, distribution of species. Floral biology, breeding objectives and procedures etc & hybrid seed production	1
7.	Crop improvement in **Field pea;** Centers of origin, distribution of species. Floral biology, breeding objectives and procedures etc.	1
8.	Crop improvement in **Rapeseed Mustard;** Centers of origin, distribution of species. Floral biology breeding objectives and procedures etc.	1
9.	Crop improvement in **Cumin;** Centers of origin, distribution of species. Floral biology, breeding objectives and procedures etc & hybrid seed production	1
10.	Crop improvement in **Sunflower;** Centers of origin, distribution of species. Floral biology, breeding objectives and procedures etc.	1
11.	Crop improvement in **Berseem** and **potato;** Centers of origin, distribution of species. Floral biology, breeding objectives and procedures etc & hybrid seed production	1
12.	Crop improvement in **Isabgol;** Centers of origin, distribution of species. Floral biology, breeding objectives and procedures etc.	1
13.	Modern innovative approaches for development of hybrids and varieties for yield, adaptability, stability, abiotic and biotic stress tolerance and quality (physical, chemical, nutritional)	1
14.	Seed production technology in self-pollinated, cross pollinated and vegetatively propagated crops	1
15.	Ideotype concept	1
16.	Climate resilient crop varieties for future	1

Practical Schedule:

S. No.	Name of Topic	No. of practical
1.	Emasculation and hybridization techniques in wheat, oat, barley.	1
2.	Emasculation and hybridization techniques in chickpea, lentil, field pea.	1
3.	Emasculation and hybridization techniques in rapeseed and mustard.	1
4.	Emasculation and hybridization techniques in Sunflower, Potato	1
5.	Emasculation and hybridization techniques in berseem, cumin and isabgol.	1
6.	Maintenance breeding of different *rabi* crops.	1
7.	Handling of germplasm and segregating populations by different methods like pedigree, bulk and single seed decent methods.	1
8.	Study of field techniques for seed production and hybrid seeds production in rabi crops.	1
9.	Estimation of heterosis, inbreeding depression and heritability.	1
10.	Layout of field experiments.	1
11.	Study of quality characters.	1
12.	Donor parents for different characters.	1
13.	Visit to seed production plots.	2
14.	Visit to AICRP plots of different field crops.	2

Suggested Readings:

1. Bahl, P. N. and Salimath, P. M. 1996. Genetics, Cytogenetics and Breeding of Crop Plants Vol I. Pulses and Oilseeds. Oxford & IBH Publsihing Co Pvt Ltd., New Delhi.

2. Chaddha. K. L. and Rajendra Gupta. 1995. Advances in Horticulture Vol. II Medicinal and Aromatic Plant. Malhotra Publishing House, New Delhi.
3. Chopra, V. L. 2000. Breeding of Field Crops (Edt.). Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
4. Kumar, N. 2006. Breeding of Horticultural Crops – Principles and Practices.New India Publishing Agency, New Delhi.
5. Mandal, A. K., Ganguli, P. K. and Banerjee, S. P. 1991. Advances in Plant Breeding Vol. I and II. CBS Publishers and Distributors, New Delhi.
6. Manjit, S. Kang, 2004. Crop Improvement: Challenges in the Twenti-First Century (Edt). International Book Distributing Co. Lucknow.
7. Poehlman, J. M. 1987. Breeding of Field Crops. AVI Publishing Co. INC, East Port, Conneacticut, USA.
8. Ram, H. H. and Singh, H. G. 1994. Crop Breeding and Genetics. Kalyani Publishers, New Delhi.
9. Ram. H. H. 2005. Vegetable Breeding -Principles and Practices. Kalyani Publishers, New Delhi.
10. Sharma, A. K. 2005. Breeding Technology of Crop Plants (Edt.). Yash Publishing House, Bikaner.

AGENGG-321 Renewable Energy in Agriculture and Allied Sector 2 (1+1)

Course Status : Core
Contact Hours (L-T-P) : 1-0-1
Course Objective : This course intends to provide basic knowledge about renewable energy and its application in agriculture sector, the basic concepts different solar energy gadgets, bioenergy and wind energy potential in agriculture sector, help students to develop their orientation skills towards the agriculture.
Course Outcomes (CO) : After the completion of this course, the student will be able to learn about -
CO-1: different types of materials used in Renewable Energy
CO-2: importance of Renewable Energy technology and its applications
CO-3: applications of solar thermal technology.

Course Description :

Theory:	**CO Mapping**
Unit 1: Material used in Renewable Energy Classification of energy sources; Biomass utilization for biofuel production; Biogas plants and gasifiers; Bioalcohol and biodiesel; Biooil production and their utilization	CO-1
Unit 2: Solar energy for Agriculture Solar energy, and study of collectors; Solar energy gadgets-Agriculture Application; Solar Photovoltaic – Power Generation	CO-2
Unit 3: Wind Energy Wind Potential; Types of wind turbine; Application of wind mill	CO-3
Unit 4: Biomass to Bioenergy Study on availability of biomass; Biomass conversion to biofuels; Biofuel Application in Allied sector	

Practical:

Familiarization with renewable energy gadgets. To study biogas plants, gasifier, production process of biodiesel, briquetting machine, production process of bio-fuels. Familiarization with different solar energy gadgets. To study solar photovoltaic system: solar light, solar pumping,

solar fencing, solar cooker and solar drying system. To study solar distillation, solar pond and solar wind hybrid system. Field visit to Solar –Wind farm.

Theory Lecture Schedule:

S. No.	Name of Topic	No. of lecture
1.	Classification of energy sources, Renewable and non renewable energy sources.	1
2.	Contribution of renewable energy sources in agricultural sector.	1
3.	Familiarization with biomass utilization for biofuel production and their application.	1
4.	Familiarization with types of biogas plants.	1
5.	Familiarization with types of gasifiers.	1
6.	Introduction of Bioalcohol.	1
7.	Biodiesel and biooil production and their utilization as bioenergy resource.	1
8.	Introduction of solar energy, collection and their application.	1
9.	Familiarization with solar energy gadgets.	1
10.	solar cooker, solar water heater, application of solar energy.	1
11.	Introduction of solar drying, solar pond, solar distillation.	1
12.	Solar photovoltaic system and their application.	1
13.	Introduction of wind energy.	1
14.	Classification of wind mill.	1
15.	Application of wind energy.	1
16.	Availability of bio mass and their application in different places.	1

Practical Schedule:

S. No.	Name of Topic	No. of practical
1.	Study of biogas plant – fixed dome type.	1
2.	Study of biogas plant – floating dome type.	1
3.	Study of cross draft, updraft and down draft gasifiers.	1
4.	Study of production process of bio diesel.	1
5.	Study of production process of bio fuel.	1
6.	To study briquetting machine.	1
7.	Study of box type solar cooker.	2
8.	Study of solar water heating system.	1
9.	Study of solar distillation system.	1
10.	Study of solar cookers.	1
11.	Study of solar dryer.	1
12.	Study of solar photovoltaic water pumping system and visit to nearby solar photovoltaic water pumping system.	2
13.	Study of solar photovoltaic sprayer.	1
14.	To study solar distillation and solar pond.	1
15.	Field visit to Solar –Wind farm.	1

Suggested Readings:

1. C.S. Solanki. 2011. Solar Photovoltaic – Fundamentals, Technologies and Applications. PHI Learning Pvt. Ltd.
2. S. Sukhatme and J. Nayak. 2008. Solar Energy: Principles of Thermal Collection and Storage. Third Edition (Tata McGraw-Hill).
3. V.V.N. Kishore. 2008. Renewable Energy Engineering and Technology: Principles and Practice, Teri, India.
4. Rathore, N. S., Kurchania, A. K. and Panwar, N. L. 2007. Renewable Energy, Theory and Practice. Himanshu Publications.
5. Rathore, N. S., Kurchania, A. K. and Panwar, N. L. 2007. Non Conventional Energy Sources. Himanshu Publications.

AGRON-321 Dryland Agriculture/ Rainfed Agriculture and Watershed Management 2 (1+1)

Course Status : Core
Contact Hours (L-T-P) : 1-0-2
Course Objective :
1. To learn about characteristics and conditions of dryland/ rainfed agriculture.
2. To gain knowledge about drought and its mitigation.
3. To impart knowledge on water harvesting and watershed management.

Course Outcomes (CO) : After the completion of this course, the student will be able to-
CO-1: know the problems and prospects of Dryland/rainfed agriculture.
CO-2: learn the soil and water conservation approaches under rainfed condition.
CO-3: get acquainted with the nature of drought and water harvesting systems.
CO-4: learn and evaluate the sustainable crop management practices for dryland/rainfed agriculture.

Course Description :

Theory:	**CO Mapping**
Unit 1: Introduction 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 prevalent in dryland/rainfed areas. Length of Growing Period (LGP), Soil Moisture Availability (SMA) and its impact on crop and cropping system.	CO-1
Unit 2: Management approaches Soil and water conservation techniques. Efficient utilization of water through soil and crop management practices. Crops and cropping systems in dryland/rainfed areas; Management of crops in dryssland/rainfed areas.	CO-2
Unit 3: Drought and water harvesting Drought: types, effect of water deficit on physio- morphological characteristics of the plants; Crop adaptation and mitigation to drought; Water harvesting: importance, its techniques.	CO-3
Unit 4: Crop planning, watershed management and sustainable practices of dryland/rainfed agriculture Contingent crop planning for aberrant weather conditions; Watershed management: Concept, history, objective, principles and components of watershed management, factors affecting watershed management. Long term rainfall analysis in relation to simple mathematical models and forecasting the weather abnormalities. Alternate land use system location; Regional and crop specific dryland principles and practices for profitable and sustainable dryland farming and allied enterprises.	CO-4

Practical:

Studies on climate classification, studies on rainfall pattern in rainfed areas of the country and pattern of onset and withdrawal of monsoons. Calculation of Length of Growing Period (LGP) and Soil Moisture Availability (SMA) Studies on cropping pattern of different rainfed areas in the country and demarcation of rainfed area on map of India. Interpretation of meteorological data and scheduling of supplemental irrigation on the basis of evapo-transpiration demand of crops. Critical analysis of rainfall and possible drought period in the country. Effective rainfall and its calculation. Studies on cultural practices for mitigating moisture stress including mechanical and agronomic measure. Soil moisture determination under different land situations, Importance of

seed priming to mitigate drought. Assessment of meteorological drought. Characterization and delineation of model watershed. Seed treatment, viz., seed hardening and seed priming techniques for all the agricultural crops Field demonstration on soil and moisture conservation measures. Field demonstration on construction of water harvesting structures. Visit to rainfed research station/watershed.

Theory Lecture Schedule:

S. No.	Name of Topic	No. of lecture
1.	Dryland/Rainfed agriculture- Introduction, types and characteristics.	1
2.	History of dry land/rainfed agriculture in India and problems and and prospects of dryland/rainfed agriculture.	1
3.	Soil and climatic conditions prevalent in dry land/rainfed areas.	1
4.	Length of Growing Period (LGP) and Soil Moisture Availability (SMA) and its impact on crop and cropping system.	1
5.	Soil and water conservation techniques.	1
6.	Drought: types, effect of water deficit on physio- morphological characteristics of the plants.	1
7.	Crop adaptation and mitigation to drought.	1
8.	Water harvesting: importance, its techniques.	1
9.	Efficient utilization of water through soil and crop management practices.	1
10.	Crops and cropping systems in dry land/rainfed areas.	1
11.	Management of crops in dry land/rainfed areas.	1
12.	Contingent crop planning for aberrant weather conditions.	1
13.	Watershed management- concept, history, objectives and principles and components and factors affecting watershed management.	1
14.	Log term rainfall analysis in relation to simple mathematical models and forecasting the weather abnormalities.	1
15.	Alternate land use system location; regional and crop specific dryland principles and practices for profitable and sustainable dryland farming and allied enterprises.	2

Practical Schedule:

S. No.	Name of Topic	No. of practical
1.	Studies on climate classification.	1
2.	Studies on rainfall pattern in rainfed areas of the country and pattern of onset and withdrawal of monsoons.	1
3.	Calculation of Length of Growing Period (LGP) and Soil Moisture Availability (SMA).	
4.	Studies on cropping pattern of different rainfed areas in the country and demarcation of rainfed area on map of India.	1
5.	Interpretation of meteorological data and scheduling of supplemental irrigation on the basis of evapo-transpiration demand of crops.	1
6.	Critical analysis of rainfall and possible drought period in the country.	1
7.	Field demonstration on construction of water harvesting structures.	1
8.	Effective rainfall and its calculation.	1
9.	Studies on cultural practices for mitigating moisture stress including mechanical and agronomic measure.	1
10.	Soil moisture determination under different land situations.	1
11.	Importance of seed priming to mitigate drought and assessment of meteorological drought.	1
12.	Characterization and delineation of model watershed.	1
13.	Seed treatment, viz., seed hardening and seed priming techniques for all the agricultural crops.	1

14.	Field demonstration on soil and moisture conservation measures.	1
15.	Field demonstration on construction of water harvesting structures.	1
16.	Visit to rainfed research station/watershed.	1

Suggested Readings:

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

PPATH-321 Agricultural Microbiology and Phyto-remediation 2 (1+1)

Course Status : Core
Contact Hours (L-T-P) : 2-1-2
Course Objective : This course intends to provide knowledge about the basic concepts of Agriculture Microbiology and Phyto-remediation, help students to develop their knowledge about microbiology with specific focus on its significance in agriculture science.
Course Outcomes (CO) : After the completion of this course, the student will be able to learn about -

CO-1: Introduction to microbiology with specific focus on its significance in agriculture science.
CO-2: Bacterial structure and the function of the different bacterial components.
CO-3: Different fields of microbiology and Biological control and the role of biopesticides in plant disease management.
CO-4: Bioremediation of polluted soils using microbial mediators and phytoremediation.

Course Description :

Theory:	**CO Mapping**
Unit-I : Introduction. Microbial world: Prokaryotic and eukaryotic microbes Introduction of Microbiology, Definition, applied areas of Microbiology and Importance of Microbiology in agriculture; History of Microbiology: Discovery of microorganisms, spontaneous generation theory, Germ theory of diseases, Immunization, fermentation, and origin of life. Prokaryotic and eukaryotic microbes, Sterilization, disinfection and pasteurization.	CO-1
Unit-II: Bacterial structure and the genetic function of the different bacterial components Bacteria: cell structure, growth, Gram positive and Gram nagative bacteria, chemoautotrophy, photoautotrophy; Bacterial genetics: Genetic recombination-transformation, conjugation and transduction, Plasmid, Gene transfer, genetic engineering.	CO-2
Unit-III: Different fields of microbiology	CO-3

Soil Microbiology: Nutrient mineralization and microbial transformation of nutrients; Air Microbiology: Phyllosphere microflora, Phylloplane microflora, microflora of floral parts etc. Food Microbiology: Microbial spoilage and principles of food preservations, Food poisoning. Water Microbiology: Types of water, water microorganisms, and microbial analysis of water e.g. coliform test, Purification of water. Industrial Microbiology: Microbial products, Biodegradation, Biogas production, Biodegradable plastics etc.	
UNIT-IV: Biocontrol agents and the role of biopesticides in plant disease management Biological control: Concept, types, mode of action, uses and practical constraints & applications of biocontrol agents. Biocontrol agent for sustainable agriculture. Different types of biocontrol agents. Microbial biopesticides for plant disease management; Concepts of rhizosphere microbiology- Rhizodeposits -biochemical nature, release mechanism in rhizosphere, function. Carbon flow in rhizosphere, Rhizosphere micro biomeresidents and their roles; Plant growth promoting rhizobacteria (PGPR), Mechanism of plant growth promotion by PGPR and it Potential in in soil health and sustainability; Endophytes, type of endophtes and roles in soil health and sustainability.	
Unit-V: Bioremediation of polluted soils using microbial mediators and phytoremediation Bioremediation of polluted soils using microbial mediators. Phytoremediation of polluted soils.	CO-4

Practical:

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

Theory Lecture Schedule:

S. No.	Name of Topic	No. of lecture
1.	Introduction of Microbiology, Definition, applied areas of Microbiology and Importance of Microbiology in agriculture.	1
2.	History of Microbiology: Discovery of microorganisms, spontaneous generation theory, Germ theory of diseases, Immunization, fermentation, and origin of life.	1
3.	Prokaryotic and eukaryotic microbes, Sterilization, disinfection and pasteurization.	1
4.	Bacteria: cell structure, growth, Gram positive and Gram nagative bacteria, chemoautotrophy, photoautotrophy.	1
5.	Bacterial genetics: Genetic recombination- transformation, conjugation and transduction, Plasmid, Gene transfer, genetic engineering.	1
6.	Soil Microbiology: Nutrient mineralization and microbial transformation of nutrients.	1
7.	Air Microbiology: Phyllosphere microflora, Phylloplane microflora, microflora of floral parts etc.	1
8.	Food Microbiology: Microbial spoilage and principles of food preservations, Food poisoning.	1
9.	Water Microbiology: Types of water, water microorganisms, and microbial analysis of water e.g. coliform test, Purification of water.	1
10.	Industrial Microbiology: Microbial products, Biodegradation, Biogas	1

	production, Biodegradable plastics etc.	
11.	Biological control: Concept, types, mode of action, uses and practical constraints & applications of biocontrol agents. Biocontrol agent for sustainable agriculture. Different types of biocontrol agents. Microbial biopesticides for plant disease management.	1
12.	Concepts of rhizosphere microbiology- Rhizodeposits -biochemical nature, release mechanism in rhizosphere, function.	1
13.	Carbon flow in rhizosphere, Rhizosphere micro biomeresidents and their roles.	1
14.	Plant growth promoting rhizobacteria (PGPR), Mechanism of plant growth promotion by PGPR and it Potential in in soil health and sustainability.	1
15.	Endophytes, type of endophtes and roles in soil health and sustainability.	1
16.	Bioremediation of polluted soils using microbial mediators, Phytoremediation of polluted soils.	1

Practical Schedule:

S. No.	Name of Topic	No. of practical
1.	Introduction of microbiology laboratory and its equipment.	1
2.	Methods of sterilizations.	1
3.	Study of the microscope; Microscopic parts, Principal of Microscope. Observation of different groups of microorganisms: moulds (Fungi); Direct staining of bacteria by crystal violet; Negative or indirect staining of bacteria by nigrosin; Gram staining of bacteria etc.	2
4.	Nutritional media, Nutritional broth and their preparation.	2
5.	Methods of isolation and purification of phyllosphere and rhizosphere microflora.	2
6.	Isolation and purification of Rhizobium from legume root nodule.	2
7.	Isolation and purification of Azotobacter and Azosirillum from soil.	2
8.	Isolation and purification of Phosphorus solubilizers from soil.	1
9.	Isolation and purification of Zine solubilizers from soil.	1
10.	Isolation and purification of Endophytes.	2

Suggested readings

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

AGECON-321 Agricultural Finance & Cooperation 2 (1+1)

Course Status : Core
Contact Hours (L-T-P) : 1-0-2
Course Objective : To impart knowledge on issues related to lending to priority sector credit management and financial risk management.
Course Outcomes (CO) : After the completion of this course, the student will be able to learn -

CO-1: introduction to Finance and financial test.
CO-2: to understand role of financial institution in agriculture field.
CO-3: to understand different type of financial statements.
CO-4: to understand different type of insurance scheme.

Course Description :

Theory:	**CO Mapping**
Unit-I : Agricultural Finance meaning and scope Agricultural Finance- meaning, scope and significance, credit needs and its role in Indian agriculture. Agricultural credit: meaning, definition, need, classification. Credit analysis: 3 R's, and 3C's of credits.	CO-1
Unit-II: Sources of Agricultural Finance Sources of agricultural finance: institutional and noninstitutional sources, commercial banks, social control and nationalization of commercial banks. Micro financing including KCC. Lead bank scheme, RRBs, Scale of finance and unit cost. An introduction to higher financing institutions – RBI, NABARD, ADB, IMF, World Bank, Insurance and Credit Guarantee Corporation of India.	CO-2
Unit-III: Cost of credit and financial statement Cost of credit. Recent development in agricultural credit. Preparation and analysis of financial statements – Balance Sheet and Income Statement. Basic guidelines for preparation of project reports. Bank norms – SWOT analysis.	CO-3
UNIT-IV: Agricultural Cooperation Agricultural Cooperation – Meaning, brief history of cooperative development in India, objectives, principles of cooperation, significance of cooperatives in Indian agriculture. Agricultural Cooperation in India- credit, marketing, consumer and multi-purpose cooperatives, farmers' service cooperative societies, processing cooperatives, farming cooperatives, cooperative warehousing; role of ICA, NCUI, NCDC, NAFED. 3 R's, 5 C's and 7 P's of credit.	
Unit-V: Agricultural Insurance Scheme Crop insurance: its scope, significance and limitations and the potential of the newly launched 'Pradhan Mantri Fasal Bima Yojana' (Prime Minister's Crop Insurance Scheme). Successful cooperative systems in Gujarat (AMUL), Tamil Nadu (Aavin), Karnataka (Nandini), Maharashtra and Punjab.	CO-4

Practical:

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

Theory Lecture Schedule:

S. No.	Name of Topic	No. of lecture
1.	Agricultural Finance- meaning, scope and significance, credit needs and its role in Indian agriculture.	1
2.	Agricultural credit: meaning, definition, need, classification. Credit analysis: 3 R's, and 3C's of credits.	1
3.	Sources of agricultural finance: institutional and noninstitutional sources, commercial banks, social control and nationalization of commercial banks.	1

4.	Micro financing including KCC.	1
5.	Lead bank scheme, RRBs, Scale of finance and unit cost.	1
6.	An introduction to higher financing institutions – RBI, NABARD, ADB, IMF.	1
7.	World Bank, Insurance and Credit Guarantee Corporation of India.	1
8.	Cost of credit. Recent development in agricultural credit. Preparation and analysis of financial statements – Balance Sheet and Income Statement.	1
9.	Basic guidelines for preparation of project reports. Bank norms – SWOT analysis.	1
10.	Agricultural Cooperation – Meaning, brief history of cooperative development in India, objectives, principles of cooperation, significance of cooperatives in Indian agriculture.	2
11.	Agricultural Cooperation in India- credit, marketing, consumer and multi-purpose cooperatives, farmers' service cooperative societies, processing cooperatives, farming cooperatives.	2
12.	Cooperative warehousing; role of ICA, NCUI, NCDC, NAFED. 3 R's, 5 C's and 7 P's of credit.	1
13.	Crop insurance: its scope, significance and limitations and the potential of the newly launched 'Pradhan Mantri Fasal Bima Yojana' (Prime Minister's Crop Insurance Scheme).	1
14.	Successful cooperative systems in Gujarat (AMUL), Tamil Nadu (Aavin), Karnataka (Nandini), Maharashtra and Punjab.	1

Practical Schedule:

S. No.	Name of Topic	No. of practical
1.	Analysis of progress and performance of commercial banks and RRBs using published data.	2
2.	Analysis of progress and performance of cooperatives using published data.	2
3.	Visit to a commercial bank, cooperative bank and cooperative society to acquire first-hand knowledge of their management, schemes and procedures.	2
4.	Preparation and analysis of balance sheet – A case study. Preparation and analysis of income statement – A case study	2
5.	Appraisal of a loan proposal - A case study. Techno-economic parameters for preparation of projects.	2
6.	Preparation of Bankable projects for various agricultural products and its value-added products.	2
7.	Seminar on selected topics.	2
8.	Different types of repayment plans.	2

Suggested Readings:

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

BIOCHEM-321 Essentials of Plant Biochemistry 3 (2+1)

Course Status : Core
Contact Hours (L-T-P) : 2-0-2
Course Objective : To impart the fundamental knowledge on structure and function of cellular components, biomolecules and the biological processes in plants.

Course Outcomes (CO) : After the completion of this course, the student will be able to -
CO-1: understand and describe biochemical concepts .
CO-2: analyze enzyme kinetics and mechanisms.
CO-3: apply metabolic pathways to understand energy generation and regulation.

Course Description :

Theory:	**CO Mapping**
Unit 1: Introduction to Biochemistry Introduction to biochemistry and its importance, Properties of water in biological systems, pH and buffer systems Structure and function of plant cells and their components	CO-1
Unit 2: Bio-Molecules Structure, classification, properties, and functions of: Carbohydrates, Amino acids, Proteins, Lipids, Nucleic acids, Vitamins-physiological and metabolic role	
Unit 3: Enzymes and Their Mechanisms Enzymes: General properties; Classification; Mechanism of action; Michaelis and Menten and Line Weaver Burk equation and plots; Introduction to allosteric enzymes, use of enzymes	CO-2
Unit 4: Metabolic Pathways and Energy Generation Metabolic energy and its generation – Metabolism – Basic concepts, Glycolysis, Citric acid Cycle, Pentose phosphate pathway, oxidative phosphorylation, Fatty acid oxidation.	CO-3
Unit 5: Biosynthetic Pathways and Secondary Metabolites Biosynthetic Pathways – Photosynthesis, Gluconeogenesis, nitrogen fixation, fatty acid and starch formation. Regulation of metabolic pathways. Secondary metabolites, Terpenoids, Alkaloids, Phenolic and their applications in food and pharmaceutical industries.	

Practical:

Preparation of standard solutions and reagents, Determination of pH, Qualitative tests of carbohydrates and amino acids, Quantitative estimation of soluble sugars and starch, Estimation of protein by Kjeldhal method and Lowry's method, Preparation of mineral solution from ash, Estimation of fat by Soxhlet method, Determination of acid value, saponification value and iodine number, Estimation of ascorbic acid, Qualitative/quantitative tests of secondary metabolites

Theory Lecture Schedule:

S. No.	Name of Topic	No. of lecture
1.	Introduction to biochemistry and its importance.	1
2.	Properties of water in biological systems.	1
3.	pH and buffer systems.	1
4.	Structure and function of plant cells and their components.	1
5.	Structure, classification, properties, and functions of: Carbohydrates, Amino acids, Proteins, Lipids, Nucleic acids.	5
6.	Overview of vitamins and their physiological and metabolic roles.	2
7.	General properties of enzymes.	1
8.	Classification of enzymes.	1
9.	Mechanism of enzyme action.	1
10.	Michaelis-Menten kinetics and Lineweaver-Burk plots.	2
11.	Introduction to allosteric enzymes and their functions and applications of enzymes.	2
12.	Overview of metabolism and energy generation.	1
13.	Glycolysis and its regulation.	1
14.	Citric acid cycle (Krebs cycle).	1

15.	Pentose phosphate pathway	1
16.	Oxidative phosphorylation and fatty acid oxidation .	2
17.	Photosynthesis, Gluconeogenesis, Nitrogen fixation, Fatty acid and starch formation.	4
18.	Secondary metabolites: Terpenoids, Alkaloids, Phenolic compounds and their applications in food and pharmaceuticals.	2
19.	Regulation of metabolic pathways.	2

Practical Schedule:

S. No.	Name of Topic	No. of practical
1.	Preparation of standard solutions and reagents.	1
2.	Determination of pH.	1
3.	Qualitative tests of carbohydrates and amino acids.	1
4.	Qualitative tests of amino acids.	1
5.	Quantitative estimation of soluble sugars and starch.	1
6.	Quantitative estimation of starch.	1
7.	Estimation of protein by Kjeldhal method.	1
8.	Estimation of protein by Lowry's method.	1
9.	Preparation of mineral solution from ash.	1
10.	Estimation of fat by Soxhlet method.	1
11.	Determination of acid value.	1
12.	Determination of saponification value.	1
13.	Determination of iodine number.	1
14.	Estimation of ascorbic acid.	1
15.	Qualitative tests of secondary metabolites.	1
16.	Quantitative tests of secondary metabolites.	1

Suggested Readings:

1. Nelson and Cox. 2008. Lehninger Principles of Biochemistry. Fourth/Fifth edition. Freeman
2. Conn, Stumpf, Bruening and Doi. 2006. Outlines of Biochemistry. Fifth Edition. Wiley
3. Horton, Moran, Rawn, Scrimgeour, Perry. 2011. Principles of Biochemistry. Fifth Edition. Pearson/Prentice Hall (Can be downloaded)
4. Heldt. 2005. Plant Biochemistry. Elsevier (Can be downloaded).
5. Goodwin and Mercer. 2005. Introduction to Plant Biochemistry. 2nd edition. CBS.

GPB-322 Fundamentals of Seed Science and Technology 2 (1+1)

Course Status : Core
Contact Hours (L-T-P) : 1-0-2
Course Objective : 1. To impart basic and fundamental knowledge on principles and practices seed science and technology.
2. To impart practical skills on scientific seed production and post-harvest quality management.
Course Outcomes (CO) : After the completion of this course, the student will be able to learn about-
CO-1: History, nature and goals of Seed technology.
CO-2: Foundation and certified seed production of important crops.
CO-3: Seed drying, Processing, Storage, and Marketing.
CO-4: Seed certification, Seed Act and Seed Act enforcement.
Course Description :

Theory:	CO Mapping
Unit 1: Introduction to Seed Technology and its Importance Introduction to seed technology, definition and importance; Seed quality -	CO-1

definition, characters of good quality seed; Causes of deterioration of varietal purity and assessment of genetic purity, different classes of seed.	
Unit 2: Foundation and certified seed production of important crops Foundation and certified seed production of important cereals, pulses and oilseed, field inspection, importance and procedures; Post-harvest seed quality management; seed processing procedures, seed drying; Seed treatment, its importance, method of application and seed packing;	CO-2
Unit 3: Seed Processing and seed Marketing seed storage - general principles, stages and factors affecting seed longevity during storage; Seed health management during storage.	CO-3
Unit 4: Seed certification and Legislation Seed Certification and legislation; Seed Act and Seed Act enforcement, duty and powers of seed inspector, offences and penalties. Seeds Control Order 1983, basics of seed quality testing; New Seed Bill 2019; Seed quality enhancement techniques.	CO-4

Practical:

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

Theory Lecture Schedule:

S. No.	Name of Topic	No. of lecture
1.	Seed and seed technology: introduction, definition and importance.	1
2.	Seed quality; Definition, Characters of good quality seed, different classes of seed.	1
3.	Causes of deterioration of varietal purity and assessment of genetic purity.	1
4.	Foundation and certified seed production of important cereals.	1
5.	Foundation and certified seed production of important pulses.	1
6.	Foundation and certified seed production of important oilseeds.	1
7.	Field inspection, importance and procedures.	1
8.	Post-harvest seed quality management.	1
9.	Seed processing procedures, Seed drying.	1
10.	Seed treatment, its importance, method of application and seed packing.	1
11.	Seed storage; general principles, stages and factors affecting seed longevity during storage; Seed health management during storage.	1
12.	Seed Certification and legislation.	1
13.	Seed Act and Seed Act enforcement. Duty and powers of seed inspector, offences and penalties. Seeds Control Order 1983.	1
14.	Basics of seed quality testing.	1
15.	New Seed Bill 2019.	1
16.	Seed quality enhancement techniques.	1

Practical Schedule:

S. No.	Name of Topic	No. of practical
1.	Seed Structure.	1
2.	Seed sampling methods.	1
3.	Physical purity test.	1
4.	Moisture determination.	1
5.	Germination test.	1
6.	Seed and seedling vigour test.	1
7.	Seed Viability Test.	1

8.	Genetic purity test: Grow out test.	1
9.	Field inspection.	1
10.	Seed health testing using blotter method.	1
11.	Seed health testing agar plate method.	1
12.	Visit to seed production farms.	2
13.	Visit to seed testing laboratories.	2
14.	Visit to seed processing plant.	1

Suggested Readings:

1. Agarwal, R.L. 1995. Seed Technology (2nd edition). Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi, India.
2. Khare, D. and Bhale, M.S. 2019. Seed Technology (2nd revised & enlarged edn), Scientific Publishers, ISBN: 978-81-72338-84-8, New Pali Road, P.O. Box 91, Jodhpur, India
3. Vanangamudi, K. 2014. Seed Technology (An illustrated book), New India Publishing Agency, New Delhi, India.
4. Bhojwani, S.S. and Bhatnagar, S.P. 1999. The Embryology of Angiosperm. Vikas Publ
5. McDonald, M.B. Jr and Copeland, L.O. 1997. Seed Production: Principles and Practices. Chapman & Hall.
6. Tunwar, N.S. and Singh, S.N. 1988. Indian Minimum Seed Certification Standards. CSCB, Ministry of Agriculture, New Delhi.

ST-321 Educational Tours 2 (0+2)

Course Status : Common (Non-Gradial)
Contact Hours (L-T-P) : 10-14 days' duration
Course Objective : This course aims to exposing the students to the indigenous as well as the latest technologies in their related fields and will also help the students to know about the socio-economic-cultural variations within the country.
Course Outcomes (CO) : After the completion of study tour, the student will be able to have the knowledge about national institutions and organizations and by interactions with outside faculty, the students' knowledge and skills will be broaden.

Activity: There will be a study tour of 10-14 days' duration during the 3rd year Semester-II of the UG programme. The students will preferably visit the leading industries/ enterprises/ institutions/ organisations and other places of academic interest outside the state (of location of the institution).

ELECTIVE COURSES

AGECON-411 Agri-Business Management 4 (3+1)

Course Status : Elective
Contact Hours (L-T-P) : 3-0-2
Course Objective : To impart knowledge on concepts, processes, significance and role of Management and organizational behavior.
Course Outcomes (CO) : After the completion of this course, the student will be able to learn -
CO-1: The meaning and concept of Agribusiness Management.
CO-2: Agro-industries aspects of the rural economy as they affect the agricultural sector.
CO-3: The Financial and Capital Management techniques.
CO-4: the organizational behavior and management concepts of Agri-Business.

Course Description :

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

Practical:

Study of agri-input markets: Seed, fertilizers, pesticides. Study of output markets: grains, fruits, vegetables, flowers. Study of product markets, retails trade commodity trading, and value added products. Study of financing institutions- Cooperative, Commercial banks, RRBs, Agribusiness Finance Limited, NABARD. Preparations of projects and Feasibility reports for agribusiness entrepreneur. Case study of agro-based industries. Trend and growth rate of prices of agricultural commodities. Appraisal/evaluation techniques of identifying viable project- discounted and non-discounting techniques.

Theory Lecture Schedule:

S. No.	Name of Topic	No. of lecture
1.	Transformation of agriculture into agribusiness, various stakeholders and components of agribusiness systems.	2

2.	Importance of agribusiness in the Indian economy and New Agricultural Policy.	2
3.	Distinctive features of Agribusiness Management: Importance and needs of agro-based industries.	3
4.	Classification of industries and types of agro based industries. Institutional arrangement, procedures to set up agro based industries.	4
5.	Constraints in establishing agro-based industries.	2
6.	Agri-value chain: Understanding primary and support activities and their linkages.	2
7.	Business environment: PEST and SWOT analysis.	3
8.	Management functions: Roles and activities.	2
9.	Organization culture. Planning, meaning, definition, types of plans.	2
10.	Purpose or mission, goals or objectives, Strategies, polices procedures, rules, programs and budget. Components of a business plan.	4
11.	Steps in planning and implementation.	2
12.	Organization, staffing, directing and motivation. Ordering, leading, supervision, communications, control.	3
13.	Capital management and financial management of Agribusiness.	2
14.	Financial statements and their importance.	2
15.	Sales and distribution management.	2
16.	Pricing policy, various pricing methods.	2
17.	Project management definition, project cycle, identification, formulation, appraisal, implementation, monitoring and evaluation.	4
18.	Project Appraisal and evaluation techniques.	4

Practical Schedule:

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

Suggested Readings:

1. Broadway, A.C. and Broadway, Arif, A. 2002. A textbook of Agri-Business Management. Kalyani Publishers.
2. Bairwa, S.L. 2016. Objective on Fundamentals of Agri-business Management. Kalyani Publishers.
3. Anjan Nishra, Debasish Biswas and Arunangshu Giri. 2019. Agribusiness Management, Himalaya Publishing House, 220p.

4. Shoji Lal Bairwa, Chandra Sen, L.K. Meena and Meera Kumari. 2018. Agribusiness Management Theory and Practices, Write and Print Publications.
5. Virender Kamalvanshi. Agribusiness Management. Random.

AGRON-411 Management of Natural Resources 4 (3+1)

Course Status : Elective
Contact Hours (L-T-P) : 3-0-2
Course Objective :
1. To enlighten students about available natural resources and their relationship with crop production.
2. To impart the knowledge of principles and practices of natural resource management.

Course Outcomes (CO) : After the completion of this course, the student will be able to -
CO-1: develop understanding of natural resource bases and their management.
CO-2: understand the status and problems of land, water and energy resources and their management.
CO-3: get acquainted with the paradigms and approaches in resource managememt
CO-4: learn soil loss estimation methods, soil erosion, its control measures and water harvesting techniques.

Course Description :

Theory:	**CO Mapping**
Unit 1: Natural Resource Bases Introduction to Natural Resource Bases, Concept of resource, classification of natural resources. Factors influencing resource availability, distribution and uses. Interrelationships among different types of natural resources. Concern on Productivity issues. Ecological, social and economic dimension of resource management.	CO-1
Unit 2: Land, water and energy resources Land resources: Land as a resource. Dry land, land use classification, land degradation, man induced landslides, soil erosion and desertification. Landscape impact analysis, wetland ecology and management. Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.Water ecology and management. Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources.	CO-2
Unit 3: Resource Management Resource Management Paradigms: Resource management the evolution and history of resource management paradigms. Resource conflicts: Resource extraction, access and control system. Approaches in Resource Management: Ecological approach; economic approach; ethnological approach; implications of the approaches; integrated resource management strategies.	CO-3
Unit 4: Soil erosion and their conservation measures Introduction to soil and water conservation and causes of soil erosion. Definition and agents of soil erosion, water erosion - Forms of water erosion, Gully classification and control measures. Soil loss estimation by universal soil loss equation - Soil loss measurement techniques. Principles of erosion control - Introduction to contouring, strip cropping. Contour bund - Graded bund and bench terracing. Wind erosion - Mechanics of wind erosion, types of soil movement- Principles of wind erosion control and its control measures, Water harvesting techniques - Lining of ponds, tanks and canal systems.	CO-4

Practical:

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

Theory Lecture schedule:

S. No.	Name of Topic	No. of lecture
1.	Introduction to Natural Resource Bases: Concept of resource, classification of natural resources.	2
2.	Factors influencing resource availability, distribution and uses.	2
3.	Interrelationships among different types of natural resources.	2
4.	Concern on Productivity issues.	2
5.	Ecological, social and economic dimension of resource management.	2
6.	Land resources: Land as a resource.	1
7.	Land degradation.	1
8.	Man induced landslides.	1
9.	Soil erosion and desertification.	2
10.	Landscape impact analysis.	1
11.	Wetland ecology and management.	1
12.	Water resources.	1
13.	Use and over-utilization of surface and ground water.	1
14.	Floods	1
15.	Drought	2
16.	Conflicts over water.	1
17.	Dams-benefits and problems.	1
18.	Water ecology and management.	2
19.	Energy resources: Growing energy needs.	1
20.	Renewable and non-renewable energy sources.	1
21.	Use of alternate energy sources.	1
22.	Resource Management Paradigms.	1
23.	Resource management the evolution and history of resource management paradigms.	1
24.	Resource conflicts: Resource extraction, access and control system.	1
25.	Approaches in Resource Management: Ecological approach; economic approach; ethnological approach.	2
26.	Implications of the approaches.	1
27.	Integrated resource management strategies.	1
28.	Introduction to soil and water conservation and causes of soil erosion.	1
29.	Definition and agents of soil and water erosion.	1
30.	Forms of water erosion, Gully classification and control measures.	2
31.	Soil loss estimation by universal soil loss equation.	1
32.	Soil loss measurement techniques.	1
33.	Principles of erosion control - Introduction to contouring and strip cropping.	1
34.	Contour bund - Graded bund and bench terracing.	1
35.	Wind erosion - Mechanics of wind erosion.	1
36.	Types of soil movement - Principles of wind erosion control and its control measures.	1
37.	Water harvesting techniques.	1

38.	Lining of ponds, tanks and canal systems.	1

Practical Schedule:

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

Suggested Readings:

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

AGRON-412 System Simulation and Agro advisory 4 (3+1)

Course Status : Elective
Contact Hours (L-T-P) : 3-0-2
Course Objective :
1. To impart the knowledge of Systems approach and crop models.
2. To get acquainted with different weather forecasting techniques and their usability analysis
3. To study about the preparation and dissemination of agro-advisory bulletin.

Course Outcomes (CO) : After the completion of this course, the student will be able to -
CO-1: get the basic knowledge on system approaches of SPAC.
CO-2: know about various crop models and crop responses to weather elements.
CO-3: enhance skills in crop production under potential and resource limited condition.
CO-4: familiarisation with the weather forecasting system and its utility.
CO-5: prepare agroadvisory by using weather forecasting and simulation models.

Course Description :

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

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 and achievable production; yield forecasting, insect and disease forecasting models. Simulation with limitations of water and nutrient management options. Sensitivity analysis of varying weather and crop management practices. Use of statistical approaches in data analysis and preparation of historical, past and present meteorological data for medium range weather forecast. Feedback from farmers about the agro- advisory.

Theory Lecture Schedule:

S. No.	Name of Topic	No. of lecture
1.	System approach for representing soil-plant-atmospheric continuum, system boundaries.	2
2.	Crop models; Introduction, definition and concepts.	2
3.	Crop models; Techniques, advantage and disadvantage.	1
4.	Types of crop models.	2
5.	Data requirements for crop models.	2
6.	Relational diagrams of crop models.	2
7.	Evaluation of crop responses to weather elements.	2
8.	Elementary crop growth models.	2
9.	Calibration of models.	2
10.	Validation of models.	2
11.	Verification and sensitivity analysis of models.	3
12.	Potential and achievable crop production- concept and modelling, techniques for their estimation	3
13.	Crop production in moisture and nutrients limited conditions.	2
14.	Components of soil water and nutrients balance.	3
15.	Weather forecasting; types and methods.	2
16.	Tools and techniques for weather forecasting.	2
17.	Forecast verification.	2
18.	Value added weather forecast.	2
19.	ITK for weather forecast and its validity.	2
20.	Crop- Weather Calendars.	2
21.	Preparation of agro-advisory bulletin based on weather forecast.	3

22.	Use of crop simulation model for preparation of Agro- advisory and its effective dissemination.	3

Practical schedule:

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

Suggested Readings:

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

AGRON-413 Climate Resilient Agriculture 4 (3+1)

Course Status : Elective
Contact Hours (L-T-P) : 3-0-2
Course Objective :
1. To impart the concept of climate resilient agriculture under the present context of climate change.
2. To study the integrated role of different sectors in building resilience to climate change in agriculture.

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

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

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

CO-3: get acquainted with the Climate-Resilient Agricultural Practices.

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

Course Description :

Theory:	CO Mapping
Unit 1: Overview of agriculture under climate change Climate change and impacts of climate change on agriculture and food security; crop productivity under different climate change scenarios including extreme events such as drought, flood, pest and disease outbreak etc. Basics of adaption and mitigation in the agricultural sectors; analyzing and assessing climate	CO-1

vulnerability to identify vulnerable sectors and possible adaptation options in agriculture; assessing biophysical and socio-economic impacts on agricultural sector; risk assessment strategies, preparedness for weather and climate risks in agriculture; application of geospatial tools and techniques for sustainable agriculture.	
Unit 2: Climate resilient agriculture (CRA) Climate resilient agriculture (CRA)n– concept, scope and importance with special reference to India, climate resilient technologies for enhancing crop productivity and sustainability – role of weather and climatic information, agroadvisories, ICTs and simulation models.	CO-2
Unit 3: Climate resilient agronomic practices Climate resilient agronomic practices – crop/cultivar selection, crop diversification/ crop mixtures; water management practices – rain water harvesting, micro-irrigation, deficit irrigation and drainage management, organic/natural farming, integrated farming systems (IFS); site specific nutrient management (SSNM), conservation agriculture technologies to build soil organic carbon, harnessing microbial biodiversity, biomass recycling; use of renewable sources of energy.	CO-3
Unit 4: Crop protection and improvement strategies under changing climatic scenario Climate resilient pest-disease management strategies. Breeding strategies for development of climate change resilient crops and varieties. Development of biotic and abiotic stress tolerant/resistant cultivars under changed climatic scenarios including extreme weather events.	CO-4

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.

Theory Lecture Schedule:

S. No.	Name of Topic	No. of lecture
1.	Climate change and impacts of climate change on agriculture and food security.	2
2.	Crop productivity under different climate change scenarios including extreme events such as drought, flood, pest and disease outbreak etc.	2
3.	Basics of adaption and mitigation in the agricultural sectors.	2
4.	Analyzing and assessing climate vulnerability to identify vulnerable sectors and possible adaptation options in agriculture.	2
5.	Assessing biophysical and socio-economic impacts on agricultural sector.	2
6.	Risk assessment strategies.	2
7.	Preparedness for weather and climate risks in agriculture.	2
8.	Application of geospatial tools and techniques for sustainable agriculture.	2
9.	Climate resilient agriculture (CRA)n– concept, scope and importance with special reference to India.	2
10.	Climate resilient technologies for enhancing crop productivity and sustainability.	2

11.	Role of weather and climatic information and agroadvisories.	2
12.	ICTs and simulation models.	2
13.	Climate resilient agronomic practices – crop/cultivar selection, crop diversification/ crop mixtures.	2
14.	Water management practices – rain water harvesting, micro-irrigation, deficit irrigation and drainage management.	3
15.	Organic/natural farming.	2
16.	Integrated farming systems (IFS).	2
17.	Site specific nutrient management (SSNM).	1
18.	Conservation agriculture technologies to build soil organic carbon.	2
19.	Harnessing microbial biodiversity.	2
20.	Biomass recycling.	2
21.	Use of renewable sources of energy.	2
22.	Climate resilient pest-disease management strategies.	2
23.	Breeding strategies for development of climate change resilient crops and varieties.	2
24.	Development of biotic and abiotic stress tolerant/resistant cultivars under changed climatic scenarios including extreme weather events.	2

Practical Schedule:

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

Suggested Readings:

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

AGRON-414 Geoinformatics and Remote Sensing, Precision Farming 4 (3+1)

Course Status : Elective
Contact Hours (L-T-P) : 3-0-2
Course Objective :
1. To acquaint the knowledge on basics of remote sensing technique for precision farming applications.
2. To provide a comprehensive knowledge of remote sensing, precision farming and its benefits in improving crop production and soil health management.

Course Outcomes (CO) : After the completion of this course, the student will be able to -
CO-1: get acquainted with the principles and application of remote sensing in soil survey, crop stress and yield forecasting.
CO-2: know about data sharing and its applications.
CO-3: know about the basics of probability and statistics.
CO-4: familiar with the basics of machine and deep learning systems.

Course Description :

Theory:	**CO Mapping**
Unit 1: Remote sensing Introduction and history of remote sensing; sources, Principles of remote sensing, propagation of radiations in atmosphere; Interaction with matter; Application of remote sensing techniques land use soil surveys; crop stress and yield forecasting; Advantages and disadvantages of remote sensing; Remote sensing institutes in India; Basic Concepts about geoinformatics.	CO-1
Unit 2: Data sharing Data sharing; Expert System: Introduction to expert system, Characteristics and features of expert system, Applications of Expert System, Importance of Expert system, Rule based system architecture; Software Agents; Impact of Block chain and it's concepts.	CO-2
Unit 3: Probability and Statistics Probability and Statistics: Bayes Theorem, correlation and Covariance, Continuous Random variables and probability distribution function, various forms of distributions, central limit theorem.	CO-3
Unit 4: Basics of Machine and Deep Learning Basics of Machine Learning: Random forest, SVM, ensemble methods; Basics of Deep learning: various model architectures and it's training aspects; Hyperspectral and Thermal Remote Sensing; Proximal Soil and Crop Sensors.	CO-4

Practical:

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

Theory Schedule:

S. No.	Name of Topic	No. of lecture
1.	Introduction and history of remote sensing.	2
2.	Sources and Principles of remote sensing.	2
3.	Propagation of radiations in atmosphere; Interaction with matter.	2
4.	Application of remote sensing techniques land use soil surveys; crop stress and yield forecasting.	3
5.	Advantages and disadvantages of remote sensing.	1
6.	Remote sensing institutes in India.	1

7.	Basic Concepts about geoinformatics.	1
8.	Data sharing.	2
9.	Expert System: Introduction to expert system.	2
10.	Characteristics and features of expert system.	2
11.	Applications of Expert System.	2
12.	Importance of Expert system.	1
13.	Rule based system architecture.	2
14.	Software Agents.	2
15.	Impact of Block chain and it's concepts; Probability and Statistics.	2
16.	Bayes Theorem.	2
17.	Correlation and Covariance.	2
18.	Continuous Random variables and probability distribution function.	2
19.	Various forms of distributions.	2
20.	Central limit theorem.	2
21.	Basics of Machine Learning.	2
22.	Random forest, SVM, ensemble methods.	3
23.	Basics of Deep learning: various model architectures and it's training aspects.	2
24.	Hyperspectral and Thermal Remote Sensing.	2
25.	Proximal Soil and Crop Sensors.	2

Practical Schedule:

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

Suggested Readings:

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

AGRON-415 Principles and Practices of Organic Farming/ Conservation Agriculture 4 (3+1)

Course Status : Elective
Contact Hours (L-T-P) : 3-0-2
Course Objective :
1. To teach students the principles of crop production under organic and conservation agriculture situation.
2. To impart practical knowledge of organic and conservation agriculture practices.

Course Outcomes (CO) : After the completion of this course, the student will be able to -
CO-1: know about concepts, importance and management aspects of organic farming.
CO-2: get acquainted with certification, processing and marketing system of organic farming.
CO-3: know initiatives taken by public and private sector for promotion of organic farming.
CO-4: familiar with the basics and practices using in conservation agriculture.
CO-5: calcualte doses of organic manures for recommendation.

Course Description :

Theory:	**CO Mapping**
Unit 1: Introduction to organic crop management Concept of organic farming, principles and its scope in India; Choice of crops and varieties in organic farming. Nutrient management in organic farming and their sources; Fundamentals of insect, pest, disease and weed management under organic mode of production.	CO-1
Unit 2: Certification and marketing of organic products Operational structure of NPOP; Certification process and crop standards of organic farming; Processing, labelling, economic considerations and viability, marketing and export potential of organic products.	CO-2
Unit 3: Initiatives taken by public and private sector Initiatives taken by Government (central/state), NGOs and other organizations for promotion of organic agriculture.	CO-3
Unit 4: Conservation agriculture Conservation agriculture: definition, origin, principles, advantages, challenges. Primary practices in conservation agriculture: minimum soil disturbance, crop residue retention, and crop diversification, complementary practices, conservation agriculture *vis a vis* Climate Smart Agriculture.	CO-4
Unit 5: Organic manures Organic manures- recommended doses and application in comparison to inorganic fertilizers for major crops.	CO-5

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.

Theory Lecture Schedule:

S. No.	Name of Topic	No. of lecture
1.	Organic farming: Concept, principles and its scope in India.	3
2.	Choice of crops and varieties in organic farming.	2
3.	Nutrient management in organic farming and their sources.	3

4.	Fundamentals of insect, pest, disease and weed management under organic mode of production.	3
5.	Operational structure of NPOP.	3
6.	Certification process and crop standards of organic farming.	3
7.	Processing, labelling, economic considerations and viability, marketing and export potential of organic products.	3
8.	Initiatives taken by Government (central/state), NGOs and other organizations for promotion of organic agriculture.	3
9.	Conservation agriculture: definition, origin, principles and advantages.	3
10.	Challenges in conservation agriculturte.	2
11.	Primary practices in conservation agriculture.	3
12.	Minimum soil disturbance.	2
13.	Crop residue retention.	2
14.	Crop diversification.	3
15.	Complementary practices.	2
16.	Conservation agriculture vis a vis Climate Smart Agriculture.	3
17.	Organic manures; Introduction and classification.	2
18.	Organic manures- recommended doses and application in comparison to inorganic fertilizers for major crops.	3

Practical schedule:

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

Suggested Readings:

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

ENTO-411 Agrochemicals 4 (3+1)

Course Status : Elective
Contact Hours (L-T-P) : 3-0-2
Course Objective : To impart knowledge on different classes of agrochemicals.
Course Outcomes (CO) : After the completion of this course, the student will be able to learn about to -

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

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

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

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

Course Description :

Theory:	**CO Mapping**
Unit 1: Introduction to Agrochemicals and Herbicides An introduction to agrochemicals, their type and role in agriculture, effect on environment, soil, human and animal health, merits and demerits of their uses in agriculture, management of agrochemicals for sustainable agriculture. Herbicides -Major classes, properties and important herbicides. Fate of herbicides.	CO-1
Unit 2: Introduction to Fungicides and Insecticides Fungicides- classification –Inorganic fungicides-characteristics, preparation and use of sulphur and copper. Mode of action- Bordeaux mixture and copper oxychloride. Organic fungicides –Mode of action –Dithiocarbamates-characteristics, preparation and use of Zineb and maneb. Systemic fungicides-Benomyl, carboxin, oxycarboxin, Metalaxyl, Carbendazim, characteristics and use. Introduction and classification and insecticides: inorganic and organic insecticides organochorine, Ogranophosphates, Carbamates, Synthetic pyrethriods Neonicotinoids, Biorationals. Insecticide Act and rules, Insecticides banned, withdrawn and restricted use. Fate of insecticides in soil and plant. IGR Biopesticides, Reduced risk insecticides, Botanical, Plant and animal systemic insecticides their characteristics and uses.	
Unit 3: Introduction to Fertilizers and Primary Fertilizers Fertilizers and their importance. Nitrogenous fertilizers: Feedstocks and Manufacturing of ammonium sulphate, ammonium nitrate, ammonium chloride, urea. Slow release N-fertilizers. Phosphatic fertilizers: feedstock and manufacturing of single superphosphate. Preparation of bone meal and basic slag. Potassic fertilizers: Natural sources of potash, manufacturing of potassium chloride, potassium sulphate and potassium nitrate.	CO-2
Unit 4: Mixed and complex fertilizers Mixed and complex fertilizers: Sources and compatibility preparation of major, secondary and micronutrient mixtures. Complex fertilizers: Manufacturing of ammonium phosphates, nitrophosphates and NPK complexes.	CO-3
Unit 5: Fertilizer control order Fertilizer control order. Fertilizer logistic and marketing.	CO-4

Practical:

Sampling of fertilizers and pesticides. Pesticides application technology to study about various pesticides appliances. Quick tests for identification of common fertilizers. Identification of anion and cation in fertilizer. Calculation of doses of insecticides to be used. To study and identify

various formulations of insecticide available kin market. Estimation of nitrogen in Urea. Estimation of water soluble P_2O_5 and citrate soluble P_2O_5 in single super phosphate. Estimation of potassium in Muraite of Potash/ Sulphate of Potash by flame photometer. Determination of copper content in copper oxychloride. Determination of sulphur content in sulphur fungicide.

Theory Lecture Schedule:

S. No.	Name of Topic	No. of lecture
1.	An introduction to agrochemicals, their type and role in agriculture, effect on environment, soil, human and animal health.	2
2.	Merits and demerits of their uses in agriculture, management of agrochemicals for sustainable agriculture.	2
3.	Herbicides -Major classes, properties.	2
4.	Important herbicides. Fate of herbicides.	2
5.	Fungicides- classification –Inorganic fungicides-characteristics.	3
6.	Preparation and use of sulphur and copper.	2
7.	Mode of action- Bordeaux mixture and copper oxychloride.	1
8.	Organic fungicides –Mode of action –Dithiocarbamates- characteristics, preparation and use of Zineb and maneb.	3
9.	Systemic fungicides- Benomyl, carboxin, oxycarboxin, Metalaxyl, Carbendazim, characteristics and use.	3
10.	Introduction and classification and insecticides: inorganic and organic insecticides organochorine, Ogranophosphates, Carbamates, Synthetic pyrethriods Neonicotinoids.	3
11.	Biorationals. Insecticide Act and rules, Insecticides banned, withdrawn and restricted use.	3
12.	Fate of insecticides in soil and plant. IGR Biopesticides, Reduced risk insecticides.	2
13.	Botanical, Plant and animal systemic insecticides their characteristics and uses.	2
14.	Fertilizers and their importance.	1
15.	Nitrogenous fertilizers: Feedstocks and Manufacturing of ammonium sulphate, ammonium nitrate, ammonium chloride, urea.	3
16.	Slow release N-fertilizers.	1
17.	Phosphatic fertilizers: feedstock and manufacturing of single superphosphate.	1
18.	Preparation of bone meal and basic slag.	1
19.	Potassic fertilizers: Natural sources of potash, manufacturing of potassium chloride, potassium sulphate and potassium nitrate.	2
20.	Mixed and complex fertilizers: Sources and compatibility preparation of major, secondary and micronutrient mixtures.	3
21.	Complex fertilizers: Manufacturing of ammonium phosphates, nitrophosphates and NPK complexes.	3
22.	Fertilizer control order. Fertilizer logistic and marketing.	3

Practical Schedule:

S. No.	Name of Topic	No. of practical
1.	Sampling of pesticides.	1
2.	Sampling of fertilizers.	1
3.	Pesticides application technology to study about various pesticides appliances.	2
4.	Quick tests for identification of common fertilizers.	2
5.	Identification of anion and cation in fertilizer.	1
6.	Calculation of doses of insecticides to be used.	1
7.	To study and identify various formulations of insecticide available kin	2

	market.	
8.	Estimation of nitrogen in Urea.	1
9.	Estimation of water soluble P_2O_5 and citrate soluble P_2O_5 in single super phosphate.	2
10.	Estimation of potassium in Muraite of Potash/ Sulphate of Potash by flame photometer.	1
11.	Determination of copper content in copper oxychloride.	1
12.	Determination of sulphur content in sulphur fungicide.	1

Suggested Readings:

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

FSN-411 Food Safety and Standards 4 (3+1)

Course Status : Elective
Contact Hours (L-T-P) : 3-0-2
Course Objective : This course intends to provide knowledge about the basic concepts & implementation of food safety for development of safe products
Course Outcomes (CO) : After the completion of this course, the student will be able to learn about -
CO-1: To develop skill to convert raw materials into safe, attractive food products.
CO-2: Management of the production of food products.
CO-3: to have the know-how of recent concerns to food safety.

Course Description :

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

and Nutritional labelling. Genetically modified food/transgenic. Organic foods. Newer approaches to food safety. Recent Outbreaks.	

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 plants for Implementation of FSMS-HACCP, ISO:22000.

Theory Lecture Schedule:

S. No.	Name of Topic	No. of lecture
1.	Food safety –Definition, Importance.	1
2.	Scope and Factors affecting Food Safety.	1
3.	Hazards and Risks.	1
4.	Type of Hazards - Biological, Chemical, Physical hazards.	3
5.	Management of hazards – Needs.	1
6.	Control of Parameters.	1
7.	Temperature Control.	1
8.	Food Storage.	1
9.	Production Designs.	1
10.	Hygiene and Sanitation in Food Service Establishments- Introduction.	1
11.	Sources of contamination and their control.	1
12.	Water Analysis.	1
13.	Surface Sanitation.	1
14.	Personal Hygiene.	1
15.	Food Safety Management Tools and Basic concepts of Food safety Measures.	5
16.	PRPs, GHPs, GMPs, SSOPs etc.	4
17.	HACCP.	1
18.	ISO series.	1
19.	TQM- concept and need for quality, components of TQM, Kaizen.	3
20.	Risk Analysis.	1
21.	Accreditation and Auditing.	2
22.	Waste Disposal.	1
23.	Pest and Rodent Control,Personnel Hygiene.	1
24.	Food laws and Standards Indian Food Regulatory Regime.	3
25.	FSSA. Global Scenario CAC.	1
26.	Other laws and standards related to food.	1
27.	Indian and International Standards for food products.	1
28.	Recent concerns -New and Emerging Pathogens.	1
29.	Packaging, Product labelling and Nutritional labelling.	3
30.	Genetically modified food/transgenic.	1

Practical Schedule:

S. No.	Name of Topic	No. of practical
1.	Water quality analysis.	1
2.	Physico – chemical analysis	1
3.	Microbiological. Preparation of different types of media.	1
4.	Microbiological examination of different food samples.	2
5.	Assessment of surface sanitation by swab/rinse method.	2
6.	Assessment of personal hygiene.	1
7.	Biochemical tests for identification of bacteria.	3
8.	Scheme for the detection of food borne pathogens.	3

9.	Preparation of plants for Implementation of FSMS-HACCP	1
10.	ISO:22000.	1

Suggested Readings:

1. Text book of Food Science and Technology: Avantina Sharma.
2. Handbook of Food Safety: D.S.L. Khatekar and N. Sarkate. Step Up Academy, 576p.
3. Food and Beverage Management: Bernard Davis. Andrew Lockwood, Ioannis Pantelidis, Peter Alcott Routle.dge
4. Food safety and Quality Control: Pulkit Mathur. The Orient Blackswan.332p.
5. Safe Food Handling: HACCP booklet for Food Handlers. Cletus Fernandes, Notion Press.

FSN-412 Food Science and Nutrition 4 (3+1)

Course Status : Elective
Contact Hours (L-T-P) : 3-0-2
Course Objective : To impart knowledge on the biochemical aspects of various nutrients and their interactions in foods during processing, storage and deterioration.
Course Outcomes (CO) : After the completion of this course, the student will be able to learn about -
CO-1: Composition of food and fundamentals of nutrition.
CO-2: Characteristics of nutrients and their metabolism.
CO-3: Principles of food processing and preservation.
Course Description :

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

Practical:

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

Theory Lecture Schedule:

S. No.	Name of Topic	No. of lecture
1.	Introduction on fundamentals of foods and human nutrition.	2
2.	Basic food groups.	2

3.	Concept of balanced diets.	2
4.	Recommended Daily Allowances (RDA) for various age groups.	2
5.	Biochemical composition, energy and food value of various food grains, fruits and vegetables.	4
6.	Carbohydrates, proteins, fats as nutrients and their interactions.	4
7.	Physio-chemical, functional and nutritional characteristics of essential nutrients- sources and functions.	3
8.	Nutritional requirements, malnutrition, inborn errors of metabolism and deficiency diseases.	2
9.	Digestion, absorption, transport and metabolism of nutrients in human system.	3
10.	Protein quality evaluation.	2
11.	Biochemical and nutritional aspects of vitamins, minerals, nutraceuticals, antioxidant, antinational factors.	4
12.	Biochemistry of postharvest storage, losses during processing.	2
13.	Effect of cooking, processing and preservation on nutrients of different food products.	4
14.	Biochemical aspects of food spoilage.	2
15.	Food fads, food safety and quality standards.	3
16.	Enzymes in food industry .	2
17.	Food additives.	2
18.	Nutritional quality of plant, animal, dairy, marine and fermented products.	4

Practical Schedule:

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

Suggested Readings:

1. Damodaran, S. and Parkin, K.L. (Ed.). 2017. Fennema's Food Chemistry. CRC Press.
2. Gibney, M. J., Lanham-New, S.A., Cassidy, A. and Voster, H.H. (Ed.). 2009. Introduction to Human Nutrition. Wiley-Blackwell.
3. Trueman, P. 2007. Nutritional Biochemistry. MJP Publishers.
4. Rekhi, Tejmeet and Yadav, Heena. 2014. Fundamentals of Food and Nutrition. Elite Publishing House. 257p.
5. Dharmesh Kumar. Food Science and Nutrition. Random.

EXT-411 Agricultural Journalism 4 (3+1)

Course Status : Elective
Contact Hours (L-T-P) : 3-0-2
Course Objective : To impart knowledge and skill in agricultural journalism.
Course Outcomes (CO) : After the completion of this course, the student will be able to -
CO-1: Define and differentiate the agricultural journalism from other journalism, its types, principles, objectives and the role of agricultural journalists in promoting agricultural development.

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

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

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

Course Description :

Theory:	**CO Mapping**
Unit 1: Agricultural Journalism and its Role in Communication Journalism - Meaning, nature, importance, and types of journalism. Agricultural Journalism – Meaning, definition, principle, objectives, types, and scope. Similarities and difference between agricultural journalism and other types of journalism. Role of agricultural journalist, Training of agricultural journalist. Qualities of journalist, Role of journalist /journalism in agricultural development and development of newspaper and magazines readers. Newspaper and magazines as communication media: Characteristics, kinds and functions of newspaper and magazines, Characteristics of newspaper and magazines readers. Form, content, style and language of newspaper and magazines, Standard part of newspaper and magazines.	CO-1
Unit 2: Writing and Structuring Agricultural Stories The agricultural stories: Types of Agriculture stories, subject matter of the agricultural story, structure of the agricultural story. Gathering farm information -Sources of farm information: abstracting from research and scientific materials, interviews, coverage of events. Other sources: electronic media, field study. Success stories definition, nature, components, guidelines of writing a success story. Writing a news story difference between news and feature story, the principle of writing a news story, Inverted pyramid structure. Organizing the material, treatment of the story, writing the news lead and the body.	CO-2
Unit 3: Readability, Visual Elements in Agricultural Journalism Readability measure-readability ease score, automated readability index, gunning fog index. How to improve readability of articles and stories. Use of photograph in agricultural journalism- Basic principles of photography - composition, exposure, lens, light. Use of artwork (Graphs, charts maps, etc.). Writing the captions.	CO-3
Unit 4: Editorial Processes in Agricultural Journalism Editorial mechanism: Copy reading, headline and title writing. Proofreading: definition, signs and symbols of proofreading, level of proofreading, duties of a proof-reader. Layout – meaning, principles of layout and design	CO-4

Practical:

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

Theory Lecture Schedule:

S. No.	Name of Topic	No. of Lecture
1.	Journalism – Meaning, nature, importance and types of journalism.	3

	Agricultural Journalism – Meaning, definition, principle, objectives, types, and scope.	
2.	Similarities and difference between agricultural journalism and other types of journalism. Role of agricultural journalist, Training of agricultural journalist.	3
3.	Qualities of journalist, Role of journalist /journalism in agricultural development and development of newspaper and magazines readers.	4
4.	Newspaper and magazines as communication media: Characteristics, kinds and functions of newspaper and magazines, Characteristics of newspaper and magazines readers.	4
5.	Form, content, style and language of newspaper and magazines, Standard part of newspaper and magazines.	4
6.	The agricultural stories: Types of Agriculture stories, subject matter of the agricultural story, structure of the agricultural story.	3
7.	Gathering farm information -Sources of farm information: abstracting from research and scientific materials, interviews, coverage of events. Other sources: electronic media, field study. Success stories definition, nature, components, guidelines of writing a success story.	5
8.	Writing a news story difference between news and feature story, the principle of writing a news story, Inverted pyramid structure.	3
9.	Organizing the material, treatment of the story, writing the news lead and the body.	3
10.	Readability measure-readability ease score, automated readability index, gunning fog index, How to improve readability of articles and stories.	4
11.	Use of photograph in agricultural journalism- Basic principles of photography – composition, exposure, lens, light. Use of artwork (Graphs, charts maps, etc.).	4
12.	Writing the captions. Editorial mechanism: Copy reading, headline and title writing.	3
13.	Proofreading: definition, signs and symbols of proofreading, level of proofreading, duties of a proof-reader.	3
14.	Layout – meaning, principles of layout and design.	2

Practical Schedule:

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

Suggested Readings*:*

1. Carole Fleming, Emma Hemmingway, and Gillian Moore. Introduction to Journalism.
2. Rangaswami Parthasarathy. Basic Journalism.
3. K. M. Shrivastava. News Reporting and Editing.
4. M.V. Kamath. Professional Journalism.

5. M.V. Kamath. The Journalist's Handbook Book.
6. Bhaskaran et al. Farm Journalism and Media Management.
7. A K Singh. Agricultural Extension and farm Journalism.
8. Jana and Mitra. Farm Journalism.
9. Rathore, O. S. et al. Handbook of Extension Education.
10. Dudhani, C.M., Hirevenkatgoudar, L.V., Manjunath, L. Hanchinal, S.N. and Patil, S.L. Extension Teaching Methods and Communication Technology.
11. Sandhu, A.S. Text book on Agricultural Communication: Process and Methods.
12. Singh, A.K., Lakhan Singh, R. and Roy Burman. Dimensions of Agricultural Extension.

GPB-411 Commercial Plant Breeding 4 (3+1)

Course Status : Elective
Contact Hours (L-T-P) : 3-0-2
Course Objective :
1. To learn about the hybrid development and various crop improvement aspects of field crops viz., rice, wheat, maize, pearl millet, sorghum, pigeonpea, chickpea, green gram, black gram, lentil, soybean, groundnut, rapeseed-mustard, cotton etc.
2. To provide understanding on tissue culture and biotechnological approaches as alternative strategies for line and cultivar development.
3. To impart knowledge on seed production, release and notification of varieties and PPV & FR Act, 2001.

Course Outcomes (CO) : After the completion of this course, the student will be able to learn about -
CO-1: The types of crops and modes of plant reproduction.
CO-2: Various methods of hybrid seed production.
CO-3: Special breding methods and plant variety protection laws.
CO-4: Principles of seed production techniques.

Course Description :

Theory:	**CO Mapping**
Unit 1: Line Development and Maintenance breeding Types of crops and modes of plant reproduction. Line development and maintenance breeding in self- and cross- pollinated crops (A/B/R and two-line system) for development of hybrids and seed production. Genetic test of commercial hybrids.	CO-1
Unit 2: Advances in hybrid seed production of field crops Advances in hybrid seed production of maize, rice, sorghum, pearl millet, castor, sunflower, cotton pigeon pea, Brassica etc.	CO-2
Unit 3: Special Breding Methods Speed Breeding, Breeding Management systems, High-throughput phenotyping and genotyping platforms, Quality seed production of vegetable crops under open and protected environment. Alternative strategies for the development of the line cultivators: haploid inducer, tissue culture techniques and biotechnological tools.	CO-3
Unit 4: IPR and PPV & FR Act, Variety testing, release and notification systems IPR issues in commercial plant breeding: DUS testing and registration of verities under PPV and FR Act. Variety testing, release and notification systems in India.	
Unit 5: Principles and techniques of seed production Principles and techniques of seed production, types of seeds, quality testing in self- and cross- pollinated crops.	CO-4

Practical:

Floral biology in self- and cross- pollinated species, selfing and crossing techniques. Techniques of seed production in self- and cross- pollinated crops using A/B/R and two-line system. Learning techniques in hybrid seed production using male- sterility in field crops. Understanding the difficulties in hybrid seed production. Tools and techniques for optimizing hybrid seed production. Concept of rouging in seed production plot. Concept of line its multiplication and purification in hybrid seed production. Role of pollinators in hybrid seed production. Hybrid seed production techniques in sorghum, pearl millet, maize, rice, rapeseed-mustard, sunflower, castor, pigeon pea, cotton and vegetable crops. Sampling and analytical procedures for purity testing and detection of spurious seed. Seed drying and storage structure in quality seed management. Screening techniques during seed processing, viz. grading and packaging. Visit to public private seed production and processing plants.

Theory Lecture Schedule:

S. No.	Name of Topic	No. of lecture
1.	Types of crops and modes of plant reproduction.	2
2.	Line development in self- and cross- pollinated crops (A/B/R and two-line system) for development of hybrids and seed production .	2
3.	Maintenance breeding in self- and cross- pollinated crops (A/B/R and two-line system) for development of hybrids and seed production.	2
4.	Genetic purity test of commercial hybrids.	2
5.	Advances in hybrid seed production of maize and rice.	3
6.	Advances in hybrid seed production of sorghum and pearl millet.	3
7.	Advances in hybrid seed production of castor, sunflower and cotton.	3
8.	Advances in hybrid seed production of pigeon pea, Brassica etc.	4
9.	Speed Breeding.	1
10.	Breeding Management systems.	2
11.	High-throughput phenotyping and genotyping platforms.	2
12.	Quality seed production of vegetable crops under open environment.	2
13.	Quality seed production of vegetable crops under protected environment.	2
14.	Alternative strategies for the development of the line and cultivars.	1
15.	Haploid inducer.	2
16.	Tissue culture techniques.	2
17.	Biotechnological tools.	2
18.	IPR issues in commercial plant breeding.	2
19.	DUS testing and registration of verities under PPV and FR Act	2
20.	Variety testing, release and notification systems in India.	2
21.	Principles and techniques of seed production.	2
22.	Types of seeds and quality testing in self- and cross- pollinated crops.	3

Practical Schedule:

S. No.	Name of Topic	No. of practical
1.	Floral biology in self- and cross-pollinated species, selfing and crossing techniques.	1
2.	Techniques of seed production in self- and cross-pollinated crops using A/B/R and two-line system.	1
3.	Learning techniques in hybrid seed production using male-sterility in field crops.	1
4.	Understanding the difficulties in hybrid seed production, Tools and techniques for optimizing hybrid seed production.	1
5.	Concept of rouging in seed production plot.	1
6.	Concept of line its multiplication and purification in hybrid seed production.	1
7.	Role of pollinators in hybrid seed production.	1

8.	Hybrid seed production techniques in sorghum and pearl millet.	1
9.	Hybrid seed production techniques in maize and rice.	1
10.	Hybrid seed production techniques in rapeseed-mustard and sunflower.	1
11.	Hybrid seed production techniques in castor and pigeon pea.	1
12.	Hybrid seed production techniques in cotton and vegetable crops.	1
13.	Sampling and analytical procedures for purity testing and detection of spurious seed.	1
14.	Seed drying and storage structure in quality seed management.	1
15.	Screening techniques during seed processing viz., grading and packaging.	1
16.	Visit to public private seed production and processing plants.	1

Suggested Readings:

1. Commercial Plant Breeding at a glance by Phundan Singh, Pratibha Bisen, Reshu Tiwari. Daya Publishing House.
2. Plant Breeding: Principles and Methods by B. D. Singh. Kalyani Publishers.
3. Principles of Plant Breeding (1st & 2nd Edition) by R.W. Allard.
4. Breeding Field Crops by J.M. Poehlman.
5. Commercial Plant Breeding Objective: Phundan Singh, Mridula Billore and Monika Singh. Astral Publishing, 160p.
6. Breeding and Crop Production: H. Padmalatha, Random.
7. Biotechnology for Agricultural Breeding: Mangal, S. K. Gene Tech Books.

GPB-412 Micro-propagation Technologies 4 (3+1)

Course Status : Elective
Contact Hours (L-T-P) : 3-0-2
Course Objective : This course intends to provide a basic knowledge about tissue culture techniques.
Course Outcomes (CO) : After the completion of this course, the student will be able to learn about -
CO-1: Micropropagation techniques and cryopreservation,
CO-2: Identification and handling of equipment in Tissue culture.
CO-3: Organogenesis and Cryopreservation.

Course Description :

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

Practical:

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

Theory Lecture Schedule:

S. No.	Name of Topic	No. of lecture
1.	Introduction to micro propagation technologies.	2
2.	History of micro propagation technologies.	3
3.	Advantages and limitations of micro propagation technologies.	4
4.	Types of cultures: Seed and Embryo culture.	4
5.	Types of cultures: Organ and Callus culture.	4
6.	Types of cultures: Cell culture.	2
7.	Stages of Micro propagation.	3
8.	Axillary bud proliferation.	3
9.	Shoot tip culture.	2
10.	Meristem culture.	2
11.	Bud culture.	2
12.	Organogenesis: Callus and direct organ formation.	3
13.	Somatic embryogenesis.	2
14.	Cell suspension cultures.	3
15.	Production of secondary metabolites.	3
16.	Somaclonal variation.	3
17.	Cryopreservation.	3

Practical Schedule:

S. No.	Name of Topic	No. of practical
1.	Identification and use of equipments in tissue culture Laboratory.	2
2.	Nutrition media composition.	1
3.	Sterilization techniques for media.	2
4.	Sterilization techniques for containers and small instruments.	2
5.	Sterilization techniques for explants.	2
6.	Preparation of stocks and working solution.	1
7.	Preparation of working medium.	1
8.	Culturing of explants.	1
9.	Seeds, shoot tip and single node.	1
10.	Callus induction.	1
11.	Induction of somatic embryos regeneration of whole plants from different explants.	1
12.	Hardening procedures.	1

Suggested Readings:

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

GPB-413 Commercial Seed Production 4 (3+1)

Course Status : Elective
Contact Hours (L-T-P) : 3-0-2
Course Objective : To provide the knowledge of basic principles of planting material production at commercial scale and seed quality evaluation.

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

CO-1: General Principles of Seed Production seed processing.
CO-2: General Principles of Seed Testing and seed certification.
CO-3: Seed Industry and Seed Marketing.
CO-4: Role of Biotechnology in Seed Seed Production.

Course Description :

Theory:	**CO Mapping**
Unit 1: General Principles of Seed Production Raising the seed crop, Introduction, Procurement of a class of Improved seeds, Reporting to Monitoring or certification Agency, Principles and practices of selection of area and agronomic requirement of seed production of field crops, Importance of isolation distance and Rouging, Principles of hybrid seed production in field crops, Principles and practices of selection of area and agronomic requirement of seed production of horticultural crops, Concept of apomixes, male sterility and self-incompatibility and its application in hybrid seed production of horticultural crops, Farmers participatory seed production.	CO-1
Unit 2: General Principles of Seed Processing Introduction, Objectives of Seed Processing, Seed Drying, Principles of Drying, Water vapour equilibrium, Methods of drying seeds, Cleaning and grading, Air and screen machines, Dimensional separators, Density separators, Surface texture separators, Colour separators, Spiral separators, Electric separators, Vibrator separators, Separation based on Affinity to liquids, Seed treatment, Temperature treatment, Chemical treatment, Bagging and Labelling.	
Unit 3: 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.	CO-2
Unit 4: Seed Certification History, concept and objectives of seed certification; seed certification agency/organization and staff requirement Indian Minimum Seed Certification Standards (I.M.S.C.S.)- general and specific crop standards including GM varieties, field and seed standards.	
Unit 5: Seed Industry and Seed Marketing Introduction, Evolution of the seed industry, Development of the vegetable and Flower seed industry, Seed marketing – concept, definition and purpose, importance and promotion of quality seed, formal and informal seed supply systems, Seed marketing intelligence and product mix, sales promotion, distribution channels, marketing costs and margins; packaging and labelling, Seed Associations, Factors influencing seed marketing, Seed marketing programs, Seed industry organizations, Marketing of public versus private players, Demand and supply of seed; role of seed replacement rate (SRR), seed multiplication ratio (SMR), economics of seed production; determining seed needs, Seed pricing and price policy, seed processing and/ packaging, demand forecasting and factors affecting demand for seeds, effect of price and farm income on seed demand, Role of WTO in seed marketing.	CO-3
Unit 5: 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	CO-4

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 equipment; effect of drying temperature and duration on seed germination and storability seed processing equipment; seed treating equipment. 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 entrepreneurships 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 seedborne 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.

Theory Lecture Schedule:

S. No.	Name of Topic	No. of lecture
1.	Raising the seed crop, Introduction, Procurement of a class of Improved seeds.	1
2.	Reporting to Monitoring or certification Agency, Principles and practices of selection of area and agronomic requirement of seed production of field crops.	1
3.	Importance of isolation distance and Rouging, Principles of hybrid seed production in field crops.	2
4.	Principles and practices of selection of area and agronomic requirement of seed production of horticultural crops.	2
5.	Concept of apomixes, male sterility and self-incompatibility and its application in hybrid seed production of horticultural crops.	2
6.	Farmers participatory seed production.	1
7.	Introduction, Objectives of Seed Processing.	1
8.	Seed Drying, Principles of Drying, Water vapour equilibrium, Methods of drying seeds, Cleaning and grading, Air and screen machines.	2
9.	Dimensional separators, Density separators, Surface texture separators, Colour separators, Spiral separators, Electric separators, Vibrator separators, Separation based on Affinity to liquids.	2
10.	Seed treatment, Temperature treatment, Chemical treatment, Bagging and Labelling	1
11.	Seed testing-Introduction, Procedure of Seed testing.	1
12.	components of seed quality testing genetic, physical, physiological and seed health testing.	1
13.	Seed sampling, Types of seed sampling, Requirements of sampling	2
14.	Concept of seed viability and vigour; dormancy, types and principles of seed dormancy, Physiological quality of seed.	2
15.	Principles of seed Germination, types of germination, biochemical and genetic basis.	2

16.	History, concept and objectives of seed certification.	1
17.	seed certification agency/organization and staff requirement	1
18.	Indian Minimum Seed Certification Standards (I.M.S.C.S.)- general and specific crop standards including GM varieties, field and seed standards.	2
19.	Introduction, Evolution of the seed industry.	1
20.	Development of the vegetable and Flower seed industry.	2
21.	Seed marketing – concept, definition and purpose, importance and promotion of quality seed, formal and informal seed supply systems.	2
22.	Seed marketing intelligence and product mix, sales promotion, distribution channels, marketing costs and margins; packaging and labelling.	2
23.	Seed Associations, Factors influencing seed marketing, Seed marketing programs, Seed industry organizations, Marketing of public versus private players.	2
24.	Demand and supply of seed; role of seed replacement rate (SRR), seed multiplication ratio (SMR), economics of seed production; determining seed needs.	2
25.	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.	2
26.	Role of WTO in seed marketing.	1
27.	History of plant tissue culture, Laboratory organization, Composition of nutrient medium.	1
28.	Micro-propagation, Axillary bud proliferation approach, Meristem and shoot tip culture, Bud culture.	2
29.	Advantages of Micro-propagation, Problems associated with micro-propagation.	1
30.	Synthetic seed production, Types of synthetic seeds, methods of development of synthetic seeds.	1
31.	Components of nutrient media for synthetic seed development, Storage of synthetic seeds.	1
32.	Advantages and limitations of synthetic seed production.	1

Practical Schedule:

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

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

Suggested Readings:

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

HORT-411 Landscaping 4 (3+1)

Course Status : Elective
Contact Hours (L-T-P) : 3-0-2
Course Objective :
1. To educate the students on designing different styles and types of gardens.
2. To enable the students to identify different ornamental plants and their utilization in landscape designs
3. To enable students to design landscapes in softwares like AutoCAD, ArchiCAD etc.

Course Outcomes (CO) : After the completion of this course the student will be able to learn-
CO-1: Principles of landscaping, different styles and types of gardens.
CO-2: Selection and utilization of different ornamental plants in landscaping.
CO-3: Landscaping of various places and use of softwares like AutoCAD, ArchiCAD.

Course Description :

Theory	CO Mapping
Unit 1: Introduction and principles of landscaping garden styles and types Importance and scope of landscaping, history of gardening and famous garden of India. Principles of landscaping, garden styles and types, terrace gardening, vertical gardening, garden components, adornments, lawn making, rockery, water garden, walk-paths, bridges, other constructed features etc. Gardens for special purposes.	CO-1

Unit 2: Selection and utilization of ornamental plants in landscaping Trees: selection, propagation, planting schemes, canopy management. Shrubs and herbaceous perennials: selection, propagation, planting schemes, architecture. Climber and creepers: importance, selection, propagation, planting. Annuals: selection, propagation, planting scheme. Other garden plants: palms, ferns, grasses and cacti succulents. Pot plants: selection, arrangement, management.	CO-2
Unit 3: Bioaesthetic planning and landscaping of different places Bioaesthetic 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.	CO-3

Practical:

Identification of ornamental 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. Symbols for landscape designing, 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.

Theory Lecture Schedule:

S. No.	Name of Topic	No. of lecture
1.	Importance and scope of landscaping, history of gardening and famous garden of India.	2
2.	Principles of landscaping- Basic principles and factors of landscaping.	5
3.	Garden styles and types	6
4.	Terrace gardening.	1
5.	Vertical gardening.	1
6.	Garden components, adornments, lawn making, rockery, water garden, walk-paths, bridges, other constructed features etc.	7
7.	Gardens for special purposes.	2
8.	Trees: selection, propagation, planting schemes, canopy management.	1
9.	Shrubs: selection, propagation, planting schemes, architecture.	1
10.	Herbaceous perennials: selection, propagation, planting schemes.	1
11.	Climber and creepers: importance, selection, propagation, planting.	1
12.	Annuals: selection, propagation, planting scheme.	1
13.	Other garden plants: palms, ferns, grasses and cacti-succulents.	2
14.	Pot plants: selection, arrangement, management.	1
15.	Bio-aesthetic planning: definition, need, planning.	1
16.	Landscaping of urban and rural areas.	1
17.	Peri-urban landscaping.	1
18.	Landscaping of schools, public places like bus station, railway station, townships, river banks, hospitals, play grounds, airports, industries, institutions.	7
19.	Bonsai principles and management.	3
20.	Lawn: establishment and maintenance.	2
21.	CAD application.	1

Practical Schedule:

S. No.	Name of Topic	No. of practical
1.	Identification of ornamental trees, shrubs, annuals, pot plants.	1
2.	Identification of tools and implements used in landscape designing.	1

3.	Propagation of trees and shrubs.	1
4.	Propagation of annuals.	1
5.	Care and maintenance of plants.	1
6.	Potting and repotting.	1
7.	Training and pruning of plants for special effects.	1
8.	Lawn establishment and maintenance.	1
9.	Symbols for landscape designing.	1
10.	Layout of formal gardens.	1
11.	Layout of informal gardens.	1
12.	Special type of gardens (sunken garden, terrace garden, rock garden).	2
13.	Designing of conservatory and lathe house.	1
14.	Use of computer software.	1
15.	Visit to important gardens/parks/institutes.	1

Suggested Readings:

1. Arora, J. S. 2010. Introductory Ornamental Horticulture. Kalyani Publisher.
2. Bose, T. K., Malti, R. G., Dhua, R. S. and Das, P. 2012. Floriculture and Landscaping (Vol.-1 & -2, 2nd Rev. Edn.). Nayaprakash.
3. Chandrasekhar, S. Y. and Hemla N.B. 2020. Principles of Landscape Gardening. ICAR.
4. Mishra, P. and B. Naik. 2022. Principles of Landscape Architecture. NIPA.
5. Pradhan, S. 2018. Landscape Gardening. Biotech Books.
6. Randhawa, G. S. and A. Mukhopadhyay. 2004. Floriculture in India. Allied Publishers.
7. Singh, A.K. and Anjana Sisodia. 2017. Textbook of Floriculture and Landscaping. NIPA.
8. Singh, R. and B.K. Singh. 2020. Introductory Ornamental Horticulture and Landscape Gardening. Bio-Green Books.

HORT-412 Hi-tech Horticulture 4 (3+1)

Course Status : Elective
Contact Hours (L-T-P) : 3-0-2
Course Objective : 1. To educate the students on the latest technology of hi-tech horticulture.
2. To educate students on the concepts and prospects of hi-tech horticulture.

Course Outcomes (CO) : After the completion of this course, the student will be able to -
CO-1: about advanced technologies developed for protected cultivation/hi-tech production.
CO-2: know the micropropagation process, components, and micro-irrigation system.
CO-3: know the application of precision farming elements in horticultural crops.

Course Description :

Theory:	**CO Mapping**
Unit-1: Introduction Introduction & importance of Hi-tech horticulture, Nursery management, and use of recent technologies for farm mechanization.	CO-1
Unit-2: Modern techniques Micropropagation of horticultural crops; Modern field preparation and planting methods; Techniques used for protected cultivation: advantages, controlled conditions, application method; Micro irrigation systems and its components; EC, pH-based fertilizer scheduling; Canopy management and high-density orcharding.	CO-2
Unit-3: Precision farming	CO-3

Components of precision farming: Remote sensing, Geographical Information System (GIS), Differential Geo-positioning System (DGPS), Variable Rate Applicator (VRA); Application of precision farming in horticultural crops (fruits, vegetables, and ornamental crops); Mechanized harvesting of horticultural produce.	

Practical:

Types of poly-houses and shade net houses, Intercultural operations, tools, and equipment identification and application, Micropropagation, Nursery- portrays, micro-irrigation, EC, pH-based fertilizer scheduling, canopy management, visit hi-tech orchard/nursery.

Theory Lecture Schedule:

S. No.	Name of Topic	No. of lecture
1.	Introduction of Hi-tech horticulture.	2
2.	Importance of Hi-tech horticulture.	1
3.	Nursery management.	3
4.	Nursery mechanization.	2
5.	Micropropagation of horticultural crops.	2
6.	Modern field preparation.	1
7.	Planting methods.	3
8.	Protected cultivation.	2
9.	Protected cultivation: advantages.	1
10.	Protected cultivation: controlled conditions.	1
11.	Protected cultivation: method and techniques.	3
12.	Micro irrigation systems.	2
13.	Components of micro irrigation system.	3
14.	EC, pH-based fertilizer scheduling.	2
15.	Canopy management.	2
16.	High-density orcharding.	2
17.	Components of precision farming: Remote sensing.	2
18.	Geographical Information System (GIS).	2
19.	Differential Geo-positioning System (DGPS).	1
20.	Variable Rate Applicator (VRA).	1
21.	Application of precision farming in horticultural crops; fruits.	3
22.	Application of precision farming in horticultural crops; vegetables.	3
23.	Application of precision farming in horticultural crops; ornamental crops.	2
24.	Mechanized harvesting of produce.	2

Practical Schedule:

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

Suggested Readings:

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

2. Greenhouse Operation and Management by Paul V. Nelson.
3. Hi-Tech Horticulture (Pb) by S. Prasad, Dharam Singh and R.L. Bharadwaj, Agrobios
4. Instant Horticulture by S.N. Gupta. Jain Brothers. 488p.
5. Hydroponics for Beginners and Advanced: The Ultimate Hydroponic and Aquaponic Gardening Guide by Tom Garden, Webb Eleanor.

HORT-413 Protected Cultivation 4 (3+1)

Course Status : Elective
Contact Hours (L-T-P) : 3-0-2
Course Objective : To educate students on the scientific and commercial cultivation of important value-added products in protected cultivation.
Course Outcomes (CO) : After the completion of this course the student will be able to learn-
CO-1: Importance of protected cultivation and different types of protected structures and cladding materials.
CO-2: Greenhouse design, environment control irrigation and fertigation.
CO-3: Cultivation practices of economically important horticultural crops suitable for greenhouse.

Course Description :

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

Practical:

Raising of seedlings and saplings under protected conditions, use of pro-trays in quality planting material production, Bed preparation and planting of crop for production. Inter-cultural operations, Soil EC and pH measurement. Regulation of irrigation and fertilizers through drip, fogging and misting.

Theory Lecture Schedule:

S. No.	Name of Topic	No. of lecture
1.	Protected cultivation- importance and scope.	1
2.	Status of protected cultivation in India and World.	1
3.	Types of protected structures based on site and climate.	2
4.	Cladding material involved in greenhouse/poly house.	1
5.	Greenhouse design, environment control, artificial lights, Automation.	3
6.	Soil preparation and management, Substrate management.	2
7.	Types of benches and containers.	2
8.	Irrigation and fertigation management.	2

9.	Propagation and production of quality planting material of horticultural crops.	4
10.	Greenhouse cultivation of Rose.	2
11.	Greenhouse cultivation of Carnation.	2
12.	Greenhouse cultivation of Chrysanthemum.	1
13.	Greenhouse cultivation of Gerbera.	1
14.	Greenhouse cultivation of Orchids.	1
15.	Greenhouse cultivation of Anthurium.	1
16.	Greenhouse cultivation of Lilium.	1
17.	Greenhouse cultivation of Tulip.	1
18.	Greenhouse cultivation of Tomato.	2
19.	Greenhouse cultivation of Bell pepper.	1
20.	Greenhouse cultivation of Cucumber.	2
21.	Greenhouse cultivation of Strawberry.	2
22.	Greenhouse cultivation of Pot plants.	1
23.	Greenhouse cultivation of Turmeric.	1
24.	Greenhouse cultivation of Ginger.	1
25.	Greenhouse cultivation of economically important medicinal and aromatic plants.	5
26.	Off-season production of flowers and vegetables.	3
27.	Insect pest and disease management.	2

Practical Schedule:

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

Suggested Readings:

1. Jha, M.K., S.S. Paikra and M.R. Sahu. 2019. Protected Cultivation of Horticultural Crops. Edu-creation Publishing.
2. Kumar, B.A., R. Eggadi and V. Sindhu. 2022. Textbook of Protected Cultivation and Precision Farming for Horticultural Crops. Jain Brothers.
3. Nelson, P.V. 2002. Greenhouse Operation and Management. Pearson Education Limited.
4. Prabhakar, I., B.L. Manjunatha and B.S. Swetha. 2020. Protected Cultivation of Horticulture Crops. Satish Serial Publishing House.
5. Sagar, M., G.J. Dinkar and T. Shaknar. 2021. Protected Cultivation and Smart Agriculture. New Delhi Publishers.
6. Singh, B., B. Singh, N. Sabir and M. Hasan, 2015. Advances in Protected Cultivation. NIPA.

HORT-414 Post-Harvest Technology and Value Addition 4 (3+1)

Course Status : Elective
Contact Hours (L-T-P) : 3-0-2
Course Objective :
1. To educate about pre-harvest, harvest and post-harvest factors which affecting the postharvest life of fruits and vegetables.
2. To educate about preparation techniques of value-added products.
3. To educate about the different dehydration techniques of

horticultural crops.

Course Outcomes (CO) : After the completion of this course the student will be able to learn-
CO-1: Importance of post-harvest technology in fruits and vegetables.
CO-2: Preparation techniques of value-added products.
CO-3: Dehydration techniques of horticultural crops.

Course Description :

Theory:	**CO Mapping**
Unit 1: Introduction Importance of post –harvest processing of fruits and vegetables, extent and possible causes of post-harvest losses: Pre-harvest factors affecting post-harvest quality, maturity, ripening and changes occurring during ripening; Respiration and factors affecting respiration rate; Maturity, harvesting and field handling; Storage (ZECC, cold storage, CA, MA and hypobaric).	CO-1
Unit 2: Value-addition Value addition concept; Principles and methods of preservation; Intermediate moisture food (jam, jelly, marmalade, preserve, candy) - concepts and standards; Fermented and non-fermented beverages. Tomato products - concepts and standards.	CO-2
Unit 3: Dehydration and canning techniques Drying /Dehydration of fruits and vegetables – concept and methods, osmotic drying. Canning – concepts and standards, packaging of products.	CO-3

Practical:

Applications of different types of packing, containers 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 and tomato products, canned products. Quality evaluation of products- Physico-chemical and sensory. Visit to processing unit/industry.

Theory Lecture Schedule:

S. No.	Name of Topic	No. of lecture
1.	Importance of post-harvest processing of fruits and vegetables.	1
2.	Extent and possible causes of post-harvest losses.	2
3.	Pre-harvest factors affecting post-harvest quality, maturity, ripening and changes occurring during ripening.	5
4.	Respiration and factors affecting respiration rate.	3
5.	Maturity, harvesting and field handling.	3
6.	Storage (ZECC, cold storage, CA, MA, and hypobaric).	5
7.	Value addition concept; Principles and methods of preservation.	5
8.	Intermediate moisture food (Jam, Jelly, Marmalade, Preserve, Candy)- Concepts and Standards.	5
9.	Fermented and non-fermented beverages.	3
10.	Tomato products- Concepts and Standards	4
11.	Drying/Dehydration of fruits and vegetables- Concept and methods, osmotic drying.	5
12.	Canning – Concepts and Standards.	2
13.	Packaging of products.	2

Practical Schedule:

S. No.	Name of Topic	No. of practical
1.	Applications of different types of packings and containers for shelf-life extension.	1
2.	Effect of temperature on shelf life and quality of produce.	1

3.	Demonstration of chilling and freezing injury in vegetables and fruits.	1
4.	Extraction and preservation of pulps and juices.	1
5.	Preparation of Jam.	1
6.	Preparation of Jelly.	1
7.	Preparation of RTS.	1
8.	Preparation of Nectar.	1
9.	Preparation of Squash.	1
10.	Preparation of Osmotically dried products.	1
11.	Preparation of fruit bar candy.	1
12.	Preparation of Tomato products.	1
13.	Preparation of Canned products.	1
14.	Quality evaluation of products- Physico-chemical and sensory.	1
15.	Visit to processing unit/industry.	2

Suggested Readings:

1. Goel, A.K., R. Kumar and S.S. Mann. 2007. Postharvest Management and Value Addition. Daya Publishing House.
2. R. L. Bhardwaj, Sharma Y.K. and Latika Vyas. 2021. Postharvest Handling of Horticultural Crops, Jaya Publishing House, New Delhi.
3. John, P.J. 2008. A Handbook on Post Harvest Management of Fruits and Vegetables. Daya Publishing House.
4. Kureel, M.K., D.S. Mandloi, K.V. Singh and R. Lekhi. 2007. Postharvest Management and Value Addition of Fruits and Vegetables. Biotech.
5. Mitra, S. K. 1997. Postharvest Physiology and Storage of Tropical Fruits. CABI.
6. Qureshi, S.N., K. Javeed and A.K. Sinha. 2018. Post-Harvest Technology. Bioscientific Publishers.
7. S.K. Sharma and M.C. Nautiyal.1999. Post-harvest Technology of Horticultural Crops. NIPA.
8. Srivastava, R. P. and Kumar, S. 2007. Fruits and Vegetable Preservation: Principles and Practice. IBDC.
9. Sudheer, K.P. and V. Indira. 2007. Postharvest Technology of Horticultural Crops. NIPA.

PBT-411 Biotechnology of Crop Improvement 4 (3+1)

Course Status : Elective
Contact Hours (L-T-P) : 3-0-2
Course Objective : This course intends to provide knowledge about the biotechnological tools of crop improvement, direct and indirect methods of gene transfer, introduce about gene editing in plants and to provide knowledge about marker assisted breeding and genomic selection.
Course Outcomes (CO) : After the completion of this course, the student will be able to learn about -
CO-1: the basic concepts of plant tissue culture and its application.
CO-2: gene transformation and silencing techniques.
CO-3: genome editing tool, marker assisted selection and its application in crop improvement.

Course Description :

Theory:	**CO Mapping**
Unit 1: Plant tissue culture techniques and its applications Impact of Biotechnology on crop improvement and the perspective of society; Various biotechnological techniques available for crop improvement - Plant Tissue Culture, Genetic Engineering, Genome editing, Marker Assisted breeding and Genomic Selection. Biosafety regulations and their application in Agricultural Biotechnology. Somaclonal variation and its use in crop	CO-1

improvement; embryo culture; anther/pollen culture; somatic embryogenesis; artificial seeds; techniques of protoplast culture, regeneration and somatic cell hybridization, achievements and limitations, utility in the improvement of crop plants.	
Unit 2: Gene transformation methods Direct and Indirect methods of gene transfer in plants - Agrobacterium-mediated gene transfer in dicots and monocots; Direct DNA delivery methods (microinjection, particle gun method, electroporation).	CO-2
Unit 3: Gene silencing techniques 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.	CO-3
Unit 4: Genome editing tool- CRISPR-Cas9 Introduction to genome editing – Various tools of genome editing; CRISPR-Cas9 with specific emphasis on Indian regulations; Cloning genomic targets into CRISPR/Cas9 plasmids; electroporation of Cas9 plasmids into cells; purification of DNA from Cas9 treated cells and evaluation of Cas9 gene editing; in vitro synthesis of single guide RNA (sgRNA); using Cas9/sgRNA complexes to test for activity on DNA substrates; evaluate Cas9 activity by T7E1 assays and DNA sequence analysis; Applications of CRISPR/cas9 technology in crop plants.	
Unit 5: Marker assisted selection and its application Marker Assisted Breeding and Genomic Selection: Introduction to various DNA-based markers and their use in marker-assisted breeding; Foreground Selection, Recombinant Selection and background Selection; Marker-assisted backcross breeding, marker-assisted selection – success stories; Introduction to Genomic Selection.	

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.

Theory Lecture Schedule:

S. No.	Name of Topic	No. of lecture
1.	Impact of Biotechnology on crop improvement and the perspective of society.	2
2.	Various biotechnological techniques available for crop improvement – plant tissue culture, genetic engineering.	2
3.	Various biotechnological techniques available for crop improvement - genome editing, marker assisted breeding and genomic selection.	3
4.	Biosafety regulations and their application in agricultural biotechnology.	1
5.	Somaclonal variation and its use in crop improvement.	1
6.	Embryo culture.	1
7.	Anther/pollen culture.	2
8.	Somatic embryogenesis.	1
9.	Artificial seeds.	1
10.	Protoplast culture, regeneration and somatic cell hybridization.	3
11.	Direct and Indirect methods of gene transfer in plants.	2
12.	Agrobacterium-mediated gene transfer in dicots and monocots.	2
13.	Direct DNA delivery methods (microinjection, particle gun method,	2

	electroporation).	
14.	Gene targeting and gene silencing techniques.	1
15.	Introduction to siRNA technology; Micro RNA; construction of siRNA vectors.	1
16.	Principle and application of gene silencing.	2
17.	Creation of transgenic plants; debate over GM crops.	2
18.	Introduction to methods of genetic manipulation in different model systems.	1
19.	Introduction to genome editing – Various tools of genome editing.	1
20.	CRISPR-Cas9 with specific emphasis on Indian regulations.	1
21.	Cloning genomic targets into CRISPR/Cas9 plasmids; electroporation of Cas9 plasmids into cells.	2
22.	Purification of DNA from Cas9 treated cells and evaluation of Cas9 gene editing.	1
23.	*In vitro* synthesis of single guide RNA (sgRNA); using Cas9/sgRNA complexes to test for activity on DNA substrates.	2
24.	Evaluate Cas9 activity by T7E1 assays and DNA sequence analysis.	1
25.	Applications of CRISPR/cas9 technology in crop plants.	1
26.	Marker assisted breeding and genomic selection: introduction to various DNA-based markers.	3
27.	Application of marker-assisted breeding; foreground selection, recombinant selection and background selection.	2
28.	Marker-assisted backcross breeding.	1
29.	Marker-assisted selection – success stories.	2
30.	Introduction to genomic selection.	1

Practical Schedule:

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

Suggested Readings:

1. Brown, T. A. 2006. Genomes (3rd edn). Garland Science Pub, New York.
2. Gene Cloning and DNA Analysis. 2010. Retrieved from http://biolab.szu.edu.cn/otherweb/lzc/genetic%20engineering/courseware/b1.pdf
3. Green, M. R. and Sambrook, J. 2012. Molecular Cloning: a Laboratory Manual. Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press.
4. Kumar, Pranav and Mina, Usha. 2015. Biotechnology: A Problem Approach. Pathfinder Publication.
5. Old, R. W., Primrose, S. B. and Twyman, R. M. 2001. Principles of Gene Manipulation and Genomics 7th Edition: Oxford: Blackwell Scientific Publications.
6. Ram, Hari Har. 2019. Crop Breeding and Biotechnology. Kalyani Publications.
7. Rastogi, S.C. 2020. Biotechnology: Principles and Applications. Narosa.

8. Sander, J.D. and Joung, J.K. 2014. CRISPR-Cas systems for Editing, Regulating and Targeting Genomes. Nat Biotechnol. 32:347-355.
9. Singh, K.H., Kumar, Ajay and Parmar, Nehanjali. 2019. Agricultural Biotechnology at a Glance, science technology.
10. Slater. 2008. Plant Biotechnology: The Genetic Manipulation of Plants. Oxford, 400p.

PPATH-411 Bioformulation and Nano Formulation 4 (3+1)

Course Status : Elective
Contact Hours (L-T-P) : 3-0-2
Course Objective : 1. To provide knowledge on principles, methods, and mechanisms of bio-control agents and their use against plant diseases.
2. To provide knowledge on principles, methods, and mechanism of biofertilizers and their use in agriculture.
Course Outcomes (CO) : After the completion of this course, the student will be able to learn about -
CO-1: different types of biopesticides and their mass production techniques.
CO-2: the types, structure and characteristics of bacterial, cyanobacterial, and fungal biofertilizers.
CO-3: the mechanisms of nitrogen fixation, phosphate solubilization, and biofertilizer production technology.
CO-4: the application, storage, shelf life and marketing strategies for biofertilizers.
Course Description :

Theory:	**CO Mapping**
Unit 1: Introduction and histrory of bio-pesticides History and concept of bio pesticides. Importance, scope and potential of bio pesticides. Definitions, concepts and classification of bio pesticides *viz.* Pathogen, botanical pesticides, and bio rationales. Botanicals and their uses.	CO-1
Unit 2: Mass production and application of bio-pesticides Mass production technology of bio-pesticides. Virulence, pathogenicity and symptoms of entomopathogenic pathogens and nematodes, Methods of application of bio pesticides. Methods of quality control and Techniques of bio pesticides. Impediments and limitation in production and use of bio pesticides.	CO-1
Unit 3: Introduction , structure and characteristics of biofertilizers Biofertilizers - Introduction, status and scope. Structure and characteristics features of bacterial biofertilizers– *Azospirillum*, *Azotobacter*, *Bacillus*, *Pseudomonas*, *Rhizobium* and *Frankia*; Cynobacterial bio fertilizers- *Anabaena*, n*ostoc*, *Hapalosiphon* and fungal biofertilizers– AM mycorrhiza and ectomycorhiza.	CO-2
Unit 4: Mechanismof nitrogen fixation,phosphate solubilisation and Production Technology of biofertilizers Nitrogen fixation –Free living and symbiotic nitrogen fixation. Mechanism of phosphate solubilisation and phosphate mobilization, K solubilisation. Production Technology: Strain selection, sterilization, growth and fermentation, mass production of carrier based and liquid biofertilizers. FCO specifications and quality control of biofertilizers.	CO-3
Unit 5: Application, Storage and marketing Application technology for seeds, seedlings, tubers, sets etc. Biofertilizers-Storage, shelf life, quality control and marketing. Factors influencing the efficiency of biofertilizers.	CO-4

Practical:

Isolation and purification of important biopestisides: *Trichoderma Pseudomonas*, *Bacillus*, Metarhyziumetc. and its production. Identification of important botanicals. Visit to biopesticide laboratory in nearby area. Field visit to explore naturally infected cadavers. Identification of entomopathogenic entities in field condition. Quality control of biopesticides. Isolation and purification of *Azospirillum*, *Azotobactor*, *Rhizobium*, P-solubilizers and *Cyanobacteria*. Mass multiplication and inoculums production of biofertilizers. Isolation of AM fungi- Wet sieving method and sucrose gradient method. Mass production of AM inoculants.

Theory Lecture Schedule:

S. No.	Name of Topic	No. of lecture
1.	History and concept of bio pesticides. Importance, scope and potential of bio pesticides.	3
2.	Definitions, concepts and classification of bio pesticides *viz.* Pathogen, botanical pesticides, and bio rationales.	3
3.	Botanicals and their uses.	2
4.	Mass production technology of bio-pesticides.	4
5.	Virulence, pathogenicity and symptoms of entomopathogenic pathogens and nematodes, Methods of application of bio pesticides.	3
6.	Methods of quality control and Techniques of bio pesticides.	3
7.	Impediments and limitation in production and use of bio pesticides.	2
8.	Biofertilizers - Introduction, status and scope	2
9.	Structure and characteristic features of bacterial biofertilizers – *Azospirillum*, *Azotobacter*, *Bacillus*, *Pseudomonas*, *Rhizobium* & *Frankia*.	3
10.	Structure and characteristic features of Cynobacterial bio fertilizers- Anabaena, Nostoc, Hapalosiphon.	3
11.	Structure and characteristic features of Fungal biofertilizers – AM mycorrhiza and ectomycorrhiza.	3
12.	Nitrogen fixation –Free living and symbiotic nitrogen fixation.	2
13.	Mechanism of phosphate solubilisation and phosphate mobilization, K solubilisation.	3
14.	Production Technology: Strain selection, sterilization, growth and fermentation, mass production of carrier based and liquid biofertilizers.	4
15.	FCO specifications and quality control of biofertilizers.	3
16.	Application technology for seeds, seedlings, tubers, sets etc.	1
17.	Biofertilizers-Storage, shelf life, quality control and marketing.	2
18.	Factors influencing the efficiency of biofertilizers.	2

Practical Schedule:

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

Suggested Readings:

1. Baker, E.F. and James, R.C. 1982. Biological Control of Plant Pathogens. American Phytopathological Society

2. Bhatnagar, R.K. and Palta, R.K. Earthworm Vermiculture and Vermicomposting. Kalyani Publishers.
3. Boland, G.J. and David, L.1998. Plant Microbe Interactions and Biological Control. Kuykendall Marel Dekker, INC.
4. Borkar, S.G. 2015. Beneficial Microbes as Biofertilizers and its Production Technology.
5. Ciancia, A. and Mukerji, K.J. 2007. General Concepts of Integrated Pest and Disease Management. Edited Published by Springer.
6. Cincholkar, S.B. and Mukherji, K.G. 2007. Biological Control of Plant Diseases. Hawarth Food and Agricultural Products.
7. Gehlot, Dushyent. Organic Farming: Standards, Accreditation, Certification and Inspection. Agrobios (India).
8. Gnanamanickam, S.S. 2002. Biological Control of Crop Disease. Kuykendall Marel Dekker, INC.
9. Nehra, Sampat. Biofertilizers for Sustainable Agriculture. Aavishkar Publishers, Jaipur, India.
10. Ramanujam, B. and Rabindra, R.J. 2006. Current Status of Biological Control of Plant Disease using Antagonistic Organisms in India. Precision Fototype Services, Bengaluru.
11. Singh, Awani Kr. Handbook of Microbial Biofertilizers. Agrotech Press, Jaipur, India.
12. Singh, A.K. Organic Farming. New India Publishing Agency, New Delhi.
13. Singh, S.P. and Hussanini, S.S. 1998. Biological Suppression of Plant Disease, Phytoparasitic Nematodes and Weeds. Precision Fototype Services, Bengaluru.
14. Trivedi, P.C. Fungal Biopesticides and VAM applications. Pointer Publishers, Jaipur, India.

SSAC-411 Biopesticides and Biofertilizers 4 (3+1)

Course Status : Elective
Contact Hours (L-T-P) : 3-0-2
Course Objective :
1. To provide knowledge on principles, methods and mechanisms of bio-control agents and their use against plant diseases.
2. To provide knowledge on principles, methods, and mechanism of biofertilizers and their use in agriculture.

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

CO-1: the types biopesticides and mass production technology of bio-pesticides.

CO-2: the types, structure and characteristics of bacterial, cyanobacterial, and fungal biofertilizers Learn the mechanisms of nitrogen fixation, phosphate solubilization, and biofertilizer production technology.

CO-3: genome editing tool, marker assisted selection and its application in crop improvement.

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

Course Description :

Theory:	**CO Mapping**
Unit 1: Introduction of bio-pesticides: History and concept of bio pesticides, Importance, scope and potential of biopesticides, Definitions, concepts and classification of biopesticides viz. Pathogen, botanical pesticides, and bio rationales.	CO-1
Unit 2: Mas production Technology of Bio-pesticides Botanicals and their uses. Mass production technology of bio-pesticides, Virulence, pathogenicity and symptoms of entomopathogenic pathogens and nematodes, Methods of application of biopesticides. Methods of quality control and Techniques of bio pesticides. Impediments and limitation in production and	

use of biopesticides.	
Unit 3: Introduction , structure and characteristics of biofertilizers Biofertilizers - Introduction, status and scope. Structure and characteristics features of bacterial biofertilizers– *Azospirillum*, *Azotobacter*, *Bacillus*, *Pseudomonas*, *Rhizobium* and *Frankia*; Cynobacterial bio fertilizers- *Anabaena*, n*ostoc*, *Hapalosiphon* and fungal biofertilizers – AM mycorrhiza and ectomycorhiza.	CO-2
Unit 4: Mechanismof nitrogen fixation,phosphate solubilisation and Production Technology of biofertilizers Nitrogen fixation– Free living and symbiotic nitrogen fixation. Mechanism of phosphate solubilisation and phosphate mobilization, K-solubilization. Production Technology: Strain selection, sterilization, growth and fermentation, mass production of carrier based and liquid biofertilizers. FCO specifications and quality control of biofertilizers.	CO-3
Unit 5: Application, Storage and marketing Application technology for seeds, seedlings, tubers, sets etc. Biofertilizers-Storage, shelf life, quality control and marketing. Factors influencing the efficiency of biofertilizers.	CO-4

Practical:

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

Theory Lecture Schedule:

S. No.	Name of Topic	No. of lecture
1.	History and concept of bio pesticides, Importance, scope and potential of biopesticides.	4
2.	Definitions, concepts and classification of biopesticides viz. Pathogen, botanical pesticides, and bio rationales.	4
3.	Botanicals and their uses.	3
4.	Mass production technology of bio-pesticides, Virulence, pathogenicity and symptoms of entomopathogenic pathogens and nematodes.	4
5.	Methods of application of biopesticides.	1
6.	Methods of quality control and Techniques of bio pesticides.	1
7.	Botanicals and their uses.	2
8.	Impediments and limitation in production and use of biopesticides.	1
9.	Biofertilizers - Introduction, status and scope	1
10.	Structure and characteristics features of bacterial biofertilizers – *Azospirillum*, *Azotobacter*, *Bacillus*, *Pseudomonas*, *Rhizobium* and *Frankia*.	5
11.	Structure and characteristics features of Cynobacterial bio fertilizers-*Anabaena*, *Nostoc*, *Hapalosiphon*.	3
12.	Structure and characteristics features of Fungal biofertilizers – AM mycorrhiza and ectomycorrhiza.	1
13.	Nitrogen fixation –Free living and symbiotic nitrogen fixation.	1
14.	Mechanism of phosphate solubilisation and phosphate mobilization, K solubilisation.	4
15.	Production Technology: Strain selection, sterilization, growth and fermentation, mass production of carrier based and liquid biofertilizers.	4
16.	FCO specifications and quality control of biofertilizers.	2

17.	Application technology for seeds, seedlings, tubers, sets etc.	3
18.	Biofertilizers-Storage, shelf life, quality control and marketing.	3
19.	Factors influencing the efficiency of biofertilizers.	1

Practical:

Isolation and purification of important biopestisides: *Trichoderma*, *Pseudomonas*, *Bacillus*, Metarhyzium etc. and its production. Identification of important botanicals. Visit to biopesticide laboratory in nearby area. Field visit to explore naturally infected cadavers. Identification of entomopathogenic entities in field condition. Quality control of biopesticides. Isolation and purification of *Azospirillum*, *Azotobactor*, *Rhizobium*, P-solubilizers and C*yanobacteria*. Mass multiplication and inoculums production of biofertilizers. Isolation of AM fungi- Wet sieving method and sucrose gradient method. Mass production of AM inoculants.

Practical Schedule:

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

Suggested Readings:

1. Baker, E.F. and James, R.C. 1982. Biological Control of Plant Pathogens. American Phytopathological Society
2. Bhatnagar, R.K. and Palta, R.K. Earthworm Vermiculture and Vermicomposting. Kalyani Publishers.
3. Boland, G.J. and David, L.1998. Plant Microbe Interactions and Biological Control. Kuykendall Marel Dekker, INC.
4. Borkar, S.G. 2015. Beneficial Microbes as Biofertilizers and its Production Technology.
5. Ciancia, A. and Mukerji, K.J. 2007. General Concepts of Integrated Pest and Disease Management. Edited Published by Springer.
6. Cincholkar, S.B. and Mukherji, K.G. 2007. Biological Control of Plant Diseases. Hawarth Food and Agricultural Products.
7. Gehlot, Dushyent. Organic Farming: Standards, Accreditation, Certification and Inspection. Agrobios (India).
8. Gnanamanickam, S.S. 2002. Biological Control of Crop Disease. Kuykendall Marel Dekker, INC.
9. Nehra, Sampat. Biofertilizers for Sustainable Agriculture. Aavishkar Publishers, Jaipur.
10. Ramanujam, B. and Rabindra, R.J. 2006. Current Status of Biological Control of Plant Disease using Antagonistic Organisms in India. Precision Fototype Services, Bengaluru.
11. Singh, Awani Kr. Handbook of Microbial Biofertilizers. Agrotech Press, Jaipur, India.
12. Singh, A.K. Organic Farming. New India Publishing Agency, New Delhi.
13. Singh, S.P. and Hussanini, S.S. 1998. Biological Suppression of Plant Disease, Phytoparasitic Nematodes and Weeds. Precision Fototype Services, Bengaluru.
14. Trivedi, P.C. Fungal Biopesticides and VAM applications. Pointer Publishers, Jaipur.

Skill Enhancement Courses

SEC-111 Vermicompost Production Technology 2 (0+2)

Course Status : Skill Enhancement Course
Contact Hours (L-T-P) : 0-0-4
Course Objective : To develop entrepreneurial skills of students in Vermicompost Production.
Course Outcomes (CO) : After the completion of this course, the student will be able to -
CO-1: know the scope and importance of Vermicompost Production.
CO-2: know about the vermicompost production economics/ marketing of its.

Course Description :

Practical:	**CO Mapping**
Unit 1: Introduction to Vermicompost Vermicompost: Introduction, Definition and objectives of vermi-technology. Importance of vermicomposting in utilization of Agriculture waste and organic recycling of nutrients.	CO-1
Unit 2: Method of preparation of vermicompost Classification of earthworm's. Method of preparation of vermicompost. Method and doses of vermicompost application for cereals, vegetables, tress and pots. Role of vermicomposting in organic farming and soil fertility. Identification of earthworms. Preparation of vermicompost. Separation and procurement of vermiculture and vermicompost.	CO-2
Unit 3: Quality Analysis for standards of vermicompost Analysis for quality standards and fractionation of vermicompost- Microbial viability, C:N ratio, Moisture, Organic Carbon, Nitrogen, Phosphorus, Potassium and Micronutrient. Drawing of flow-sheet chart and preparation of vermicompost project.	

Practical Schedule:

S. No.	Name of Topic	No. of practical
1.	Vermicompost: Introduction, Definition and objectives of vermitechnology.	1
2.	Importance of vermicompost in utilization of Agriculture waste, and organic recycling of nutrients.	2
3.	Classification of earth worms.	1
4.	Method of preparation of vermicompost.	1
5.	Method and doses of vermicompost application for cereals, pulses, trees vegetables and pots.	2
6.	Role of vermicomposting in organic farming and soil fertility.	2
7.	Identification of earthworms.	1
8.	Collection and preparation of bedding materials.	2
9.	Preparation of beds for vermicompost and inoculation of vermiculture.	2
10.	Separation of vermiculture and vermicompost.	2
11.	Maintenance of vermiculture.	1
12.	Preservation and packing of vermicompost.	2
13.	Determination of quality standards of vermicompost (Microbial viability, C:N ratio, Moisture, Organic Carbon, Nitrogen, Phosphorus, Potassium and Micronutrient).	10
14.	Fractionation of vermicompost.	2
15.	Preparation of project for vermicomposting.	1

Suggested Readings:

1. Bhatnagar, R.K. and Palta, R.K. (2002). Vermiculture and vermicomposting. Kalyani Publishers, Ludhiana.
2. Clive A. Edwards, Norman Q. Arancon, and Rhonda L. Sherman (2011). Vermiculture Technology: Earthworms, Organic Wastes, and Environmental Management". CRC Press. *ISBN:* 9781439809877
3. Insam H., Franke-Whittle I., Goberna M (2010. Microbes at Work: From Wastes to Resources, Springer-Verlag. *ISBN:* 9783642112039
4. Anshu B. Gupta (2018). Vermicompost: Practices in India. *Publisher:* Astral International, *ISBN:* 9789386652991
5. Dr. M. Gunasekaran (2021). "Vermiculture Biotechnology: An Option for Organic Waste Management" Scientific Publishers (India), *ISBN:* 9788172339281
6. Dr. Arun K. Sharma (2020), Vermicomposting for Sustainable Agriculture, New India Publishing Agency, *ISBN:* 9789385516812.

SEC-112 Mushroom Production Technology 2 (0+2)

Course Status : Skill Enhancement Course
Contact Hours (L-T-P) : 0-0-4
Course Objective : To develop analytical and entrepreneurial skills in students and turned them into mushroom entrepreneur.
Course Outcomes (CO) : After the completion of this course, the student will be able to -
CO-1: acquaint about the status, scope and importance of mushrooms in the state of Rajasthan.
CO-2: produce spawn and mushrooms at large scale.
CO-3: know about value added products of mushroom and economics/ marketing of mushroom and its products.

Course Description :

Practical:	**CO Mapping**
Unit 1: Introduction to mushroom cultivation in India and Rajasthan Current status and scope of mushroom cultivation in India and Rajasthan. Important features of edible fungi. Nutritional and medicinal value of mushrooms. Collection of wild mushroom flora of Rajasthan.	CO-1
Unit 2: Spawn production technology Preparation of media. Tissue culture preparation. Sub-culturing for culture maintenance and its preservation. Spawn preparation techniques.	CO-2
Unit 3: Mushroom production technology Mushroom farm design and infrastructure required for the commercial unit. Raw material formulations for Button mushroom (*Agaricus bisporus*). Composting (long method and short method). Casing preparation. Cultivation techniques of: Dhingri mushroom (*Pleurotus florida*), Shiitake mushroom (*Lentunus edodes*), Milky mushroom (*Calocybe indica*), Paddy straw mushroom (*Volvariella volvacea*). Crop management practices. Mushroom diseases and their control.	
Unit 4: Value added products and marketing Preparation of value-added products from mushrooms. Economics of mushrooms. Marketing of mushrooms. Exposure visits to commercial farms.	CO-3

Practical Schedule:

S. No.	Name of Topic	No. of practical
1.	Current status and scope of mushroom cultivation in India and Rajasthan.	1
2.	Important features of edible fungi.	1
3.	Nutritional and medicinal value of mushrooms	1
4.	Collection of wild mushroom flora of Rajasthan.	1
5.	Preparation of media.	1

6.	Tissue culture preparation.	1
7.	Sub-culturing for culture maintenance and its preservation.	1
8.	Spawn preparation techniques.	2
9.	Mushroom farm design and infrastructure required for the commercial unit.	2
10.	Raw material formulations for Button mushroom (*Agaricus bisporus*).	1
11.	Composting (long method and short method).	2
12.	Casing preparation.	2
13.	Cultivation technique of Dhingri mushroom (*Pleurotus florida*),	2
14.	Cultivation technique of Shiitake mushroom (*Lentunus edodes*),	2
15.	Cultivation technique of Milky mushroom (*Calocybe indica*),	2
16.	Cultivation technique of Paddy straw mushroom (*Volvariella volvacea*).	2
17.	Crop management practices.	1
18.	Mushroom diseases and their control.	1
19.	Preparation of value-added products from mushrooms.	2
20.	Economics of mushrooms.	1
21.	Marketing of mushrooms.	1
22.	Exposure visits to commercial farms.	2

Suggested Readings:

1. Singh, M., Vijay, B., Kamal, S., Wakchaure, G.C. (2011). Mushrooms: cultivation, marketing and consumption. Directorate of Mushroom Research. ICAR-Chambaghat, Solan –173213 (HP).
2. A textbook on mushroom cultivation: Theory and Practice, Aggarwal, A., Sharma, Y. P. and Jangra, E., Newrays Publishing House.
3. Mushroom Cultivation, Tripathi, D.P. (2005) , Oxford & IBH Publishing Co. Pvt.Ltd., New Delhi.
4. Mushroom cultivation technology, Acharya, K., Roy, A. and Sarkar, J., Techno world, Kolkata.
5. Mushroom production and processing thechnology (2010), Pathak Yadav Gour, Agrobios (India).
6. Upadhyay, R.C., Singh, S.K., and Tewari, R.P. (2004). Mushroom spawn production and infrastructure requirements. Technical Bulletin, DMR, Solan.

SEC-113 Horticulture Nursery Management 2 (0+2)

Course Status : SEC (Skill Enhancement Course)
Contact Hours (L-T-P) : 0-0-4
Course Objective : To educate students about the scientific horticultural nursery management practices.
Course Outcomes (CO) : After the completion of this course the student will be able to learn-
CO-1: he importance and scope of horticultural nursery.
CO-2: the basic principles and methods of propagation of horticultural plants.
CO-3: skills of horticultural nursery management and nursery registration.
Course Description :

Practical:	**CO Mapping**
Unit 1: Introduction Importance and scope of nurseries. Nursery tools and equipments. Types of nurseries. Planning, site selection and layout of nursery. Components of a model nursery. Types and preparation of nursery beds. Planting and maintenance of	CO-1

mother blocks.	
Unit 2: Horticultural plant propagation Sexual and asexual methods of horticultural plant propagation with merits and demerits. Seed dormancy: types and methods to overcome dormancy. Use of rootstocks & scions in nursery. Growing media: preparation, sterilization, physical and chemical properties. Plant propagation structures. Nursery containers and raising nursery in pro-trays. Micropropagation of horticultural crops.	CO-2
Unit 3: Nursery management Nursery operations *viz.,* seed treatment, fumigation, irrigation, nutrient management *etc.* Use of plant growth regulators, biofertilizers and bioagents in nursery. Insect-pest and disease management in nursery. Transplanting of nursery plants. Lifting, labeling and packing of nursery plants. Marketing of seedlings. Economics of nursery production. Nursery registration and record management. Nursery project preparation.	CO-3

Practical Schedule:

S. No.	Name of Topic	No. of practical
1.	Identification of different fruits, vegetables and ornamental plants.	1
2.	Identification of nursery tools and equipments.	1
3.	Planning, site selection and layout of nursery.	1
4.	Layout of mother orchards and planting systems.	1
5.	Nursery bed preparation, sterilization and raising of seedlings.	1
6.	Practice in seed treatments and breaking dormancy.	1
7.	Collection of appropriate bud-wood for propagation.	1
8.	Practice in propagation of horticultural crops by seeds.	1
9.	Practice in propagation of horticultural crops by cuttings.	1
10.	Practice in propagation of horticultural crops by layerings.	1
11.	Practice in propagation of horticultural crops by buddings.	1
12.	Practice in propagation of horticultural crops by graftings	1
13.	Growing media: preparation, sterilization, physical and chemical properties.	2
14.	Different propagation structures used in nursery.	1
15.	Nursery raising in pro-trays.	1
16.	Micropropagation of horticultural crops (practice/visit).	1
17.	Potting and repotting of nursery plants.	1
18.	Use of biofertilizers and bioagents in nursery.	1
19.	Preparation and application of nutrients to nursery plants.	1
20.	Preparation and application of plant protection chemicals to nursery plants.	2
21.	Hardening of plants in nursery.	1
22.	Lifting, labeling and packing of nursery plants.	1
23.	Marketing of seedlings; grading of quality stock and pricing.	1
24.	Economics of nursery production.	1
25.	Nursery record management.	1
26.	Nursery registration.	1
27.	Project preparation on Hi-tech nursery.	1
28.	Project preparation on fruit and ornamental nursery.	1
29.	Visit of commercial nurseries.	2

Suggested Readings

1. Bose, T.K., D. Sanyal and M.L. Sandhu. 1998. *Propagation of Horticultural Crops.* Naya Prakash Publishers.

2. Chundawat, B.S. 2017. *Plant Propagation and Nursery Management.* Agrotech Publishing Academy.
3. Devies, F.D., R.L. Geneve, and S.B. Wilson. 2017. *Hartmann & Kester's Plant Propagation: Principles and Practices.* Pearson Publishers, London.
4. Krishnan P.R., R.K. Kalia, J.C. Tewari and M.M. Roy. 2014. *Plant Nursery Management and Plant Nursery Management: Principles and Practices.* CAZRI, Jodhpur.
5. Sharma, R.R. and H. Krishna. 2007. *Textbook of Plant Propagation and Nursery Management.* CBS Publishers & Distributors.
6. Singh, Jitendra. 2022. *Basic Horticulture.* Kalyani Publishers.

SEC-114 Food Processing 2 (0+2)

Course Status : SEC (Skill Enhancement Course)
Contact Hours (L-T-P) : 0-0-4
Course Objective : This course intends to provide a basic knowledge different food product preparations.
Course Outcomes (CO) : After the completion of this course, the student will be able to -
CO-1: know about the machines and equipments used in food processing and preparation.
CO-2: know about the different types of food products.
Course Description :

Practical:	**CO Mapping**
Unit 1: Introduction to food processing Familiarization of machine and equipment used in food processing, Preparation of ready to serve drink, preparation of nectar, squash, carbonated beverage, fruit-based whey beverage, whey-based tomato soup, sherbet.	CO-1
Unit 2: Preparation different food products Preparation of medium and heavy tomato puree, tomato paste, tomato ketchup, Drying of onion slices by sun and oven drying, green leafy vegetable, Microwave drying of curry leaves, channa. Preparation of flavored milk, curd/yogurt, lassi, to perform conditioning of wheat, determination of gluten content in wheat flour, to perform milling of pearl millet, manufacture of dalia from cereal and legumes, preparation and evaluation of wheat-based cookies, cookies with variable formulations, unleavened flat breads, Preparation of spaghetti pasta, penne pasta, fusilli pasta, fettuccine/tagliatelle pasta, noodles, vermicelli, instant noodles.	CO-2

Practical Schedule:

S. No.	Name of Topic	No. of practical
1.	Familiarization of machine and equipment used in food processing.	1
2.	Preparation of ready to serve drink.	1
3.	Preparation of nectar.	1
4.	Preparation of squash.	1
5.	Preparation of carbonated beverage.	1
6.	Preparation of fruit-based whey beverage.	1
7.	Preparation of whey-based tomato soup.	1
8.	Preparation of sherbet.	1
9.	Preparation of medium and heavy tomato puree.	1
10.	Preparation of tomato paste.	1
11.	Preparation of tomato ketchup.	1
12.	Drying of onion slices by sun and oven drying.	1
13.	Drying of green leafy vegetable.	1
14.	Microwave drying of curry leaves.	1

15.	Preparation of channa.	1
16.	Preparation of flavored milk.	1
17.	Preparation of curd/yogurt.	1
18.	Preparation of lassi.	1
19.	To perform conditioning of wheat.	1
20.	Determination of gluten content in wheat flour.	1
21.	To perform milling of pearl millet.	1
22.	Manufacture of dalia from cereal and legumes.	1
23.	Preparation and evaluation of wheat-based cookies.	1
24.	Preparation of cookies with variable formulations.	1
25.	Preparation of unleavened flat breads.	1
26.	Preparation of spaghetti pasta.	1
27.	Preparation of penne pasta.	1
28.	Preparation of fusilli pasta.	1
29.	Preparation of fettuccine/tagliatelle pasta.	1
30.	Preparation of noodles.	1
31.	Preparation of vermicelli.	1
32.	Preparation of instant noodles.	1

Suggested Readings:

1. Gibney, M. J., Lanham-New, S.A., Cassidy, A. and Voster, H.H. (Ed.). 2009. Introduction to Human Nutrition. Wiley-Blackwell.
2. Rekhi, Tejmeet and Yadav, Heena. 2014. Fundamentals of Food and Nutrition. Elite Publishing House. 257p.
3. Dharmesh Kumar. Food Science and Nutrition. Random.

SEC-121 Soil, Plant and Water Testing 2 (0+2)

Course Status : Skill Enhancement Course
Contact Hours (L-T-P) : 0-0-4
Course Objective : To impart the knowledge of Soil, Plant and Water testing to the students.
Course Outcomes (CO) : After the completion of this course, the student will be able to -
CO-1: will have the skill of testing the different parameters of soil, plant and water.
CO-2:.The student will be specialist in rappid test of plant tissue.
Course Description :

Practical:	**CO Mapping**
Unit 1: Unit-1: Standardization of solutions and reagents Standardization of solutions and reagents, collection and preparation of soil samples, estimation of pH, EC, organic carbon, NPKS, micronutrients, CEC and exchangeable sodium in soil. Determination of EC and pH of saturation extract/ paste.	CO-1
Unit 2: Plant sampling and Estimation of ions Estimation of cations (Ca^{++}, Mg^{++} and Na^{+}) and anions (CO_3^{--} and HCO_3^{-}) in saturation extract. Plant sampling and sample preparation for analysis, digestion of plant material and estimation of N, P, K in plant.	
Unit 3: Rapid plant tissue test Rapid plant tissue test for N, P and K Determination of EC, pH, cations (Ca^{++} +Mg^{++}, Na^{+}, K^{+}) and anions (CO_3^{--}, HCO_3^{-}, Cl^{-}) in irrigation water and computation of SAR and RSC.	CO-2

Practical Schedule:

S. No.	Name of Topic	No. of practical
1.	Standardization of solutions and reagents	2
2.	Collection and preparation of soil samples	1
3.	Estimation of pH	1
4.	Estimation of EC	1
5.	Determination of organic carbon in soil	1
6.	Determination of available nitrogen in soil	1
7.	Determination of available phosphorus in soil	1
8.	Determination of available potassium in soil	1
9.	Determination of available sulphur in soil	1
10.	Determination of available DTPA extractable Zn ,Fe, Mn and Cu in soil	2
11.	Determination of CEC in soil	1
12.	Determination of exchangeable sodium in soil	1
13.	Determination of EC and pH of saturation extract of soil	1
14.	Determination of Ca++ and Mg++ in saturation extract of soil	1
15.	Determination Na+ in saturation extract of soil	1
16.	Determination of CO3 and HCO3 in saturation extract of sol	1
17.	Plant sampling and sample preparation for analysis	2
18.	Digestion of plant material	1
19.	Estimation of nitrogen content in plant	1
20.	Estimation of phosphorus content in plant	1
21.	Estimation of potassium content in plant	1
22.	Rapid plant tissue test for N, P and K	1
23.	Determination of pH and EC in irrigation water	1
24.	Determination of Ca++ and Mg++ in irrigation water	1
25.	Determination of Na+ and K+ in irrigation water	2
26.	Determination of Cl - in irrigation water	1
27.	Determination of CO3 and HCO3 in irrigation water	1
28.	Computation of SAR and RSC in irrigation water	1

Suggested Readings:

1. S.L. Chopra and J.S. Kanwar, 1999. Analytical Agriculture Chemistry,Kalyani Publisher, Lucknow.
2. M.L. Jackson 1973. Soil Chemical Analysis, Prentice Hall of India Pvt. Ltd., New Delhi.
3. H.L.S. Tandon 1990. Methods of Analysis of soil, plant, water and fertilizers, FDCO, New Delhi.
4. P. K. Gupta 1999-2000. Soil, Plant, Water and Fertilizer Analysis, AgroBotanica, Bikaner.
5. Richards, L.A. (1954). Diagnosis and improvement of saline and alkali soils. USDA Hand book No. 60, Washington, DC USA.

SEC-122 Production Technology of Bioagents 2 (0+2)

Course Status : Skill Enhancement Course
Contact Hours (L-T-P) : 0-0-4
Course Objective : To equip the students with the practical knowledge of mass production techniques, application methods, and quality control practices for the effective use of bioagents in the management of diseases and other stresses.
Course Outcomes (CO) : After the completion of this course, the student will be able to:
CO-1: Acquaint the comprehensive knowledge of bioagents.
CO-2: Gain practical skills in mass production, handling and effective use of bioagents.
CO-3: Understand the challenges and limitations in their

production and application for sustainable agriculture.
CO-4: Know the application, storage, shelf life, and marketing strategies for bioagents.

Course Description :

Practical:	**CO Mapping**
Unit 1: Introduction of Bioagents: History, importance, scope and potential of bioagents; Definitions, concepts and classification of bioagents.	CO-1
Unit 2: Production technology of bioagents: Mass production technology of bioagents *viz., Trichoderma, Bacillus, Pseudomonas* and entomopathogenic pathogens *viz., Metarhyzium, Beauveria, Bt* and nematodes.	CO-2
Unit 3: Methods of application: Methods of application of bioagents for seeds, seedlings, tubers, sets, soil, etc.	CO-3
Unit 4 Storage and Marketing Bioagents, shelf life, quality control, and marketing. Factors influencing the efficiency of bioagents. Impediments and limitations in production and use of bioagents.	CO-4

Practical Schedule:

S. No.	**Name of Topic**	**No. of Practical**
1	Laboratory equipment for biocontrol laboratory.	1
2	Isolation and purification of *Trichoderma viride* from soil.	2
3	Isolation and purification of *Pseudomonas fluorescence*, *Bacillus thuringiensis* and *Bacillus subtilis* from soil.	2
4	Isolation and purification of Metarhyzium and *Beauveria* from soil and infected insects by these entomopathogenic fungi.	2
5	Mass production technology of *Trichoderma viride*.	3
6	Mass production technology of *Pseudomonas fluorescence*.	3
7	Mass production technology of *Bacillus subtilis*.	3
8	Mass production technology of *Metarhyzium* and *Beauveria*.	3
9	Mass production technology of *Bacillus thuringiensis*.	3
10	Visit to bioagents laboratory in the nearby area.	1
11	Field visit for identification of bioagents.	1
12	Methods of evaluation of biopesticides.	2
13	Methods of application of bioagents for seeds, seedlings, tubers, sets, soil etc.	1
14	Shelf life and Quality control of bioagents.	2
15	Factors influencing the efficiency of bioagents.	2
16	Impediments and limitations in the production and use of bioagents.	1

Suggested Readings*:*

1. Campbell, R. 1989. Biological Control of Microbial Plant Pathogens. Cambridge Univ. Press, Cambridge.
2. Cook, R. J. and Baker, K. F. 1983. The Nature and Practice of Biological Control of Plant Pathogens. APS, St Paul, Minnesota.
3. Dhaliwal, G. S. and Koul, O. 2007. Biopesticides and Pest Management. Kalyani Publ., New Delhi.
4. Mukerji, K. G., Tewari, J. P., Arora, D. K. and Saxena, G. 1992. Recent Developments in Biocontrol of Plant Diseases. Aditya Books, New Delhi.
5. Mukherjee, N. and Ghosh, T. 1998. Agricultural Microbiology. Kalyani Publishers, New Delhi.
6. Rangaswami, G. and Bagyaraj, D. J. 1993. Agricultural Microbiology. Prentice Hall of India Pvt. Limited, New Delhi.
7. Srivastava, K. P. 2004. A Text Book of Entomology. Vol. I, Kalyani Publishers, New Delhi.

8. Vishunavat, K. and Kolte, S. J. 2005. Essentials of Phytopathological Techniques. Kalyani Publishers, New Delhi.

SEC-123 Post-harvest Processing Technology 2 (0+2)

Course Status : SEC (Skill Enhancement Course)
Contact Hours (L-T-P) : 0-0-4
Course Objective : 1. To educate about processing techniques of fruits and vegetables.
2. To educate about quality control measures, HACCP, FSSAI and FPO license.
Course Outcomes (CO) : After the completion of this course the student will be able to-
CO-1: Prepare processed products of fruits and vegetables.
CO-2: Obtain FPO license and establish processing unit.
Course Description :

Practical:	**CO Mapping**
Unit 1: Processing and value-addition Machinery and equipments used in processing. Preservatives and food additives. Value addition and preservation techniques of fruits and vegetables. Intermediate moisture foods (jam, jelly, marmalade, preserve, candy), Fermented and non-fermented beverages. Drying/dehydration of fruits and vegetables, Osmotic drying. Tomato products; Chutneys, Pickles, Canning. Utilization of fruit and vegetable processing waste.	CO-1
Unit 2: HACCP and quality control FSSAI, HACCP and quality control. Physio-chemical and sensory analysis of processed products. Packaging, labelling and storage of processed products. Layout and establishment of processing unit. FPO license.	CO-2

Practical Schedule:

S. No.	Name of Topic	No. of practical
1.	Study of machinery and equipments used in processing of fruits and vegetables.	1
2.	Study of food preservatives.	1
3.	Study of food additives, food colours and food flavours.	1
4.	Study of pasteurization and sterilization techniques.	1
5.	Blanching and pre-treatments of fruits and vegetables.	1
6.	Extraction and preservation of pulp and juices.	1
7.	Preparation of Jam.	1
8.	Preparation of Jelly.	1
9.	Preparation of Marmalade.	1
10.	Preparation of RTS.	1
11.	Preparation of Nectar.	1
12.	Preparation of Squash/Syrup.	1
13.	Preparation of Carbonated beverages.	1
14.	Drying/dehydration of fruits and vegetables.	1
15.	Preparation of Osmotically dried products.	1
16.	Preparation of Fruit bar/leather.	1
17.	Preparation of Fruit candy.	1
18.	Preparation of Fruit preserve.	1
19.	Preparation of Tomato puree/paste/soup.	1
20.	Preparation of Tomato sauce/ketchup.	1
21.	Preparation of Chutneys.	1
22.	Preparation of Pickles.	1
23.	Preparation of Canned products.	1

24.	Utilization of processing waste.	1
25.	FSSAI, HACCP and quality control .	1
26.	Quality evaluation of processed products- Sensory and Physico-chemical analysis.	2
27.	Different types of food packages and containers.	1
28.	Labelling and storage of processed products.	1
29.	Layout and establishment of processing unit, FPO license.	2
30.	Visit to processing unit/industry.	1

Suggested Readings:

1. Goel, A.K., R. Kumar and S.S. Mann. 2007. Postharvest Management and Value Addition. Daya Publishing House.
2. Kureel, M.K., D.S. Mandloi, K.V. Singh and R. Lekhi. 2007. Postharvest Management and Value Addition of Fruits and Vegetables. Biotech.
3. Rajarathnam, S. and R.S. Ramteke. 2011. Advances in Preservation and Processing Technologies of Fruits and Vegetables. NIPA.
4. Ranganna, S. 2017. Handbook of Analysis and Quality Control for Fruit and Vegetable Products (2nd Edn.). Tata McGraw Hill Publishing Company.
5. Srivastava, R.P. and Kumar, S. 2007. Fruits and Vegetable Preservation: Principles and Practice. IBDC.
6. Sudheer, K.P. and V. Indira. 2007. Postharvest Technology of Horticultural Crops. NIPA.

SEC-124 Organic Production Technology 2 (0+2)

Course Status : Skill Enhancement Course
Contact Hours (L-T-P) : 0-0-4
Course Objective : 1. To teach students the principles of crop production under organic situation.
2. To impart practical knowledge of organic agriculture practices.
Course Description : Organic production requirement, Crop management in organic farming, organic seed production, organic manures, composting, vermi composting, Green manuring, biofertilizers, organic liquid fertilizers, organic management protection for controlling insects, disease and weeds, organic certification, processing and marketing, Quality standards; Important herbs, shrubs and trees their identification, uses and characteristics; habitat management is rainfed and integrated farm, integrated farming system.

Practical schedule:

S. No.	Name of Topic	No. of Practical
1.	Organic production requirement.	2
2.	Crop management in organic farming.	2
3.	Organic seed production.	2
4.	Organic manures.	2
5.	Composting.	3
6.	Vermi composting.	3
7.	Green manuring.	2
8.	Biofertilizers.	2
9.	Organic liquid fertilizers.	2
10.	Organic management protection for controlling insects, disease and weeds.	3
11.	Organic certification, processing and marketing.	2
12.	Quality standards.	2

13.	Important herbs, shrubs and trees their identification uses and characteristics.	3
14.	Habitat management is rainfed and integrated farm.	2
15.	Integrated farming system.	2

SEC-211 Poultry Production Technology 2 (0+2)

Course Status : Skill Enhancement Course
Contact Hours (L-T-P) : 0-0-4
Course Objective :
1. Introductory knowledge of poultry farming.
2. Breed and breeding management.
3. Nutrition and health management of poultry birds.

Course Outcomes (CO) : After the completion of this course, the student will be able to -
CO-1: Importance of poultry industry in national economy.
CO-2:.Breed and their breeding management.
CO-3:.Care and management practices of poultry
CO-4: Nutrition practices of poultry.
CO-5: Health management of poultry.

Course Description :

Practical:	**CO Mapping**
Unit 1: Unit-1: Introduction of poultry husbandry Importance of poultry industry including backyard poultry farming in national economy. Improved strains for backyard poultry farming in Rajasthan. Housing principles, layout, space requirements for chick, grower and layer.	CO-1
Unit 2: Poultry breed and breeding management Reproduction in poultry and their improvement & conservation.Important Indian breeds of poultry. Important Exotic breeds of poultry. Incubation & Care and management during Hatching of fertile eggs.	CO-2
Unit 3: Care and Management of poultry Brooding of layer chicks (0 to 08 weeks). Brooding of broiler chicks (0 to 08 weeks). Management of grower and Layer.	CO-3
Unit 4: Poultry Nutritional practices Feed formulation for chicks, grower and layer. Feed supplements & Feed additives and feed ingredients for ration. Digestion & feeding of poultry.	CO-4
Unit-5: Poultry health Practices Introduction of important diseases of poultry and their control. Prevention measurement of disease management of poultry. Project formulation.	CO-5

Practical Schedule:

S. No.	Name of Topic	No. of practical
1.	Importance of poultry industry including backyard poultry farming in national economy.	2
2.	Improved strains for backyard poultry farming in Rajasthan.	2
3.	Housing principles, layout ,space requirements for chick, grower and layer.	2
4.	Reproduction in poultry and their improvement and conservation.	2
5.	Important Indian breeds of poultry.	2
6.	Important Exotic breeds of poultry.	2
7.	Incubation & Care and management during Hatching of fertile eggs.	2
8.	Brooding of layer chicks (0 to 8 weeks).	2
9.	Brooding of broiler chicks (0 to 8 weeks).	2
10.	Management of grower and Layer.	2

11.	Feed formulation for chicks, grower and layer.	2
12.	Feed supplements & Feed additives and feed ingredients for ration.	2
13.	Digestion & Feeding of poultry.	2
14.	Introduction of important diseases of poultry and their control.	2
15.	Prevention measurement of disease management of poultry.	2
16.	Project formulation.	2

Suggested Readings:

1. Banerjee, G. C. 2011. A Text Book of Animal Husbandry. VIII ed. Oxford and IBH Publications. New Delhi.
2. Choudhary, J. L. and Gupta L. 2016. A Text Book of Animal Husbandry. Somani Publication
3. Singh, R. A. 1996. Poultry Production. 3rd ed. Kalyani Publications. New Delhi.
4. Thomas, C. K., Sastry, N. S. R. and Singh, R. A. 1982. Farm Animal Management and Poultry Production. Vikas Publications. New Delhi.

SEC-212 Seed Production and Testing Technology 2 (0+2)

Course Status : SEC (Skill Enhancement Course)
Contact Hours (L-T-P) : 0-0-4
Course Objective : To develop analytical and entrepreneurial skills in students and turned them into quality seed producer.
Course Outcomes (CO) : After the completion of this course, the student will be able to -
CO-1: acquaint about the basic concepts of seed production and certification.
CO-2: produce seeds/hybrid seeds at large scale.
CO-3: know about seed processing and seed testing.

Course Description :

Practical:	**CO Mapping**
Unit 1: Basic concept of seed production and certification Techniques of seed production in self- and cross-pollinated crops, Maintenance and Requirements for different classes of seeds in field crops, Concept and objectives of seed certification. Visit to seed certification agency.	CO-1
Unit 2: Seed production technology Principles and practices of selection of area and agronomic requirement of seed production of field crops, Importance of isolation distance and Rouging, field inspection.	CO-2
Unit 3: Hybrid seed production Principles of hybrid seed production in field crops, Principles and practices of selection of area and agronomic requirement of hybrid seed production, field inspection, exposure visits to commercial seed production farms.	
Unit 4: Seed Testing Seed sampling methods, physical purity test, moisture determination, germination test, seed and seedling vigour test, seed viability test, genetic purity test: grow out test, seed health testing using blotter method seed health testing agar plate method.	CO-3
Unit 5: Seed Processing seed drying and storage structure in quality seed management, screening techniques during seed processing viz., grading and packaging, exposure visits to seed processing units.	

Practical Schedule:

S. No.	Name of Topic	No. of practical
1.	Techniques of seed production in self- and cross-pollinated crops.	1

2.	Maintenance and Requirements for different classes of seeds in field crops.	1
3.	Concept and objectives of seed certification.	1
4.	Visit to seed certification agency.	1
5.	Seed Production of pulses, oilseed.	6
6.	Hybrid Seed Production of Pearl millet, castor.	7
7.	Seed sampling methods.	1
8.	Physical purity test.	1
9.	Moisture determination.	1
10.	Germination test.	1
11.	Seed and seedling vigour test.	1
12.	Seed viability test.	1
13.	Genetic purity test: Grow out test.	1
14.	Seed health testing using blotter method.	1
15.	Seed health testing agar plate method	1
16.	Seed drying and storage structure in quality seed management.	1
17.	Screening techniques during seed processing viz., grading and packaging.	1
18.	Exposure visits to commercial seed production farms.	2
19.	Exposure visits to seed processing units.	1
20.	Exposure visits to seed testing laboratory.	1

Suggested Readings*:*

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

SEC-213 Floriculture and Landscaping 2 (0+2)

Course Status : SEC (Skill Enhancement Course)
Contact Hours (L-T-P) : 0-0-4
Course Objective : 1. To enhance technical knowledge of production technology of commercial flower crops.
2. To provide knowledge of principles of landscape gardening and inculcate entrepreneurial skills in designing of gardens.

Course Outcomes (CO) : After the completion of this course the student will be able to learn-
CO-1: the production techniques of commercial flower crops.
CO-2: the principles of landscaping and technical skills of landscape designing of different types of gardens.

Course Description :

Practical:	**CO Mapping**
Unit 1: Floriculture Production technology of commercial flowers (rose, carnation, chrysanthemum, marigold, tuberose, gerbera, gladiolus, jasmines, tulip, anthurium, lilium and orchids). Harvesting and postharvest handling of commercial flowers. Marketing of flowers. Cost Analysis. Visit to flower growing areas and Export Houses. Flower arrangements and making of flower bouquets, garlands, button holes,	CO-1

wreath, veni, gazaras *etc.* Dry flower technology.	
Unit 2: Landscaping Principles and elements of landscaping. Planning and designing, site analysis, selection and use of plant material for landscaping (annuals, shrubs, trees, climbers, ferns, bulbous plants, cacti & succulents, palms and grasses). Styles and types of gardens. Garden features, Making of lawns. Bio-aesthetic planning, landscape plans of home gardens, landscaping of places of public importance (public parks, traffic circles, avenues, institutions, high ways, railway stations, dams *etc.*). Use of softwares in landscaping. Bonsai making. Visit to institutional, industrial and public gardens.	CO-2

Practical Schedule:

S. No.	Name of Topic	No. of practical
1.	Identification and brief description of important flower crops.	1
2.	Identification and brief description of important ornamental plants.	1
3.	Identification and brief description of garden tools.	1
4.	Symbols used in landscape designing.	
5.	Nursery raising of annual flower seeds and transplanting of seedlings.	1
6.	Propagation of flower crops by cutting/layering.	1
7.	Propagation of flower crops by budding.	1
8.	Propagation of flower crops by specialized storage organs.	1
9.	Practice of training and pruning in flower crops.	1
10.	Study of production technology of commercial flower crops and marketing of flowers.	1
11.	Cost analysis of commercial flower cultivation.	1
12.	Harvesting and postharvest handling of important flowers.	1
13.	Flower arrangements and making of flower bouquets, garlands, button holes, wreath, veni, gazaras *etc.*	1
14.	Dry flower technology.	1
15.	Study of principles and elements of landscaping.	1
16.	Site analysis for landscape gardening.	1
17.	Study of styles and types of gardens.	
18.	Planning and designing of landscape gardens- Formal gardens.	1
19.	Planning and designing of landscape gardens- Informal gardens.	1
20.	Selection and use of plant material for landscaping (annuals, shrubs, trees, climbers, ferns, bulbous plants, cacti & succulents, palms and grasses).	2
21.	Study of garden features (hedges, edges, carpet beds, flower beds, herbaceous borders, shrubbery, arches, pergola, standards *etc.*).	2
22.	Establishment and maintenance of lawn.	1
23.	Bio-aesthetic planning and landscaping of home gardens.	1
24.	Plant containers, potting mixtures, potting and repotting.	1
25.	Landscaping of places of public importance (public parks, institutions, railway stations *etc.*).	1
26.	Landscaping of places of public importance (traffic circles, avenues, high ways *etc.*).	1
27.	Use of softwares in landscaping.	1
28.	Bonsai making.	1
29.	Visit to flower growing areas and Export Houses.	1
30.	Visit to institutional, industrial and public gardens.	1

Suggested Readings

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

2. Bose, T. K., Malti, R. G., Dhua, R. S. and Das, P. 2012. Floriculture and Landscaping (Vol. 1 &2, 2nd Rev. Edn.). Nayaprakash.
3. Chadha, K.L. 2019. Handbook of Horticulture (2 Vol., 2nd Rev. Edn.). ICAR, New Delhi.
4. Randhawa, G. S. and A. Mukhopadhyay. 2004. Floriculture in India. Allied Publishers.
5. Singh, A.K. and Anjana Sisodia. 2017. Textbook of Floriculture and Landscaping. NIPA.

SEC-221 Agriculture Waste Management 2 (0+2)

Course Status : SEC (Skill Enhancement Course)
Contact Hours (L-T-P) : 0-0-4
Course Objective :
1. To impart knowledge on various aspects of biowastes and agricultural wastes for managing as organic amendments in agricultural production system.
2. To develop skills on various methods of conversion of decomposable wastes into organic manures.

Course Outcomes (CO) : After the completion of this course the student will be able to learn-
CO-1: Use of organic waste in production of manures.
CO-2: aware about biogas production technology.

Course Description :

Practical:	**CO Mapping**
Unit 1: Organic waste and its use Introduction to agricultural waste management, type of wastes, and sources of agriculture waste. Visit of different agriculture waste management units, Collection, transport, sorting, treatment, storage and utilization of Agriculture Wastes, Preparation of Organic Manures from agriculture Wastes, Production of compost by aerobic and anaerobic methods from agriculture waste, Enriched compost production from agriculture waste, Production of Vermicompost from agriculture wastes, Production of enrich vermicompost from agriculture waste.	CO-1
Unit 2: Biogas Production Technology Biogas Production from Agriculture waste and utilization of slurry, Production of enriched biogas slurry, Collection and preparation agricultural waste sample for analysis, Quality analysis (N, P, and K) of manure, compost, vermicompost and biogas slurry. Collection and preparation agricultural waste sample for analysis. Quality analysis (N, P, and K) of manure, compost, vermicompost and biogas slurry. Recommended doses and application of manure, compost, vermicompost and biogas slurry for major crops and others.	CO-2

Practical Schedule:

S. No.	Name of Topic	No. of practical
1.	Introduction to agricultural waste management, type of wastes, and sources of agriculture waste.	**1**
2.	Visit of different agriculture waste management units.	3
3.	Collection, transport, sorting, treatment, storage and utilization of Agricultural wastes.	2
4.	Preparation of Organic Manures from agriculture Wastes	3
5.	Production of compost by aerobic and anaerobic methods from agriculture wastes.	4
6.	Enriched compost production from agriculture wastes.	2
7.	Production of Vermicompost from agriculture wastes.	4
8.	Production of enrich vermicompost from agriculture waste.	2
9.	Biogas Production from Agriculture waste and utilization of slurry.	4
10.	Production of enriched biogas slurry.	2
11.	Collection and preparation agricultural waste sample for analysis.	1

12.	Quality analysis (N, P, and K) of manure, compost, vermicompost and biogas slurry.	3
13.	Recommended doses and application of manure, compost, vermicompost and biogas slurry for major crops and others.	1

#Course shall be shared with Department of Agronomy.

Suggested Readings:

1. Bhatnagar, R.K. and Palta, R.K. (2002). Vermiculture and vermicomposting. Kalyani Publishers, Ludhiana.
2. Clive A. Edwards, Norman Q. Arancon, and Rhonda L. Sherman (2011). Vermiculture Technology: Earthworms, Organic Wastes, and Environmental Management". CRC Press.
3. M. Devender Reddy, Mandapati Roja, Ch. Deepthi (2019). Agricultural Waste Management. Kalyani Publishers, Delhi.
4. Thelma Bosso (2016). Agricultural Waste Management. Callisto Publishers,U.K.
5. Vir Singh, Poonam Gusain, Meenakshi Arya (2018). Agro Waste Management, SSDN Publishers.

SEC-222 Goat Farming 2 (0+2)

Course Status : SEC (Skill Enhancement Course)
Contact Hours (L-T-P) : 0-0-4
Course Objective :
1. To acquaint students about importance of goat farming.
2. Important species of livestock provide employment and supplementary income.
3. Principles of Housing, Feeding, and breeding management of goats.

Course Outcomes (CO) : After the completion of this course, the student will be able to -
CO-1: Importance of goat husbandry in national economy.
CO-2: Breed and their breeding management.
CO-3: Care and management practices of goats.
CO-4: Nutrition practices of goats.
CO-5: Health management of goats**.**

Course Description :

Practical:	**CO Mapping**
Unit 1: Introduction of goats husbandry Importance of goats farming in State and National economy. Housing principles, layout ,space requirements for kids, yearling and doe's. Milk and its therapeutic use, milking, avoidance of goaty odour in milk.	CO-1
Unit 2: Goat breed and breeding management Important Indian breeds of goats. Important Exotic breeds of goats. Breeding management to improve the reproductive efficiency.	CO-2
Unit 3: Care and Management of goats Goat farming under different system of management. Care and management of different classes of goat. Selection of breeding animals.	CO-3
Unit 4: Nutritional practices Feed and fodder resources for small ruminants. Principles and system of feeding in different categories of goat. Pasture utilization and improvement.	CO-4
Unit 5: Health Practices Introduction of important diseases of goat and their control. Prevention & control measures including vaccination and deworming and spraying. Transportation of small ruminants.	CO-5

Practical Schedule:

S. No.	Name of Topic	No. of practical
1.	Importance of goats farming in State and National economy.	2
2.	Housing principles, layout ,space requirements for kids, yearling and doe's.	2
3.	Milk and its therapeutic use, milking, avoidance of goaty odour in milk.	2
4.	Important Indian breeds of goats.	2
5.	Important Exotic breeds of goats.	2
6.	Goat farming under different system of management.	2
7.	Care and management of different classes of goat.	2
8.	Selection of breeding animals.	2
9.	Feed and fodder resources for small ruminants.	2
10.	Principles and system of feeding in different categories of goat.	2
11.	Pasture utilization and improvement.	2
12.	Introduction of important diseases of goat and their control.	2
13.	Prevention & control measures including vaccination and deworming and spraying.	2
14.	Transportation of small ruminants.	2
15.	Breeding management to improve the reproductive efficiency.	2
16.	Project formulation.	2

Suggested Readings:

1. Banerjee, G. C. 2011. A Text Book of Animal Husbandry. VIII ed. Oxford and IBH Publications. New Delhi.
2. Choudhary, J. L. and Gupta L. 2016. A Text Book of Animal Husbandry. Somani Publication.

SEC-223 Beneficial Insect Farming 2 (0+2)

Course Status : SEC (Skill Enhancement Course)
Contact Hours (L-T-P) : 0-0-4
Course Objective : This course intends to provide a basic knowledge about beneficial Insect and their management.
Course Outcomes (CO) : After the completion of this course, the student will be able to -
CO-1: Rear and management beehives for bee products.
CO-2: Cultivate mulberry and rear the silkworm for silk production.
CO-3: Inoculate lac insect and commercial production of lac.
CO-4: Mass produce natural enemies and identify various other beneficial insects**.**
Course Description :

Practical:	CO Mapping
Unit 1: Introduction and Apiculture Importance and scope of beneficial insects, types of beneficial insects. Honey bee species, castes of bees. Beekeeping appliances and seasonal management, bee enemies and disease. Bee pasturage, bee foraging and communication.	CO-1
Unit 2: Sericulture Types of silkworm, voltinism and biology of silkworm. Mulberry cultivation, mulberry varieties and methods of harvesting and preservation of leaves. Rearing techniques of silkworm and Pest and diseases of silkworm.	CO-2
Unit 3: Lac culture Species of lac insect, host plant identification. Lac cultivation and lac production – seed lac, button lac, shellac, lac- products. Natural enemies of lac and their	CO-3

management.	
Unit 4: Seed Testing: Seed sampling methods, physical purity test, moisture determination, germination test, seed and seedling vigour test, seed viability test, genetic purity test: grow out test, seed health testing using blotter method seed health testing agar plate method.	CO-4
Unit 5: Other beneficial insects Identification of major parasitoids and predators commonly being used in biological control; Insect orders bearing predators and parasitoids used in pest management; Identification and techniques for mass multiplication of natural enemies. Important species of pollinator, weed killers and scavengers with their importance. Entomophagy, and medicinal uses of insects. Insects of forensic importance and insects in waste management.	CO-5

Practical Schedule:

S. No.	Name of Topic	No. of practical
1.	Importance and scope of beneficial insects, types of beneficial insects. Honey bee species, castes of bees.	4
2.	Beekeeping appliances and seasonal management, bee enemies and disease.	3
3.	Bee pasturage, bee foraging and communication.	2
4.	Types of silkworm, voltinism and biology of silkworm.	2
5.	Mulberry cultivation, mulberry varieties and methods of harvesting and preservation of leaves.	2
6.	Rearing techniques of silkworm and Pest and diseases of silkworm.	2
7.	Species of lac insect, host plant identification.	1
8.	Lac cultivation and lac production – seed lac, button lac, shellac, lac-products. Natural enemies of lac and their management.	3
9.	Identification of major parasitoids and predators commonly being used in biological control.	3
10.	Insect orders bearing predators and parasitoids used in pest management.	2
11.	Identification and techniques for mass multiplication of natural enemies.	2
12.	Important species of pollinator, weed killers and scavengers with their importance.	3
13.	Entomophagy, and medicinal uses of insects. Insects of forensic importance and insects in waste management.	4

Suggested Readings:

1. Abrol, D. P. 2013. Beekeeping: A Comprehensive Guide to Bee and Beekeeping. Scientific Publishers, Jodhpur.
2. Aruga, H. 1994. Principles of Sericulture. Oxford & IBH, New Delhi.
3. Atwal, A. S. 2006. The World of the Honey Bee. Kalyani Publ., New Delhi.
4. De Bach, P. 1974. Biological control by Natural enemies. Cambridge University Press.
5. Dhaliwal, G. S. and Arora, R. 2001. Integrated Pest Management: Concepts and approaches. Kalyani Publ., New Delhi.
6. Dhaliwal, G. S. and Koul, O. 2007. Biopesticides and Pest Management. Kalyani Publ., New Delhi.
7. Gautam, R. D. 2008. Biological Pest Suppression. Westville Publising House, New Delhi.
8. Manfred Mackaur, Laster E. Ehler and Jens Roland. 1990. Critical Issues in Biological control- Intercept Ltd. Project Directorate of Biological control. 1994. Technology for mass production of Natural enemies. Technical Bulletin-4.
9. Srivastava, K. P. 2004. A Text Book of Entomology. Vol. I, Kalyani Publishers, New Delhi.

Rural Agricultural Work Experience and Agro-industrial Attachment (RAWE, AIA & ELP)			
S. No.	**Activities**	**No. of weeks**	**Credit Hours**
1.	General orientation & On campus training by different faculties.	1	1
2.	Village Attachment Programme - Unit attachment in University/ College/ KVK/ Research Station Attachment	5	5
3.	Plant clinic/ Agro-Industrial Attachment	4	4
4.	Experiential Learning Programme (ELP)	9	9
5.	Project Report Preparation, Presentation and Evaluation.	1	1
	Total weeks for RAWE, AIA & ELP	**20**	**20**

Component-I: RAWE (Village Attachment Training Programme)

S.No.	**Activity**	**Duration**
1	Orientation and survey of village	1 week
2	Agronomical interventions and Soil improvement interventions (Soil sampling and testing)	1 week
3	Plant protection interventions and Animal production interventions	1 week
4	Fruit and vegetable production interventions and Food processing and storage interventions	1 week
5	Identification of specific problems, Extension and transfer of technology activities	1 week

Component–II Agro- Industrial Attachment: The students will be attached with the agro-industries for a period of 4 weeks to get an experience of the industrial environment and working. Industries include Seed/Sapling production, Pesticides-insecticides, Post harvest-processing-value addition, Agri-finance institutions, etc.

Activities and Tasks during Agro-Industrial Attachment Programme:

- Acquaintance with industry and staff.
- Study of structure, functioning, objective and mandates of the industry.
- Study of various processing units and hands-on trainings under supervision of industry staff.
- Ethics of industry.
- Employment generated by the industry.
- Contribution of the industry promoting environment.
- Learning business network including outlets of the industry.
- Skill development in all crucial tasks of the industry.
- Documentation of the activities and task performed by the students.
- Performance evaluation, appraisal and ranking of students.

Component-III: Experiential Learning Programme (ELP)

Under Experiential Learning Programme (ELP), student will opt one module from the following twelve modules

(i) Mushroom Cultivation Technology
(ii) Production Technology for Bioagents and Biofertilizer
(iii) Soil, plant, water and seed Testing
(iv) Poultry Production Technology
(v) Commercial Horticulture
(vi) Floriculture and Landscaping
(vii) Food Processing
(viii) Agriculture Waste Management
(ix) Commercial Sericulture

ELP-421	Mushroom Cultivation Technology	9 (0+9)

Construction cultivation room/structure and Disinfection; Compost preparation and pasteurization; Procurement of mother culture and spawn preparation; Procurement of casing soil and preparation for production; Mushroom seeding, Casing with soil and maintenance, Harvesting, processing, grading, packing, marketing and cost economics of mushroom culture.

ELP-422#	Production Technology for Bioagents and Biofertilizer	9 (0+9)

Isolation and pure culture establishment of bio-fertilizers and bio-pesticides; Culture methods and substrates; Scale of methods for bio-fertilizers and bio-agents; Substrate preparation and mixing techniques; Quality analysis of bio-fertilizers and bio-pesticides.Testing the final product in small scale level. Storage, marketing and cost analysis of bio-fertilizers and bio-pesticides.
Course shall be shared with Soil Science

ELP-423	Soil, Plant and Water Testing	9 (0+9)

Collection and soil water and plant sample for analyses, soil profile study, bulk density, particle density, porosity, water holding capacity, soil texture, estimation of soil moisture by gravimetric and volumetric methods, lime requirement, soil pH, EC, organic carbon and available major and micronutrient in soil and plant sample, leaf area by leaf area meter, relative water content of leaf, specific leaf weight, chlorophyll content of leaf, irrigation water quality analysis, measurement of soil water potential, water flood measurement.

ELP-424	Poultry Production Technology	9 (0+9)

Important Indian and foreign breeds of poultry; Breeding management of Chick, Grower and Layer birds; Incubation and hatching, management of incubator during incubation; care and management of chicks — grown up birds, equipment, feeders, drinker systems, housing programs — Farm knout, house design, orientation of shed, cross ventilation, lighting systems — floor space requirements, brooder space, water space and feeding space at different age of broilers — random weighting of chicks, commonly used major feed in gradients identification — Feed manufacturing — preparation of feed for different age groups of broilers different methods of injection and procedure; structure of poultry eggs, selection and care of hatching egg; disease of poultry, vaccination schedule.

ELP-425	Commercial Horticulture	9 (0+9)

Nursery production of fruit crops: Raising of rootstocks, grafting and budding of rootstocks, management of grafted plants, plant certification, packaging and marketing, quality control; Nursery production of ornamentals: Production of plantlets, production of potted plants, management and maintenance, sale and marketing; Protected cultivation of vegetables and flowers: Nursery raising/procurement and transplanting, management and maintenance of the crop, postharvest handling, quality control and marketing.

ELP-426	Floriculture and Landscaping	9 (0+9)

Preparation of project report, soil and water analysis, preparation of land and layout; Production and Management of commercial flowers; Harvesting and postharvest handling of produce; Marketing of produce, Cost Analysis, Institutional Management, Visit to Flower growing areas

and Export House, Attachment with private landscape agencies; Planning and designing, site analysis, selection and use of plant material for landscaping; Formal and informal garden, features, styles, principles and elements of landscaping; Preparation of landscape plans of home gardens, farm complexes, public parks, institutions, high ways, dams and avenues; Making of lawns, use of software in landscape; Making of bouquets, button hole, wreath, veni and gazaras, car and marriage palaces; Dry flower Technology (identification of suitable species, drying, packaging and forwarding techniques).

ELP-427 **Food Processing** **9 (0+9)**

Planning and execution of a market survey, preparation of processing schedule, preparation of project module based on market information, calculation of capital costs, source of finance, assessment of working capital requirements and other financial aspects, identification of sources for procurement of raw material, production and quality analysis of fruits and vegetables products at commercial scale, packaging, labeling, pricing and marketing of product.

ELP-428# **Agriculture Waste Management** **9 (0+9)**

Analysis and design of systems for vermicomposting and compost; Collection, storage, treatment, transport and utilization of disposable organic water and west waters, operating system and laboratory evaluation of materials and processes, mass and energy balance for process systems, water and water analysis; Physical, chemical and biological basis for waste treatment and recycling; waste treatment systems, management of dead animals rendering plants, incineration, disposal pits; gaseous waste treatment.
Course shall be shared with Agronomy.

ELP-429 **Commercial Beekeeping** **9 (0+9)**

Beneficial insect, scope of apiculture, honey bee colony, different bee hives and apiculture equipment, summer and winter management of colony, Honey extraction and bottling; Study of pests and disease of honey bees; Specifies of honey bees, Bee pasturage, Honey composition and value, bee crop and tissue.

ONLINE COURSES

Course Status : On-line course
Contact Hours (L-T-P) : Minimum of 10 credits
Course Objective : The objective is to allow the students to groom their passion or strengthen their knowledge and competency in any field beyond prescribed courses.
Course Outcomes (CO) : Students will able to learn other fields beyond prescribed courses.
Course Description :

The students will have to take a minimum of 10 credits of online courses, which will comprise of one or more courses, as a partial requirement for the UG programme. The courses will be non-gradial as separate certificates would be issued by institutes offering the courses. These can be taken any time during the duration of UG program, but preferably during the 3rd and 4th years. (As per UGC guideline, a 1- to 3- credit SWAYAM course is expected to be covered in 4-12 weeks' duration including the assessment component, in which it should be 40 hours for 3-credit courses to 80 hours for a 6-credit course for the learning from e-content, reading references material, discussion forum posting and assignment.)
The online courses can be from any field such as Basic Sciences, Humanities, Psychology, Anthropology, Economics, Engineering, Business Management, Languages including foreign language, Communication skills/ Music, etc., and can be taken from NPTEL, mooKIT, edX, Coursera, SWAYAM or any other portal.

The student will take prior approval of the courses they opt from the Dean/ Pricipal of the Faculty/ College. The courses will be non-gradial as separate certificates would be issued by the Institute/ University offering the courses. However, the University/ institute will keep a record of such courses registered and completed by each student and will indicate the title of the (successfully completed) courses in final transcript issued to the student.

The courses can be taken during whole span of degree parogram as per choice of students. The MOOC courses taken by the student will be separately registered/ approved at the University level. The final transcript will indicate the title of courses taken by the student and the total weeks.

List of Suggestive Online Courses

S. No.	Course Title	Duration	Credits
1.	Digital Media	16 weeks	1
2.	Basics of Photography	12 weeks	1
3.	Design, Technology and Innovation	8 weeks	1
4.	Visual Communication Design for Digital Media	4 weeks	1
5.	Certificate course in Environmental Sustainability	8 weeks	1
6.	Consumer Protection Legislation	8 weeks	1
7.	Communication and Extension for Sustainable Development	15 weeks	1
8.	Intellectual Property	12 weeks	1
9.	Biopsychology	15 weeks	1
10.	NGO'S and Sustainable Development	15 weeks	1
11.	Counseling Psychology	12 weeks	1
12.	Gender Sensitization: Society Culture and Change	16 weeks	1
13.	Basics of Health Promotion and Education Intervention	8 weeks	1
14.	Psychology of Stress, Health and Well-being	12 weeks	1
15.	Diet Management in Health and Disease	12 weeks	1
16.	Dairy and Food Process and Products Technology	12 weeks	1
17.	Thermal Processing of Foods	12 weeks	1
18.	Nano-technology, Science and Applications	8 weeks	1

19.	Food Science and Processing	12 weeks	1
20.	Diet Management in Health and Disease	8 weeks	1
21.	Human Nutrition and Biochemistry	12 weeks	1
22.	Personality Development and Communication Skills	8 weeks	1
23.	Public Speaking	8 weeks	1
24.	Personality Development	8 weeks	1
25.	Emotional Intelligence	8 weeks	1
26.	Yoga Practices-1	12 weeks	1
27.	Yoga Practices-2	12 weeks	1
28.	Ethics: Theories and Applications	12 weeks	1
29.	Information Sources and Library Services	6 weeks	1
30.	Qualitative Research Methods and Research Writing	12 weeks	1
31.	Food Science & Processing	12 weeks	1
32.	Food Safety & Quality Control	8 weeks	1
33.	*Communication Skills and Computer Operations	24 weeks	2
34.	*Human Resource Management	24 weeks	2
35.	*Business Plan and Finance Management	24 weeks	2

INSTITUTIONAL TRAINING SYLLABUS

COMMON SUBJECTS				
S no.	Subject	Periods (1 hour duration each)		
		Lectures/Tutorials	Practicals	Total
1.	NCC General	06	-	06
2.	National Integration	04		04
3.	Drill	-	45	45
4.	Weapon Training	-	25	25
5.	Personality Development	25		25
6.	Leadership	12	-	12
7.	Disaster Management	13		13
8.	Social Service & Community Development	08	39	47
9.	Health & Hygiene	-	10	10
10	Adventure	01		01
11	Environmental awareness & conservation	03		03
12.	Obstacle Training	-	09	09
13.	General Awareness	04		04
14.	Border & Coastal Areas	06		06
		82	**128**	**210**
SPECIALZED SUBJECTS (ARMY)				
1.	Armed Forces	09	-	09
2	Map Reading	-	24	24
3	Communications	03	03	06
4	Infantry Weapons	03	03	06
5.	Field Craft & Battle Craft		22	22
6	Military History	23	-	23
TOTAL HOURS SPECIALISED SUBJECTS		**38**	**52**	**90**
GRAND TOTAL HOURS (TOTAL CREDITS)		120 (08 cr)* *15 HOUR THEORY = 1 CREDIT POINT	180 (6 cr)** **30 HOURS PRACTICAL TRAINING = 1 CREDIT POINT	**300**

SEMSTER WISE DISTRIBUTION OF NCC SYLLABUS FOR THEORY

S. NO.	SUBJECT	SEMESTER						TOTAL
		I	II	III	IV	V	VI	
1	NCC General	6	-	-	-	-	-	6
2	National Integration and Awareness	4	-	-	-	-	-	4
3	Personality Development	2	5	5	4	6	3	25
4	Leadership	-	5	4	3	-	-	12
5	Disaster Management	-	-	3	10	-	-	13
6	Social Service and Community Development	3	5	-	-	-	-	8
7	Adventure	-	-	1	-	-	-	1
8	Environmental awareness & conservation	-	-	-	3	-	-	3
9	General Awareness	-	-	-	4	-	-	4
10	Border & Coastal Areas	-	-	2	-	2	2	6
11	Armed Forces	-	-	-	6	-	3	9
12	Infantry Weapons	-	-	-	-	3	-	3
13	Communication	-	-	-	-	-	3	3
14	Military History	-	-	-	-	4	19	23
	Total Periods	15	15	15	30	15	30	120
	Total Credit Points	1	1	1	2	1	2	08

SEMSTER WISE DISTRIBUTION OF NCC SYLLABUS FOR PRACTICAL

S. NO.	SUBJECT	SEMESTER						TOTAL
		I	II	III	IV	V	VI	
1.	Drill	12	12	8	7	3	3	45
2.	Field Craft & Battle Craft	3	4	4	4	4	3	22
3	Map Reading	3	5	4	4	4	4	24
4	Weapon Training	5	4	4	4	4	4	25
5	Communication	-	-	-	-	-	3	03
6	Infantry Weapons	-	-	-	-	-	3	03
7	Social Service and Community Development	7	5	5	6	5	10	38
8	Health & Hygiene	-	-	-	5	5	-	10
9	Obstacle Training	-	-	5	-	5	0	10
10	Total Periods	30	30	30	30	30	30	180
	Total Credit Points	1	1	1	1	1	1	6

NCC CAMP TRAINING SYLLABUS

COMMON SUBJECTS				
S No.	**Subjects**	**Periods**		**Total**
		L/T	P	
1.	Physical Training	-	18	18
2.	Drill	-	32	32
3.	Weapon Training	08	28	32
4.	National Integration and Awareness	08	-	04
5.	Personality Development	08	12	20
6.	Leadership	08	-	04
7.	Disaster Management	08	-	04
8.	Social Service and Community Development	-	08	08
9.	Health & Hygiene	08		04
10.	Obstacle Training	-	04	04
11.	Military History	04	-	-
12.	Communication	04	-	-
13.	Games	-	18	18
14.	Culture	-	18	18
15.	Spare	-	04	04
	TOTAL	**56**	**142**	**170**
SPECIALISED SUBJECTS				
1.	Map Reading			
2.	Infantry Weapons	04	24	24
3.	Field Craft & Battle Craft		02	04
	TOTAL	04	12	12
		60(4 cr)	**180(6 cr)**	**240(10 cr)**

Appendix"B"

(Format of Mid Term for courses with Theory and Practical for 20 Marks)

Name of College…….

(Agriculture University, Jodhpur)

Mid Term Examination, B.Sc. (Hons.) Ag. Part-I/II/III Semester-I 20...-...

Course No :……Date :……Time : 1 hour

Subject: …… …..Marks : 20

Roll No……..

Part A (To be submitted in 10 mins) **MM:06**

Q. No. 1(A) Fill in the blanks (all compulsory) **3 (6x0.5)**

खाली स्थान को भरो (सभी प्रश्न करने अनिवार्य है)।

Q. No. 1(B) Choose the correct answer (all compulsory) **3 (6x0.5)**

सही उत्तर चुने। (सभी प्रश्न करने अनिवार्य है)।

Name of College…….

(Agriculture University, Jodhpur)

Mid Term Examination, B.Sc. (Hons.) Ag. Part-I/II/III Semester-I 20…..-..

Course No :……Date :……Time : 1 hour

Subject: ……Marks : 20

Roll No……..

Part B **MM:14.0**

Q. No. 2. Defined as any 4 out of 6 in 2-3 lines **2**

(4x0.5)

छह में से कोई चार का उत्तर 2–3 लाईन में परिभाषित कीजिए।

Q. No. 3. Write answer of any 4 out of 6 in 4-6 lines **4 (4x1.0)**

छह में से कोई चार का उत्तर 4–6 लाईन में दीजिए।

Q. No. 4. Attempt any 2 out of 3 question in 1 to 1.5 pages **8 (2x4.0)**

निम्न तीन में से कोई दो का उत्तर 1–1.5 पृष्ठों में दीजिए।

Format of Quiz for 10 Marks)

1) Fill in blanks (10*0.5)
2) MCQs (10*0.5)

Note: The format of assessment and duration of quizzes/ progressive assessment will depend upon the course teacher as per course requirement.

(Format of Mid Term for courses with Theory for 30 Marks)

Name of College…….

(Agriculture University, Jodhpur)

Mid Term Examination, B.Sc. (Hons.) Ag. Part-I/II/III Semester-I 20...-...

Course No :……..Date :……Time : 1 hour

Subject: ……Marks : 30

Roll No……..

Part A (To be submitted in 10 mins) **MM:06**

Q. No. 1(A) Fill in the blanks (all compulsory) **3 (6 x 0.5)**

खाली स्थान को भरो (सभी प्रश्न करने अनिवार्य है)।

Q. No. 1(B) Choose the correct answer (all compulsory) **3 (6 x 0.5)**

सही उत्तर चुने। (सभी प्रश्न करने अनिवार्य है)।

Name of College…….

(Agriculture University, Jodhpur)

Mid Term Examination, B.Sc. (Hons.) Ag. Part-I/II/III Semester-I 20…..-..

Course No :……..Date :……Time : 1 hour

Subject: ……Marks : 30

Roll No……..

Part B **MM:24**

Q. No. 2. Defined as any 6 out of 8 in 2-3 lines **6 (6 x1.0)**

आठ में से कोई छह का उत्तर 2–3 लाईन में परिभाषित कीजिए।

Q. No. 3. Write answer of any 4 out of 6 in 4-6 lines **8 (4x 2.0)**

छह में से कोई चार का उत्तर 4–6 लाईन में दीजिए।

Q. No. 4. Attempt any 2 out of 3 question in 1-1.5 Pages **10 (2x5.0)**

निम्न तीन में से कोई दो का उत्तर 1–1.5 पृष्ठों में दीजिए।

(Format of Mid Term for courses with Practical for 30 Marks)

Name of College……..

(Agriculture University, Jodhpur)

Mid Term Examination, B.Sc. (Hons.) Ag. Part-I/II/III Semester-I 20...-...

Course No :……..Date :……Time : 1 hour

Subject: ……Marks : 30

Roll No……..

Q.1. Major Exercise	**(10.0*2)**
Q.2. Minor Exercise:	**(5.0*2)**

Formats for Practical Examination
(For Courses with Theory and Practical for 20 Marks)
Name of College……..
AGRICULTURE UNIVERSITY, JODHPUR
B.Sc. (Ag.)……., Semester-I,
Final Practical Examination 202…….

Course Title…… Course No.: ……..

Maximum Mark: ……20…….. Roll No…….

Q.1. Major Exercise	**(6.0)**
Q.2. Minor Exercise:	**(4.0)**
Q.3. Comment and/or identify the terms given	**(4.0)**
Q.4. *Viva-Voce* **(3.0)**	
Q.5. Practical Record	**(3.0)**

Formats for Practical Examination
(For Courses with Theory and Practical for 50 Marks)
Name of College……..
AGRICULTURE UNIVERSITY, JODHPUR
B.Sc. (Ag.)……., Semester-I,
Final Practical Examination 202…….

Course Title…… Course No.: ……..

Maximum Mark: ……50…….. Roll No…….

Q.1. Major Exercise	**(20.0)**
Q.2. Minor Exercise:	**(10.0)**
Q.3. Comment and/or identify the terms given	**(8.0)**
Q.4. *Viva-Voce* **(6.0)**	
Q.5. Practical Record	**(6.0)**

Format of Final Theory Exam

Bachelor of Science Agriculture (Honours) Part-.....
Examination of the Four-year Degree Course, 2023-2024
SEMESTER-II

.....

(.....)

Time: 2Hours and 30 Minutes
Maximum Marks: 50 (10 marks for Section-I + 40 marks for Section-II)

Note:- All questions are essential to write and after English, questions write in Hindi. All questions should be clear and correct. Any of questions should not repeat.

नोटः–सभी प्रश्न लिखने अनिवार्य हैं एवं अंग्रेजी के पश्चात प्रश्नों को हिन्दी में लिखें। प्रश्न स्पष्ट एवं सुव्यस्थित होने चाहिए। किसी भी प्रश्न का दोहराव नहीं होना चाहिए।

SECTION - I

Maximum Marks: 10

1. (a) Fill in the blanks: **$10\times{}^{1}/_{2}=5$**

रिक्त स्थानों की पूर्ति कीजिए :

(b) Choose the correct answer and write the number of correct answer 1 or 2 or 3 or 4 in the square given against each sub question.
सही उत्तर चुनते हुऐ उसकी संख्या 1 या 2 या 3 या 4 प्रत्येक उप प्रश्न के सामने दिये गये वर्ग में लिखिए। **$10\times{}^{1}/_{2}=5$**

SECTION- II

खण्ड–II

Maximum Marks: 40

2. Answer any ***ten*** out of the following thirteen questions. Answer of each question should be 2-3 lines .

निम्नलिखित तेरह प्रश्नो मे से किन्हीं दस के उत्तर दीजिए। प्रत्येक प्रश्न का उत्तर 2 से 3 पंक्तियों में हो। **10×1=10**

3. Answer any ***five*** out of the following eight questions. Answer of each question should be in 6-8 lines.

निम्नलिखित आठ प्रश्नों में से किन्हीं पाँच के उत्तर दीजिए। प्रत्येक प्रश्न का उत्तर 6–8 पंक्तियों में हो। **5×2=10**

4. Answer any ***two***out of the following three questions. Answer of each question should be in 1-2 pages.

निम्नलिखित तीन प्रश्नों में से किन्हीं दो के उत्तर दीजिए। प्रत्येक प्रश्न का उत्तर 1–2 पृष्ठों में हो। **2×10=20**

Bachelor of Science Agriculture (Honours) Part-.....
Examination of the Four-year Degree Course, 2023-2024
SEMESTER-II

.....

(.....)

Time: 2Hours and 30 Minutes
Maximum Marks: 40 (08 marks for Section-I + 32 marks for Section-II)

Note:- All questions are essential to write and after English, questions write in Hindi. All questions should be clear and correct. Any of questions should not repeat.

नोटः–सभी प्रश्न लिखने अनिवार्य हैं एवं अंग्रेजी के पश्चात प्रश्नों को हिन्दी में लिखें। प्रश्न स्पष्ट एवं सुव्यस्थित होने चाहिए। किसी भी प्रश्न का दोहराव नहीं होना चाहिए।

SECTION - I

Maximum Marks: 10

1. (a) Fill in the blanks: **$08\times{}^{1}/_{2}=4$**

रिक्त स्थानों की पूर्ति कीजिए :

(b) Choose the correct answer and write the number of correct answer 1 or 2 or 3 or 4 in the square given against each sub question.
सही उत्तर चुनते हुऐ उसकी संख्या 1 या 2 या 3 या 4 प्रत्येक उप प्रश्न के सामने दिये गये वर्ग में लिखिए। **$08\times{}^{1}/_{2}=4$**

SECTION- II

खण्ड–II

Maximum Marks: 40

2. Answer any ***eight*** out of the following thirteen questions. Answer of each question **should be 2-3 lines.**

निम्नलिखित ग्यारह प्रश्नो मे से किन्हीं आठ के उत्तर दीजिए। प्रत्येक प्रश्न का उत्तर 2 से 3 पंक्तियों में हो। **8 ×1=8**

3. Answer any ***five*** out of the following eight questions. Answer of each question should be in 6-8 lines.

निम्नलिखित आठ प्रश्नों में से किन्हीं पाँच के उत्तर दीजिए। प्रत्येक प्रश्न का उत्तर 6–8 पंक्तियों में हो। **5×2=10**

4. Answer any ***two***out of the following three questions. Answer of each question should be in 1-2 pages.

निम्नलिखित तीन प्रश्नों में से किन्हीं दो के उत्तर दीजिए। प्रत्येक प्रश्न का उत्तर 1–2 पृष्ठों में हो। **2×7=14**

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