

COURSE STRUCTURE AND SYLLABI

B.Sc.(Hons)Agriculture

2022-23 Batch



Centurion
UNIVERSITY

Shaping Lives... Empowering Communities...

**M.S.SWAMINATHAN SCHOOL OF AGRICULTURE
CENTURION UNIVERSITY OF TECHNOLOGY & MANAGEMENT
Odisha-761211, INDIA,**

Web Site: - www.cutm.ac.in

Bachelor's Programme :

B.Sc. (Hons) Agriculture

Semester- wise distribution of courses

I Semester		L-P-P	Course No
1.	Fundamentals of Agronomy	3 (2+1+0)	ASAG1101
2.	Fundamentals of Genetics	3(2+1+0)	ASPG1101
3.	Fundamentals of Soil Science	3(2+1+0)	ASAC1101
4.	Agricultural Economics & Trade/Statistical Method	3(3+0+0)/2(1+1+0)	ASEC1101/ ASAS1101
5.	Agricultural Heritage*/Comprehension & Communication Skills in English	1(1+0+0)/2 (1+1+0)	ASAH1101/ ASEL1101
6.	Fundamentals of Horticulture	2(1+1+0)	ASHO1101
7.	Fundamentals of Plant Pathology	3(2+1+0)	ASPP1101
8.	Rural Sociology & Educational Psychology	2 (1+1+0)	ASEE1102
9.	Soil and Water Conservation Engineering	2(1+1+0)	ASAE1101
10.	Job Readiness	3 credit	CUTM1182
11.	Introductory Biology*/Elementary Mathematics*	2(1+1+0)/ 2(2+0+0)*	ASIB1101/A SEM1101
	NSS/NCC/Physical Education & Yoga Practices**	2 (0+2)**	ASPE1101
TOTAL		22(14+8+)/13+9+0)	
*R: Remedial course; **NC: Non-gradual courses			
II Semester		L-P-P	Course No
1.	Fundamentals of Crop Physiology	3(2+1+0)	ASPH1201
2.	Introduction to Forestry	2(1+1+0)	ASIF1201
3.	Introductory Agro meteorology and climate change	2(1+1+0)	ASAG1202
4.	Agricultural Microbiology	2(1+1+0)	ASAM1201
5.	Statistical Method/ Agricultural Economics & Trade	2(1+1+0)/3(3+0+0)	ASAS1101/ ASEC11 01
6.	Comprehension & Communication Skills in English/Agricultural Heritage*	2 (1+1+0)/1(1+0+0)	ASEL1101/ ASAH1101
7.	Irrigation water management	2(1+1+0)	ASAG1206
8.	Production Technology for Vegetables and Spices	2 (1+0+1)	ASHO1203
9.	Fundamentals of Entomology –I (Insect Morphology and Taxonomy)	3(2+1+0)	ASEN1201
10.	Fundamentals of Agricultural Extension Education	3(2+1+0)	ASEE1201
11.	Farm Machinery and Power	2 (1+1+0)	ASAE1202
12.	Job Readiness	3 credit	CUTM1182

	NSS/NCC/Physical Education & Yoga Practices**	2 (0+2+0)**	ASPE1101
Total		25(15+9+1/16+8+1)	
III Semester		L-P-P	Course No
1.	Crop Production Technology – I (<i>Cereals, millets and pulses</i>) <i>Kharif crops</i>	3 (2+0+1)	ASAG2103
2.	Fundamentals of Plant Breeding	3 (2+1+0)	ASPG2103
3.	Agricultural Finance and Cooperation/Agricultural Marketing & Prices	2 (1+1+0)	ASEC2102/A SEC2103
4.	Fundamentals of Entomology- II (Insect ecology and concepts of IPM)	2(1+1+0)	ASEN2102
5.	Weed management	2 (1+1+0)	ASAG2105
6.	Fundamentals of Plant Biochemistry	3(2+1+0)	ASBC2101
7.	Production technology of fruits and plantation crops	2(1+0+1)	ASHO2102
8.	Agricultural Informatics	2(1+1+0)	ASAI2101
9.	Livestock and poultry management	3(2+1+0)	ASAP2101
10.	Communication skills and personality development	2(1+1+0)	ASEE2104
11.	Job Readiness	3 credit	CUTM1182
	Human Values & Ethics (Non-gradual)	1(1+0+0)**	ASHV2101
Total		24(15+7+2)	
IV Semester		L-P-P	Course No
1.	Crop Production Technology –II (<i>Oil seeds, fiber, sugar, tobacco, and fodder Crops</i>) <i>Rabi crops</i>	3(2+0+1)	ASAG2204
2.	Production Technology for Ornamental Crops, MAP and Landscaping	2(1+0+1)	ASHO2204
3.	Renewable Energy and Green Technology	2(1+1+0)	ASAE2203
4.	Manures, Fertilizers and Soil Fertility Management	3(2+1+0)	ASAC2202
5.	Agricultural Marketing & Prices/ Agricultural Finance and Cooperation	2 (1+1+0)	ASEC2103/A SEC2102
6.	Fundamentals of Plant Biotechnology	2(1+1+0)	ASPB2201
7.	Rain-fed Agriculture & Watershed Management	2 (1+1+0)	ASAG2211
8.	Principles of seed technology	3(2+1+0)	ASPG2202
9.	Diseases of Field and Horticultural Crops and their Management –I	3 (2+1+0)	ASPP2202
10.	Job Readiness	3 credit	CUTM1182
Total		22(14+6+2)	

V Semester		L-P-P	Course No
1.	Entrepreneurship Development and Business Communication	2 (1+1+0)	ASEE3103
2.	Problematic Soils and their Management	2 (1+1+0)	ASAC3103
3.	Pests of field Crops and Stored Grain and their Management	3 (2+1+0)	ASEN3103
4.	Diseases of Field and Horticultural Crops and their Management-II	3 (2+1+0)	ASPP3103
5.	Crop Improvement-I (<i>Cereals, millets, pulses and oil seeds etc</i>)(Kharif crops)	2 (1+0+1)	ASPG3104
6.	Geoinformatics and Nano-technology for Precision Farming	2 (1+1+0)	ASAG3110
7.	Practical Crop Production – I (<i>Kharif</i> crops)	2 (0+0+2)	ASAG3108
8.	Three domain courses	9 credits(each of 1+2+0)	
Total		25(11+11+3)	
VI Semester		L-P-P	Course No
1.	Farming System & Organic farming for Sustainable Agriculture	3(2+0+1)	ASAG3207
2.	Practical crop production II (Rabi crops)	2 (0+0+2)	ASAG3209
3.	Post-harvest Management and Value Addition of Fruits and Vegetables	2 (1+1+0)	ASHO3205
4.	Pests of horticultural crops and their management and Beneficial Insects	3 (2+1+0)	ASEN3204
5.	Crop Improvement-II (<i>fibre, sugar, starches, narcotics, Vegetables, fruits, and flowers</i>)	2 (1+0+1)	ASPG3205
6.	Principles of Integrated Pest and Disease Management (50% Entomology and 50% Pathology)	2(1+1+0)	ASPP3204
7.	Protected cultivation and post harvest technologies	2(1+1+0)	ASAE3204
8.	Intellectual Property Rights	1(1+0+0)	ASIP3201
9.	Production Economics & Farm Management	2 (1+1+0)	ASEC3204
10.	Environmental studies and disaster management	3(2+1+0)	ASES3101
11.	Principles of food science and nutrition	2 (2+0+0)	ASFS3101
Total		24 (14 +6+4)	

Domain courses for B.Sc.(Hons) Agriculture

Sl.No	Domain	Credit	T+P+P
1	Organic Farming	29	3+15+11
2	Intensive Aquaculture	29	3+15+11
3	Seed Production using Manual and Molecular Methods	29	3+15+11
4	Genetic Engineering & Genomics	29	3+15+11
5	Nutraceuticals	29	3+9+17
6	SMART Agriculture	29	3+15+11
7	Protected Horticulture	29	3+15+11
8	Food Processing	29	3+15+11
9	Agri Business Management	23	2+0+21
10	Commodity and Food Storage	29	3+15+11
11	Dairy Processing and Development	28	3+15+10
12	Smart Farm Machinery	28	6+9+13
13	Soil and water conservation through watershed	28	4+11+13
14	Fish Processing Technology	25	3+11+11
15	Plant Tissue culture and Vegetative Propagation	29	3+15+11
16	Animal Cell Culture	29	3+15+11

Job Readiness (0-3-0)

Course I: IELTS - Reading, Listening, Speaking and Writing

Course II: IELTS Verbal

Course III: Quantitative Aptitude

Course IV: Logical Reasoning

Course I: IELTS - Reading, Listening, Speaking and Writing

Module I: IELTS Reading

- Skimming and Scanning
- Sentence Completion
- Choose the Correct options (A, B, C, D)
- Locating the Specific Information
- Assessment on Reading Skill

Module II: IELTS Listening

- Notes/ Form/Table completion
- Label the Map/Passage, Multiple Choice Questions
- Complete the Sentences, Listening to Find Information
- Assessment on Listening Skills

Module III: IELTS Speaking

- Speaking about yourself, your family, your work and your interests
- Introduction & Interview
- Topic Discussion (e.g., Environment, Covid 19, Job)
- Assessment on Speaking Skills

Module IV: IELTS Writing

- Summarising the chart, table or graph
- Comparing and contrasting graphs and tables
- Describing maps & diagrams
- Agreeing & disagreeing
- Expressing a personal view & opinion
- Assessment on Writing Skill
- CV Writing (2nd year)
- Letter Writing
- Email Writing(2nd year)
- Getting Started –writing an introduction

Course II: IELTS Verbal

Module I: Grammar (4 Hrs.)

- Articles
- Prepositions
- Subject-Verb
- Spotting Errors
- Sentence Correction

Module II: Vocabulary (5 Hrs.)

- Synonyms
- Antonyms
- Contextual Vocabulary

Module III: Reading Comprehension (3 Hrs.)

- Paragraph/ Sentence Completion
- Jumbled Sentences/ Jumbled Paragraph
- Reading Comprehension

Module IV: Verbal Analogies (3 Hrs.)

Course III: Quantitative Aptitude

Module I: Number System & Operation (14 Hrs.)

- Speed Math-1 : Multiplication tricks, Square, cube, square root, Cube root tricks
- Speed Math-2 : Speed Calculations
- Number System-01 : Operation on Numbers, Classification of Numbers, Tests of Divisibility, Unit Digit Calculation
- Number System-02 : Arithmetic Progression, Geometric Progression, Factors & Factorials, Trailing Zeroes, Remainder Theorem
- HCF & LCM : Concepts, short tricks, question discussion
- Average : Concepts, short tricks, question discussion
- Assessments

Module II: Basic Arithmetic (16 Hrs.)

- Percentage-01 : Basics of Percentage, Effective percentage, shortcuts
- Percentage-02 : Advanced questions and discussions
- Profit & Loss-01 : Basics and advanced questions of Profit & Loss and shortcuts
- Profit & Loss-02 : MRP, Discount, Successive discount
- Ratio & Proportion : Types of ratios, Basics & Advanced Question
- Age : Concepts & Shortcuts
- Partnership : Concepts & Shortcuts
- Mixture & Alligation : Rule of Alligation, Basics & Advanced question, Short tricks
- Assessments

Module III: Time & Analysis (17 Hrs.)

- Time, Speed, Distance : Concepts, Problems based on relations, Average speed, Stoppage time
- Trains : Relative Speed & All types of train problems
- Boats & Streams : Basics, Upstream, Downstream & Shortcuts
- Race : All concepts & Shortcuts
- Time & Work : Efficiency, wages, alternative day, chain rule
- Pipes & Cistern : Positive & Negative work
- Simple Interest : Concepts & Shortcuts on Simple Interest & Instalments
- Compound Interest : Concepts & Shortcuts on Simple Interest & Instalments
- Logarithm : All Formulae, concepts & Shortcuts

- Assessments

Module IV: Advanced Arithmetic (16 Hrs.)

- Equation : Linear & Quadratic
- Permutation : All concepts & Shortcuts on factorial, fundamental principles of counting
- Combination : All concepts & Shortcuts on Selection (Groups/teams)
- Probability: Terms related to Probability, Event, Theorems related Probability, Conditional Probability. Shortcuts on coins, dices, balls, cards, etc
- Data Interpretation : (Bar/Pi-Chart /Line) graph
- Mensuration : Area & Volume
- Height & Distance : Lines of Sight, Horizontal line, Angle of Elevation, Angle of Depression
- Assessments

Course IV: Logical Reasoning

Module I: Verbal Reasoning-I (14 Hrs.)

- Series-1 : Number series (Missing & Wrong)
- Series-2 : Letter, Alpha numeric, Miscellaneous series
- Coding & Decoding : Letter Coding, Number coding, Message coding, Substitution coding, Conditional coding
- Word Problem : Analogy, Odd man out, word formation, letter pair
- Logical Thinking : Brain Riddles
- Assessments

Module II: Verbal Reasoning-II (14 Hrs.)

- Order & Ranking : Ranking & Sequence
- Direction Sense Test : Shortest Distance, Angular movement concept and Dusk & Dawn
- Clock : Concepts of Angle, Reflex angle, Right angle Opposite, Coincide and Incorrect clock
- Calendar : All concepts & Shortcuts
- Blood Relation : Jumbled-up descriptions, coded relations, Relation Puzzles
- Assessments

Module III: Non Verbal Reasoning (14 Hrs.)

- Cubes & Dices
- Cubes & Cuboids
- Embedded Figure & Figure series
- Figure Puzzle & Figure grouping
- Figure Counting
- Mirror & Water Image
- Paper Cutting & Paper folding
- Assessments

Module IV: Advanced Reasoning (16 Hrs.)

- Sitting Arrangement : Circular, Square, Rectangular, Linear, Triangular
- Puzzle : Box, Floor, Month, Day
- Advanced Puzzle : 3 variable
- Logical Venn Diagram
- Syllogism
- Statement & Conclusion
- Data Sufficiency
- Assessments

VII Semester

Rural Agricultural Work Experience and Agro-industrial Attachment (RAWE & AIA)

Sl No.	Activities	No. of weeks	Credit hours
1	General orientation & On campus training by different faculties	1	14
2	Village attachment	8	
	Unit attachment in Univ./ College. KVK/ Research Station Attachment	5	
3	Plant clinic	2	02
	Agro-Industrial Attachment(respective domain related industry)	3	04
4	Project Report Preparation, Presentation and Evaluation	1	
	Total weeks for RAWE & AIA	20	20

*Agro- Industrial Attachment: The students would be attached with the agro-industries (respective domain related industry) for a period of 3 weeks to get an experience of the industrial environment and working.

*Educational tour will be conducted in break between IV & V Semester or VI & VII Semester

RAWE Component-I

Village Attachment Training Programme

Sl. No.	Activity	Duration
1	Orientation and Survey of Village	1 week
2	Agronomical Interventions	1 week
3	Plant Protection Interventions	1 week
4	Soil Improvement Interventions (Soil sampling and testing)	1 week
5	Fruit and Vegetable production interventions	1 week
	Food Processing and Storage interventions	

	Animal Production Interventions	1 week
	Extension and Transfer of Technology activities	1 week

RAWE Component –II

Agro Industrial Attachment

*Students shall be placed in Agro-and Cottage industries and Commodities Boards(respective domain related industry) for 03 weeks.

*Industries include Seed/Sapling production, Pesticides-insecticides, Post harvest-processing value addition, Agri-finance institutions, etc.(respective domain related industry)

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

Modules for Skill Development and Entrepreneurship

A student has to select a track (domain) of 29 credits including 9 credits of electives which are offered from 4th semester onwards. The student has to continue it with the track (domain) in VIII semester. Further, A student has to register 20 credits opting for Tracks consisting of three track course practical's (0+09) credits and 0+11 credits in production by using the technology in the VIII semester.

Track/ Domain courses for B.Sc.(Hons) agriculture. For VIII semester

Course Code	Name of the Domain	Credits	T-P-P
FMCU2220	Smart Farm Machinery	28	6+9+13
CUFM2220	Product Development Brief	2	0+1+1
CUFM2221	Sensor, Actuators and Robot Operating Systems	4	2+2+0
CUFM2222	Farm Machinery Design	3	2+0+1
CUFM2223	Piloting a Drone	3	1+2+0
CUFM2224	PLM using Dassault Tools	3	1+2+0

CUFM2225	Testing of Farm Machinery	3	0+2+1
CUFM2226	Product Development Project	10	0+0+10
CUFM2227	Internship	4	0+0+4
CUFM2228	Project	6	0+0+6
OFCU2230	Organic Farming	29	3+15+11
CUOF2230	Organic Farming	3	1+2+0
CUOF2231	Certification and Inspection Systems in Organic Farming in India.	3	1+2+0
CUOF2232	Biopesticides and Biofertilizers	3	1+2+0
CUOF2233	Organic Production- Field Crops	3	0+3+0
CUOF2234	Organic Production- Horticultural Crops	3	0+3+0
CUOF2235	Biofertilizer and Biopesticide Production Technology	3	0+3+0
CUOF2236	AELP Project	11	0+0+11
DPCU2240	Dairy Processing and Development	28	3+15+10
CUDP2240	Milk Processing in Dairy Industry	3	1+2+0
CUDP2241	Dairy Starters in Fermented Milk Products	3	1+2+0
CUDP2242	Quality Assurance in Dairy Industry	3	1+2+0
CUDP2243	Dairy Products Development	3	0+3+0
CUDP2244	Symbiotic Dairy Foods	3	0+3+0
CUDP2245	Quality Analysis of Milk and Milk Products	3	0+3+0
CUDP2246	Project & Industrial Internship	10	0+0+10
AQCU2250	Intensive Aquaculture	29	3+15+11
CUAQ2250	Intensive Fish Rearing	3	1+2+0
CUAQ2251	Ornamental Fish Farming	3	1+2+0
CUAQ2252	Biofloc Aquaculture	3	1+2+0

CUAQ2253	Framing of SOPs for Intensive Fish Culture and Ornamental Fish Culture	3	0+3+0
CUAQ2254	Health Management in Aquaculture	3	0+3+0
CUAQ2255	Feed Management in Aquaculture	3	0+3+0
CUAQ2256	Aquaculture Rearing	11	0+0+11
SPCU2260	Seed Production using Manual and Molecular Methods	29	3+15+11
CUSP2260	Breeding methods: Conventional and Molecular Approach	3	1+2+0
CUSP2261	Seed Production of Vegetable and Cereals Crops	3	1+2+0
CUSP2262	Seed Certification	3	1+2+0
CUSP2263	Hybridization Techniques	3	0+3+0
CUSP2264	Vegetable Seed Production	3	0+3+0
CUSP2265	Cultivar Purity and Seed Quality Testing	3	0+3+0
CUSP2266	AELP Project	11	0+0+11
GECU2270	Genetic Engineering & Genomics	29	3+15+11
CUGE2270	Computational Biology	3	1+2+0
CUGE2271	Genetic Engineering and its applications	3	1+2+0
CUGE2277	Genetics and Genomics	3	1+2+0
CUGE2273	Molecular Genomics	3	0+3+0
CUGE2274	Plant Tissue Culture Technologies	3	0+3+0
CUGE2275	Techniques in Molecular Biology	3	0+3+0
CUGE2276	AELP Project	11	0+0+11
NUCU2280	Nutraceuticals	29	3+9+17
CUNU2280	Introduction to Nutraceutical	3	1+2+0
CUNU2281	Functional Food	3	1+2+0
CUNU2282	Nutrigenetics	3	1+2+0

CUNU2283	Development of Personalized Food and Medicine	3	0+1+2
CUNU2284	Development of Biopesticides and Biofertilizers	3	0+1+2
CUNU2285	Development of Immune Boosters	3	0+1+2
CUNU2286	AELP Project	11	0+0+11
AGCU2290	SMART Agriculture	29	3+6+20
CUAG2290	Applied Hi-tech Horticulture	3	1+2+0
CUAG2291	Protected Cultivation of Vegetable Crops	3	1+2+0
CUAG2292	High-tech Fruit Culture	3	1+2+0
CUAG2293	Management of High-value Cut-flowers	3	0+3+0
CUAG2294	Management of Crops in Hydroponics	3	0+3+0
CUAG2295	Use of Smart Tools for Precision Crop Management	3	0+3+0
CUAG2296	AELP Project	11	0+0+11
PHCU2300	Protected Horticulture	29	3+15+11
CUPH2300	Applied Hi-tech Horticulture	3	1+2+0
CUPH2301	Protected Cultivation of Vegetable Crops	3	1+2+0
CUPH2302	High Tech Fruit Culture	3	1+2+0
CUPH2303	Production Technology of Cut Flowers & Loose Flowers	3	0+3+0
CUPH2304	Protected Floriculture	3	0+3+0
CUPH2305	Production Management of Medicinal and Aromatic Crops	3	0+3+0
CUPH2306	AELP Domain	11	0+0+11
FPCU2310	Food Processing	29	3+15+11
CUFP2310	Processing Technology of Cereals and Millets	3	1+2+0
CUFP2311	Processing Technology of Legumes and Oilseeds	3	1+2+0
CUFP2312	Processing Technology of Fruits, Vegetables, Spices and Condiments	3	1+2+0

CUFP2313	Product Development and Packaging Technologies	3	0+3+0
CUFP2314	Food Standards and Regulations and HACCP Systems	3	0+3+0
CUFP2315	Sensory Evaluation and Nutritional Labelling of Foods	3	0+3+0
CUFP2316	AELP Project	11	0+0+11
CUFP2317	Internship	5	0+0+5
CUFP2318	Project	6	0+0+6
ABCU2320	Agri Business Management	29	5+1+23
CUAB2320	Agri Food Markets and Value Chain Analysis	3	1+0+2
CUAB2321	Agri Input Marketing	3	1+0+2
CUAB2323	Community Owned and Managed Agri Businesses	2	0+0+2
CUAB2324	Agri Warehouse Management	2	0+0+2
CUAB2325	Sales and Distribution of Agrifood Products	11	0+0+11
CUAB2326	Principles of Management & Agribusiness	2	1+1+0
CUAB2327	Agri Technology Management	2	1+0+1
CUAB2329	E-Commerce and Agribusiness	2	1+0+1
CUAB2328	Market Survey & Price Analysis	2	0+0+2
FSCU2330	Commodity and Food Storage	29	3+15+11
CUFS2330	Storage Entomology	3	1+2+0
CUFS2331	Seed Pathology	3	1+2+0
CUFS2332	Post-harvest Biochemistry and Physiology of Crops	3	1+2+0
CUFS2333	Recent Trends in Post-harvest Technology	3	0+3+0
CUFS2334	Pest Management Techniques in Storage	3	0+3+0
CUFS2335	Post-harvest Storage of Fruits and Vegetables	3	0+3+0
CUFS2336	AELP Project	11	0+0+11

SWCU2340	Soil and Water Conservation through Watershed	28	4+11+13
CUSW2340	Rainwater Harvesting and Artificial Recharge	3	1+2+0
CUSW2341	Integrated Watershed Management	3	2+1+0
CUSW2342	Sustainable Watershed	3	1+2+0
CUSW2343	R programming in Watershed Hydrology	3	0+2+1
CUSW2344	Modelling and Simulation of Watershed Processes	3	0+2+1
CUSW2345	Geo-spatial Application in Watershed Management	3	0+2+1
CUSW2346	Industrial Internship	10	0+0+10
CUSW2347	Internship	4	0+0+4
CUSW2348	Project	6	0+0+6
FTCU2350	Fish Processing Technology		
CUFT2350	Post harvest handling and processing of fish and shellfish	3	1+2+0
CUFT2351	Design, maintenance of fish processing plant and instrumentation	3	1+2+0
CUFT2352	Quality assurance, management and certification	3	1+2+0
CUFT2353	Fish and shellfish waste management	3	0+3+0
CUFT2354	Microbiological analysis of fish and fisheries products	3	0+3+0
CUFT2355	Biochemical analysis of fish and fisheries product	3	0+3+0
CUFT2356	Preparation of different fisheries products and quality assessment(AELP)	11	0+0+11
PTCU2420	Plant Tissue Culture & Vegetative Propagation	29	3+15+11
CUPT2420	Technologies of Plant Tissue Culture	3	1+2+0
CUPT2421	Biotransformation using plant cells, organ cultures and enzyme systems	3	1+2+0
CUPT2422	Vegetative Propagation – Methods and Techniques	3	1+2+0
CUPT2423	Commercial Plant Tissue Culture	3	0+3+0
CUPT2424	Applied Plant Tissue Culture	3	0+3+0

CUPT2425	Techniques for conservation of Plant Genetic Resources	3	0+3+0
CUPT2426	AELP Project	11	0+0+11
ACCU2430	Animal Cell Culture	29	3+15+11
CUAC2430	Stem Cell and Developmental Biology	3	1+2+0
CUAC2431	Animal Cell Culture and its Application	3	1+2+0
CUAC2432	Instrumentation of Animal Biotechnology	3	1+2+0
CUAC2433	Handling of Mammalian Cell Culture	3	0+2+1
CUAC2434	Effect of different phytochemicals on Cell Culture	3	0+2+1
CUAC2435	Handling of Instruments and maintenance of culture room	3	0+2+1
CUAC2436	AELP Project	11	0+0+11

As per V Dean's committee suggestion, the A ELP modules were developed in the track mode where in a student will learn in one subject and develop expertise.

Evaluation for track I as that of practical courses mode.

Evaluation of Experiential Learning Programme/ HOT Track II

Sl no.	Parameter	Max marks
1	Project Planning and Writing	10
2	Presentation	10
3	Regularity	10
4	Monthly Assessment	10
5	Output delivery	10
6	Technical Skill Development	10
7	Entrepreneurship Skills	10
8	Business networking skills	10
9	Report Writing Skills	10
10	Final Presentation	10
	Total	100

SEMESTER – I

1.Fundamentals of Agronomy	[ASAG1101]	3(2+1)
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Objective: Understand the subject of agronomy and its scope in agriculture. Know the basic topics of agronomy to understand the subject in future

Course Outcomes: On successful completion of this course and basing on the diversified outcomes this course offers a wide scope for students in Skill development sector.

Theory

Agronomy and its scope, seeds and sowing, tillage and tilth, crop density and geometry, Crop nutrition, manures and fertilizers, nutrient use efficiency, water resources, crop water requirement, water use efficiency, irrigation- scheduling criteria and methods; logging;

Weeds and its importance, crop-weed competition, concepts of weed management – principles and methods, herbicides- classifications and selectivity;

Growth and development of crops, factors affecting growth and development, plant ideotypes, crop rotation and its principles, adaptation and distribution of crops, crop management technologies in problematic areas, harvesting and threshing of crops;

Practical

Identification of crops, seeds, fertilizers, pesticides and tillage implements, study of agro-climatic zones of India (including map pointing), Identification of major weeds in crops; methods of herbicide and fertilizer application; study of yield contributing characters and yield estimation, seed germination and viability test, numerical exercises on fertilizer requirement, plant population, herbicides and water requirement, Use of tillage implements-reversible plough, one way plough, harrow, leveler, seed drill and visit for on-farm and on-station field crops;

References

1. Reddy, S.R. 2016. Principles of Agronomy. Kalyani Publishers, Ludhiana, 5th Edition.
2. Yellamanda Reddy, T. and SankaraReddi, G.H. 2016. Principles of Agronomy, Kalyani Publishers, Ludhiana.
3. Gopal Chandra De. 1989. Fundamentals of Agronomy. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.

2. Fundamentals of Genetics	[ASPG1101]	3(2+1)
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Objective: The student knows about the different aspects of cell ultra-structure. The students with general concepts and classification of mutagens. The students have knowledge with general characteristics of chromosomes, genetical disorder and chromosomal aberrations. To acquaint the students with microscopic work on cellular components, mitosis and meiosis. To acquaint the students with different molecular aspect like DNA, RNA & proteins.

Course Outcomes: This course offers a good scope for students to take up employment.

Theory

Pre and Post Mendelian concepts of heredity, Mendelian principles of heredity, Cell division – mitosis, meiosis, Probability and Chi-square. Dominance relationships, gene interaction.

Multiple alleles, pleiotropism and pseudoalleles, Sex determination and sex linkage, sex limited and sex influenced traits, Blood group genetics, Linkage and its estimation, crossing over mechanisms, chromosome mapping. Structural changes in chromosome, Mutation, classification, Methods of inducing mutation & CIB technique, mutagenic agents and induction of mutation. Qualitative & Quantitative traits, Polygenes and continuous variations, multiple factor hypothesis, Epistatic interactions with examples. Cytoplasmic inheritance. Genetic disorders. Nature, structure & replication of genetic material. Protein synthesis, Transcription and translational mechanism of genetic material, Gene concept: Gene structure, function and regulation, Lac and Trp operons.

Practical

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

References

1. Pundhan Singh, 2006, Genetics, Kalyani Publishers, Ludhiana
2. Singh, B.D. 2015. Fundamentals of Genetics. Kalyani Publishers, Ludhiana
3. Gupta, P.K. 2007. Genetics. Rastogi Publications, Meerut
4. Khanna, V.K. 2002. Genetics Numerical Problems. Kalyani publishers. 2nd edition
5. Pundhan Singh. 2011. Genetics at a Glance. Kalyani Publishers, Ludhiana
6. Verma, P.S. 2013. Cell Biology, Genetics, Molecular Biology, Evolution and Ecology, S. Chand & Company Pvt. Ltd., Kolkata.
7. Snustad, D.P. and Simmons, M.J. 2010. Principles of Genetics, 5th Ed. John Wiley & Sons, 111, River Street, Hoboken, NJ, U.S.A.
8. Strickberger, M.W. 2006, Genetics, Prentice-Hall of India Pvt. Ltd., New Delhi

3.	Fundamentals of Soil Science	[ASAC1101]	3(2+1)
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Objective: Understand general concept about soil physical, chemical and biological properties and their characteristics. The students have general concepts and classification of soils of India. The students have knowledge with different types of soils and its importance.

Course Outcomes: This course offers a wide scope for students in skill development sectors.

Theory

Soil as a natural body, Pedological and edaphological concepts of soil; Soil genesis: soil forming rocks and minerals; weathering, processes and factors of soil formation; Soil Profile, components of soil; Soil physical properties: soil-texture, structure, density and porosity, soil colour, consistence and plasticity; Elementary knowledge of soil taxonomy classification and soils of India; Soil water retention, movement and availability; soil air, composition, gaseous exchange, problem and plant growth; source, amount and flow of heat in soil; soil temperature and plant growth; Soil reaction-pH,

soil acidity and alkalinity, buffering, effect of pH on nutrient availability; soil colloids - inorganic and organic; silicate clays: constitution and properties; sources of charge ion exchange, cation exchange capacity, base saturation; soil organic matter: composition, properties and its influence on soil properties; humic substances - nature and properties; soil organisms: macro and micro organisms, their beneficial and harmful effects; Soil pollution - behaviour of pesticides and inorganic contaminants, prevention and mitigation of soil pollution.

Practical

Study of soil profile in field. Study of soil sampling tools, collection of representative soil sample, its processing and storage. Study of soil forming rocks and minerals. Determination of soil density, moisture content and porosity. Determination of soil texture by feel and Bouyoucos Methods. Studies of capillary rise phenomenon of water in soil column and water movement in soil. Determination of soil pH and electrical conductivity. Determination of cation exchange capacity of soil. Study of soil map. Determination of soil colour. Demonstration of heat transfer in soil. Estimation of organic matter content of soil.

References

1. Indian Society of Soil Science 2012. Fundamentals of Soil Science. IARI, New Delhi
2. Das, D.K. 2015 Introductory soil science, 4th edition, Kalyani Publishers, New Delhi.
3. Sehgal, J. L. 2015. A text book of pedology. Kalyani Publishers, New Delhi.

4.i	Agricultural Economics and trade	[ASEC1101]	3(3+0)
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Objective: Derive clear understanding of the basic micro and macro-economic principles as they apply to agriculture. Understand and synthesize the magnitude and structure of the agricultural sector. Establish foundation knowledge for the advancement of agricultural economics and agribusiness trade. Broaden the educational knowledge base of the students in the area of agricultural economics and related sciences and their role in the broader Indian

Course Outcomes: This course offers a wide scope for students in employment sectors (Finance, etc).

Theory

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

Demand: meaning, law of demand, demand schedule and demand curve, determinants, utility theory; law of diminishing marginal utility, equi-marginal utility principle. Consumer's equilibrium and derivation of demand curve, concept of consumer surplus. Elasticity of demand: concept and measurement of price elasticity, income elasticity and cross elasticity.

Production: process, creation of utility, factors of production, input output relationship. *Laws of returns:* Law of variable proportions and law of returns to scale.

Cost: Cost concepts, short run and long run cost curves.

Supply: Meaning, law of supply, supply schedule, supply curve, determinants of supply, elasticity of supply.

Market structure: meaning and types of market, basic features of perfectly competitive and imperfect markets. Price determination under perfect competition; short run and long run equilibrium of firm and industry, shut down and break even points. Distribution theory: meaning, factor market and pricing of factors of production. Concepts of rent, wage, interest and profit.

National income: Meaning and importance, circular flow, concepts of national income accounting and approaches to measurement, difficulties in measurement. *Population*: Importance, Malthusian and Optimum population theories, natural and socio-economic determinants, current policies and programmes on population control. *Money*: Barter system of exchange and its problems, evolution, meaning and functions of money, classification of money, money supply, general price index, inflation and deflation. *Banking*: Role in modern economy, types of banks, functions of commercial and central bank, credit creation policy. *Agricultural and*

Public finance: meaning, micro v/s macro finance, need for agricultural finance, public revenue and public expenditure. *Tax*: meaning, direct and indirect taxes, agricultural taxation, VAT and GST.

Economic systems: Concepts of economy and its functions, important features of capitalistic.

Agricultural prices and policy: Meaning and functions of price; administered prices; need for agricultural price policy; *Trade*: Concept of International Trade and its need, theories of absolute and comparative advantage. Present status and prospects of international trade in agri-commodities; GATT and WTO; Agreement on Agriculture (AoA) and its implications on Indian agriculture; IPR.

References

1. Dewett,K.K. and Varma, J.D.2003.Elementary Economic Theory. S.Chand and Co, New Delhi
2. Dewett,K.K. and Chand,A.2009. Modern Economic Theory. S.Chand and Co, New Delhi
3. Paul A. Samuelson and Nordhus.2010. Economics. 19th Edition, Tata-Mac Graw Hill Education, New Delhi
4. Jhingan,M.L. 1990. Advanced Economic Theory. Vikas Publishing House, New Delhi
5. Koutsoyiannis.2015. Modern Microeconomics. Tata-Mac Graw Hill Publishers, New Delhi
6. The Economy 2016, www.core.econ.org.
7. www.wto.org

4.ii	Statistical Methods	[ASAS1101]	2(1+1)
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Objective: To impart knowledge to the students on basic concepts and statistical techniques applied in agriculture and allied sciences.

Course outcome: To enable the students to analyze data and draw appropriate statistical conclusions. To recognize and examine the relationships between inputs and outputs in their agricultural field to make effective and profitable decisions. Students will demonstrate an ability to engage in critical thinking by analyzing situations and constructing and selecting viable solutions to solve problems.

Theory

Introduction to Statistics and its Applications in Agriculture, Graphical Representation of Data, Measures of Central Tendency & Dispersion, Definition of Probability, Addition and Multiplication Theorem (without proof). Simple Problems Based on Probability. Binomial & Poisson Distributions, Definition of Correlation, Scatter Diagram. Karl Pearson's Coefficient of Correlation. Linear Regression Equations. Introduction to Test of Significance, One sample & two sample test t for Means, Chi-Square Test of Independence of Attributes in 2 · 2 Contingency Table. Introduction to Analysis of Variance, Analysis of One Way Classification. Introduction to Sampling Methods, Sampling versus Complete Enumeration, Simple Random Sampling with and without replacement, Use of Random Number Tables for selection of Simple Random Sample.

Practical

Graphical Representation of Data. Measures of Central Tendency (Ungrouped data) with Calculation of Quartiles, Deciles & Percentiles. Measures of Central Tendency (Grouped data) with Calculation of Quartiles, Deciles & Percentiles. Measures of Dispersion (Ungrouped Data). Measures of Dispersion (Grouped Data). Moments, Measures of Skewness & Kurtosis (Ungrouped Data). Moments, Measures of Skewness & Kurtosis (Grouped Data). Correlation & Regression Analysis. Application of One Sample t-test. Application of Two Sample Fisher's t-test. Chi-Square test of Goodness of Fit. Chi-Square test of Independence of Attributes for 2 · 2 contingency table. Analysis of Variance One Way Classification. Analysis of Variance Two Way Classification. Selection of random sample using Simple Random Sampling.

References

1. Nageswara Rao, G 2007. Statistics for Agricultural Sciences. B.S Publications, Hyderabad
2. Rangaswamy, R 1995. A Text Book of Agricultural Statistics. New Age International (P) Ltd., Publishers, Hyderabad.
3. Chandel SRS, Hand Book of Agricultural Statistics. Achal Prakashan Mandir Publications, New Delhi.
4. Agrawal, B.L. programmed Statistics. 2nd Edition, New Age International Publishers, Hyderabad.

5.i	Agricultural Heritage	[ASAH1101]	1(1+0)
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Objective: This Course offers a wide scope for students in employment sector. Know the heritage of Indian agriculture and its relevance to present context. Get an idea of present situation, problem and prospects of Indian agriculture. Acquire information on agricultural set-up of the country as well as world.

Course Outcomes: On completion of this course, the successful students should be able to get employment.

Theory

Introduction of Indian agricultural heritage; Ancient agricultural practices, Relevance of heritage to present day agriculture; Past and present status of agriculture and farmers in society; Journey of Indian agriculture and its development from past to modern era; Plant production and protection through indigenous traditional knowledge; Crop voyage in India and world; Agriculture scope; Importance of agriculture and agricultural resources available in India; Crop significance and classifications; National agriculture setup in India; Current scenario of Indian agriculture; Indian agricultural concerns and future prospects.

References

1. Choudary S.L., Sharma, G.S. and Nene, Y.L. (eds). Ancient and Medieval History of Indian Agriculture and its relevance to sustainable agriculture in the 21st century; Proceedings of the summer school held from 28 May to 17 June 1999. Rajasthan College of Agriculture, Udaipur 313001.
2. Nene Y.L. (ed.) 2005. Agricultural Heritage of Asia. Proceedings of the International conference, 6-8 December 2004, Asian-Agri History Foundation, Secunderabad- 500 009, Andhra Pradesh, India.

- Nene, Y.L. 2007. Glimpses of Agricultural Heritage of India. Asian-Agri History Foundation, 47 ICRISAT Colony-1, Brig. Syed Road, Secunderabad- 5000 009, AP, India 901 pp. ISBN-81-903963-0-7.

5.ii	Comprehension and Communication Skills in English	[ASEL1101]	2(1+1)
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Objective: To understand the basic concepts of spoken English and communication skills

Course Outcome: After completion of this course, the students will have proficiency in basic speaking and communication skills in English.

Theory

War Minus Shooting- The sporting Spirit. A Dilemma- A layman looks at science Raymond B. Fosdick. You and Your English – Spoken English and broken English G.B. Shaw. Reading Comprehension, Vocabulary- Antonym, Synonym, Homophones, Homonyms, often confused words. Exercises to Help the students in the enrichment of vocabulary based on TOEFL and other competitive examinations. Functional grammar: Articles, Prepositions, Verb, Subject verb Agreement, Transformation, Synthesis, Direct and Indirect Narration. Written Skills: Paragraph writing, Precise writing, Report writing and Proposal writing. The Style: Importance of professional writing. Preparation of Curriculum Vitae and Job applications. Synopsis Writing. Interviews: kinds, Importance and process.

Practical

Listening Comprehension: Listening to short talks lectures, speeches (scientific, commercial and general in nature). Oral Communication: Phonetics, stress and intonation, Conversation practice. Conversation: rate of speech, clarity of voice, speaking and Listening, politeness & Reading skills: reading dialogues, rapid reading, intensive reading, improving reading skills. Mock Interviews: testing initiative, team spirit, leadership, intellectual ability. Group Discussions.

References

- Balasubramanian, T. 1989. A Text Book of Phonetics for Indian Student, Orient Longman, New Delhi.
- Balasubramanyam, M. 1985. Business Communication. Vani Education Books, New Delhi.
- Jean Naterop, B. and Rod Revell. 1977. Telephoning in English. Cambridge University Press, Cambridge.
- Krishna Mohan and Meera Banerjee. 1990. Developing Communication Skills. McMillan India Ltd., New Delhi.
- Krishnaswamy, N and Sriramman, T. 1985. Current English for Colleges. Mc Millan India Ltd., Madras.
- Narayanaswamy V R. 1979. Strengthen Your Writing. Orient Longman, New Delhi.
- Sharma R C and Krishna Mohan. 1978. Business Correspondence. Tata Mc Graw Hill Publishing Company, New Delhi.

6.	Fundamentals of Horticulture	[ASHO1101]	2 (1+1)
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Objective: Students get an introductory knowledge about horticulture crops. Knowledge about the use of various fertilizers, plant growth regulators and irrigation management. Get acquainted with the tools and implements used for various cultural practices of horticulture.

Course Outcomes: This course offers a wide scope for students in employment sectors.

Theory

Horticulture-Its definition and branches, importance and scope; horticultural and botanical classification; climate and soil for horticultural crops; Plant propagation-methods and propagating structures; principles of orchard establishment; Principles and methods of training and pruning, juvenility and flower bud differentiation; unfruitfulness; pollination, pollinizers and pollinators; fertilization and parthenocarpy; kitchen gardening; garden types and parts; lawn making; medicinal and aromatic plants; species and condiments; use of plant bio-regulators in horticulture. Irrigation & fertilizers application-method and quantity.

Practical

Identification of garden tools. Identification of horticultural crops. Preparation of seed bed/nursery bed. Practice of sexual and asexual methods of propagation. Layout and planting of orchard plants. Training and pruning of fruit trees. Transplanting and care of vegetable seedlings. Making of herbaceous and shrubbery borders. Preparation of potting mixture, potting and repotting. Fertilizer application in different crops. Visits to commercial nurseries/orchard.

References

1. Chadha,K.L.2001. Handbook of Horticulture, ICAR, New Delhi
2. Jitendra Singh, 2012, Basic Horticulture, Kalyani Publishers, New Delhi
3. Randhawa, G.s. and Mukhopadhyaya, A.1994. Floriculture in India. Allied Publishers Pvt. Ltd. New Delhi.
4. Kumar, N. 1997. Introduction to Horticulture. Rajyalakshmi Publications. Nagorcoil, Tamilnadu.

7.	Fundamentals of Plant Pathology	[ASPP1101]	3(2+1)
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Objective: The student knows about the early development & role of different micro-organism in development of plant disease. The students gain knowledge on general concepts and classification of plant diseases. The students have knowledge with general characteristics of fungi, bacteria, virus and mycoplasma like organisms causing plant diseases. To acquaint the students with reproduction in fungi and fungal like organisms causing plant diseases.

Course Outcomes: On successful completion of this course and basing on the diversified course outcomes this course offers a good scope for students in employment sector.

Theory

Introduction: Importance of plant diseases, scope and objectives of Plant Pathology. History of Plant Pathology with special reference to Indian work. Terms and concepts in Plant Pathology. Pathogenesis. Cause and classification of plant diseases. Important plant pathogenic organisms, different groups: fungi, bacteria, fastidious vesicular bacteria, phytoplasmas, spiroplasmas, viruses, viroids, algae, protozoa, phanerogamic parasites and nematodes with examples of diseases caused by them. Diseases and symptoms due to abiotic causes.

Fungi: general characters, definition of fungus, somatic structures, types of fungal thalli, fungal tissues, modifications of thallus, reproduction (asexual and sexual). Nomenclature, Binomial system of nomenclature, rules of nomenclature, classification of fungi. Key to divisions,sub-divisions, orders and classes.

Bacteria and mollicutes: general morphological characters. Basic methods of classification and reproduction.

Viruses:nature, architecture, multiplication and transmission.

Study of phanerogamic plant parasites.

Nematodes: General morphology and reproduction, classification, symptoms and nature of damage caused by plant nematodes (Heterodera, Meloidogyne, *Anguina* etc.)

Principles and methods of plant disease management.

Nature, chemical combination, classification, mode of action and formulations of fungicides and antibiotics.

Practical:

Acquaintance with various laboratory equipments and microscopy.Preparation of media, isolation and Koch's postulates.General study of different structures of fungi.Study of symptoms of various plant diseases. Study of representative fungal genera. Staining and identification of plant pathogenic bacteria. Transmission of plant viruses. Study of phanerogamic plant parasites.

Study of morphological features and identification of plant parasitic nematodes. Extraction of nematodes from soil.

Study of fungicides and their formulations. Methods of pesticide application and their safe use. Calculation of fungicide sprays concentrations.

References

1. Dube, H.C. 2013, An Introduction to Fungi, 4th (Edition), Scientific Publishers, Jodhpur, India, (major text book)
2. Webster, j.1989. Introduction to fungi, Cambridge Univ.Press(for life cycles of Fungi)
3. Dasgupta, M.K.1987. Principles of Plant Pathology, Allied Publ.Pvt.Ltd. p985.(for rust life cycles)
4. Students are also advised to refer Introductory Mycology by Alexopoulos, Mims and Blackwell(4th Edition) for Fungi.
5. For Bacteria, Viruses, Viroids, Phanerogamic Plant Parasites, Nematodes.
6. Agrios, G.N. 2006, Plant Pathology, Elsevier Publishers, New Delhi.

8.	Rural Sociology & Educational Psychology	[ASEE1102]	2(1+1)
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Objective: Students know the rural society, culture, caste and value system of rural society. Students understand leadership and its role in agricultural extension Students understand the Teaching-Learning process, Students understand various institutions involved in rural society.

Course Outcomes: This course offers a wide scope for students in employment sectors (NGO).

Theory

Sociology and Rural sociology: Definition and scope, its significance in agriculture extension, Rural society, Social Groups, Social Stratification, Culture concept, Social Institution, Social Change & Development. Educational psychology: Meaning & its importance in agriculture extension. Behavior: Cognitive, affective, psychomotor domain, Personality, Learning, Motivation, Theories of Motivation, Intelligence.

Practical

Visit to village to study the characteristics of rural society and rural stratification; social groups, village institutions- school/ co operative society/ gram panchayat / water users association; visit to a

village to list out the Folkways, Mores, Taboos, Ritual, Customs, Tradition, Culture, Etiquette, Social Values, Simulated Exercises for positive and Negative Emotions of farmers in a village. Administering Psychological Tests to assess personality Types of Human Beings. Experiment: 1. Eysenk personality inventory; 2. Edward's Personality inventory. Types of intelligence and frustrations among farmers, Creating a Learning Situation under village Conditions- Organizing a extension Talk for Farmers in the village / conduct of a Method Demonstration in a village situation.

References

1. Adivi Reddy, A. 2006. Extension Education. Sree Lakshmi Press, Bapatla
2. Chitamber, J.B. 1997. Introductory Rural Sociology. Wiley Eastern Limited, New Delhi.
3. Daivadeenam,P. 2006. Educational Psychology in Agriculture. Agrotech Publishing Academy, Udaipur.
4. Mangal, S.K. 2000. Educational Psychology. Prakash Brothers, Ludhiana.
5. Ray, G.L. 2006. Extension Communication and Management. Naya Prokash/Kalyani Publishers, Ludhiana.
6. VidyaBhushan and Sach Dev.D.R. 1998. An Introduction to Rural Sociology. Kitab Mahal Agencies Allahabad.

9.	Soil and Water Conservation Engineering	[ASAE1101]	2(1+1)
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Objective: To have an understanding about the degradation of productive soil and the causes of its erosion, measurement techniques for soil loss and wind erosion and suggesting control measures
 Course Outcomes: After learning the topic a student will be able to know about the various types of soil, water and wind erosion along with its mitigation measures and agronomic and engineering methods of conservation and the design of bunds and terraces being implemented on the field.

Theory

Introduction to Soil and Water Conservation, causes of soil erosion. Definition and agents of soil erosion, water erosion: Forms of water erosion. Gully classification and control measures. Soil loss estimation by universal Loss Soil Equation. Soil loss measurement techniques. Principles of erosion control: Introduction to contouring, strip cropping. Contour bund. Graded bund and bench terracing. Grassed water ways and their design. Water harvesting and its techniques. Wind erosion: mechanics of wind erosion, types of soil movement. Principles of wind erosion control and its control measures.

Practical

General status of soil conservation in India. Calculation of erosion index. Estimation of soil loss. Measurement of soil loss. Preparation of contour maps. Design of grassed water ways. Design of contour bunds. Design of graded bunds. Design of bench terracing system. Problem on wind erosion.

References

1. Ghanashyam Das, 2012. Hydrology and soil conservation Engineering, including watershed management. Second edition, PHI Learning Pvt. Ltd., New Delhi
2. Murthy, V.V.N. 2004. Land and Water Management Engineering, Kalyani Publishers, New Delhi
3. Micheal, A.M. 2007. Irrigation Theory and Practice. Second edition. Vikas Publishing House, Pvt. Ltd.
4. Mal, B.C. 1995. Introduction to soil and water conservation engineering. Kalyani Publishers, Ludhiana.
5. Kanetkar, T.P. 1993. Surveying and Levelling. Pune Vidyarthi Griha, prakashan, Pune
6. Suresh, R. 2008. Land and Water Management. Standard Publishers and Distributors, Delhi

10.i	Introductory Biology	[ASIB1101]	2(1+1)
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Objective: To understand the basic concepts of biology and evolution of living organism

Course Outcomes: After completion of this course, students will have an updates knowledge on the living organism and their evolution

Theory

Introduction to the living world, diversity and characteristics of life, origin of life, Evolution and Eugenics. Binomial nomenclature and classification Cell and cell division. Morphology of flowering plants. Seed and seed germination. Plant systematic- viz; Brassicaceae, Fabaceae and Poaceae. Role of animals in agriculture.

Report of the ICAR Fifth Deans' Committee

Practical

Morphology of flowering plants – root, stem and leaf and their modifications. Inflorescence, flower and fruits. Cell, tissues & cell division. Internal structure of root, stem and leaf. Study of specimens and slides. Description of plants - Brassicaceae, Fabaceae and Poaceae.

References

1. Biology- Raven P, Mason Johnson G B, Losos J.B, Singer.S.S, 10th edition, 2014, McGraw Hill Publications.
2. M.G.Simpson, 2006. Plant Systematics. Elsevier Publications.
3. H.C.Gangulee 1972 College Botany 4th edition.
4. A.C.Dutta 1964 A class book of Botany Botany for Degree Students, Oxford University Press, Calcutta.
5. N.T.Gill, 1966. Agricultural Botany. 2nd edition.

10.ii.	Elementary Mathematics	[ASEM1101]	2(2+0)
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Objective: To understand the basic concepts and calculations in mathematics

Course outcome: After successful completion of the course, students will be able to perform the basic calculations and equations in mathematics

Theory

Straight lines : Distance formula, section formula (internal and external division), Change of axes (only origin changed), Equation of co-ordinate axes, Equation of lines parallel to axes, Slope-intercept form of equation of line, Slope-point form of equation of line, Two point form of equation of line, Intercept form of equation of line, Normal form of equation of line, General form of equation of line, Point of intersection of two st. lines, Angles between two st. lines, Parallel lines, Perpendicular lines, Angle of bisectors between two lines, Area of triangle and quadrilateral.

Circle: Equation of circle whose centre and radius is known, General equation of a circle, Equation of circle passing through three given points, Equation of circle whose diameters is line joining two points (x₁, y₁) & (x₂, y₂), Tangent and Normal to a given circle at given point (Simple problems), Condition

of tangency of a line $y = mx + c$ to the given circle $x^2 + y^2 = a^2$. Differential Calculus : Definition of function, limit and continuity, Simple problems on limit, Simple problems on continuity, Differentiation of x^n , e^x , $\sin x$ & $\cos x$ from first principle, Derivatives of sum, difference, product and quotient of two functions, Differentiation of functions of functions (Simple problem based on it), Logarithmic differentiation (Simple problem based on it), Differentiation by substitution method and simple problems based on it, Differentiation of Inverse Trigonometric functions. Maxima and Minima of the functions of the form $y=f(x)$ (Simple problems based on it).

Integral Calculus : Integration of simple functions, Integration of Product of two functions, Integration by substitution method, Definite Integral (simple problems based on it), Area under simple well-known curves (simple problems based on it).

Matrices and Determinants: Definition of Matrices, Addition, Subtraction, Multiplication, Transpose and Inverse up to 3rd order, Properties of determinants up to 3rd order and their evaluation.

References

1. MVSL DN Raju and Dr. K.V. Ramana- Engineering Mathematics-1
2. MVSL DN Raju and Dr. K.V. Ramana- Engineering Mathematics-2
3. Text Book for A.P Intermediate Mathematics-Paper (IA & IIB)
4. MVSL DN Raju and K.V. Ramana-Agricultural Mathematics .

SEMESTER – II

1.	Fundamentals of Crop Physiology	[ASPH1201]	3(2+1)
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Objective: The students will be familiar with the recent developments in the area of crop physiology. Distinguish key physiological processes underlying the formation of seedlings from seed embryos, Relate crop physiological processes with agronomic practices used in crop production systems. Integrate and apply their knowledge of crop physiology for analytical thinking and solving practical problems experienced in agricultural systems. Identify the physiological factors that regulate growth and developmental processes of crops

Course Outcomes: On successful completion of this course and basing on the diversified outcomes this course offers a good scope for students in employment sector.

Theory

Introduction to crop physiology and its importance in Agriculture; Plant cell: an Overview; Diffusion and osmosis; Absorption of water, transpiration and Stomatal Physiology; Mineral nutrition of Plants: Functions and deficiency symptoms of nutrients, nutrient uptake mechanisms; Photosynthesis: Light and Dark reactions, C₃, C₄ and CAM plants; Respiration: Glycolysis, TCA cycle and electron transport chain; Fat Metabolism: Fatty acid synthesis and Breakdown; Plant growth regulators: Physiological roles and agricultural uses, Physiological aspects of growth and development of major crops: Growth analysis, Role of Physiological growth parameters in crop productivity.

Practical

Study of plant cells, structure and distribution of stomata, imbibitions, osmosis, plasmolysis, measurement of root pressure, rate of transpiration, Separation of photosynthetic pigments through paper chromatography, Rate of transpiration, photosynthesis, respiration, tissue test for mineral

nutrients, estimation of relative water content, Measurement of photosynthetic CO₂ assimilation by Infra Red Gas Analyser (IRGA).

References

1. Taiz, L. and zeiger,E. 2010. Plant Physiology 5th edition, Sinauer Associates, Sunderland, MA, USA.
2. Gardner, F.P., Pearce, R.B., and Mitchell, R.L. 1985. Physiology of Crop Plants, Scientific Publishers, Jodhpur.
3. Noggle, G.R. and Fritz, G.J., 1983. Introductory Plant Physiology. 2nd Edition. Prentice Hall Publishers, New Jersey, USA.

2.	Introduction to Forestry	[ASIF1201]	2(1+1)
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Objective: Understand the subject of forestry and its scope in agriculture. Know the basics of forestry to understand the importance in agricultural situations as well as in natural resource management

Course Outcomes: On successful completion of this course and basing on the diversified outcomes this course offers a wide scope for students in employment, skill development and entrepreneurial sectors.

Theory

Introduction – definitions of basic terms related to forestry, objectives of silviculture, forest classification, salient features of Indian Forest Policies. Forest regeneration, Natural regeneration - natural regeneration from seed and vegetative parts, coppicing, pollarding, root suckers; Artificial regeneration – objectives, choice between natural and artificial regeneration, essential preliminary considerations. Crown classification. Tending operations – weeding, cleaning, thinning – mechanical, ordinary, crown and advance thinning. Forest mensuration – objectives, diameter measurement, instruments used in diameter measurement; Non instrumental methods of height measurement - shadow and single pole method; Instrumental methods of height measurement - geometric and trigonometric principles, instruments used in height measurement; tree stem form, form factor, form quotient, measurement of volume of felled and standing trees, age determination of trees. Agroforestry – definitions, importance, criteria of selection of trees in agroforestry, different agroforestry systems prevalent in the country, shifting cultivation, taungya, alley cropping, wind breaks and shelter belts, home gardens. Cultivation practices of two important fast growing tree species of the region.

Practical

Identification of tree-species. Diameter measurements using calipers and tape, diameter measurements of forked, buttressed, fluted and leaning trees. Height measurement of standing trees by shadow method, single pole method and hypsometer. Volume measurement of logs using various formulae. Nursery lay out, seed sowing, vegetative propagation techniques. Forest plantations and their management. Visits of nearby forest based industries.

References

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4. Singh, S.P. 2009. Tree farming. Agrotech Publishing academy, Udaipur.
5. Singh, S.P.2010. Favourite Agroforestry trees, Agrotech Publishing academy, Udaipur.
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3.	Introductory Agro meteorology and climate change	[ASAG1202]	2(1+1)
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Objective: Understand different parameters of weather and climate and their relations in crop production. Get knowledge about the issues related to climate change and its impact in agricultural production system. Get knowledge on adaptation and mitigation options to combat adverse effect of climate change

Course Outcomes: On successful completion of this course and basing on the diversified outcomes this course offers a wide scope for students in employment, skill development and entrepreneurial sectors.

Theory

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, longwave and thermal radiation, net radiation, albedo; Atmospheric temperature, temperature inversion, lapse rate, daily and seasonal variations of temperature, vertical profile of temperature, Energy balance of earth; Atmospheric humidity, concept of saturation, vapor 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, Weather hazards - drought, floods, frost, tropical cyclones and extreme weather conditions such as heat-wave and cold-wave. Agriculture and weather relations; Modifications of crop microclimate, climatic normals for crop and livestock production. Weather forecasting- types of weather forecast and their uses. Climate change, climatic variability, global warming, causes of climate change and its impact on regional and national Agriculture.

Practical:

Visit of Agrometeorological Observatory, site selection of observatory, exposure of instruments and weather data recording. Measurement of total, shortwave and longwave 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 windrose. Measurement, tabulation and analysis of rain. Measurement of open pan evaporation and evapotranspiration. Computation of PET and AET.

References

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2. Reddy, S.R. 2014. Introduction to Agriculture and Agrometeorology. Kalyani Publishers, Ludhiana, Punjab.
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4.	Agricultural Microbiology	[ASAM1201]	2(1+1)
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Objective: The student knows about the early development & role of diazotrophs in plant growth. The students get acquainted with general concepts and applications of soil microbes in improving soil fertility.

Course Outcomes: On successful completion of this course and basing on the diversified course outcomes this course offers a good scope for students in employment sector.

Theory

Introduction. Microbial world: Prokaryotic and eukaryotic microbes. Bacteria: cell structure, chemoautotrophy, photo autotrophy, growth. Bacterial genetics: Genetic recombination-transformation, conjugation and transduction, plasmids, transposon.

Role of microbes in soil fertility and crop production: Carbon, Nitrogen, Phosphorus and sulphur cycles. Biological nitrogen fixation- symbiotic, associative and aysmbiotic. Azolla, blue green algae and mycorrhiza. Rhizosphere and phyllosphere. Microbes in human welfare: silage production, biofertilizers, biopesticides, biofuel production and biodegradation.

Practical

Introduction to microbiology laboratory and its equipments; Microscope- parts, principles of microscopy, resolving power and numerical aperture. Methods of sterilization. Nutritional media and their preparations. Enumeration of microbial population in soil- bacteria, fungi, actinomycetes. Methods of isolation and purification of microbial cultures. Isolation of *Rhizobium* from legume root nodule. Isolation of *Azotobacter* from soil. Isolation of *Azospirillum* from roots. Staining and microscopic examination of microbes.

References

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6. Experiments in Microbiology, Plant Pathology and Biotechnology, Aneja, K.R.2011. New Age International (P) Ltd., Publishers, New Delhi.

5.i	Statistical Methods	[ASAS1101]	2(1+1)
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Objective: To impart knowledge to the students on basic concepts and statistical techniques applied in agriculture and allied sciences.

Course outcome: To enable the students to analyze data and draw appropriate statistical conclusions. To recognize and examine the relationships between inputs and outputs in their agricultural field to make effective and profitable decisions. Students will demonstrate an ability to engage in critical thinking by analyzing situations and constructing and selecting viable solutions to solve problems.

Theory

Introduction to Statistics and its Applications in Agriculture, Graphical Representation of Data, Measures of Central Tendency & Dispersion, Definition of Probability, Addition and Multiplication Theorem (without proof). Simple Problems Based on Probability. Binomial & Poisson Distributions, Definition of Correlation, Scatter Diagram. Karl Pearson's Coefficient of Correlation. Linear Regression Equations. Introduction to Test of Significance, One sample & two sample test t for Means, Chi-Square Test of Independence of Attributes in 2 · 2 Contingency Table. Introduction to

Analysis of Variance, Analysis of One Way Classification. Introduction to Sampling Methods, Sampling versus Complete Enumeration, Simple Random Sampling with and without replacement, Use of Random Number Tables for selection of Simple Random Sample.

Practical

Graphical Representation of Data. Measures of Central Tendency (Ungrouped data) with Calculation of Quartiles, Deciles & Percentiles. Measures of Central Tendency (Grouped data) with Calculation of Quartiles, Deciles & Percentiles. Measures of Dispersion (Ungrouped Data). Measures of Dispersion (Grouped Data). Moments, Measures of Skewness & Kurtosis (Ungrouped Data). Moments, Measures of Skewness & Kurtosis (Grouped Data). Correlation & Regression Analysis. Application of One Sample t-test. Application of Two Sample Fisher's t-test. Chi-Square test of Goodness of Fit. Chi-Square test of Independence of Attributes for 2 · 2 contingency table. Analysis of Variance One Way Classification. Analysis of Variance Two Way Classification. Selection of random sample using Simple Random Sampling.

References

5. Nageswara Rao, G 2007. Statistics for Agricultural Sciences. B.S Publications, Hyderabad
6. Rangaswamy, R 1995. A Text Book of Agricultural Statistics. New Age International (P) Ltd., Publishers, Hyderabad.
7. Chandel SRS, Hand Book of Agricultural Statistics. Achal Prakashan Mandir Publications, New Delhi.
8. Agrawal, B.L. programmed Statistics. 2nd Edition, New Age International Publishers, Hyderabad.

5.ii	Agricultural Economics and trade	[ASEC1101]	3(3+0)
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Objective: Help students to contribute to better decision making by farmers, or by agencies servicing agriculture. Help students to understand why farmers respond to policies and economic opportunities in the ways they do. To acquaint the learner with introductory Agricultural Economics, development of agriculture in India, use of yield increasing inputs, marketing, trade and prices.

Course outcome: Improved decision making about things like agricultural production methods, agricultural input levels and resource conservation etc. Students should be able to communicate effectively, economic concepts, decision-making, and agricultural and trade concepts. Students should have the skills to fit into a business, agency, or academic environment and use economic concepts to quantify and analyse issues related to their employer's issues.

Theory

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

Demand: meaning, law of demand, demand schedule and demand curve, determinants, utility theory; law of diminishing marginal utility, equi-marginal utility principle. Consumer's equilibrium and derivation of demand curve, concept of consumer surplus. Elasticity of demand: concept and measurement of price elasticity, income elasticity and cross elasticity.

Production: process, creation of utility, factors of production, input output relationship. *Laws of returns*: Law of variable proportions and law of returns to scale.

Cost: Cost concepts, short run and long run cost curves.

Supply: Meaning, law of supply, supply schedule, supply curve, determinants of supply, elasticity of supply.

Market structure: meaning and types of market, basic features of perfectly competitive and imperfect markets. Price determination under perfect competition; short run and long run equilibrium of firm and industry, shut down and break even points. Distribution theory: meaning, factor market and pricing of factors of production. Concepts of rent, wage, interest and profit.

National income: Meaning and importance, circular flow, concepts of national income accounting and approaches to measurement, difficulties in measurement. Population: Importance, Malthusian and Optimum population theories, natural and socio-economic determinants, current policies and programmes on population control. Money: Barter system of exchange and its problems, evolution, meaning and functions of money, classification of money, money supply, general price index, inflation and deflation. Banking: Role in modern economy, types of banks, functions of commercial and central bank, credit creation policy. Agricultural and

Public finance: meaning, micro v/s macro finance, need for agricultural finance, public revenue and public expenditure. *Tax*: meaning, direct and indirect taxes, agricultural taxation, VAT and GST.

Economic systems: Concepts of economy and its functions, important features of capitalistic.

Agricultural prices and policy: Meaning and functions of price; administered prices; need for agricultural price policy; Trade: Concept of International Trade and its need, theories of absolute and comparative advantage. Present status and prospects of international trade in agri-commodities; GATT and WTO; Agreement on Agriculture (AoA) and its implications on Indian agriculture; IPR.

References

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2. Dewett, K.K. and Chand, A. 2009. *Modern Economic Theory*. S.Chand and Co, New Delhi
3. Paul A. Samuelson and Nordhus. 2010. *Economics*. 19th Edition, Tata-Mac Graw Hill Education, New Delhi
4. Jhingan, M.L. 1990. *Advanced Economic Theory*. Vikas Publishing House, New Delhi
5. Koutsoyiannis. 2015. *Modern Microeconomics*. Tata-Mac Graw Hill Publishers, New Delhi
6. *The Economy 2016*, www.core.econ.org.
7. www.wto.org

6.i.	Comprehension and Communication Skills in English	[ASEL1101]	2(1+1)
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Objective: To understand the basic concepts of spoken English and communication skills

Course Outcome: After completion of this course, the students will have proficiency in basic speaking and communication skills in English

Theory

War Minus Shooting- The sporting Spirit. A Dilemma- A layman looks at science Raymond B. Fosdick. You and Your English – Spoken English and broken English G.B. Shaw. Reading Comprehension, Vocabulary- Antonym, Synonym, Homophones, Homonyms, often confused words. Exercises to Help the students in the enrichment of vocabulary based on TOEFL and other competitive examinations. Functional grammar: Articles, Prepositions, Verb, Subject verb Agreement,

Transformation, Synthesis, Direct and Indirect Narration. Written Skills: Paragraph writing, Precise writing, Report writing and Proposal writing. The Style: Importance of professional writing. Preparation of Curriculum Vitae and Job applications. Synopsis Writing. Interviews: kinds, Importance and process.

Practical

Listening Comprehension: Listening to short talks lectures, speeches (scientific, commercial and general in nature). Oral Communication: Phonetics, stress and intonation, Conversation practice. Conversation: rate of speech, clarity of voice, speaking and Listening, politeness & Reading skills: reading dialogues, rapid reading, intensive reading, improving reading skills. Mock Interviews: testing initiative, team spirit, leadership, intellectual ability. Group Discussions.

References

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13. Narayanaswamy V R. 1979. Strengthen Your Writing. Orient Longman, New Delhi.
14. Sharma R C and Krishna Mohan. 1978. Business Correspondence. Tata Mc Graw Hill Publishing Company., New Delhi.

6.ii	Agricultural Heritage	[ASAH1101]	1(1+0)
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Objective: This Course offers a wide scope for students in employment sector. Know the heritage of Indian agriculture and its relevance to present context. Get an idea of present situation, problem and prospects of Indian agriculture. Acquire information on agricultural set-up of the country as well as world.

Course Outcomes: On completion of this course, the successful students should be able to get employment.

Theory

Introduction of Indian agricultural heritage; Ancient agricultural practices, Relevance of heritage to present day agriculture; Past and present status of agriculture and farmers in society; Journey of Indian agriculture and its development from past to modern era; Plant production and protection through indigenous traditional knowledge; Crop voyage in India and world; Agriculture scope; Importance of agriculture and agricultural resources available in India; Crop significance and classifications; National agriculture setup in India; Current scenario of Indian agriculture; Indian agricultural concerns and future prospects.

References

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2. Nene Y.L. (ed.) 2005. Agricultural Heritage of Asia. Proceedings of the International conference, 6-8 December 2004, Asian-Agri History Foundation, Secunderabad- 500 009, Andhra Pradesh, India.
3. Nene, Y.L. 2007. Glimpses of Agricultural Heritage of India. Asian-Agri History Foundation, 47 ICRISAT Colony-1, Brig. Syed Road, Secunderabad- 5000 009, AP, India 901 pp. ISBN-81-903963-0-7.

7.	Irrigation water management	[ASAG1206]	2(1+1)
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Objective: Get knowledge issues related to water management in crops. Get expertise in efficient water management to ensure maximum water productivity

Course Outcomes: This course offers a wide scope for students in employment, skill development and entrepreneurial sectors.

Theory

Irrigation: Definition and objectives; water resources, irrigation projects (major, medium and minor) in India and A.P. and Odisha; Soil Plant Water relationships; Methods of soil moisture estimation; Evapotranspiration and Crop water requirement; Duty of water; Conjunctive use of water; Scheduling of irrigation; Methods of irrigation-surface, subsurface, sprinkler and drip irrigation; Irrigation efficiency and Water use efficiency; Irrigation water quality criteria and its management; Water logging; Agricultural drainage.

Practical

Measurement of bulk density, study of soil moisture measuring devices, determination of field capacity and permanent wilting point, measurement of infiltration rate, irrigation water, scheduling of irrigation by IW/CPE ratio method, calculation on soil moisture, irrigation water needs, duty of water and irrigation efficiencies, layout of surface methods of irrigation, demonstration of drip and sprinkler irrigation, visit to micro irrigation systems in farmer's fields, water management practices in different crops.

References

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3. SankaraReddi, G.H. and Yellamanda Reddy, T. 2006. Efficient Use of Irrigation Water. Kalyani Publishers, Ludhiana.
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8.	Production Technology for Vegetable and Spices	[ASHO1203]	2 (1+1)
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Objective: Classification of vegetables and spices crop. Various cultural practices related to production of vegetables and spices. Seed production techniques of important crops. Economics and Marketing of vegetables and spices crop.

Course Outcomes: This course offers a wide scope for students in entrepreneurship sectors.

Theory

Importance of vegetables & spices in human nutrition and national economy, brief about origin, area, production, improved varieties and cultivation practices such as time of sowing, sowing, transplanting techniques, planting distance, fertilizer requirements, irrigation, weed management, harvesting, storage, physiological disorders, disease and pest control and seed production of important vegetable and spices.

Practical

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

References

1. Pranab Hazra, A. Chattopadhyay, K. Karmakar and S. Dutta. 2010. Modern Technology in Vegetable Production. New India Publishing Agency, New Delhi
2. Neeraj Pratap Singh, 2007. Basic Concepts of Vegetable Science. International Book Distributing Co. New Delhi, Academic Press, New Delhi.
3. Nempal Singh, Singh, D.K., Singh, Y.K. and Virendra Kumar. 2006. Vegetable Seed Production Technology. International Book Distributing Co. Lucknow.
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6. Shanmugavelu, K.G., N. Kumar and K.V. Peter 2005, Production Technology of Spices and Plantation Crops. Agrobios(India), Jodhpur.

9.	Fundamentals of Entomology-I (Insect morphology and Taxonomy)	[ASEN1201]	3(2+1)
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Objective: The student knows about Morphology of the insects. The student understands the Physiology of insects. Students have knowledge with the classification of insects and distinguished characters of different families

Course Outcomes: Basing on the diversified course outcomes this course offers a good scope for students in employment sector.

Theory

History of Entomology in India. Factors for insect's abundance. Major points related to dominance of Insecta in Animal kingdom. Classification of phylum Arthropoda upto classes. Relationship of class Insecta with other classes of Arthropoda. Morphology: Structure and functions of insect cuticle and molting. Body segmentation. Structure of Head, thorax and abdomen. Structure and modifications of insect antennae, mouth parts, legs, Wing venation, modifications and wing coupling apparatus. Structure of male and female genital organ. Metamorphosis and diapause in insects. Types of larvae and pupae. Structure and functions of digestive, circulatory, excretory, respiratory, nervous, secretary (Endocrine) and reproductive system, in insects. Types of reproduction in insects. Major sensory organs like simple and compound eyes, chemoreceptor.

Systematics: Taxonomy –importance, history and development and binomial nomenclature. Definitions of Biotype, Sub-species, Species, Genus, Family and Order. Classification of class Insecta

upto Orders, basic groups of present day insects with special emphasis to orders and families of Agricultural importance like Orthoptera: Acrididae, Tettigonidae, 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, Papilionidae, Noctuidae, Sphingidae, Pyralidae, Gelechiidae, Arctiidae, Saturnidae, Bombycidae; Coleoptera: Coccinellidae, Chrysomelidae, Cerambycidae, Curculionidae, Bruchidae, Scarabaeidae; Hymenoptera: Tenthredinidae, Apidae. Trichogrammatidae, Ichneumonidae, Braconidae, Chalcididae; Diptera: Cecidomyiidae, Tachinidae, Agromyziidae, Culicidae, Muscidae, Tephritidae.

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); Dissection of male and female reproductive systems 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.

References

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2. Nayar, K.K. Ananthakrishnan, T.N. and David, B.V. 1976. General and Applied Entomology. Tata McGraw-Hill Publishing Co. Ltd., New Delhi.
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6. Upadhyaya K D and Divide 1997. A text book of plant nematology. Aman Publishing House Meerat
7. Vasantha Raj David, B. 2003. Elements of Economic Entomology. Popular Book Depot, Coimbatore.

10	Fundamentals of Agricultural Extension Education	[ASEE1201]	3 (2+1)
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Objective: Students have the knowledge of concept of extension education and its importance in agricultural development. Students are exposed towards various rural development programmes aimed at poverty alleviation and to increase employment opportunities and their analysis. Students have knowledge about extension system worldwide and new dimensions of Agricultural Extension in India.

Course Outcomes: This course offers a wide scope for students in employment sectors (NGO's, agribusiness companies).

Theory

Education: Meaning, definition & Types; Extension Education- meaning, definition, scope and process; objectives and principles of Extension Education; Extension Programme planning- Meaning, Process, Principles and Steps in Programme Development. Extension systems in India: extension efforts in pre-independence era (Sriniketan, Marthandam, Firka Development Scheme, Gurgaon Experiment, etc.) and post-independence era (Etawah Pilot Project, Nilokheri Experiment, etc; various extension/ agriculture development programmes launched by ICAR/ Govt. of India (IADP, IAAP,

HYVP, KVK, IVLP, ORP, ND,NATP, NAIP, etc.). New trends in agriculture extension: privatization extension, cyber extension/ e-extension, market-led extension, farmer-led extension, expert systems, etc.

Rural Development: concept, meaning, definition; various rural development programmes launched by Govt. of India. Community Dev.-meaning, definition, concept & principles, Physiology of C.D. Rural Leadership: concept and definition, types of leaders in rural context; extension administration: meaning and concept, principles and functions. Monitoring and evaluation: concept and definition, monitoring and evaluation of extension programmes; transfer of technology: concept and models, capacity building of extension personnel; extension teaching methods: meaning, classification, individual, group and mass contact methods, media mix strategies; communication: meaning and definition; models and barriers to communication. Agriculture journalism; diffusion and adoption of innovation: concept and meaning, process and stages of adoption, adopter categories.

Practical

To get acquainted with university extension system. Group discussion- exercise; handling and use of audio visual equipments and digital camera and LCD projector; 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 and other development departments at district level; visit to NGO 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.

References

1. Adivi Reddy, A. 2006. Extension Education. Sree Lakshmi Press, Bapatla.
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13. Jana, B.L. and Mitra. 2010. Farm Journalism, Agrotech Publishing Academym Udaipur
14. AnandarajaN, Chandrakandan K and Ramasubramaniam. 2008. Extension of Technologies from Labs to Lands. New India Publishing Agency, New Delhi.

11	Farm Machinery and Power	[ASAE1202]	2(1+1)
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Objectives : To enable the students to understand the basic principles and parts internal combustion engine and different tillage, sowing, intercultural, plant protection equipment ,working principles of threshers, harvesting of field and horticultural crops .

Course Outcomes: The students will be able to understand the working principle of different systems and parts of internal combustion engines and intercultural and plant protection machinery needed for agricultural farms.

Theory

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, 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.

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 transplanter Familiarization with different types of sprayers and dusters Familiarization with different inter-cultivation equipment, Familiarization with harvesting and threshing machinery.

References

1. Jagdiswar Sahay – Elements of Agricultural Engineering
2. Surendra Singh- Farm machinery –Principles and applications, ICAR, New Delhi
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SEMESTER – III

1.	Crop Production Technology-I , cereals, millets and pulses (Kharif Crops)	[ASAG2103]	2(1+1)
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Objective: classify the crops with relation to growing environment develop competency in field crop production by knowing scientific technology

Course Outcomes: This course offers a wide scope for students in employment, skill development and entrepreneurial sectors.

Theory

Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of *Kharif* crops. Cereals – rice, maize, sorghum, pearl millet and finger millet, pulses-pigeonpea, mungbean and urdbean; oilseeds- groundnut, and soybean; fibre crops- cotton & Jute; forage crops-sorghum, cowpea, cluster bean and napier.

Practical

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

References:

1. Rajendra Prasad (ed.), 2006. Text Book of Field Crop Production, ICAR, New Delhi.
2. Reddy, S.R. and Reddi Ramu. 5th edition. Agronomy of Field Crops, Kalyani Publishers, Ludhiana.
3. GururajHunsigi and Krishna K.R. 2007. Scientific Field Crop Production, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
4. De Datta, S.K. 1981. Principles and Practices of Rice Production. John Willey and Sons, New York.

2.	Fundamentals of Plant Breeding	[ASPG2103]	3(2+1)
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Objective: In theoretical point of view students came to know about different breeding methods in both self- pollinated and cross pollinated crop and their application in the crop improvement. Students also acquired the concepts related to different stress (biotic and abiotic) faced by crops and their breeding methods, pre-breeding aspects through wider hybridization and also basic concepts on markers and their importance and application in crop improvement. In practical point of view students come to know the different procedure and techniques of emasculation and hybridization in some of the self & cross pollinated crops. In practical point of view students came to know about the statistical calculations viz., mean, range, variance, standard deviation, heritability and also about different designs used in plant breeding experiment mainly analysis of Randomized Block Design.

Course Outcomes: This course offers a good scope for students in employment.

Theory

Historical development, concept, nature and role of plant breeding, major achievements and future prospects; Genetics in relation to plant breeding, modes of reproduction and apomixes, self – incompatibility and male sterility- genetic consequences, cultivar options. Domestication, Acclimatization, introduction; Centre of origin/diversity, component of Genetic variation; Heritability and genetic advance; 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; Heterosis and inbreeding depression, development of inbred lines and hybrids, composite and synthetic varieties; Breeding methods in asexually propagated crops, clonal selection and hybridization; Wide hybridization and pre-breeding; Polyploidy in relation to plant breeding, mutation breeding-methods and uses; Breeding for important biotic and abiotic stresses; Biotechnological tools-DNA markers and marker assisted selection. Participatory plant breeding; Intellectual Property Rights, Patenting, Plant Breeders and & Farmer’s Rights.

Practical

Plant Breeder’s kit, Study of germplasm of various crops. Study of floral structure of self-pollinated and cross pollinated crops. Emasculation and hybridization techniques in self & cross pollinated crops. Consequences of inbreeding on genetic structure of resulting populations. Study of male sterility system. Handling of segregation populations. Methods of calculating mean, range, variance, standard deviation, heritability. Designs used in plant breeding experiment, 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.

References

- 1 Phundan Singh, 2014. Essentials of Plant Breeding. Kalyani Publishers, New Delhi.
- 2 Singh, B.D.2015. Plant Breeding: Principles and Methods. Kalyani Publishers, New Delhi.
- 3 Gupta, S.K.2010. Plant Breeding Theory and Techniques, Wiley India Pvt. Ltd., New Delhi
- 4 Allard, R.W.2010. Principles of Plant Breeding , John Wiley and Sons, New York
- 5 Poehlman, J.M. and Borthakur, D.1995. Breeding of Asian field Crops, Oxford and IBH Publishing Co., New Delhi
- 6 Sharma, J.r.1994, Principles and Practice of Plant Breeding. Tata McGraw Hill, Publishing Company Ltd., New Delhi.

3.i	Agricultural Finance and Co-Operation	[ASEC2102]	2(1+1)
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Objective: Prepare detailed project report (DPR) on investment analysis and projections of it in future. Understand the level and type of risk analysis. Monitor different kinds of feasibility and evaluation of different projects. Understand about role of different financial institutions and their working procedures, feasibility test of credit, cooperatives and their working procedures, existing and ongoing schemes related to agricultural insurance.

Course Outcomes: This course offers a wide scope for students in employment sectors (Finance, Panchayati Raj Development, Data analytics, etc).

Theory

Agricultural Finance- meaning, scope and significance, credit needs and its role in Indian agriculture. Agricultural credit: meaning, definition, need, classification. Credit analysis: 4 R’s, and 3C’s of credits. Sources of agricultural finance: institutional and non-institutional sources, commercial banks,

social control and nationalization of commercial banks, Micro financing including KCC. Lead bank scheme, RRBs, Scale of finance and unit cost. An introduction to higher financing institutions – RBI, NABARD, ADB, IMF, world bank, Insurance and Credit Guarantee Corporation of India. Cost of credit. Recent development in agricultural credit. Preparation and analysis of financial statements – Balance Sheet and Income Statement. Basic guidelines for preparation of project reports- Bank norms – SWOT analysis.

Agricultural Cooperation – Meaning, brief history of cooperative development in India, objectives, principles of cooperation, significance of cooperatives in Indian agriculture. Agricultural Cooperation in India- credit, marketing, consumer and multi-purpose cooperatives, farmers’ service cooperative societies, processing cooperatives, farming cooperatives, cooperative warehousing; role of ICA, NCUI, NCDC, NAFED.

Practical

Determination of most profitable level of capital use. 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 firsthand 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.

References

1. Johil, S.S. and C.V. More. 1970. Essentials of Farm Financial Management. Today and Tomorrow Printers and Publishers, New Delhi
2. John, J. Hampton. 1983. Financial decision making: Concepts, Problems and Cases of India. New Delhi
3. Matoria, C.B. and R.D. Saksena. 1973. Co-Operatives in India. Kitab Mahal, Allahabad.
4. Mukhi, H.R. 1983. Cooperation in India and Abroad. New Heights Publishers, New Delhi.
5. Muniraj, R. 1987. Farm Finance for Development. Oxford & IBH Publishing Company Ltd., New Delhi.
6. Subba Reddy, S. and P. Raghuram, P., Sastry, T.V.N. and Bhavani Devi, I. 2016. Agricultural Economics. Oxford & IBH Publishing Company Private Ltd., New Dehi
7. Pandey, U.K. Agricultural Finance in India.
8. Wiiliam, G. Murray and Nelson Aarson, G. Agricultural Finance. The Iowa State University Press, Ames, Iowa State University Press Ames, IOWA.
9. www.rbi.org
10. www.nabard.Org
11. www.wb.org

3.ii	Agricultural Marketing and prices	[ASEC2103]	2(1+1)
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Objective: Apply economic theory to problems of agricultural marketing, gain skill to analyze marketing function, market information and intelligence. Design strategies for effective market performance. Use marketing concepts for analyzing market structure and performance in agriculture and formulate effective agricultural marketing policy. Apply theoretical models of imperfect market structures to inform public policy. Appreciate organizational forms unique to agricultural industries; and understand price discovery mechanisms under different market structures.

Course Outcomes: This course offers a wide scope for students in employment sectors(Finance, Panchayatiraj etc).

Theory

Agricultural Marketing: Concepts and definitions of market, marketing, agricultural marketing, market structure, marketing mix and market segmentation, classification and characteristics of agricultural markets; demand, supply and producer's surplus of 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; product life cycle (PLC) and competitive strategies: Meaning and stages in PLC; characteristics of PLC; strategies in different stages of PLC; pricing and promotion strategies: pricing considerations and approaches – cost based and competition based pricing; market promotion – advertising, personal selling, sales promotion and publicity – their meaning and merits & demerits; marketing process and functions: Marketing process-concentration, dispersion and equalization; exchange functions – buying and selling; physical functions – storage, transport and processing; facilitating functions – packaging, branding, grading, quality control and labeling (Agmark);Market functionaries and marketing channels: Types and importance of agencies involved in agricultural marketing; meaning and definition of marketing channel;number of channel levels; marketing channels for different farm products; Integration, efficiency, costs and price spread: Meaning, definition and types of market integration; marketing efficiency; marketing costs, margins and price spread; factors affecting cost of marketing; reasons for higher marketing costs of farm commodities; ways of reducing marketing costs; Role of Govt. in agricultural marketing: Public sector institutions- CWC, SWC, FCI, CACP & DMI – their objectives and functions; cooperative marketing in India; Risk in marketing: Types of risk in marketing; speculation & hedging; an overview of futures trading;

Practical

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 and price 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.

References

1. Subba Reddy,S. and P.Raghuram,P., Sastry,T.V.N. and Bhavani Devi,I. 2016. Agriculral Economics.Oxford &IBH Publishing Company Private Ltd.,New Dehi
2. S.S.Acharya and N.L.Agarwal. 2012. Agricultural Marketing in India. Oxford &IBH Publications Co.Pvt Ltd., New Delhi
3. S.S.Acharya and N.L.Agarwal. Agricultural Price: analysis and Policy. Oxford &IBH Publications Co.Pvt Ltd., New Delhi
4. Kahlon,A.S. and Tyagi, D.S. 1983. Agricultural price policy in India. Allied Publishers Pvt. Ltd.,New Delhi
5. Matoria,C.B. and Joshi,R.L. 1995.Principles and Practices of Marketing in India. Kitab Mahal, Allahabad
6. Philipkumar, Kevin Lane Keller, Abraham Koshy and Mithileswar Jha. 2009. Marketing Management. A South asian Perspective. International 13th edition. Pearson Prentice Hall.
7. www.wto.org

4.	Fundamentals of Entomology II: (Insect Ecology and concepts of IPM)	[ASEN2102]	2(1+1)
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Objective: The student Knows the influence of ecological factors on insect development and distribution. Students Understand the components of integrated pest management. Students Know the classification of insecticides and their use in pest management. Students understand the mass multiplication techniques of major bio-agents

Course Outcomes: Basing on the diversified course outcomes this course offers a good scope for students in employment sector.

Theory

Insect Ecology: Introduction, Environment and its components. Effect of abiotic factors—temperature, moisture, humidity, rainfall, light, atmospheric pressure and air currents. Effect of biotic factors – food competition, natural and environmental resistance. Concepts of Balance of life in nature, biotic potential and environmental resistance and causes for outbreak of pests in agro-ecosystem.

Pest surveillance and pest forecasting. Categories of pests. Host plant resistance, Components/ tools of IPM, Cultural, Mechanical, Physical, Legislative, Biological (parasites, predators & transgenic plant pathogens such as bacteria, fungi and viruses). Methods of control: Chemical control—importance, hazards and limitations. Classification of insecticides, toxicity of insecticides and formulations of insecticides. Recent methods of pest control, repellents, antifeedants, hormones, attractants, gamma radiation and genetic control. Practices, scope and limitations of IPM. Insecticides Act 1968—Important provisions. Insecticide act 1969—important provisions. Application techniques of spray fluids. Phytotoxicity of insecticides. Symptoms of poisoning, first aid and antidotes. Beneficial insects: parasites and predators used in pest control and their mass multiplication techniques. Beneficial insects: Important species of pollinators, weed killers and scavengers, their importance.

Practical:

Study and distribution patterns of insects in crop eco systems – Sampling techniques for the estimation of insect population and damage- Pest surveillance through light traps, pheromone traps and fore casting of pest incidence- Calculation of doses/ concentrations of different insecticidal formulations – Acquintance of insecticide formulations. Compatibility of pesticides with other agrochemicals and phytotoxicity of insecticides –acquintance of mass multiplication techniques of important predators; Cheilomenes, Chrsoperlaand cryptolaemus. Important parasitoids; Egg, larval, and pupal parasitoids Viz., Trichogramma, Apanteles and Tetrastichus. Important Entomomorphogenic Fungi Beauveria bassiana and Nucleo Polyhedro Virus (NPV) on Helicoverpa and Spodoptera. Study of insect pollinators, weed killers and scavengers – Identification of major non –insect pests Viz., birds, crabs, snails, slugs and mammalians. House hold and veterinary insect pests.

References

1. Dhaliwal GS and Ramesh Arora 2001. Integrated pest management: Concepts and approaches, Kalyani Publishers New Dlehi.
2. Larry P Pedigo 1991. Entomology and pest management, Mc Millan publishing Co. New York.
3. Metcalf RL and Luckman WH 1982. Introduction to insect pest management. Wiley inter science publishing, New York.

4. Nair KK, Anantha Krishnan TN and BV David 1976. General and applied entomology, Tata Mc Graw Hill publishing co. Ltd, New Delhi.
5. Richards O W and Davies R G. 1977. Imm's General text Book of entomology (vol II). Chapman and London.9
6. Yezdhani GS and Agarwal ML 1979. Elements of insect ecology Naroji publishing house, New Delhi

5.	Weed Management	[ASAG2105]	2(1+1)
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Objective: Understand the menace caused by weeds, identify weeds, quantify damage and manage in integrated manner.

Course Outcomes: This course offers a wide scope for students in employment, skill development sectors.

Theory

Introduction to weeds, characteristics of weeds their harmful and beneficial effects on ecosystem. Classification, reproduction and dissemination of weeds. Herbicide classification, concept of adjuvant, surfactant, herbicide formulation and their use. Introduction to mode of action of herbicides and selectivity. Allelopathy and its application for weed management. Bio-herbicides and their application in agriculture. Concept of herbicide mixture and utility in agriculture. Herbicide compatibility with agro-chemicals and their application. Integration of herbicides with non chemical methods of weed management. Herbicide Resistance and its management. Transformation of herbicide in plant, Fate of herbicides in soil. Residual effect of herbicides in plant and environment.

Practical

Techniques of weed preservation. Weed identification and their losses study. Biology of important weeds. Study of herbicide formulations and mixture of herbicide. Herbicide and agrochemicals study. Shift of weed flora study in long term experiments. Study of methods of herbicide application, spraying equipments. Calculations of herbicide doses and weed control efficiency and weed index. Weed survey and vegetation analysis, Field Visit to Farm to observe the effect of various weed management practices in different crops .

References

1. Gupta, O.P. 2012. Modern weed management (4th edition), Agribios (India) Ltd, Jodhpur
2. Rao, V.S. 1992. Principles of weed science (2nd edition), Oxford & IBH Publishing Co. Pvt Ltd, New Delhi.
3. Ross, M.A. and Lembi, C.A. 1999. Applied Weed Science. (2nd edition), Prentice Hall of India Pvt Ltd, New Delhi
4. Saraswat, V.N., Bhan, V.M. and Yaduraju, N.T. (Eds.). 1998. Weed management –ICAR Publication

6.	Fundamentals of Plant Biochemistry	[ASBC2101]	3(2+1)
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Objective: The students will be familiar with the recent developments in the area of Plant Biochemistry. Once should get a proficiency in all basic biochemical tests. The students get acquainted with the widely used techniques in plant biochemistry like qualitative and quantitative tests for the important biomolecules. Propagate the knowledge to different areas like agri-food industry, nutraceuticals, phyto-pharmaceutics and medical etc. Know the importance of plant extracts, small molecules and secondary metabolites, pertaining to its isolation, purification and validation aspects.

Course Outcomes: On successful completion of this course and basing on the diversified course outcomes this course offers a good scope for students in employment sector (Industries, R &D etc).

Theory

Importance of Biochemistry. Properties of Water, pH and Buffer. Carbohydrate: Importance and classification. Structures of Monosaccharides, Reducing and oxidizing properties of Monosaccharides, Mutarotation; Structure of Disaccharides and Polysaccharides. Lipid: Importance and classification; Structures and properties of fatty acids; storage lipids and membrane lipids. Proteins: Importance of proteins and classification; Structures, titration and zwitterions nature of amino acids; Structural organization of proteins. Enzymes: General properties; Classification; Mechanism of action; Michaelis & Menten and Line Weaver Burk equation & plots; Introduction to allosteric enzymes. Nucleic acids: Importance and classification; Structure of Nucleotides, A, B & Z DNA; RNA: Types and Secondary & Tertiary structure. Metabolism of carbohydrates: Glycolysis, TCA cycle, Glyoxylate cycle, Electron transport chain. Metabolism of lipids: Beta oxidation, Biosynthesis of fatty acids.

Practical

Preparation of solution, pH & buffers, Qualitative tests of carbohydrates and amino acids. Quantitative estimation of glucose/ proteins. Titration methods for estimation of amino acids/lipids, Effect of pH, temperature and substrate concentration on enzyme action, Paper chromatography/ TLC demonstration for separation of amino acids/ Monosaccharides. Sterilization techniques.

References

1. David L. Nelson, Michael M. Cox; W.H. Freeman. Lehninger Principles of Biochemistry, 6th Edition.
2. Biochemistry, Dr. U. Satyanarayana. Dr. U. Chakrapani, Books and Allied (P) Ltd. Kolkata
3. Biochemistry, S.N. Gupta, Rastogi Publications, First Edition, 2011
4. Introduction to Plant Biotechnology by HS Chawla (3rd Edition), Oxford & IBH Publishing Co. Pvt Ltd., New Delhi.

7.	Production Technology for Fruit and Plantation Crops	[ASHO2102]	2 (1+1)
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Objective: Scope, importance and classification of fruit and plantation crops. Knowledge of rootstock along with its utilization for HDP. Knowledge of different aspects related to production of Major fruits, Minor fruits and nut crops. Knowledge about different intercultural practices followed for individual crop.

Course Outcomes: This course offers a wide scope for students in entrepreneurship sectors.

Theory

Importance and scope of fruit and plantation crop industry in India; High density planting; Use of rootstocks; Production technologies for the cultivation of major fruits-mango, banana, citrus, grape, guava, litchi, papaya, apple, pear, peach and; minor fruits- pineapple, pomegranate, jackfruit, strawberry, nut crops; plantation crops-coconut, arecanut, cashew, tea, coffee & rubber.

Practical

Seed propagation. Scarification and stratification of seeds. Propagation methods for fruit and plantation crops including Micro-propagation. Description and identification of fruit. Preparation of plant bio regulators and their uses, Pests, diseases and physiological disorders of above fruit and plantation crops, Visit to commercial orchard.

References

1. Bose, T.K. and Mitra, S.K. 1990. fruits-Tropical and Sub-tropical. Naya Prakashan, Calcutta.
2. Chattopadhyay, P.K. Year. Text Book on Pomology (Fundamentals of Fruit Growing). Kalyani Publishers, Ludhiana.
3. Bijendra Singh. 2012. Horticulture at a Glance. Kalyani Publishers, Ludhiana.
4. Parthasarathy, V.A., P.K. Chattopadhyay and Bose, T.K. 2006. Plantation Crops. Vol I and II. Parthasankar basu Naya Udyog, Kolkata.
5. Kumar, N., Abdul Khader, J.B.M., Rangaswamy, P. and Irulappan, I. 2004. Introduction to Spices, Plantation crops, Medicinal and Aromatic Crops. Oxford and IBH Publishing Co., New Delhi

8.	Agricultural Informatics	[ASAI2101]	2(1+1)
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Objectives To acquire a clear understanding of theory and application of Information & Community technology in various fields and promoting the applications of ICT in Agriculture

Course Outcomes : The students will be able to understand the basic concept of computer, MS Office, database, Internet and WWW and their application in agriculture

Theory

Introduction to Computers, Anatomy of Computers, Memory Concepts, Units of Memory, Operating System, definition and types, Applications of MS-Office for creating, Editing and Formatting a document, Data presentation, tabulation and graph creation, statistical analysis, mathematical expressions, Database, concepts and types, creating database, uses of DBMS in Agriculture, Internet and World Wide Web (WWW), Concepts and components.

Computer Programming, General Concepts, Introduction to Visual Basic, Java, Fortran, C/ C++, etc, concepts and standard input/output operations.

e-Agriculture, concepts, design and development. Application of innovative ways to use information and communication technologies (IT) in Agriculture. Computer Models in Agriculture: statistical, weather analysis and crop simulation models, concepts, structure, inputs-outputs files, limitation, advantages and application of models for understanding plant processes, sensitivity, verification, calibration and validation. IT application 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 advises, 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.

Practical

Study of Computer Components, accessories, practice of important DOS Commands. Introduction of different operating systems such as windows, Unix/ Linux, Creating, Files & Folders, File Management. Use of MS-WORD and MS Power-point for creating, editing and presenting a scientific Document. 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/CropSyst/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, for generating information important for Agriculture. Hands on practice on preparation of Decision Support System. Preparation of contingent crop planning.

References

1. John Walkenbach, Herb Tyson, Michael R. Groh, Faithe Wempen, Microsoft Office 2010 Bible
2. Bangia, Learning Ms Office 2010
3. Prof. Satish Jain and M. Geetha, MS-Office 2010 Training Guide
4. Johnson, Microsoft Office 2010.....on Demand
5. Kate Shoup, Microsoft Office 2010
6. Melanie Gass, It's All about You! Office 2010
7. Nancy Conner and Matthew MacDonald, Office 2010: The Missing Manual

9.	Livestock & Poultry Management	[ASAP2101]	3(2+1)
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Objectives: To meet the basic and overall knowledge requirement of the students on various livestock specifically the farm animals including poultry with respect to physiological and reproductive system.

Course Outcomes: The course knowledge directly reflects on the operation of livestock and poultry farming being taken as a major component of integrated farming system in agriculture.

Theory

Role of livestock in the national economy. Reproduction in farm animals and poultry. Housing principles, space requirements for different species of livestock and poultry. Management of calves, growing heifers and milch animals. Management of sheep, goat and swine. Incubation, hatching and brooding. Management of growers and layers.

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

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

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

Practical

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

References

1. A Textbook of Animal Husbandry – G.C. Benerjee

2. Livestock Production and Management – N.S.R. Sastri, C.K. Thomas, R.A. Singh
3. Essentials of Animal Production and Management – R. Singh
4. A Handbook of Animal Husbandry – ICAR
5. A Textbook of Livestock Production Management in Tropics – D.N. Verma

10	Communication Skills and Personality Development	[ASEE2104]	2(1+1)
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Objective: Students develop communication skills and creative content writing as well as positive personality traits, Students acquire a language suitable for technical communication and writing. Students inculcate the habit of regular reading and writing

Course Outcomes: This course offers a wide scope for students in employment sectors (social sector, NGO's).

Theory

Communication Skills: Structural and functional grammar; meaning and process of communication, verbal and nonverbal communication; listening and note taking, writing skills, oral presentation skills; field diary and lab record; indexing, footnote and bibliographic procedures. Reading and comprehension of general and technical articles, precise writing, summarizing, abstracting; individual and group presentations, impromptu presentation, public speaking; Group discussion. Organizing seminars and conferences.

Practical

Listening and note taking, writing skills, oral presentation skills; field diary and lab record; indexing, footnote and bibliographic procedures. Reading and comprehension of general and technical articles, precise writing, summarizing, abstracting; individual and group presentations.

References

1. Dangi K.L.,S.S. Sisoda, Pravesh Singh Chauhan and Yogita Ranavat. A Text Book of Communication Skills. Agrotech Publications.
2. Mangal S.K. 2016. Essentials of Educational Psychology. PHI Learning Private Ltd.,New Delhi.
3. Nirajkumar. 1997. A Genesis of Behavioural Science. Gyan Publishing House, New Delhi.
4. Eric Berne. 1964. Games People Play-The Psychology of Human Relationship. Grove Press Publishers.
5. Thomas Anthony Harris. 1967. I am Ok You are Ok. Harper Publishers.
6. Scott Bill. 1981. Skills of Negotiating.
7. Goleman Daniel. 1995. Emotional Intelligence.
8. Ratan Reddy B and Supriya Reddy. Soft Skills for Professional Excellence.
9. Shivkhera. 2002. You can win. MacMillan Publishing Company. New Delhi.
10. Shivaraman K. 2009. Communication Skills. APH publications.

SEMESTER – IV

1.	Crop Production Technology-II (oil seeds, fibre, sugar, tobacco and fodder crops)(Rabi crops)	[ASAG2204]	3(2+1)
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Objective: classify the crops with relation to growing environment develop competency in field crop production by knowing scientific technology.

Course Outcomes: This course offers a wide scope for students in employment, skill development and entrepreneurial sectors.

Theory

Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of *Rabi* crops; cereals –wheat and barley, pulses-chickpea, lentil, peas, oilseeds-rapeseed, mustard and sunflower; sugar crops-sugarcane; other crops- potato, Forage crops-berseem, lucerne and oat.

Practical

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

References

1. Reddy, S.R. and ReddiRamu. 5th edition. Agronomy of Field Crops, Kalyani Publishers, Ludhiana.
2. Chidda Singh, Singh, P. and Singh, R. 2003. Modern Techniques of Raising Field Crops. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
3. Rajendra Prasad (ed.), 2004. Text Book of Field Crop Production, Commercial Crops, Volume -II. ICAR, New Delhi.
4. Panda, S.C. 2014. Agronomy of Fodder and Forage Crops, Kalyani Publishers, Ludhiana.

2.	Production Technology for Ornamental Crops, MAPs and Landscaping	[ASHO2204]	2 (1+1)
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Objective: Importance and scope of Ornamental Crops, MAPs and Landscaping. Knowledge about production technology of cut flower, loose flower, medicinal and aromatic plants. Uses of tree, shrub, climbers, potted plants in landscaping. Processing and value addition in ornamental plants and MAPs produce.

Course Outcomes: This course offers a wide scope for students in entrepreneurship sectors.

Theory

Importance and scope of ornamental crops, medicinal and aromatic plants and landscaping. Principles of landscaping. Landscape uses of trees, shrubs and climbers. Production technology of important cut flowers like rose, gerbera, carnation, liliun and orchids under protected conditions and gladiolus, tuberose, chrysanthemum under open conditions. Package of practices for loose flowers like marigold and jasmine under open conditions. Production technology of important medicinal plants like asparagus, aloe, costus, Cinnamomum, periwinkle, isabgol and aromatic plants like mint, lemongrass, citronella, palmarosa, ocimum, rose, geranium, vetiver. Processing and value addition in ornamental crops and MAPs produce.

Practical

Identification of Ornamental plants. Identification of Medicinal and Aromatic Plants. Nursery bed preparation and seed sowing. Training and pruning of Ornamental plants. Planning and layout of garden. Bed preparation and planting of MAP. Protected structures – care and maintenance. Intercultural operations in flowers and MAP. Harvesting and post harvest handling of cut and loose flowers. Processing of MAP. Visit to commercial flower/MAP unit.

References

1. Bose T.K.1999. floriculture and Landscaping. Naya Prakash, Kolkatta.
2. Bose, T.K. and Yadav, L.P. 1992. Commercial Flowers. Naya Prakash, Kolkatta
3. Randhawa, G.S. and Mukhopadhyaya, A.1994. Floriculture in India. Allied Publishers Pvt. Ltd., New Delhi.
4. Chattopadhyay,S.K. 2007. Commercial Floriculture. Gene-Tech Books, New Delhi
5. Srivastava,H.C.2014.Medicinal and Aromatic Plants, ICAR, New Delhi.
6. Kumar,N., Abdul Khader, J.B.M,Rangaswamy, P and Irulappan, I. 2004. Introduction to Spieces, Plantation Crops, Medicinal and Aromatic Crops. Oxford and IBH publishing Co., New Delhi.

3.	Renewable Energy and Green Technology	[ASAE2203]	2(1+1)
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Objectives: To understand basic characteristics of renewable sources of energy and technologies for their utilization for the thermal and electrical energy needs and also the environmental aspects of these resources

Course Outcomes: The students will be able to understand the role of renewable energy in product and service sectors, as well as its importance in the energy chain: processing, transportation, distribution and end use.

Theory

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

Practical

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

References

1. Rai, G.D. 2004. Non-Conventional Energy Sources. Khanna Publishers, New Delhi
2. Rajput, R.K. 2012. Non-Conventional Energy Sources. S.Chand Publishers, New Delhi
3. Rathore, N.S., Mathur, A.N. and S.Kothari. Alternate sources of energy. ICAR , New Delhi
4. Chakrava rthy, A. and Amalendu Chakravarthy . 1989. Biotechnology and other Alyernative Technologies for Utilization of Biomass-Agriculture wastes. 1st edition, Oxford and IBH Publishers, New Delhi

4.	Manures, Fertilizers and Soil Fertility Management	[ASAC2202]	3(2+1)
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Objective: The students have knowledge with basic principle of soil fertility management. The students with general concepts and classification of manures and fertilizer. The students have knowledge about methods of fertilizer recommendation to crops.

Course Outcomes: This course offers a wide scope for students in employment & entrepreneurship sectors.

Theory

Introduction and importance of organic manures, properties and methods of preparation of bulky and concentrated manures. Green/leaf manuring. Integrated nutrient management.

Chemical fertilizers: classification, composition and properties of major nitrogenous, phosphatic, potassic fertilizers, secondary & micronutrient fertilizers, Complex fertilizers, nano fertilizers Soil amendments, Fertilizer Storage, Fertilizer Control Order.

History of soil fertility and plant nutrition. criteria of essentiality. role, deficiency and toxicity symptoms of essential plant nutrients, Mechanisms of nutrient transport to plants, factors affecting nutrient availability to plants. Chemistry of soil nitrogen, phosphorus, potassium, calcium, magnesium, sulphur and micronutrients. Soil fertility evaluation, Soil testing. Critical levels of different nutrients in soil. Forms of nutrients in soil, plant analysis, rapid plant tissue tests. Indicator plants. Methods of fertilizer recommendations to crops. Factor influencing nutrient use efficiency (NUE), methods of application under rainfed and irrigated conditions.

Practical

Introduction of analytical instruments and their principles, calibration and applications, Colorimetry and flame photometry. Estimation of available N in soils. Estimation of available P in soils. Estimation of available K. Estimation of available S in soils. Estimation of available Ca and Mg in soils. Estimation of available Zn in soils. Estimation of N in plants. Estimation of P in plants. Estimation of K in plants. Estimation of S in plants.

References

1. Indian Society of Soil Science 2012. Fundamentals of Soil Science. IARI, New Delhi
2. Das, D.K. 2015. Introductory soil science, 4th edition, Kalyani Publishers, New Delhi.
3. Samuel Tisdale, Nelson Werner L, Beaton James D and Havlin John L. 2005. Soil fertility and fertilizers: An introduction to Nutrient Management, Macmillian Publishing Co., New York
4. Yawalkar, K.S., Agarwal, T.P. and Bokde, S. 1995. Manures and fertilizers. Agril. Publishing house, Nagpur.

5.i	Agricultural Marketing and prices	[ASEC2103]	2(1+1)
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Course Objectives: To Enable students to gain knowledge on agricultural marketing, challenges and prospects for improving agricultural marketing system.

Course Outcome: At the end of this course, students will understand and appreciate the structure and working of the agricultural marketing system .

Theory

Agricultural Marketing: Concepts and definitions of market, marketing, agricultural marketing, market structure, marketing mix and market segmentation, classification and characteristics of agricultural markets; demand, supply and producer's surplus of 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; product life cycle (PLC)

and competitive strategies: Meaning and stages in PLC; characteristics of PLC; strategies in different stages of PLC; pricing and promotion strategies: pricing considerations and approaches – cost based and competition based pricing; market promotion – advertising, personal selling, sales promotion and publicity – their meaning and merits & demerits; marketing process and functions: Marketing process-concentration, dispersion and equalization; exchange functions – buying and selling; physical functions – storage, transport and processing; facilitating functions – packaging, branding, grading, quality control and labeling (Agmark);Market functionaries and marketing channels: Types and importance of agencies involved in agricultural marketing; meaning and definition of marketing channel;number of channel levels; marketing channels for different farm products; Integration, efficiency, costs and price spread: Meaning, definition and types of market integration; marketing efficiency; marketing costs, margins and price spread; factors affecting cost of marketing; reasons for higher marketing costs of farm commodities; ways of reducing marketing costs; Role of Govt. in agricultural marketing: Public sector institutions- CWC, SWC, FCI, CACP & DMI – their objectives and functions; cooperative marketing in India; Risk in marketing: Types of risk in marketing; speculation & hedging; an overview of futures trading;

Practical

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 and price 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.

References

1. Subba Reddy,S. and P.Raghuram,P., Sastry,T.V.N. and Bhavani Devi,I. 2016. Agriculral Economics.Oxford &IBH Publishing Company Private Ltd.,New Dehi
2. S.S.Acharya and N.L.Agarwal. 2012. Agricultural Marketing in India. Oxford &IBH Publications Co.Pvt Ltd., New Delhi
3. S.S.Acharya and N.L.Agarwal. Agricultural Price: analysis and Policy. Oxford &IBH Publications Co.Pvt Ltd., New Delhi
4. Kahlon,A.S. and Tyagi, D.S. 1983. Agricultural price policy in India. Allied Publishers Pvt. Ltd.,New Delhi
5. Mamoria,C.B. and Joshi,R.L. 1995.Principles and Practices of Marketing in India. Kitab Mahal, Allahabad
6. Philipkumar, Kevin Lane Keller, Abraham Koshy and Mithileswar Jha. 2009. Marketing Management. A South asian Perspective. International 13th edition. Pearson Prentice Hall.
7. www.wto.org
8. www.agricoop.nic.in

5.ii	Agricultural Finance and Co-Operation	[ASEC2102]	2(1+1)
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Objectives: to impart knowledge and expertise in the field of agricultural finance

Course Outcomes: on the completion of the course, students will be able to Learn sources of Agricultural Micro-Macro financing and credit systems and significance of Farming Cooperatives.

Theory

Agricultural Finance- meaning, scope and significance, credit needs and its role in Indian agriculture. Agricultural credit: meaning, definition, need, classification. Credit analysis: 4 R's, and 3C's of credits. Sources of agricultural finance: institutional and non-institutional sources, commercial banks, social control and nationalization of commercial banks, Micro financing including KCC. Lead bank scheme, RRBs, Scale of finance and unit cost. An introduction to higher financing institutions – RBI, NABARD, ADB, IMF, world bank, Insurance and Credit Guarantee Corporation of India. Cost of credit. Recent development in agricultural credit. Preparation and analysis of financial statements – Balance Sheet and Income Statement. Basic guidelines for preparation of project reports- Bank norms – SWOT analysis.

Agricultural Cooperation – Meaning, brief history of cooperative development in India, objectives, principles of cooperation, significance of cooperatives in Indian agriculture. Agricultural Cooperation in India- credit, marketing, consumer and multi-purpose cooperatives, farmers' service cooperative societies, processing cooperatives, farming cooperatives, cooperative warehousing; role of ICA, NCUI, NCDC, NAFED.

Practical

Determination of most profitable level of capital use. 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 firsthand 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.

References

1. Johil, S.S. and C.V. More. 1970. Essentials of Farm Financial Management. Today and Tomorrow Printers and Publishers, New Delhi
2. John, J. Hampton. 1983. Financial decision making: Concepts, Problems and Cases of India. New Delhi
3. Mamoria, C.B. and R.D. Saksena. 1973. Co-Operatives in India. Kitab Mahal, Allahabad.
4. Mukhi, H.R. 1983. Cooperation in India and Abroad. New Heights Publishers, New Delhi.
5. Muniraj, R. 1987. Farm Finance for Development. Oxford & IBH Publishing Company Ltd., New Delhi.
6. Subba Reddy, S. and P. Raghuram, P., Sastry, T.V.N. and Bhavani Devi, I. 2016. Agricultural Economics. Oxford & IBH Publishing Company Private Ltd., New Delhi
7. Pandey, U.K. Agricultural Finance in India.
8. William, G. Murray and Nelson Aarson, G. Agricultural Finance. The Iowa State University Press, Ames, Iowa State University Press Ames, IOWA.
9. www.rbi.org
10. www.nabard.org

www.wb.org

6.	Fundamentals of Plant Biotechnology	[ASPB2201]	2(1+1)
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Objective: The students will be familiarized with the key developments in the sphere of Plant Biotechnology. Achieve self-sufficiency in the area of production of agronomically and horticulturally

important crop species. The students get acquainted with the widely exploited techniques in plant molecular biology.

Course Outcomes: On successful completion of this course and basing on the diversified out comes this course offers a wide scope for students in employment sector(Industries, R &D etc).

Theory:

Concepts and applications of plant biotechnology: Scope, organ culture, embryo culture, cell suspension culture, callus culture, anther culture, pollen culture and ovule culture and their applications; Micro-propagation methods; organogenesis and embryogenesis, Synthetic seeds and their significance; Embryo rescue and its significance; somatic hybridization and cybrids; Somaclonal variation and its use in crop improvement; cryo-preservation; Introduction to recombinant DNA methods: physical (Gene gun method), chemical (PEG mediated) and Agrobacterium mediated gene transfer methods; Transgenics and its importance in crop improvement; PCR techniques and its applications; RFLP, RAPD, SSR; Marker Assisted Breeding in crop improvement; Biotechnology regulations.

Practical

Composition of various tissue culture media and preparation of stock solutions for MS nutrient medium. Callus induction from various explants. Micro-propagation, hardening and acclimatization. Demonstration on isolation of DNA. Demonstration of gel electrophoresis techniques and DNA finger printing.

References

1. David L. Nelson, Michael M.Cox; W.H. Freeman. Lehninger Principles of Biochemistry, 6th Edition.
2. Biochemistry, Dr.U.Satyanarayana. Dr.U.Chakrapani, Books and Allied(P) Ltd. Kolkata
3. Biochemistry, S.N.Gupta, Rastogi Publications, First Edition, 2011
4. Introduction to Plant Biotechnology by HS Chawla (3rd Edition), Oxford & IBH Publishing Co. Pvt Ltd., New Delhi.

7.	Rainfed Agriculture and Watershed Management	[ASAG2211]	2(1+1)
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Objective: Understand contingent crop planning for aberrant weather conditions Assure efficient utilization of water through soil and crop management practices. Choose crops and their agronomic management under rainfed conditions.

Course Outcomes: This course offers a wide scope for students in employment, skill development sectors.

Theory

Rainfed agriculture: Introduction, types, History of rainfed agriculture & watershed in India; Problems and prospects of rainfed agriculture in India ; Soil and climatic conditions prevalent in rainfed areas; Drought: types, effect of water deficit on physio- morphological characteristics of the plants, Mechanism of crop adaptation under moisture deficit condition; Water harvesting: importance, its techniques, Efficient utilization of water through soil and crop management practices, Management of crops in rainfed areas, Contingent crop planning for aberrant weather conditions, Concept, objective, principles and components of watershed management, factors affecting watershed management.

Practical

Studies on climate classification, studies on rainfall pattern in rainfed areas of the country and pattern of onset and withdrawal of monsoons. Studies on cropping pattern of different dry land areas in the country and demarcation of dry land 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 viz; mulching, plant density, depth of sowing, thinning and leaf removal for mitigating moisture stress. Characterization and delineation of model watershed. Field demonstration on soil & moisture conservation measures. Field demonstration on construction of water harvesting structures. Visit to rainfed research station/watershed.

References

1. Reddy, S.R. and Prabhakar Reddy, G. 2015. Dryland Agriculture. Kalyani Publishers.
2. Arnon, I. 1972. Crop Production in Dry Regions (Vol. 1), Leonard Hill Pub. Co., London.
3. Dhruva Narayan, V.V., Sastry, G.S. and Patnaik, V.S. 1999. Watershed Management in India. ICAR, New Delhi.
4. Jeevananda Reddy, S. 2002. Dryland Agriculture in India: An agro-climatological and agro-meteorological perspective. B.S. Publications

8.	Principles of Seed Technology	[ASPG2202]	3(1+2)
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Objective: Distinguish between various crop seeds and their germination pattern as well as have an distinct idea about seed's morphological features Know about the various seed production procedure of crops and how it varies from commercial crop production. Carry out various seed testing related to determination of viability, vigour, germination, etc.

Course Outcomes: This course offers a good scope for students in skill development and entrepreneurship activities.

Theory

Seed and seed technology: introduction, definition and importance. Deterioration causes of crop varieties and their control; Maintenance of genetic purity during seed production, seed quality; Definition, Characters of good quality seed, different classes of seed. Foundation and certified seed production of important **cereals, pulses, oilseeds, fodder and vegetables**. Seed certification, phases of certification, procedure for seed certification, field inspection. Seed Act and Seed Act enforcement. Duty and powers of seed inspector, offences and penalties. Seeds Control Order 1983, Varietal Identification through Grow Out Test and Electrophoresis, Molecular and Biochemical test. Detection of genetically modified crops, Transgene contamination in non-GM crops, GM crops and organic seed production.

Seed drying, processing and their steps, seed testing for quality assessment, seed treatment, its importance, method of application and seed packing. Seed storage; general principles, stages and factors affecting seed longevity during storage. Measures for pest and disease control during storage. Seed marketing: structure and organization, sales generation activities, promotional media. Factors affecting seed marketing, Role of WTO and OECD in seed marketing.

Practical

Seed production in major cereals: Wheat, Rice, Maize, Sorghum and Bajra. Seed production in major pulses: Urd, Mung, Pigeonpea, Lentil, Gram, Fieldpea. Seed production in major oilseeds: Soybean, Rapeseed and Mustard. Seed production in vegetable crops. Seed sampling and testing: Physical purity, germination, viability, etc. Seed and seedling vigour test. Genetic purity test: Grow out test and electrophoresis. Seed certification: Procedure, Field inspection, Preparation of field inspection report. Visit to seed production farms, seed testing laboratories and seed processing plant. \

References

1. Agarwal, P.K. 1994. Principles of seed technology. ICAR, New Delhi
2. Agarwal, P.K. and Dadlani, M. 1986. techniques of Seed Science and Technology. South Asian Publishers, New Delhi
3. Agarwal, R.L. 1995. Seed Technology. Oxford and IBH Publication Co., New Delhi
4. Dhrendra Khare and Mohan S. Bhale. 2007. Seed Technology. Scientific Publishers (India), Joghpur
5. Thomson, J.R. 1979. An introduction of seed technology. Leonard Hill, London

9.	Diseases of Field & Horticultural Crops & their Management-I	[ASPP2202]	3(2+1)
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Objective: The student have knowledge with different diseases of different crop with respect to farmer field. The students with general concepts and classification of plant diseases with relation to environmental condition. The students have knowledge with management of plant disease economically.

Course Outcomes: On successful completion of this course and basing on the diversified course outcomes this course offers a good scope for students in employment sector.

Theory

Symptoms, etiology, disease cycle and management of major diseases of following crops:

Field Crops: Rice: blast, brown spot, bacterial blight, sheath blight, false smut, khaira and tungro; Maize: stalk rots, downy mildew, leaf spots; Sorghum: smuts, grain mold and anthracnose, Bajra :downy mildew and ergot; Groundnut: early and late leaf spots, wilt

Soybean: Rhizoctonia blight, bacterial spot, seed and seedling rot and mosaic; Pigeonpea: Phytophthora blight, wilt and sterility mosaic; Finger millet: Blast and leaf spot; black & green gram: Cercospora leaf spot and anthracnose, web blight and yellow mosaic; Castor: Phytophthora blight; Tobacco: black shank, black root rot and mosaic. Horticultural Crops: Guava: wilt and anthracnose; Banana: Panama wilt, bacterial wilt, Sigatoka and bunchy top; Papaya: foot rot, leaf curl and mosaic; Pomegranate: bacterial blight; Cruciferous vegetables: Alternaria leaf spot and black rot; Brinjal: Phomopsis blight and fruit rot and Sclerotinia blight; Tomato: damping off, wilt, early and late blight, buck eye rot and leaf curl and mosaic; Okra: Yellow Vein Mosaic; Beans: anthracnose and bacterial blight; Ginger: soft rot; Colocasia: Phytophthora blight; Coconut: wilt and bud rot; Tea: blister blight; Coffee: rust

Practical

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; Note: Students should submit 50 pressed and well-mounted specimens.

References

1. Rangaswami, Gand K. Mahadevan. 2001. Diseases of crop plants in India. Prentice Hall of India Pvt. Ltd., New Delhi
2. Singh, R.S. 2005. Plant Diseases. Oxford & IBH Publication, New Delhi

SEMESTER – V

1.	Entrepreneurship Development and Business Communication	[ASEE3103]	2(1+1)
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Objective: Students understand with key concepts and processes in entrepreneurship and business development. Students know the processes in the form of differences between small and large firms, and the economic environment. Students have knowledge about key debates around entrepreneurship and small businesses. Students get exposed towards various industries and business communication

Course Outcomes: This course offers a wide scope for students in employment sectors (agribusiness companies)

Theory

Concept of Entrepreneur, Entrepreneurship Development, Characteristics of entrepreneurs; Assessment of entrepreneurship skills, SWOT Analysis & achievement motivation, Entrepreneurial behavior, Government policy and programs and institutions for entrepreneurship development, Entrepreneurial Development Process; Business Leadership Skills; Communication skills for entrepreneurship development, Developing organizational skill, Developing Managerial skills, Problem solving skill, Achievement motivation; time management; Supply chain management and Total quality management, Project Planning Formulation and report preparation; Opportunities for entrepreneurship and rural entrepreneurship.

Practical

Assessing entrepreneurial potential, problem solving ability, managerial skills and achievement motivation, exercise in creativity, time audit, preparation of business plan and proposal writing, visit to entrepreneurship development institute and entrepreneurs.

References

1. Anil Kumar, S., Poornima, S.C., Mini, K., Abraham and Jayashree, K. 2003. Entrepreneurship Development. New Age International Publishers, New Delhi.
2. Bhaskaran, S. 2014. Entrepreneurship Development & Management. Aman Publishing House, Meerut.
3. Gupta, C.B. 2001. Management: Theory and Practice. Sultan Chand and Sons, New Delhi.
4. Indu Grover 2008. Handbook on empowerment and Entrepreneurship. Agrotech Publishing Academy, Udaipur.
5. Khanka, S.s. 1999. Entrepreneurship Development. S.Chand and Co., New Delhi.
6. Mary Coulter 2008. Entrepreneurship in Action. Prentice Hall of India Pvt. Ltd., New Delhi
7. Mohanty, S.K. 2009. Fundamentals of Entrepreneurship. Prentice Hall of India Pvt. Ltd., New Delhi
8. Prasad, R. 2003. Entrepreneurship- Concepts and Cases. IC F A I Publications, Hyderabad.
9. Sagar Mondal and Ray, G.L. 2003. Text Book of Entrepreneurship and Rural Development. Kalyani Publishers, Ludhiana
10. Singh, D. 1995. Effective Managerial Leadership. Deep and Deep Publications, New Delhi.
11. Vasanta Desai. 1997. Small Scale Industries and Entrepreneurship. Himalaya Publishing House, New Delhi.
12. Vasanta Desai. 2000. Dynamics of Entrepreneurial Development and Management. Himalaya Publishing House, New Delhi.

2.	Problematic Soils and their Management	[ASAC3103]	2(1+1)
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Objective: The students have knowledge with different types of problematic soils. Management process of problematic soils and reclamation techniques.

Course Outcomes: This course offers a wide scope for students in skill development sectors.

Theory

Soil quality and health, Distribution of Waste land and problem soils in India. Their categorization based on properties. Reclamation and management of Saline and sodic soils, Acid soils, Acid Sulphate soils, Eroded and Compacted soils, Flooded soils, Polluted soils.

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

Multipurpose tree species, bio remediation through MPTs of soils, land capability and classification, land suitability classification. Problematic soils under different Agroeco systems.

Practical

Field identification of problem soils. Determination of soil pH, EC, gypsum requirement of alkali soils, lime requirement of acid soils, calcium carbonate content in soils, Water quality assessment (pH, Ec, alkalinity, chlorides, SAR, RSC).

References

1. Indian Society of Soil Science 2012. Fundamentals of Soil Science. IARI, New Delhi
2. Das, D.K. 2015 Introductory soil science, 4th edition, Kalyani Publishers, New Delhi.

3.	Pests of field Crops and Stored Grains and their Management	[ASEN3103]	3(2+1)
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Objective: Students have knowledge about pests of various field crops, their symptoms and management. Students have knowledge about various stored grain and non-insect pests along with their management.

Course Outcomes: This course offers a good scope for students in employment sector

Theory

General account on nature and type of damage by different arthropods pests. Scientific name, order, family, host range, distribution, biology and bionomics, nature of damage, and management of major pests and scientific name, order, family, host range, distribution, nature of damage and control practice other important arthropod pests of various field crop, vegetable crop, fruit crop, plantation crops, ornamental crops, narcotics, spices and condiments. Factors affecting losses of stored grain and role of physical, biological, mechanical and chemical factors in deterioration of grain. Insect pests, mites, rodents, birds and microorganisms associated with stored grain and their management. Storage structure and methods of grain storage and fundamental principles of grain store management.

Practical

Identification of different types of damage. Identification and study of life cycle and seasonal history of various insect pests attacking crops and their produce: (a) Field Crops; (b) Vegetable Crops; (c) Fruit Crops; (d) Plantation, gardens, Narcotics, spices & condiments. Identification of insect pests and Mites associated with stored grain. Determination of insect infestation by different methods. Assessment of losses due to insects. Calculations on the doses of insecticides application

technique. Fumigation of grain store / godown. Identification of rodents and rodent control operations in godowns. Identification of birds and bird control operations in godowns. Determination of moisture content of grain. Methods of grain sampling under storage condition. Visit to Indian Storage Management and Research Institute, Hapur and Quality Laboratory, Department of Food., Delhi. Visit to nearest FCI godowns.

References

1. Atwal, A.S. 1976. *Agricultural Pests of India and South East Asia*. Kalyani Publishers, Ludhiana.
2. Butani, D.K. and Jotwani, M.G. 1984. *Insects in Vegetables*. Periodical Export Book Agency, New Delhi.
3. Butani, D. K. 1984. *Insects and Fruits*. Periodical Export Book Agency, New Delhi.
4. Dennis S Hill 1987 *Agricultural Insect Pests of tropics and their control*, Cambridge University Press, New York
5. Khare, S.P. 1993. *Stored Grain Pests and Their Management*. Kalyani Publishers, Ludhiana.
6. Nair MRGK. 1986. *Insects and Mites of crops in India*. Indian Council of Agricultural Research New Delhi.
7. Ramakrishna Ayyar, T.V. 1963. *Handbook of Economic Entomology for South India*. Government Press, Madras.
8. Vasantharaj David, B. 2003. *Elements of Economic Entomology*. Popular Book Depot, Coimbatore.
9. Vasantharaj David, B and Aanathakrishnan, T.N. 2006. *General and Applied Entomology*. Tata McGraw-Hill Publishing House, New Delhi.
10. Upadhyaya K.P. and Kusum Dwivedi. 1996. *A Text Book of Plant Nematology*. Aman Publishing House, Meerut.

4.	Diseases of Field & Horticultural Crops & their Management-II	[ASPP3103]	3(2+1)
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Objective: The student have knowledge with different diseases of different crop with respect to farmer field. The students with general concepts and classification of plant diseases with relation to environmental condition The students have knowledge with management of plant disease economically

Course Outcomes: On successful completion of this course and basing on the diversified course outcomes this course offers a good scope for students in employment sector.

Theory

Symptoms, etiology, disease cycle and management of following diseases:

Field Crops:

Wheat: rusts, loose smut, karnal bunt, powdery mildew, alternaria blight, and ear cockle;

Sugarcane: red rot, smut, wilt, grassy shoot, ratoon stunting and Pokkah Boeng;

Sunflower: Sclerotinia stem rot and Alternaria blight; **Mustard:** Alternaria blight, white rust, downy mildew and Sclerotinia stem rot; **Gram:** wilt, grey mould and Ascochyta blight; **Lentil:** rust and wilt; **Cotton:** anthracnose, vascular wilt, and black arm; **Pea:** downy mildew, powdery mildew and rust; **Horticultural Crops:** **Mango:** anthracnose, malformation, bacterial blight and powdery mildew; **Citrus:** canker and gummosis; **Grape vine:** downy mildew, Powdery mildew and anthracnose; **Apple:** scab, powdery mildew, fire blight and crown gall; **Peach:** leaf curl

Strawberry: leaf spot **Potato:** early and late blight, black scurf, leaf roll, and mosaic;

Cucurbits: downy mildew, powdery mildew, wilt; Onion and garlic: purple blotch, and Stemphylium blight; Chillies: anthracnose and fruit rot, wilt and leaf curl; Turmeric: leaf spot Coriander: stem gall Marigold: Botrytis blight; Rose: dieback, powdery mildew and black leaf spot.

Practical

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.

Note: Students should submit 50 pressed and well-mounted specimens.

References

1. Rangaswami, G & Mahadevan, K. 2001. Diseases of crop plants in India, Prentice Hall of India Pvt. Ltd., New Delhi
2. Singh, R.S. 2005. Plant Diseases. Oxford & IBH Publications, New Delhi
3. Pathak, V.n. 2001. Diseases of Fruit crops. Oxford & IBH Publications, New Delhi
4. Singh, R.S. 1999. Diseases of vegetable crops. Oxford & IBH Publications, New Delhi
5. Chaube, H.S and V.S. Pundhir, 2012. Crop Diseases & Their Management. PHI Pvt. Ltd., New Delhi

5.	Crop Improvement – I (Cereals, millets, pulses and oil seeds etc.) (<i>Kharif crops</i>)	[ASPG3104]	2(1+1)
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Objective: The students able to know about the origin, distribution and wild relatives of important kharif crops. The students able to know about the plant genetic resources, and different breeding methods adopted for the development of varieties and hybrids. The students able to know about the floral biology, emasculation and pollination techniques operated in different kharif crops.

Course Outcomes: This course offers a wide scope for students in employment, skill development sectors.

Theory

Centers of origin, distribution of species, wild relatives in different cereals; pulses; oilseeds; fibres; fodders and cash crops; vegetable and horticultural crops; Plant genetic resources, its utilization and conservation Floral biology, study of genetics of qualitative and quantitative characters; Important concepts of breeding self pollinated, cross pollinated and vegetatively propagated crops; Major breeding objectives and procedures including conventional and modern innovative approaches for development of hybrids and varieties for yield, adaptability, stability, abiotic and biotic stress tolerance and quality (physical, chemical, nutritional); Seed production technology in self pollinated, cross pollinated and vegetatively propagated crops. Hybrid seed production technology in Maize, Rice, Sorghum, Pearl millet and Pigeonpea, etc. Ideotype concept and climate resilient crop varieties for future.

Practical

Emasculation and hybridization techniques in different crop species; viz., Rice, Maize, Sorghum, Pearl Millet, Ragi, Pigeonpea, Urdbean, Mungbean, Soybean, Groundnut, Sesame, Caster, Cotton, Cowpea, Pearl millet and Tobacco. 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 seeds 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 plots of different field crops.

References

1. Allard, R.W.1960. Principles of Plant Breeding. John Wiley & Sons, New York
2. Phundan Singh,2006, Essential of Plant Breeding. Kalyani Publishers, Ludhiana
3. Poehlman, J.M. and Borthakur, D.1995. Breeding of Asian Field Crops. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi
4. Sharma, J.R. 1994, Principles and Practices of Plant Breeding. Tata McGraw-Hill Publishing Co. Ltd. New Delhi
5. Kalloo, G.1994, Vegetable Breeding, Panima Educational Book Agency, New Delhi
6. Kumar, N.2006. Breeding of Horticultural Crops-Principles and Practices, New Inda Publishing Agency, New Delhi
7. George Acquaaah.2012.Principles of Plant Genetics and Breeding,. Blackwell Publishing Ltd.,USA
8. Mono graphs available on specific crops.

6.	Principles of Food Science and Nutrition	[ASFS3101]	2 (2+0)
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Objectives: To know the principles involving various food preservation methods and gain knowledge of the role of nutrition in sustaining health and preventing diseases

Course Outcome : The student will be able to understand both fundamental and applied aspects of food science and gain insights about role of specific nutrients in maintaining health and identifying nutrient specific foods.

Theory

Concepts of Food Science (definitions, measurements, density, phase change, pH, osmosis, surface tension, colloidal systems etc.); Food composition and chemistry (water, carbohydrates, proteins, fats, vitamins, minerals, flavours, colours, miscellaneous bioactives, important reactions); Food microbiology (bacteria, yeast, moulds, spoilage of fresh & processed foods, Production of fermented foods); Principles and methods of food processing and preservation (use of heat, low temperature, chemicals, radiation, drying etc.); Food and nutrition, Malnutrition (over and under nutrition), nutritional disorders; Energy metabolism (carbohydrate, fat, proteins); Balanced/ modified diets, Menu planning, New trends in food science and nutrition.

References

1. Sumati R. Mudambi, Shalini M.Rao and M.V. Rajagopal. 2006. Food Science, 2nd Ed. New Age International(P) Limited, New Delhi.
2. Martin Eastwood. 2003. Principles of Human Nutrition. Blackwell Science Ltd., Oxford.
3. Norman N.Potter. 1998. Food Science, 5th Ed. Springer Science+ Business Media, New York.
4. Michael J.Pelczar Jr.,E.C.S. Chan and Noel R.Krieg. 1998. Microbiology, 5th Ed. Tata McGraw-Hill Education, New Delhi

5. William C.Frazier and Dennis C. Westhoff. 1987. Food Microbiology, 4th Ed. Tata McGraw-Hill Education, New Delhi.
6. L.E. Casida Jr. 1968. Industrial Microbiology. New Age International Publishers, New Delhi.
7. P. Fellows. 2000. Food Processing Technology: Principles and Practice, 2nd Ed. CRC Press, Boca Raton, FL, USA.
8. Marcus Karel and Darvl B.Lund. 2003. Physical Principles of Food Preservation, 2nd Ed. Marcel Dekker, Inc., NY,USA.
9. Gerald Wiseman. 2002. Nutrition and Health. Taylor & Francis, London.
10. An Introduction to Nutrition, v.1.0

7.	Geoinformatics and Nano-technology for Precision Farming	[ASAG3110]	2(1+1)
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Objective: Ensure targeting of inputs and outputs by adoption of precision technologies. Adopt modern hardware and software tools and equipment in crop production. Understand importance and application of nano-technology in agriculture

Course Outcomes: This course offers a good scope for students in skill development sectors.

Theory

Precision agriculture: concepts and techniques; their issues and concerns for Indian agriculture; Geo-informatics- definition, concepts, tool and techniques; their use in Precision Agriculture. Crop discrimination and Yield monitoring, soil mapping; fertilizer recommendation using geospatial technologies; Spatial data and their management in GIS; Geodesy and its basic principles; Remote sensing concepts and application in agriculture; Image processing and interpretation; Global positioning system (GPS), components and its functions; System Simulation- Concepts and principles, Introduction to crop Simulation Models and their uses for optimization of Agricultural Inputs; STCR approach for precision agriculture; Nanotechnology, definition, concepts and techniques, brief introduction about nanoscale effects, nano-particles, nano-pesticides, nano-fertilizers, nano-sensors, Use of nanotechnology in tillage, seed, water, fertilizer, plant protection for scaling-up farm productivity.

Practical

Introduction to GIS software, spatial data creation and editing. Introduction to image processing software. Visual and digital interpretation of remote sensing images. Generation of spectral profiles of different objects. Supervised and unsupervised classification and acreage estimation. Multispectral remote sensing for soil mapping. Creation of thematic layers of soil fertility based on GIS. Creation of productivity and management zones. Fertilizers recommendations based of VRT and STCR techniques. Crop stress (biotic/abiotic) monitoring using geospatial technology. Use of GPS for agricultural survey. Formulation, characterization and applications of nanoparticles in agriculture. Projects formulation and execution related to precision farming.

References

1. Pradeep, T. 2007. NANO: The Essentials: Understanding Nanosciences and Nanotechnology. Tata McGraw-Hill Publishing Company Ltd, New Delhi.
2. Lillesand, T.M. and Keifer, R.W. 1994. Remote Sensing and image interpretation (3rd edition), John Willey and Sons.
3. Anji Reddy, M. 2006. Text Book of Remote Sensing and Geographical Information Systems, (3rd edition), B.S.Publications, Hyderabad.

8	Practical Crop Production-I (Kharif Crops)	[ASAG3108]	2(0+2)
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Objective: Know cultivation technology of different crops in respect to different situations. Understand crop cycle and environmental requirements, agronomic management and economics of crop production.

Course Outcomes: This course offers a wide scope for students in skill development sectors.

Practical

Crop planning, raising field crops in multiple cropping systems: Field preparation, seed, treatment, nursery raising, sowing, nutrient, water and weed management and management of insect-pests diseases of crops, harvesting, threshing, drying winnowing, storage and marketing of produce. The emphasis will be given to seed production, mechanization, resource conservation and integrated nutrient, insect-pest and disease management technologies. Preparation of balance sheet including cost of cultivation, net returns per student as well as per team of 8-10 students.

9.	Environmental Studies and Disaster Management	[ASES3101]	3(2+1)
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Objectives : To enable students to develop a comprehensive understanding of various facets of life forms, ecological processes and how humans have impacted them

Course Outcomes: Upon completion of this course, students will acquire knowledge about the natural environment and its relationships with human activities and have capacity to obtain, analyse, and communicate information on risks, relief needs and lessons learned from earlier disasters in order to formulate strategies for mitigation in future scenarios.

Theory

Multidisciplinary nature of environmental studies Definition, scope and importance.

Natural Resources: Renewable and non-renewable resources, Natural resources and associated problems. a) Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people. b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies. d) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. e) Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies. f) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification. • Role of an individual in conservation of natural resources. • Equitable use of resources for sustainable lifestyles.

Ecosystems: Concept of an ecosystem, Structure and function of an ecosystem, Producers, consumers and decomposers, Energy flow in the ecosystem. Ecological succession, Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of the following ecosystem: a. Forest ecosystem b. Grassland ecosystem c. Desert ecosystem d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Biodiversity and its conservation: - Introduction, definition, genetic, species & ecosystem diversity and biogeographical classification of India. Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values. Biodiversity at global, National and local levels, India as a

mega-diversity nation. Hot-spots of biodiversity. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. Endangered and endemic species of India. Conservation of biodiversity: In-situ and Ex-situ 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 g. Nuclear hazards. Solid Waste Management: causes, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution.

Social Issues and the Environment: From Unsustainable to Sustainable development, 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. Wasteland reclamation. Consumerism and waste products. Environment Protection Act. Air (Prevention and Control of Pollution) Act. Water (Prevention and control of Pollution) Act. Wildlife Protection Act. Forest Conservation Act. Issues involved in enforcement of environmental legislation. Public awareness.

Human Population and the Environment: population growth, variation among nations, population explosion, Family Welfare Programme. Environment and human health: Human Rights, Value Education, HIV/AIDS. Women and Child Welfare. Role of Information Technology in Environment and human health.

Disaster management

Natural Disasters- Meaning and nature of natural disasters, their types and effects. Floods, drought, cyclone, earthquakes, landslides, avalanches, volcanic eruptions, Heat and cold waves, Climatic change: global warming, Sea level rise, ozone depletion.

Man Made Disasters- Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire, oil fire, air pollution, water pollution, deforestation, industrial waste water pollution, road accidents, rail accidents, air accidents, sea accidents.

Disaster Management- Effect to migrate natural disaster at national and global levels. International strategy for disaster reduction. Concept of disaster management, national disaster management framework; financial arrangements; role of NGOs, community –based organizations and media. Central, state, district and local administration; Armed forces in disaster response; Disaster response; Police and other organizations.

Practical

Pollution case studies. Case Studies- Field work: Visit to a local area to document environmental assets river/ forest/ grassland/ hill/ mountain, visit to a local polluted site- Urban/Rural/Industrial/Agricultural, study of common plants, insects, birds and study of simple ecosystems-pond, river, hill slopes, etc.

References

1. Bharucha, E. 2005. Text book of Environmental Studies for undergraduate courses. University Grants Commission, New Delhi.
2. Anjaneyalu, Y. 2004. Introduction to Environmental Science, BS Publications, Hyderabad, A.P., India.

SEMESTER – VI

1.	Farming System and Organic farming for Sustainable Agriculture	[ASAG3207]	3(2+1)
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Objective: Know the organic production system to achieve agricultural sustainability know the farming system approach, their requirements and the practices to obtain production sustainability

Course Outcomes: This course offers a wide scope for students in employment, skill development and entrepreneurial sectors.

Theory

Farming System-scope, importance, and concept, Types and systems of farming system and factors affecting types of farming, Farming system components and their maintenance, Cropping system and pattern, multiple cropping system, Efficient cropping system and their evaluation, Allied enterprises and their importance, Tools for determining production and efficiencies in cropping and farming system; Sustainable agriculture-problems and its impact on agriculture, indicators of sustainability, adaptation and mitigation, conservation agriculture strategies in agriculture, HEIA, LEIA and LEISA and its techniques for sustainability, Integrated farming system-historical background, objectives and characteristics, components of IFS and its advantages, Site specific development of IFS model for different agro-climatic zones, resource use efficiency and optimization techniques, Resource cycling and flow of energy in different farming system, farming system and environment.

Organic farming, principles and its scope in India; Initiatives taken by Government (central/state), NGOs and other organizations for promotion of organic agriculture; Organic ecosystem and their concepts; Organic nutrient resources and its fortification; Restrictions to nutrient use in organic farming; Choice of crops and varieties in organic farming; Fundamentals of insect, pest, disease and weed management under organic mode of production; Operational structure of NPOP; Certification process and standards of organic farming; Processing, leveling, economic considerations and viability, marketing and export potential of organic products.

Practical

Visit of organic farms to study the various components and their utilization; Preparation of enrich compost, vermicompost, bio-fertilizers/bio-inoculants and their quality analysis; Indigenous technology knowledge (ITK) for nutrient, insect, pest disease and weed management; Cost of organic production system; Post harvest management; Quality aspect, grading, packaging and handling.

References

1. Arun Kumar Sharma. 2006. A Handbook of Organic Farming. Agrobios (India), Jodhpur.
2. Jayanthi, C., Devasenapathy, P. and Vinnila, C. 2008. Farming Systems, Principles and Practices, Satish Serial Publishing House, Delhi.
3. Panda, S.C. 2011. Cropping and Farming Systems. Agrobios (India), Jodhpur.
4. Ruthenburg, H. 1980. Farming Systems in the Tropics. Oxford University Press.
5. Palaniappan, SP. and Annadurai, K. 1999. Organic Farming: Theory and Practice, Scientific Publishers, Jodhpur, India.257p.
6. Mukund Joshi and Prabhakarsetty, T.K. 2006. Sustainability through organic farming. Kalyani Publishers, New delhi. 349p.

7. Balasubramanian, R., Balakrishnan, K. and Siva Subramanian, K. 2013. Principles and Practices of organic Farming. Satish Serial Publishing House,453p.
8. Tarafdar, J.C., Tripathy, K.P. and Mahesh Kumar. 2009. Organic Agriculture. Scientific Publishers, India, 369p.
9. Tiwari, V.N., Gupta, D.K., Maloo, S.R. and Somani, L.L. 2010. Natural, organic, biological, ecological and biodynamic farming. Agrotech Publishing Academy, Udaipur, 420p.
10. Dushyent Gehlot. 2005. Organic Farming- standards, accreditation, certification and inspection. Agrobios, India.357p.

2.	Practical Crop Production-II (<i>Rabi Crops</i>)	[ASAG3209]	2(0+2)
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Course Objectives : To teach the practical growing of crop husbandry of different rabi crops

Outcomes: This course offers a wide scope for students in skill development for rabi crop production

Practical

Crop planning, raising field crops in multiple cropping systems: Field preparation, seed, treatment, nursery raising, sowing, nutrient, water and weed management and management of insect-pests diseases of crops, harvesting, threshing, drying winnowing, storage and marketing of produce. The emphasis will be given to seed production, mechanization, resource conservation and integrated nutrient, insect-pest and disease management technologies. Preparation of balance sheet including cost of cultivation, net returns per student as well as per team of 8-10 students.

3.	Post-harvest Management and Value Addition of Fruits and Vegetables	[ASHO3205]	2 (1+1)
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Objective: Knowledge about the extent and possible causes of post-harvest losses. Knowledge about harvesting, field handling of produce, processing and storage. Value addition of produce and their packaging.

Course Outcomes: This course offers a good scope for students in skill and entrepreneurship sectors.

Theory

Importance of fruits and vegetables, extent and possible causes of post harvest losses; Pre-harvest factors affecting postharvest quality, maturity, ripening and changes occurring during ripening; Respiration and factors affecting respiration rate; Role of ethylene; Post harvest disease and disorders; Heat, chilling and freezing injury; Harvesting and field handling; Storage (ZECC, cold storage, CA, MA, and hypobaric); 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; Drying/ Dehydration of fruits and vegetables – Concept and methods, osmotic drying. Canning – Concepts and Standards, packaging of products.

Practical

Applications of different types of packaging 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 and candy and tomato products, canned products. Quality evaluation of products -- physico-chemical and sensory. Visit to processing unit/ industry.

References

1. Rathore, N.S., Mathur, G.K., Chasta, S.s. 2012. Post-harvest Management and Processing of Fruits and Vegetables. ICAR, New Delhi
2. Srivastava, R.P. and Sanjeev Kumar, 2002. Fruit and vegetable Preservation: Principles and Practices. International Book Distributio Company, Lucknow.
3. Giridharilal, G.S., Siddappa and Tondon, G.L. 2007. Preservation of Fruits and Vegetables. ICAR, New Delhi.
4. Mitra, S.K. 2005, Post Har4vest Physiology and Storage of Tropical and Subtropical Fruits. CABI Publishers, Kolkatta.

4.	Pests of Horticultural crops and their management and Beneficial Insects	[ASEN3204]	3(2+1)
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Objectives: To study the causal organism, symptomatology, etiology and epidemiology of the important pests of field and horticulture crops for devising efficient management strategies against them.

Course Outcomes: This course will help the students in accurate identification of the diseases under farmer field conditions and in suggesting efficient and cost effective management strategies against them.

Theory

General account 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 pests and scientific names, order, family, host rage, distribution, nature of damage and cOntrol practices for other important arthropod pests of various vegetable crops, fruit crops, plantation crops, ornamental crops, narcotics, spices and condiments.

Importance of beneficial Insects, Beekeeping, pollinating plant and their cycle, bee biology, commercial methods of rearing, equipment used, seasonal management, bee enemies and disease. Bee pasturage, bee foraging and communication. Insect pests and diseases of honey bee.

Types of silkworm, voltinism and biology of silkworm. Mulberry cultivation, mulberry varieties and methods of harvesting and preservation of leaves. Rearing, mounting and harvesting of cocoons. Pest and diseases of silkworm, management, rearing appliances of mulberry silkworm and methods of disinfection.

Species of lac insect, morphology, biology, host plant, lac production – seed lac, button lac, shellac, lac- products. Identification of major parasitoids and predators commonly being used in biological control.

Identification of major Parasitoids, and predators commonly used in biological pest control. Insect orders bearing predators and parasitoids commonly used in pest control and their mass multiplication techniques. Important species of pollinator, weed killers and scavengers with their importance.

Practical

Identification of different types of damage. Identification and study of life cycle and seasonal history of various insect pests attacking horticultural crops – Vegetable crops, fruit crops, plantation gardens, narcotics, spices and condiments. Visit to orchards and gardens.

Honey bee species, castes of bees. Beekeeping appliances and seasonal management, bee enemies and disease. Bee pasturage, bee foraging and communication. Types of silkworm, voltinism and biology of silkworm. Mulberry cultivation, mulberry varieties and methods of harvesting and preservation of leaves. Species of lac insect, host plant identification. Identification of other important pollinators, weed killers and scavengers. Visit to research and training institutions devoted to beekeeping, sericulture, lac culture and natural enemies.

References

1. Butani, D. K. 1984. *Insects and Fruits*. Periodical Export Book Agency, New Delhi.
2. Ganga, G. and Sulochana Chetty, J 1997 (2nd ed). An introduction to Sericulture .Oxford and IBH Publishing Co. Pvt Ltd., New Delhi
3. Hisao Aragu 1994. Principles of Sericulture. Oxford and IBH Publishing Co. Pvt Ltd., New Delhi
4. Krishnaswamy, S. 1990. Sericulture manual – Silkworm, FAO
5. Singh S, 1975. Bee keeping in India . ICAR, New Delhi
6. Glover P M 1937. Lac cultivation in India>The Indian Lac Research Institute, Ranchi
7. Mishra R C 1995. Honey bees and their management in India .ICAR, New Delhi
8. Vasantharaj David, B.,and V.V. Ramanamurthy, 2003. *Elements of Economic Entomology*. Popular Book Depot, Coimbatore.

5.	Crop Improvement – II (Fibre, sugar, starches, narcotics, vegetables, fruits and flowers) (<i>Rabi crops</i>)	[ASPG3205]	2(1+1)
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Objective: The students able to know about the origin, distribution and wild relatives of important rabi crops. The students able to know about the plant genetic resources, and different breeding methods adopted for the development of varieties and hybrids. The students able to know about the floral biology, emasculation and pollination techniques operated in different Rabi crops.

Course Outcomes: This course offers a wide scope for students in employment, skill development sectors.

Theory

Centers of origin, distribution of species, wild relatives in different cereals; pulses; oilseeds; fodder crops and cash crops; vegetable and horticultural crops; Plant genetic resources, its utilization and conservation; Floral biology, study of genetics of qualitative and quantitative characters; Important concepts of breeding self pollinated, cross pollinated and vegetatively propagated crops; Major breeding objectives and procedures including conventional and modern innovative approaches for development of hybrids and varieties for yield, adaptability, stability, abiotic and biotic stress tolerance and quality (physical, chemical, nutritional); Seed production technology in self pollinated, cross pollinated and vegetatively propagated crops. Hybrid seed production technology of rabi crops. Ideotype concept and climate resilient crop varieties for future.

Practical

Emasculation and hybridization techniques in different crop species namely Wheat, Oat, Barley, Chickpea, Lentil, Field pea, Rapeseed Mustard, Sunflower, Potato, Berseem. Sugarcane, Cowpea; 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 seeds production

in *Rabi* crops; Estimation of heterosis, inbreeding depression and heritability; Layout of field experiments; Study of quality characters, study of donor parents for different characters; Visit to seed production plots; Visit to AICRP plots of different field crops.

References

1. Allard, R.W. 1960. Principles of Plant Breeding. John Wiley & Sons, New York
2. Phundan Singh. 2006. Essential of Plant Breeding, Kalyani Publishers, Ludhiana.
3. Poehlman, J.M. and Borthakur, D. 1995. Breeding of Asian Field Crops. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
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6.	Principles of Integrated Pest and Disease Management	[ASPP3204]	3(2+1)
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Objective: The students have knowledge with different method to control and manage the plant disease in field condition. Student have knowledge to establish commercial production unit of bio-pesticide.

Course Outcomes: On successful completion of this course and basing on the diversified course outcomes this course offers a good scope for students to take up employment and entrepreneurship activities.

Theory

Categories of insect pests and diseases, IPM: Introduction, history, importance, concepts, principles and tools of IPM. Economic importance of insect pests, diseases and pest risk analysis. Methods of detection and diagnosis of insect pest and diseases. Calculation and dynamics of economic injury level and importance of Economic threshold level. Methods of control: Host plant resistance, cultural, mechanical, physical, legislative, biological and chemical control. Ecological management of crop environment. Introduction to conventional pesticides for the insect pests and disease management. Survey surveillance and forecasting of Insect pest and diseases. Development and validation of IPM module. Implementation and impact of IPM (IPM module for Insect pest and disease. Safety issues in pesticide uses. Political, social and legal implication of IPM. Case histories of important IPM programmes.

Practical

Methods of diagnosis and detection of various insect pests, and plant diseases, Methods of insect pests and plant disease measurement, Assessment of crop yield losses, calculations based on economics of IPM, Identification of biocontrol agents, different predators and natural enemies. Mass multiplication of *Trichoderma*, *Pseudomonas*, *Trichogramma*, NPV etc. Identification and nature of damage of important insect pests and diseases and their management. Crop (agro-ecosystem) dynamics of a selected insect pest and diseases. Plan & assess preventive strategies (IPM module) and decision making. crop monitoring attacked by insect, pest and diseases . Awareness campaign at farmers fields.

References

1. Dhaliwal, G.S. and Ramesh Arora 2001. Integrated pest management: Concepts and approaches, Kalyani Publishers, Ludhiana

2. Metcalf, R.L. and Luckman, W.H.1982. Introduction to insect pest management Wiley inter science publishing, New York.
3. Larry P Pedigo 1991. Entomology and pest management, Prentice Hall of India Pvt. Ltd., New Delhi
4. Venugopala Rao, N., Umamaheswari, T., Rajendraprasad, P., Naidu,V.G. and Savithri,P.2004.Integrated Insect Pest Management, Agrobios (India) Limited, Jodhpur.
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9. Y.L. Nene and P.N. Thaplial, 1993, Fungicides in Plant Disease Control. Oxford & IBH Publishing Co.

7.	Protected Cultivation and Post harvest Technology	[ASAE3204]	2(1+1)
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Objectives: To impart knowledge on agro-technique and management of different horticultural crops under protected environmental conditions.

Student will be made aware of the technological changes that are occurring in this field along with pre and post-harvest technology

Course Outcomes : It will aware students and they will gain knowledge about post-harvest technology which enables storage of agricultural products during the whole year in full quality, identification and elimination of negative processes which may be occur during processes and storage

Theory

Green house technology: Introduction, Types of Green Houses; Plant response to Green house environment, Planning and design of greenhouses, Design criteria of green house for cooling and heating purposes. Green house equipments, materials of construction for traditional and low cost green houses. Irrigation systems used in greenhouses, typical applications, passive solar green house, hot air green house heating systems, green house drying. Cost estimation and economic analysis.

Important Engineering properties such as physical, thermal and aero & hydrodynamic properties of cereals, pulses and oilseed, their application in PHT equipment design and operation. Drying and dehydration; moisture measurement, EMC, drying theory, various drying method, commercial grain dryer (deep bed dryer, flat bed dryer, tray dryer, fluidized bed dryer, recirculatory dryer and solar dryer). Material handling equipment; conveyer and elevators, their principle, working and selection.

Practical

Study of different type of green houses based on shape. Determine the rate of air exchange in an active summer winter cooling system. Determination of drying rate of agricultural products inside green house.Study of green house equipments. Visit to various Post Harvest Laboratories. Determination of Moisture content of various grains by oven drying & infrared moisture methods.Determination of

engineering properties (shape and size, bulk density and porosity of biomaterials).Determination of Moisture content of various grains by moisture meter.Field visit to seed processing plant.

References

1. RadhaManohar, K. and Igathinathene.C. greenhouse Technology and Management, 2nd edition, BS publications
- 2.TiaryG.N. Greenhouse Technology for Controlled Environment.Narosa Publishing House. Pvt Ltd.
3. Singh Brrahma and Balraj Singh. 2014. Advances in Protected Cultivation, New India Publishing Company
4. Sahay, K.M. and Singh,K.K. 1994. Unit Operation of Agricultural Processing. Vikas Publishing House Pvt Ltd., New delhi
5. Chakravarthy,A. Post Harvest Technology of cereals, pulses and Oil seeds. Oxford and IBH Publishing Co. Ltd., New Delhi
6. 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

8.	Intellectual Property Rights	[ASIP3201]	1(1+0)
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Objective: To understand the necessity of patents, copyright, trademark, GI, etc. Skill development in IPR is one of the most important outcomes of this course.

Course Outcomes: This course offers a scope for student employability, skill development in the field of IPR.

Theory

Introduction and meaning of intellectual property, brief introduction to GATT, WTO, TRIPs and WIPO, Treaties for IPR protection: Madrid protocol, Berne Convention, Budapest treaty, etc.

Types of Intellectual Property and legislations covering IPR in India:-Patents, Copyrights,

Trademark, Industrial design, Geographical indications, Integrated circuits, Trade secrets. Patents Act 1970 and Patent system in India, patentability, process and product patent, filing of patent, patent specification, patent claims, Patent opposition and revocation, infringement, Compulsory licensing, Patent Cooperation Treaty, Patent search and patent database.

Origin and history including a brief introduction to UPOV for protection of plant varieties, Protection of plant varieties under UPOV and PPV&FR Act of India, Plant breeders rights, Registration of plant varieties under PPV&FR Act 2001, breeders, researcher and farmers rights. Traditional knowledge-meaning and rights of TK holders.

Convention on Biological Diversity, International treaty on plant genetic resources for food and agriculture (ITPGRFA). Indian Biological Diversity Act, 2002 and its salient features, access and benefit sharing.

References

1. Acharya, N.K. 2014. Text book of Intellectual Property Rights. Asia Law House, Hyderabad.
2. Loganathan, E.T.2012. Intellectual Property Rights. New Century Publications, New Delhi.
3. Rosedar, S.R.A. 2016. Intellectual Property Rights. Lexis Nexis(2nd Ex.) Nagpur

9.	Production Economics & Farm Management	[ASEC3204]	2(1+1)
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Objectives: Determine and outline the conditions that give the optimum use of resources in the production of crops, livestock and allied enterprises. Explain the means and methods in getting from the existing use to optimum use of resources.

Course Outcomes: This course offers a wide scope for students in entrepreneurship sectors.

Theory

Meaning and concept of farm management, objectives and relationship with other sciences. Meaning and definition of farms, its types and characteristics, changing structure, of land holdings in India and characteristics of small and marginal farm holdings, Farm management problems in India.

Principles of farm management: concept of production function and its type, use of production function in decision-making on a farm, factor-product, factor-factor and product-product relationship, law of equi-marginal/or principles of opportunity cost and law of comparative advantage.

Meaning and concept of cost, types of costs and their interrelationship, importance of cost in managing farm business and estimation of gross farm income, net farm income, family labor income and farm business income.

Farm business analysis: meaning and concept of farm income and profitability, technical and economic efficiency measures in crop and livestock enterprises. Importance of farm records and accounts in managing a farm, various types of farm records needed to maintain on farm, farm inventory, balance sheet, profit and loss accounts. Meaning and importance of farm planning and budgeting, partial and complete budgeting, steps in farm planning and budgeting-linear programming, appraisal of farm resources, selection of crops and livestock's enterprises. Concept of risk and uncertainty occurs in agriculture production, nature and sources of risks and its management strategies, Crop/livestock/machinery insurance – weather based crop insurance, features, determinants of compensation. Concepts of resource economics, differences between NRE and agricultural economics, unique properties of natural resources. Positive and negative externalities in agriculture, Inefficiency and welfare loss, solutions, Important issues in economics and management of common property resources of land, water, pasture and forest resources etc.

Practical

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

References

1. Bishop, C.E., W.E. Tousaint. 1958. Introduction to Agricultural Economic Analysis. John Wiley and Sons, London
2. Heady, Earl O., 1964. Economics of agricultural production and Resource Use. Printice Hall of India, Pvt., Ltd. New Delhi
3. Johl, S.S., J.R. Kapur. 2006. Fundamentals of Farm Business Management. Kalyani Publishers.
4. Kalhon, A.S. and Karam Singh. 1965. Principles of Farm Business Management. Kalyani Publishers.

5.Raju,V.T., and D.V.S. Rao.2006. Econocs of Farm Production and Management. Oxford &IBH Publishing Co., Pvt. Ltd, New Delhi

6. www.core_economics.org

Non-gradial courses

1. NSS/NCC

[ASPE1101] 2(0+2+0)

Theory

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

Following activities are to be taken up under the NSS course:

Introduction and basic components of NSS: Orientation NSS programmes and activities

Understanding youth

Community mobilisation

Social harmony and national integration

Volunteerism and shramdan

Citizenship, constitution and human rights

Family and society

Importance and role of youth leadership

Life competencies

Youth development programmes

Health, hygiene and sanitation

Youth health, lifestyle, HIV AIDS and first aid

Youth and yoga

Vocational skill development

Issues related environment

Disaster management

Entrepreneurship development

Formulation of production oriented project

Documentation and data reporting

Resource mobilization

Additional life skills

Activities directed by the Central and State Government

All the activities related to the National Service Scheme course is distributed under four different courses viz., National Service Scheme I, National Service Scheme II, National Service Scheme III and National Service Scheme IV each having one credit load. The entire four courses should be offered continuously for two years. A student enrolled in NSS course should put in atleast 60 hours of social work in different activities in a semester other than five regular one day camp in a year and one special camp for duration of 7 days at any semester break period in the two year. Different activities will include orientation lectures and practical works. Activities directed by the Central and State Government have to be performed by all the volunteers of NSS as per direction.

1. Physical Education and Yoga Practices

[ASPE1201] 2(0+2+0)

Semester II: Physical Education and Yoga Practices

1. Teaching of skills of Football – demonstration, practice of the skills, correction, involvement in game situation (For girls teaching of Tennikoit)
2. Teaching of different skills of Football – demonstration, practice of the skills, correction, involvement in game situation (For girls teaching of Tennikoit)
3. Teaching of advance skills of Football – involvement of all the skills in game situation with teaching of rules of the game
4. Teaching of skills of Basketball – demonstration, practice of the skills, correction of skills, involvement in game situation
5. Teaching of skills of Basketball – demonstration, practice of the skills, involvement in game situation
6. Teaching of skills of Basketball – involvement of all the skills in game situation with teaching of rule of the game
of the ICAR Fifth Deans' Committee
7. Teaching of skills of Kabaddi – demonstration, practice of the skills, correction of skills, involvement in game situation
8. Teaching of skills of Kabaddi – demonstration, practice of the skills, correction of skills, involvement in game situation
9. Teaching of advance skills of Kabaddi – involvement of all the skills in game situation with teaching of rule of the game
10. Teaching of skills of Ball Badminton – demonstration, practice of the skills, correction of skills, involvement in game situation
11. Teaching of skills of Ball Badminton – involvement of all the skills in game situation with teaching of rule of the game
12. Teaching of some of Asanas – demonstration, practice, correction and practice
13. Teaching of some more of Asanas – demonstration, practice, correction and practice
14. Teaching of skills of Table Tennis – demonstration, practice of skills, correction and practice and involvement in game situation
15. Teaching of skills of Table Tennis – demonstration, practice of skills, correction and practice and involvement in game situation
16. Teaching of skills of Table Tennis – involvement of all the skills in game situation with teaching of rule of the game
17. Teaching – Meaning, Scope and importance of Physical Education
18. Teaching – Definition, Type of Tournaments
19. Teaching – Physical Fitness and Health Education
20. Construction and laying out of the track and field (*The girls will have Tennikoit and Throw Ball).

Physical Education and Yoga Practices

1. Teaching of skills of Hockey – demonstration practice of the skills and correction.
2. Teaching of skills of Hockey – demonstration practice of the skills and correction. And involvement of skills in games situation
3. Teaching of advance skills of Hockey – demonstration practice of the skills and correction. Involvement of all the skills in games situation with teaching of rules of the game
4. Teaching of skills of Kho-Kho – demonstration practice of the skills and correction.
5. Teaching of skills of Kho-Kho – demonstration practice of the skills and correction. Involvement of the skills in games situation
6. Teaching of advance skills of Kho-Kho – demonstration practice of the skills and correction. Involvement of all the skills in games situation with teaching of rules of the game
7. Teaching of different track events – demonstration practice of the skills and correction.

8. Teaching of different track events – demonstration practice of the skills and correction.
9. Teaching of different track events – demonstration practice of the skills and correction with competition among them.
10. Teaching of different field events – demonstration practice of the skills and correction.
11. Teaching of different field events – demonstration practice of the skills and correction.
12. Teaching of different field events – demonstration practice of the skills and correction.
13. Teaching of different field events – demonstration practice of the skills and correction with competition among them.
14. Teaching of different asanas – demonstration practice and correction.
15. Teaching of different asanas – demonstration practice and correction.
16. Teaching of different asanas – demonstration practice and correction.
17. Teaching of different asanas – demonstration practice and correction.
18. Teaching of weight training – demonstration practice and correction.
19. Teaching of circuit training – demonstration practice and correction.
20. Teaching of calisthenics – demonstration practice and correction.

Note: 1) Compulsory Uniform: Half pants, Tee Shirts, Shoes and socks all white (Girls will have white Tee Shirt and Track pants) **2)** The games mentioned in the practical may be inter changed depending on the season and facilities.

1. Human Value and Ethics

[ASHV2101] 1(1+0+0)

Theory

Values and Ethics-An Introduction.Goal and Mission of Life.Vision of Life.Principles andPhilosophy.Self Exploration.Self Awareness.Self Satisfaction.Decision Making.Motivation.Sensitivity.Success.Selfless Service.Case Study of Ethical Lives.Positive Spirit.Body, Mind and Soul.Attachment and Detachment.Spirituality Quotient.Examination.

Educational Tour 2 (0+2+0)

Domain Courses (Available in www.courseware.cutm.ac.in)

Organic Farming

Track courses: 09 credits

1. Organic Farming. (1-2-0)
2. Certification and Inspection Systems in Organic Farming in India. (1-2-0)
3. Bio pesticides and Bio fertilizers. (1-2-0)

Practice Courses: 09 credits

1. Organic Production- Field Crops. (0-3-0)
2. Organic Production- Horticultural Crops. (0-3-0)
3. Bio fertilizer and Bio pesticide Production Technology. (0-3-0)

AELP Linked with Domain: 11 credits

Nutraceuticals

Track courses (3-6-0)

1. Introduction to Nutraceutical (1+2)
2. Functional Food (1+2)
3. Nutrigenetics (1+2)

Project Courses (0-3-6)

1. Development of Personalized Food and Medicine (0-1-2)
2. Development of Biopesticides and Biofertilizers (0-1-2)
3. Development of Immune Boosters (0-1-2)

AELP Linked Project Courses (0-0-11)

1. To develop personalized food and beverages rich in Antioxidants and Polyphenols
2. To Develop low-cost omega-3 capsules from fish oil that can reduce inflammation and improve hypertriglyceridemia
3. To develop immune boosters
4. To develop energy bars
5. Development and Application of different pesticides and fertilizers in Organic farm
6. Development and Application of pesticides in fishes
7. Development and Application of drug designing in lab
8. Products/Patents/Publications

Genetic Engineering and Genomics

Track Courses (3-6-0)

1. Computational Biology 1-2-0
2. Genetic Engineering and its applications 1-2-0
3. Plant Molecular Biology 1-2-0

Practice Courses (0-9-0)

1. Molecular Genomics 0-3-0
2. Plant Tissue Culture Technologies 0-3-0
3. Techniques in Molecular Biology 0-3-0

AELP Project (0-0-11)

1. Exploration of available various sequences from different crops.
2. In silico identification of pharmacophore for plant diseases.
3. In vitro micro-propagation of banana and hardening.
4. Commercial production of horticultural crops.
5. Standardization of protocol for in vitro micro-propagation of horticulture crops.
6. DNA isolation, amplification and gel electrophoresis of plant sample.

7. Phenotyping and genotyping of rice varieties for abiotic stress tolerance.
8. Genome editing techniques towards crop improvement.

Intensive Aquaculture

Track courses (3-6-0)

- Intensive Fish Rearing (1-2-0)
- Ornamental Fish Farming (1 -2-0)
- Biofloc Aquaculture (1-2-0)

Practice courses (0-9-0)

- Framing of SOPs for Intensive fish culture and ornamental fish culture (0-3-0)
- Health Management in Aquaculture (0-3-0)
- Feed Management in Aquaculture (0-3-0)

AELP Project (0-0-11)

Intensive production of commercially important fishes in different Aquaculture production systems at Fish rearing Unit and pond (0-0-11)

Dairy Processing and Development

Track courses (3-6-0)

1. Milk Processing in Dairy Industry (1-2-0)
2. Dairy Starters in Fermented Milk Products (1-2-0)
3. Quality Assurance in Dairy Industry (1-2-0)

Practice courses (0-9-0)

4. Dairy Products Development (0-3-0)
5. Synbiotic Dairy Foods (0-3-0)
6. Quality Analysis of Milk and Milk Products (0-3-0)

AELP Project (0-0-10)

7. Projects in Units/Industry/Lab (0-0-10)

SMART Agriculture

Track courses (3-6-0)

1. ASHE 2201: Applied hi-tech horticulture (1-2-0)
2. ASHE 3102: Protected cultivation of vegetable crops (1-2-0)
3. ASHE 3203 High-tech fruit culture (1-2-0)

Practice Courses (0-9-0)

1. Management of high-value cut-flowers (0-3-0)
2. Management of crops in hydroponics (0-3-0)
3. Use of smart tools for precision crop management (0-3-0)

AELP Linked Project Courses (0-0-11)

Any one of the following

1. Growing of high-value flowers
2. Production of crops in hydroponics
3. Smart rice crop management

Protected Horticulture

Track Courses (3-6-0)

1. ASHE 2201. Applied hi-tech horticulture (1-2-0)
2. ASHE 3102. Protected cultivation of vegetable crops (1-2-0)
3. ASHE 3203. High tech fruit culture (1-2-0)

Practice Courses (0-9-0)

1. ASHA 4204. Production technology of cut flowers & loose flowers (0-3-0)
2. ASHA 4205. Protected floriculture (0-3-0)
3. ASHA 4206. Production management of medicinal and aromatic crops (0-3-0)

AELP LINKED WITH DOMAIN (0-0-11)

1. Protected cultivation of vegetable crops & Marketing
2. High-density planting and management
3. Project
4. Publication

Food Processing

Track Courses (3-6-0)

1. Processing Technology of Cereals and Millets (1-2-0)
2. Processing Technology of Legumes and Oilseeds (1-2-0)
3. Processing Technology of Fruits, Vegetables, Spices and Condiments (1-2-0)

Practice Courses (0-9-0)

4. Product Development and Packaging Technologies (0-3-0)
5. Food Standards and Regulations and HACCP Systems (0-3-0)
6. Sensory Evaluation and Nutritional Labelling of Foods (0-3-0)

AELP Project (0-0-11)

7. AELP Linked Project (0-0-11)

Commodity and Food Storage

Track Courses (3-6-0)

1. Storage Entomology (1-2-0)
2. Seed pathology (1-2-0)
3. Post-harvest biochemistry and physiology of crops (1-2-0)

Practice Courses (0-9-0)

4. Recent trends in post-harvest technology (0-3-0)
5. Pest management techniques in storage (0-3-0)
6. Post-harvest storage of fruits and vegetables (0-3-0)

AELP Project (0-0-11)

7. Project (0-0-11)

Agribusiness Management

Track Courses (2-0-4)

1. Agri Food Markets and Value Chain Analysis (1-0-2)
2. Agri Input Marketing (1-0-2)

Practice Courses (0-0-6)

1. Rural Haat and Market Analysis (0-0-2)
2. Community Owned and Managed Agri Businesses (0-0-2)
3. Agri Warehouse Management (0-0-2)

AELP Project (0-0-11)

Sales and Distribution of Agrifood Products (Internship at LMDC) (0-0-11)

Seed Production Using Manual and Molecular Methods

Track Courses (3-6-0)

1. Breeding methods: conventional and molecular approach (1-2-0)
2. Seed production of vegetable and cereals crops (1-2-0)
3. Seed certification (1-2-0)

Practice Courses (0-9-0)

4. Hybridization techniques (0-3-0)
5. Vegetable Seed production (0-3-0)
6. Cultivar purity and seed quality testing (0-3-0)

AELP Project (0-0-11)

Practices in Units/Field/Lab/Project (0-0-11)

Breeding methods: conventional and molecular approach (1-2-0)

Theory

- 1.1. Classification of Plant Breeding methods
- 1.2. Genetic basis and breeding methods in self- pollinated crops
- 1.3. Hybridization techniques and handling of segregating population
- 1.4. Genetic basis and breeding methods of cross-pollinated crops
- 1.5. Heterosis and inbreeding depression
- 1.6. Hybrid breeding- steps /operations in production of hybrid varieties
- 1.7. Male sterility and its application in hybrid seed production
- 1.8. Breeding methods in asexually propagated crops
- 1.9. Special breeding techniques: Mutation breeding
- 1.10. Special breeding techniques: Breeding for abiotic stresses
- 1.11. Special breeding techniques: Breeding for biotic stresses
- 1.12. DNA markers and its application in plant breeding
- 1.13. Marker assisted selection (MAS) and QTL
- 1.14. Cultivar development-variety testing procedures, release and notification system in India and IPR

Practical

- 1.1. Emasculation and hybridization techniques in Rice
- 1.2. Emasculation and hybridization techniques in maize
- 1.3. Emasculation and hybridization techniques in vegetable crops: Tomato
- 1.4. Emasculation and hybridization techniques in vegetable crops: Okra
- 1.5. Emasculation and hybridization techniques in vegetable crops: Brinjal
- 1.6. Handling of segregating populations
- 1.7. Designs used in plant breeding experiment: RBD analysis
- 1.8. Estimation of heterosis, inbreeding depression and heritability

- 1.9. Learning techniques in hybrid seed production using male-sterility in field crops
- 1.10. Use of male sterility in hybrid seed production: Rice
- 1.11. Genetic Mechanisms for Hybrid Seed Production in vegetable crops
- 1.12. Visit to AICRP plots to know about different trials for cultivar development
- 1.13. DNA isolation, DNA purity and quantification tests
- 1.14. DNA finger printing using PCR-based DNA markers
- 1.15. Gel electrophoresis
- 1.16. Gel scoring and data analysis for tagging and phylogenetic relationship
- 1.17. Use of standard MAS procedures- screening crops for resistant to different biotic stress traits
- 1.18. Use of standard MAS procedures- screening crops for resistant to different abiotic stress traits

Suggested Readings

1. Allard, R.W.1960. Principles of Plant Breeding. John Wiley & Sons, New York
 2. Caetano-Anolles G & Gresshoff PM. 1998. *DNA Markers: Protocols, Applications and Overviews*. Wiley-VCH.
 3. Chopra VL. 2001. *Breeding Field Crops*. Oxford & IBH.
 4. Kalloo, G.1994, Vegetable Breeding, Panima Educational Book Agency, New Delhi
 5. Singh,P. 2006, Essential of Plant Breeding. Kalyani Publishers, Ludhiana
 6. Singh B. D. 2006. *Plant Breeding*. Kalyani Publishers.
2. Seed production of vegetable and cereals crops (1-2-0)

Theory

- 2.1. Importance and scope of vegetable seed production in India
- 2.2. Planning for certified, foundation and breeder seed production
- 2.3. Seed quality: Certification standards for self and cross pollinated and vegetatively propagated crops
- 2.4. Principles of seed production in vegetable crops
- 2.5. Seed production in varieties and hybrids of cereals crops: rice and maize
- 2.6. Seed production in varieties and hybrids of vegetable crops: tomato, brinjal and okra
- 2.7. Harvesting/picking stage and seed extraction in vegetables
- 2.8. Seed drying, seed processing and seed storage
- 2.9. Seed health and measures for pest and disease control during storage

Practical

- 2.1. Selection of suitable areas/locations, seed/planting material for quality seed production
- 2.2. Determination of planting ratios for hybrid seed production of cereals

- 2.3. Study of floral biology of vegetable crop: Tomato
- 2.4. Study of floral biology of vegetable crop: Okra
- 2.5. Study of floral biology of vegetable crop: Eggplant
- 2.6. Determination of planting ratios for hybrid seed production of vegetables
- 2.7. Seed extraction methods and their effect on quality of vegetables
- 2.8. Seed and seedling vigour test
- 2.9. Practice on seed production of varieties and hybrids in cereal crops
- 2.10. Practice on seed production of varieties and hybrids in vegetable crops
- 2.11. Visit to seed production farms
- 2.12. Visit to seed testing laboratories
- 2.13. Visit to seed processing unit.

Suggested Readings

1. Agarwal RL. 1997. *Seed Technology*. 2nd Ed. Oxford & IBH.
 2. Desai BB, Katecha, PM & Salunke DK. 1997. *Seed Hand Book: Biology, Production, Processing and Storage*. Marcel Dekker.
 3. Desai BB. 2004. *Seeds Handbook*. Marcel Dekker.
 4. George RAT. 1980. *Vegetable Seed Technology. A Technical Guide to Vegetable Seed Production, Processing, Storage and Quality Control*. FAO, Rome
3. Seed certification (1-2-0)

Theory

- 3.1. Seed policy
- 3.2. Seed Certification: concept, objectives and importance of seed certification
- 3.3. Rule and regulation: Seed acts, Seed certification agency/organization and legal status
- 3.4. Indian Minimum Seed Certification Standards (I.M.S.C.S.)
- 3.5. Phases, Planning and management of seed certification programmes
- 3.6. Field Inspection: principles, phases and procedures, post-harvest inspection and evaluation
- 3.7. Seed sampling and seed testing for quality assessment
- 3.8. Grant of certificate and certification fee and other service charges
- 3.9. Seed marketing: structure and organization and pricing policy
- 3.10. Role of WTO and OECD in seed marketing

Practical

- 3.1. General procedure of seed certification
- 3.2. Identification of weed and other crop seeds as per specific crops

- 3.3. Field inspection at different stages of a crop and observations recorded
- 3.4. Inspection and sampling at harvesting/threshing for seed law enforcement
- 3.5. Inspection and sampling at processing and after processing for seed law enforcement
- 3.6. Sampling methods and seed quality test
- 3.7. Specifications for tags and labels to be used for certification purpose
- 3.8. Varietal Identification through Grow Out Test
- 3.9 Varietal Identification through Electrophoresis
- 3.10. Molecular test for pre- and post-harvest quality control
- 3.11. Biochemical test for pre- and post-harvest quality control
- 3.12. Visits to regulatory seed testing laboratory, including plant quarantine lab
- 3.1.3 Visit to private and public sector seed companies
- 3.14. Visit to certification agencies, and NBPGR.

Suggested Readings

1. Agarwal RL. 1997. *Seed Technology*. Oxford & IBH.
2. Anonymous 1992. *Legislation on Seeds*. NSC Ltd., Department of Agriculture and Cooperation, Ministry of Agriculture, New Delhi.
3. Nema NP. 1986. *Principles of Seed Certification and Testing*. Allied Publs.
4. Tunwar NS & Singh SN. 1988. *Indian Minimum Seed Certification Standards*. CSCB, Ministry of Agriculture, New Delhi.

Introduction to Nutraceutical (1+2)

Theory:

Organizational elements, classification of nutraceuticals, dietary supplements, fortified foods, functional foods, and Phyto-nutraceuticals. The scope involved in the industry, Indian, and global scenario, Food Chemistry, Preservatives, food colors.

Practicals:

1. **Milk Analysis:** Determination of fat, acidity, lactose, protein, adulterants
2. **Analysis of water:** Collection of the sample, preliminary examination, Total soluble solids, Determination of total hardness, chlorides, dissolved oxygen
3. **Analysis of fats:** acid value, saponification value, iodine number, antioxidants
4. **Analysis of foods:** Determination of reducing and non reducing sugar, protein, determination of ash/total protein/moisture in dietary fibers
5. **Anti-nutritional Factors:** Trypsin inhibitor, Phytic acid, Antifungal activity of cystatin
6. **Vitamins:** Ascorbic acid by colorimetric method, estimation of Vit A/E
7. **Pigments:** Curcumin, chlorophyll, carotene

Subject 2: Functional Food (1+2)

Theory:

- Prebiotics- Definition, chemistry, sources, metabolism and bioavailability, the effect of processing, physiological effects, effects on human health, and potential applications in risk reduction of diseases. perspective for food applications for the – Non-digestible carbohydrates/oligosaccharides, Dietary fiber, Resistant starch, Gums.
- Probiotics- Taxonomy and important features of probiotic microorganisms. Health effects of probiotics including mechanism of action. Probiotics in various foods: fermented milk products, non-milk products, etc. Quality Assurance of probiotics and safety.
- Drug Discovery - Issues, Target and Lead Identification, Drug And Databases, Drug Properties, Drug Solubility/permeability, ADME, Molecular Modelling, Quantitative Structure-Activity Relationship, Target-based drug design, Docking. Pharmacokinetics/ pharmacodynamics, Discussion on Molecular Drug Designing, Targeted drug designing, Application

Practicals:

1. **Extraction Techniques:** Soxhlet Extraction, Cold Press Extraction, Super Critical Fluid Extraction, CO₂ Extraction
2. **Isolation and Purification of Phytochemicals:** TLC, Paper Chrom, Column Chrom, HPLC, Analysis of Aflatoxin
3. **Validation of Phytochemicals:** Using different microorganisms and mammalian cell lines

Subject 3: Nutrigenetics (1+2)

Theory:

Introduction to Nutrigenetics, Nutrigenomics, Concept of Personalized food with special references to athletes. Introduction to different types of public domain databases, data mining strategies, primer designing.

Practical:

1. m-RNA extraction from treated mammalian cell line
2. Preparation of c-DNA
3. Study of Gene expression in Real Time PCR
4. Electrophoresis

Domain Books:

Introduction to Nutraceuticals:

- Giuseppe Mazza; Functional Foods: Biochemical and Processing Aspects, Volume 1; CRC Press
- Robert E.C. Wildman; Handbook of Nutraceuticals and Functional Foods, Second Edition; CRC Press
- Massimo Maffei; Dietary Supplements of Plant Origin; CRC Press
- Fereidoon Sahidi, Deepthi K. Weerasinghe; Nutraceutical Beverages, Chemistry, Nutrition and Health Effects; American Chemical Society

Functional Foods:

- Ronald R. Watson; Vegetables, Fruits, and Herbs in Health Promotion; CRC Press
- Fruit and Cereal Bioactives: Sources, Chemistry and Applications; Özlem Tokusoglu; Clifford Hall III; CRC Press
- Susan Sungsoo Cho, Mark L. Dreher; Marcel; Dekker Handbook of Dietary Fibre

Nutrigenetics:

- Principles of Nutrigenetics and Nutrigenomics - 1st Edition. Print Book & E-Book. ISBN 9780128045725, 9780128045879.
- Nutrigenetics: Applying the Science of Personal Nutrition. Academic Press; Reprint edition (19 August 2016).
- Nutrigenetics and Nutrigenomics. World Review of Nutrition and Dietetics, Vol. 93

Intensive Fish Rearing(1-2-0)

Theory:

- 1.1. History, definition, scope and significance of aquaculture
- 1.2. Site selection and planning for aquaculture operation
- 1.3. Criteria for selection of species for intensive aquaculture
- 1.4. Important water quality parameters for aquaculture
- 1.5. Aquaponics
- 1.6. Cage and Pen
- 1.7. Raceway Aquaculture
- 1.8. Intensive Pond Aquaculture systems
- 1.9. Sewage Aquaculture,
- 1.10. Aquamimicry and its prospects

Practicals:

- 1.1. Water quality estimation(pH and Temperature,Alkalinity)
- 1.2. Water quality estimation(Hardness)
- 1.3. Water quality estimation(Dissolved Oxygen)
- 1.4. Water quality estimation (Ammonia and Nitrate)
- 1.5. Water quality estimation (Phosphate and Chloride)
- 1.6. Working out the economic feasibility of construction and maintenance of different fish production systems

- 1.7. Preparation of species specific feed (Formulating Feed by Software and Pearson Method and selecting specific feed ingredients)
- 1.8. Preparation of species specific feed (Preparing Feed : Field Method)
- 1.9. Engineering aspects of Intensive Aquaculture production system (Cage Design)
- 1.10. Engineering aspects of Intensive Aquaculture production system (RAS Design)
- 1.11. Hands on experience on Intensive rearing of Fishes at pond
- 1.12. Hands on experience on Intensive rearing of Fishes at Fish rearing unit.
- 1.13. Engineering aspects of Intensive Aquaculture production system (Pen Design)
- 1.14. Engineering aspects of Intensive Aquaculture production system (Aquaponics)
- 1.15. Engineering aspects of Intensive Aquaculture production system (Flow through System)
- 1.16. Visit to a local aquaculture farm

Suggested Reading

- Aquaculture: Farming Aquatic Animals and Plants, by John S. Lucas
- Aquaculture: Introduction to Aquaculture For Small Farmers by Kenn Christenson
- Aquaculture, Resource Use, and the Environment by Author Claude E. Boyd and Aaron A. McNevin

2. Ornamental Fish Farming (1-2-0)

Theory:

- 2.1. International and national Status of ornamental fish trade
- 2.2. Biology of commercially important ornamental fishes
- 2.3. Breeding and culture of ornamental fishes-Live bearers
- 2.4. Breeding and culture of ornamental fishes-egg layers
- 2.5. Breeding and culture of ornamental fishes- nest builders
- 2.6. Diseases of aquarium fishes-causes, diagnosis and treatment
- 2.7. Principles of Aquascaping
- 2.8. Ornamental aquatic plants and their propagation
- 2.9. Economics of ornamental operations
- 2.10. Government schemes for developing ornamental fisheries

Practical:

- 2.1. Breeding of Commercially important variety of ornamental fishes (Angel and Gourami)
- 2.2. Breeding of Discus and Rosy Barb
- 2.3. Breeding of Fighter fish and Sword Tail

- 2.4. Aquascaping
- 2.5. Setting and maintenance of Aquarium
- 2.6. Layout of Advanced ornamental breeding
- 2.7. Layout of ornamental rearing facility
- 2.8. Propagation of Aquarium Plant- Submerged rooted plants
- 2.9. Propagation of Submerged Brunched Aquarium Plants
- 2.10. Propagation of Floating Aquarium Plants
- 2.11. Propagation of Emergent Aquarium Plants
- 2.12. Preparation and Setting up Biofilters
- 2.13. Transportation of Ornamental fishes
- 2.14. Ornamental Fish Diseases

Suggested Reading

- Ornamental Fish Culture and Aquarium Management by Anshuman D. Dholakia
- Fundamentals of Ornamental Fish Health by Helen E. Roberts

3. Biofloc Aquaculture (1-2-0)

Theory

- 3.1. Introduction to biofloc technology: Principles, prospects and challenges
- 3.2. Integration of submerged substrates in biofloc based system
- 3.3 Microbial role in biofloc system
- 3.4. Design consideration of biofloc production system
- 3.5 Biofloc technology for water quality management in aquaculture
- 3.6 Economics of biofloc based farming
- 3.7. Aeration requirements in biofloc based shrimp culture systems
- 3.8 Nutrition and feeding strategy and health management in a biofloc system
- 3.9 Culture technology of different fishes in biofloc system
- 3.10 Culture technology of different shellfishes in biofloc system

Practical

- 3.1. Biofloc generation and management methods through Natural method
- 3.2. Biofloc generation through Biological method,
- 3.3. Biofloc generation through Inoculation method
- 3.4. Biofloc generation through Probiotic method

- 3.5. Carbon nitrogen ratio maintenance
- 3.6. Importance of feed reduction
- 3.7. Suitable Carbon sources Identification
- 3.8. Qualitative measurement of biofloc
- 3.9. Quantitative analysis of biofloc,
- 3.10. Maintaining Biofloc culture system
- 3.11. Feed and Health Management in Biofloc System
- 3.12. Microbial Quantification
- 3.13. Microscopy in bacterial identification
- 3.14. Carbohydrate fermentation test
- 3.15. Algal Characterization

Suggested Reading

- Biofloc Technology : SOPs for FLOC & Sludge Quality by S.Felix and M.Menaga
- Biofloc Technology: A Practical Guide Book by Yoram Avnimelech

Processing Technology of Cereals and Millets (1-2-0)

Theory

General Introduction, Properties of cereals and millets, Paddy Processing, Parboiling of paddy, Drying, Wheat processing, Corn milling, Malting of cereals, Rice fortification methods, Food packaging and quality

Practice

Physical properties of cereals, Physical and frictional properties of cereals, Moisture content of grain, Parboiling and cooking quality of paddy, Preparation of puffed and flaked rice and sorghum. Estimation of milling qualities in a rice mill, Proximate analysis of cereal based products, Estimation of moisture content and drying time calculations

2. Processing Technology of Legumes and Oilseeds (1-2-0)

Theory

General Introduction, Morphology, Pulse Milling, Pulse Processing, Oil seed Milling and problems in oil seed milling, Refining of oils

Practice

Estimation of physical properties of legumes and oilseeds, Determination of proximate composition of selected pulses and oilseeds, Preconditioning of pulses before milling, Laboratory milling of selected

pulses and oilseeds and its quality evaluation, Laboratory refining of selected oils, Study of cooking quality of pulses

3.Processing Technology of Fruits, Vegetables, Spices and Condiments (1-2-0)

Theory

General Introduction, Primary processing and packaging, Canning, FSSAI specifications and food quality, Value added products, Spices and Condiments, Spice Board of India

Practice

Primary processing of selected fruits and vegetables, Estimation of TSS, pH, Acidity, and Ascorbic acid, Study of steps of Can making process, Processing of food using salt, high concentration of sugar, acidulants, and fermentation techniques, Drying of fruits and vegetables using freeze-drying, Adulteration test of spices

Milk Processing in Dairy Industry

Theory

1.1. Collection and Transportation of milk: Organization of milk collection routes, practices for collection of milk, preservation at farm, refrigeration, natural microbial inhibitor, reception, chilling, classification and storage.

1.2. Standardization of milk: Addition or removal of milk fat to make different milk products, numericals.

1.3. Mechanical Separation: Sedimentation, Filtration, Centrifugal separation, Bactofugation.

1.4. Homogenization: Classification, power requirement, care and maintenance

1.5. Pasteurization: Batch, flash and HTST pasteurization

1.6. Packaging machines: Pouch filling machine pre-pack and aseptic filling bulk handling system

1.7. Mixing and agitation: Theory and purpose of mixing, Equipment used

1.8. Evaporation: Basic principles and classification

1.9. Drying: Drum drying, Spray drying

1.10. Membrane processing: Ultra filtration, Reverse Osmosis and electro dialysis, Materials for membrane construction, Ultra filtration of milk, Effect of milk constituents on operation, membranes for electro-dialysis.

Practice

1.1. Familiarization with equipments for reception of milk in plant, platform test.

- 1.2. Cream separation: parts of separator and the process.
- 1.3. Preparation of special milks: toned and double toned milk.
- 1.4. Detection of adulterant and preservatives in milk.
- 1.5. Constructional details, operation and maintenance of homogenizers.
- 1.6. Assessment of homogenization efficiency in milk.
- 1.7. Constructional details, operation and maintenance of HTST pasteurizer.
- 1.8. Constructional details, operation and maintenance of pouch filling machine.
- 1.9. Constructional details, operation and maintenance of multiple effect evaporator.
- 1.10. Constructional details, operation and maintenance of spray drier.
- 1.11. Constructional details, operation and maintenance of reverse osmosis and ultra-filtration system.

Suggested Readings

1. Ahmed, T. 1985. Dairy Plant System Engineering. Kitab Mahal, K.L. Agencies Pvt. Ltd., New Delhi.
2. Ahmed, T. 1990. Dairy Plant System Engineering and Management. Kitab Mahal, K.L. Agencies Pvt. Ltd., New Delhi.
3. Anantkrishnan, C.P. and Simha, N. N. 1987. Technology and Engineering of Dairy Plant Operations. Laxmi Publ., Delhi.
4. Food Engineering Operations. 1969. Elsevier Publ. Co., Amsterdam, New York.
5. Farrall, A. W. 1963. Engineering for Dairy and Food Products. John Wiley and Sons, New York.
6. Gardner, A. W. 1971. Industrial drying. Leonard Hill Publ., London.
7. Food Engineering and Dairy Technology. V. A. Kessler Publ., Freising, Germany. 1981.

2. Dairy Starters in Fermented Milk Products

Theory

- 2.1. Concept, importance and types of starter cultures in dairy industry.
- 2.2. Modern trends in propagation, production and preservation methods of starter cultures (liquid, spray drying, vacuum drying, freeze-drying, frozen concentrate, concentrated dried cultures, DVS Starters).
- 2.3. Metabolism of starter cultures (carbohydrate, protein, citrate).
- 2.4. Production of metabolites and antibacterial compounds by starters.
- 2.5. Starter defects and failures.
- 2.6. Bacteriophages of dairy starters and their impact on dairy industry.
- 2.7. Lactic acid bacteria as probiotics in development of health foods.

2.8. Role of starters in the preparation of various fermented milks (dahi, yoghurt, acidophilus milk and Yakult) and its associated defects.

2.9. Nutritional and therapeutic significance of fermented milks.

2.10. Cheese Starters: Bacterial and mold ripened cheeses, Rennet substitutes.

Practice

2.1. Testing purity of starter cultures by Gram's staining, catalase test; creatine test

2.2. Testing starter activity by dye reduction tests, Horrell-Elliker, White Head & Cox test.

2.3. Preparation of sterilized reconstituted skim milk and propagation of starter cultures

2.4. Preservation of starter cultures by freeze-drying techniques.

2.5. Preparation of DVS starters.

2.6. Effect of physical factors (temperature, pH, salt and Sugar) on dairy starters.

2.7. Effect of presence of antibiotic residues in milk on starter activity.

2.8. Detection of bacteriophages in cheese whey by plaque assay method.

2.9. Microbial quality of milk for preparation of fermented milks.

2.10. Preparation and microbial examination of dahi, yoghurt and cultured butter milk.

2.11. Analysis of cheese for total spore count.

Suggested Readings

1. Marth & Steele- Applied Dairy Microbiology- 2nd ed. Taylor and Francis, New York
2. Cogan, T. M. and Accolas, J. P. (1995). Dairy Starter Cultures. VCH Publ., USA.
3. Farnworth, E. R. (2008). Handbook of Fermented Functional Foods. 2nd ed. CRC Press, USA.
4. Tamime, A Y. and Robinson, R. K. (1999). Yoghurt Science and Technology, 2nd ed. Woodhead Publ. Ltd. and CRC Press LLC, USA.

3. Quality Assurance in Dairy Industry

Theory

3.1. Awareness about Quality and Safety of Dairy Foods: Concepts of quality control, quality assurance and food safety; Global quality and food safety standards, Integrated food law, its main features and functions.

3.2. Introduction to Food Safety Management System: Concepts of Quality Management System (QMS)–ISO: 9000:2000, ISO: 22000; Principles of QMS; Standard requirements for QMS

3.3. HACCP concept and principle with special reference to biological hazards in dairy foods, TQM tools and techniques.

- 3.4. Role of national and international food regulatory systems and standards: with respect to quality and safety of milk and milk products: FSSAI, PFA, AGMARK, BIS ISO, IDF, Codex, etc.
- 3.5. Introduction of risk assessment; Biosafety concepts in handling of dairy pathogens and setting up of a microbiological/ pathogen lab in a dairy plant.
- 3.6. Setting up of testing facilities and analytical laboratories; concept of mobile testing laboratories. Accreditation of analytical laboratories.
- 3.7. Preparation and standardization of reagents required in the analysis of milk and milk products.
- 3.8. Sampling plan and testing methods for the detection of adulterants, preservatives and neutralizers in milk and milk products.
- 3.9. Environmental contaminants such as pesticides, antibiotics, heavy metals in milk and milk products; Importance of milk contact surfaces, metallic contamination in dairy industry.
- 3.10. Concepts of hygiene and sanitation in dairy plant, treatment and disposal of waste water and effluents.

Practice

- 3.1. Standardization of glass wares for quality analysis.
- 3.2. Preparation and testing of Gerber sulfuric acid used in fat determination. Testing the amyl alcohol used for fat determination.
- 3.3. Preparation and standardization of dairy reagents such as acids, alkali solutions etc.
- 3.4. Chemical analysis of permissible additives used in milk and milk products.
- 3.5. Chemical analysis of detergents and sanitizers.
- 3.6. Detection of adulterants, preservatives, and neutralizers in milk and milk products. Analysis of market samples of milk and milk products.
- 3.7. Determination of temporary and permanent hardness of water.
- 3.8. Estimation of available chlorine from bleaching powder.
- 3.9. Rapid detection of antibiotic residues in milk using Delvo SP
- 3.10. Microbiological tests for assessing Environmental, equipment and personnel hygiene by swab and rinse methods.
- 3.11. Quality evaluation by HACCP in the preparation of dairy products.

Suggested Readings

1. Alli, I. (2004). Food Quality Assurance: Principles and Practices. CRC Press, Boca Raton, USA.

2. Herschdoerfer, S. M. (2004). Quality Control in the Food Industry. Vol. I & II. Academic Press, London.
3. Jacobs, M. B. (1999). Chemical Analysis of Food and Food Products. CBS Distributors, New Delhi.
4. Kramer, A. and Twigg, B. A. (Eds). (1966). Fundamentals of Quality Control for the food industry, The AVI Publ. Co., West Port, Conn., USA.
5. <http://courseware.cutm.ac.in/wp-content/uploads/2020/05/CHEMICAL-QUALITY-ASS>

ASHE 2201: Applied hi-tech horticulture (1-2-0)

Theory

- 1.1 Introduction and importance
- 1.2 Nursery management and mechanization for high-tech horticulture
- 1.3 Modern field preparation and planting methods
- 1.4 Protected cultivation: advantages, controlled conditions, method and techniques
- 1.5 Micro irrigation systems and its components
- 1.6 EC, pH based fertilizer scheduling
- 1.7 Canopy management
- 1.8 High density orcharding
- 1.9 Application of precision farming in horticultural crops (fruits, vegetables and ornamental crops)
- 1.10 mechanized harvesting of produce

Practice

- 1.1 Types of Polyhouses and shade net houses (Open and forced ventilated polyhouse and Shade-net house, Specification as per standards- length, width, height, Orientation of Polyhouse, Design of Polyhouse). Types of ventilation- forced cooling techniques - glazing materials – microirrigation and fertigation
- 1.2 Intercultural operations, tools and equipments identification and application
- 1.3 Raising of nursery-portrays
- 1.4 Micro irrigation

Track Course-2: ASHE 3102: Protected cultivation of vegetable crops (1-2-0)

Theory

- 2.1 Importance and scope of protected cultivation of vegetable crops
- 2.2 Regulatory structures used in protected structures,
- 2.3 Effect of environmental factors, viz. temperature, light, CO₂ and humidity on growth of different

vegetables

2.4 Manipulation of CO₂, light, humidity and temperature for vegetable production

2.5 Fertigation

2.6 Types of benches and containers used in protected cultivation

2.7 Different media for growing nursery

2.8 Crops: Tomato, capsicum, cucumber, melons, cabbage, broccoli and lettuce

Practice

2.1 Methods to control temperature, CO₂, light, media,

2.2 Fertigation and nutrient management

2.3 Control of insect-pests and disease in greenhouse

2.4 Economics of protected cultivation

2.5 Visit to established green/polyhouse/net house/shade house

Track Course-3: ASHE 3203 High-tech fruit culture (1-2-0)

Theory

3.1 High Density Planting

3.1.1 Mango

3.1.2 Banana

3.1.3 Guava

3.1.4 Bear

3.1.5 Apple

3.2 Canopy management

3.2.1 Mango

3.2.2 Guava

3.2.3 Grape

3.3 Precision farming in fruit crops

3.4 Mechanized harvesting

Practice

3.1 Nursery management of fruit crops

3.1.1 Mango

3.1.2 Guava

3.1.3 Papaya

3.2 High density planting

3.3 Different methods training and pruning

3.4 Canopy management of Mango and Guava

ASHE. 2201. Applied hi-tech horticulture (1-2-0)

Theory

Module 1.1: Introduction and importance

Module 1.2: Nursery management and mechanization for high-tech horticulture

Module 1.3: Modern field preparation and planting methods

Module 1.4: Protected cultivation: advantages, controlled conditions, method and techniques

Module 1.5: Micro irrigation systems and its components

Module 1.6: EC, pH based fertilizer scheduling

Module 1.7: Canopy management

Module 1.8: High density orcharding

Module 1.9: Application of precision farming in horticultural crops (fruits, vegetables and ornamental crops)

Module 1.10: mechanized harvesting of produce

Practical

Practical 1.1: Types of Polyhouses and shade net houses (Open and forced ventilated polyhouse and Shade-net house, Specification as per standards- length, width, height, Orientation of Polyhouse, Design of Polyhouse). Types of ventilation- forced cooling techniques - glazing materials

Practical 1.2: microirrigation and fertigation.

Practical 1.3: Intercultural operations, tools and equipments identification and application

Practical 1.4: Raising of nursery-portrays

Practical 1.5: Micro irrigation

Practical 1.6: EC, pH based fertilizer scheduling

Practical 1.7: Canopy management

Practical 1.8: Visit to hi-tech orchard/nursery.

2. ASHE 3102. Protected cultivation of vegetable crops (1-2-0)

Theory:

Module 2.1: Importance and scope of protected cultivation of vegetable crops

Module 2.2: Regulatory structures used in protected structures,

Module 2.3: Effect of environmental factors, viz. temperature, light, CO₂ and humidity on growth of different vegetables

Module 2.4: Manipulation of CO₂, light, humidity and temperature for vegetable production

Module 2.5: Fertigation

Module 2.6: Types of benches and containers used in protected cultivation

Module 2.7: Different media for growing nursery

Module 2.8: Crops - Tomato, capsicum

Module 2.9: Crops - Cucumber, melons

Module 2.10: Crops - Cabbage, broccoli, lettuce

Practical:

Practical 2.1: Methods to control temperature

Practical 2.2: Methods to control CO₂

Practical 2.3: Methods to control light

Practical 2.4: Methods to control media;

Practical 2.5: Fertigation and nutrient management

Practical 2.6: Control of insect-pests and disease in greenhouse

Practical 2.7: Economics of protected cultivation

Practical 2.8: Visit to established green/polyhouse/net house/shade house

3. ASHE 3203. High tech fruit culture (1-2-0)

Theory:

Module 3.1: High Density Planting - Mango, Banana

Module 3.2: High Density Planting - Guava, Ber

Module 3.3: High Density Planting - Apple

Module 3.4: Canopy management - Mango, Guava

Module 3.5: Canopy management - Grape, Apple

Module 3.6: Precision farming in fruit crops - Grape

Module 3.7: Precision farming in fruit crops - Mango, Strawberry

Module 3.8: Precision farming in fruit crops - Papaya, Citrus

Module 3.9: Mechanized harvesting in fruit crops

Module 3.10: Nutrient, water, pest- disease management in orchard

Practical:

Practical 3.1: High density planting

Practical 3.2: Different methods of training

Practical 3.3: Different methods of pruning

Practical 3.4: Canopy management of Mango

Practical 3.5: Canopy management of Citrus

Practical 3.6: Canopy management of Guava

Practical 3.7: Nursery management of fruit crops - Mango

Practical 3.8: Nursery management of fruit crops - Guava

Practical 3.9: Nursery management of fruit crops - Papaya

Storage Entomology (1-2-0)

Theory:

Importance of safe storage,

Factors affecting the food grains in storage,

Classification of storage insects,

Storage structures, Integrated control of storage pests,

Bio rational management of insects in storage,

Grain Quarantine,

Botanicals use in storage,

Indigenous grain storage.

Practical:

Estimation of storage losses,

Fumigation techniques,

Gadgets used in the storage,

Detection techniques of the pests,

New techniques in storage,

Methods of seed storage,

Sanitation in storage,

Different Chemicals used in storage,

Safety precautions to be taken in storage.

2. Seed Pathology (1-2-0)

Theory:

Introduction to seed pathology.

Important seed-borne fungi, viruses, bacteria and nematode in storage condition.

Important micro-organisms infect seed in storage conditions and toxins produced by them.

Detection, Mechanism of transmission, and management of seed-borne pathogen(special focus on stored seed pathogen).

Chemical, treatment procedure, and Equipment used for seed treatment.

Management of seed-borne disease in an organic manner.

Quarantine.

Seed certification standards.

Practical:

Collection of infected store grain seed and identify the symptom by external observation.

Use of different methods like examination of dry seed, washing test, blotter method, Agar plate method, Sodium hydroxide seed soak method, whole embryo count method.

Inoculation technique and ELISA test for identifying particular seed pathogens.

Management of microorganisms in storage.

3. Post Harvest Biochemistry and Physiology of crops (1-2-0)

Theory:

Importance of Post Harvest Technology.

Composition of Seeds and Grains (Nutritive Value and Chemical Constituents).

Composition of Fruits, Vegetables (Nutritive Value, and Chemical Constituents).

Physiology of Fruits and Vegetables.

Respiration and factors responsible for it.

Classification of Horticultural Commodities According to their Respiration Rate.

Deterioration of Horticultural Produce.

Factors Responsible for Deterioration Environmental Factors.

Major Post and Pre-harvest Defects.

Factors Affecting the Quality of Horticultural Produce (Pre-Harvest, Harvest, and Post-Harvest factors).

Physiological Disorders of Horticultural Produce.

Disorders Associated with Mineral Deficiency.

Disorders Associated with Temperature.

High-cost storage Technology/ Improved storage methods.

Low-Temperature Storage (Refrigeration/cold storage).

Factors Affecting Cold Storage its importance.

Packaging and requirement for Ideal Packaging.

Different Types of Packaging Materials and Methods.

Modern Packaging Systems.

Practical:

Proximate Analysis of Different Agricultural Crops.

Biochemical Changes During Ripening Color Development in Fruits and Vegetables.

Chemical Basis of Judging Maturity in Horticultural Produce.

Chemicals Used to Control Spoilage.

Controlled Atmosphere (CA) Storage.

Modified Atmosphere (MA) Storage.

Proximate Analysis and Chemical Constituents of different Agricultural Crops.

Effect of Different Processing Methods/Steps on Crop Nutritive Values and Biochemical Parameters.

CUAB2320 Agri Food Markets and Value Chain analysis (1-0-2)

Agri food Markets-an Introduction, Agribusiness market dynamics – characteristics of agri-food markets, role of external factors that play on agri-food markets, key elements of supply and demand and understand the basic characteristics of supply and demand curves. Role for the consumer - Role the consumer plays in the food system.Characterizing the Agri-business Value Chain (volatility, Complexity and scrutiny) . Factors affecting the Indian Agri food value chain, value chain model, Value chain design Implications for Stakeholders (Input companies, farmers, traders, food companies, retailers, Consumers)

Course-2:CUAB2321 Agri Input Marketing (1-0-2)

Agricultural input marketing – meaning and importance; Agricultural Inputs and their types – farm and nonfarm, role of cooperative, public and private sectors in agri- input marketing. Importance of seed input; Types of seeds- hybrid, high yielding and quality seeds; Demand and supply of seeds;

Seed marketing channels, pricing, export import of seeds; Role of National Seed Corporation and State Seed Corporation. Chemical Fertilizers- Production, export-import, supply of chemical fertilizers, Demand/consumption, Prices and pricing policy; subsidy on fertilizers; marketing system – marketing channels, problems in distribution; Role of IFFCO and KRIBCO in fertilizer marketing, Plant Protection Chemicals- Production, export/import, consumption, marketing system – marketing channels, Farm Machinery- Production, supply, demand, Marketing and distribution channels of farm machines; Agro- industries Corporation and marketing of farm machines /implements/Equipments.

1. **Computational Biology** **Theory:**

Biological databases: Overview of biological databases, nucleic acid & protein databases, primary, secondary, functional, composite, structural classification of databases. Alignment using BLAST and CLUSTAL W.

RNA and DNA folding: Introduction to RNA and DNA folding, Softwares and webservers used for DNA or RNA folding: Mfold, RNAfold, RNA structure

Insilico Drug Design: Basic Concepts, importance and application. Molecular Docking

Python Tools for Computational Molecular Biology: Introduction to Biopython

Practice in Project Mode: NCBI GenBank resources - Overview, Access, Data Usage, Confidentiality, International Nucleotide Sequence Database Collaboration, Data Type, European Nucleotide Archive - sequence assembly information and functional annotation, DNA Data Bank of Japan (DDBJ). Kyoto Encyclopedia of Genes and Genomes (KEGG), Retrieval of sequence/structure from databases, Visualization of structures, Docking of ligand receptors, BLAST exercises, Molecular models, drug design, Python based computational biology - Biopython.

Suggested Readings:

- Attwood TK & Parry-Smith DJ. 2003. Introduction to Bioinformatics. Pearson Education.
- Rastogi SC, Mendiratta N & Rastogi P. 2004. Bioinformatics: Concepts, Skills and Applications. CBS.

2. **Genetic Engineering and its applications**

Theory:

Plant Tissue culture: Cell culture media and sterilization techniques, Callus culture, nodal and tip culture, Protoplast and Embryo culture, Embryo culture and embryo rescue, protoplast isolation,

culture and plant regeneration Somatic embryogenesis, Somaclonal variation and crop improvement, Germplasm conservation.

Recombinant DNA technology: Introduction to genetic engineering, restriction endonucleases and methylases; DNA ligase, T4 DNA polymerase, polynucleotide kinase, alkaline phosphatase. Gene cloning vectors: Plasmids; Bacteriophages; phagemids; Lambda vectors; Cosmids; Artificial chromosome vectors (YACs; BACs). Construction of recombinant DNA and expression cassettes, Transformation (mobilization of vectors into competent bacteria), selection and analysis of recombinant clones, Isolation of mRNA and total RNA; reverse transcriptase and cDNA synthesis; Genomic DNA & plasmid DNA isolation and purification, genomic DNA and cDNA libraries, screening of libraries.

Gene transfer in Plants: Vector mediated Gene transfer, Molecular basis of crown gall and hairy root diseases, features of Ti and Ri plasmids, mechanism of T-DNA transfer, role of virulence genes, vectors based on PTi & PRi, binary and co-integrate vectors, physical and chemical methods of gene transfer. Introduction to gene editing, ZFNs & TALENs, CRISPR/Cas System, Case studies of gene editing for crop improvement.

Practice in Project Mode: DNA isolation and purification, Callus induction, Agrobacterium mediated gene transfer in plants, vector construction, cloning and transformation.

Suggested Readings:

Glick, B. R. and Pasternak (2003). Molecular Biotechnology: Principles and Applications of Recombinant DNA. ASM Press, Washington, D. C., USA.

Kyte, L. and Kleyn, J. (1996). Plants from Test Tube to: an Introduction to Micro propagation, 3rd Ed. Timber press, Port land, USA.

Reference Book

Pollard, W. J. and Walker (1990). Plant Cell and Tissue Culture Vol VI. Humana press Clifton, USA.

3. Genetics and Genomics

Theory:

Basic of genetics: Mendel's Laws, concept of dominance, segregation, independent assortment; Chromosome theory of inheritance.

Genome Mapping and Sequencing: Genetic and physical mapping, Markers for genetic mapping, Human Genome Project, Genome sequencing projects for microbes, Genome sequencing projects for plants and animals, Accessing and retrieving genome project information from the web. Genome

sequencing: assembly, alignment and annotation. DNA sequencing strategies, Next generation sequencing strategies.

Functional genomics and proteomics: Introduction to genomics, transcriptome analysis for identification and functional annotation of gene, forward and reverse genetic approaches. Introduction to proteomics, proteomics technologies: 2D-PAGE, isoelectric focusing, Mass spectrometry.

Practice in Project mode: Demonstration of web tools for genome analysis. Effect of abiotic stress on field crops (Phenotyping), Effect of growth regulators on field crops (Phenotyping), Salinity/Cold/High Temperature stress tolerance genes and their responsiveness (Genotyping), Molecular markers (RAPD, SSR, AFLP etc) and their analysis.

Suggested Readings:

- Practical Applications of Plant Molecular Biology By Robert J. Henry.
- Biochemistry and Molecular Biology of Plants edited by Bob B. Buchanan, Wilhelm Gruissem, Russell L. Jones.

Organic Farming. (1-2-0)

Theory:

Module 1.1: Organic Farming: Principles, Developing Organic farm, Conversion of Soil to Organic.

Module 1.2: Soil Cultivation and Tillage: Creating good growing conditions, Minimum disturbance, Soil compaction, and Types of Soil Cultivation.

Module 1.3: Crop Planning and Management: Crop rotation, Intercropping, Cover crops, Crop-Animal association, Designing cropping systems.

Module 1.4: Mulching: Selection of Mulch materials, Source of Mulching materials, Recommendation while using Mulches, Application of Mulch.

Module 1.5: Organically Manage: Live fencing, Water, Nutrient, Weed, Pest and Disease.

Module 1.6: Plant Propagation: Criteria for Seed evaluation, characterization and multiplication, Importance of Traditional Varieties, Seed conservation and its Certification.

Module 1.7: Animal Husbandry: Animal Housing, Animal Feeding, Animal Health, Breeding Goals.

Module 1.8: Introduction of Forest Trees: Azadirachta indica, Pongamia pinnata, Tamarindus indica, Sesbania grandiflora, Dalbergia latifolia, Terminalia chebula etc.

Module 1.9: ITKs of Gajapati: Collection, Study and Implementation.

Module 1.10: Other forms of Organic Management: Biodynamic Agriculture, Rishi Krishi, Natural Farming, Panchgavya Krishi, Natueco Farming. Homa Farming and EM-Technology.

Practical:

Practical 1.1: Preparation of Enrich Compost.

Practical 1.2: Preparation of Vermicompost.

Practical 1.3: Preparation of Green manures, Liquid manures, Panchgavya, Biodynamic and NADEP.

Practical 1.4: Preparation of different organic Insecticides/ Pesticides.

Practical 1.5: Identification and use of Mulch materials.

Practical 1.6: Water Management

Practical 1.7: Weed Management.

Practical 1.8: Seed Multiplication, conservation and Certification process.

Practical 1.9: Practical on Animal Husbandry.

Practical 1.10: Collection of ITKs.

Practical 1.11: Practical on Conversion of Soil to Organic

2. Certification and Inspection Systems in Organic Farming in India. (1-2-0)

Theory:

Module 2.1: Organic Certification: The Certification Process, Certification and Product Labelling, Certification around the World.

Module 2.2: Regulatory Mechanism for Organic Certification in India: Scope and Operational Structure of National Programme for Organic Production.

Module 2.3: National Standards for Organic Production: Conversion requirements, Maintenance of Organic Management, Crop Production, Animal Husbandry, Food Processing and Handling, Labelling, Storage and Transport.

Post-harvest handling and processing of fish and shellfish (1-1-0)

Theory:

1.1. Handling of fish and shellfish on-board fishing vessels, Unit operations, loading and unloading of fish and shellfish.

1.2. Post-harvest fishery losses, methods to reduce losses, handling of fish and shellfish in landing centres, defects and modifications needed.

1.3. Different types of ice used in storage of fish and shellfish, storage methods.

1.4. Physical, chemical, microbiological and sensory changes during handling, chill storage, iced and refrigerated storage of fishes.

- 1.5. Structure of fish and shellfish myosystems, Post-mortem changes of fish and shellfish after harvesting.
- 1.6. Factors affecting quality of fresh fish and shellfish-intrinsic and extrinsic factors.
- 1.7. Pre-processing and filleting of fish, Processing of prawns, lobster, squid, cuttle fish, crab,deperation of bivalves, etc.
- 1.8. Transportation of live fish/shell fish, Transportation of raw fish to local markets and processing centres,
- 1.9. Refrigerated transport systems, Cold chain,Improvements needed in transportation and handling of fish and shellfishes.

Practical:

- 1.1. Handling of fish, bivalves, prawns, molluscs.
- 1.2. Pre-processing and use of potable water in fish and shellfishes.
- 1.3. Different processing and cutting style of finfishes.
- 1.4. Different processing style of shellfishes (prawns, shrimps, lobster, and crab).
- 1.5. Processing style of squid, cuttle fish, bivalves, etc.
- 1.6. Storage, preservation, and treatment with natural bio preservative, organic acid and chemical agent.
- 1.7. Determination of shelf life of fish and shellfish
- 1.8. Heat load calculation of ice requirement in finfish and shellfish.
- 1.9. Chemical, physical and sensory freshness analysis of fish and shellfishes.

Course2: Design, maintenance of fish processing plant and instrumentation (1-1-0)

- 2.1. Fundamentals of processing plant design, Site selection, design and preparation of layout of processing plants - freezing plant, cold storage, canning plant, dryers etc.
- 2.2. Functions and construction of refrigeration system, Tests and inspection, Operation and handling.
- 2.3. P-H diagram and basic calculation - Application of P-H diagram, size and required power of compressor, maintenance of refrigerating machine, troubles and causes.
- 2.4. Preventive maintenance of machinery and equipment of fish processing plants, IQF, Canning plant, sausage plant, artificial dryers, smoking chambers etc.,
- 2.5. Safety controls for freezing and canning plant effluent treatment: Legislation and standards of effluent discharge, water pollution control measures in the food industry.
- 2.6. Waste water treatment process; dissolved air floatation, sedimentation, chemical treatment, biological treatment, aeration, carbon adsorption, granular media filtration and sludge handling.
- 2.7. Boilers - Classification and selection of boilers, Boiler mounting and accessories.
- 2.8. Measurement techniques Sensors, active and passive sensors, characteristic of sensors for the measurement of temperature, relative humidity, aw value, gel strength, moisture, freshness, pH, conductivity, DO, redox potential, salinity, air velocity, solar energy and brine concentration.
- 2.9. Different types of thermometers, characteristics and application. Instrumentation techniques: General configuration of instrumentation system. Instrumentation for measurement of aw value, temperature, pH, freshness, gel strength, salinity, brine concentration.
- 2.10. Thermal properties of foods, Calorie, heat loss, heat gain, specific heat, Newton's laws of cooling, heat transfer, latent heat, laws of fusion, thermal conductors, and thermal diffusivity.

Practical:

- 2.1. Design and Maintenance of Fish Processing Plants.
- 2.2. Operation and maintenance of machinery and equipment for cold storage plant, freezing plant, canning plant, sausage making, dryers, boilers etc.
- 2.3. Assembly of a refrigeration unit and charging refrigerant.
- 2.4. Measurement of temperature inside cold storage / freezer, fish during freezing and thawing.
- 2.5. Estimation of Gel strength.
- 2.6. Measurement of solar radiation, air velocity, air temperature.
- 2.7. Measurement of salinity, conductivity, pH.
- 2.8. Estimation of water activity.

3. Quality assurance, management and certification (1+0+0)

Theory:

Quality management, total quality concept and application in fish trade.

3.1. Quality assessment of fish and fishery products - physical, chemical, organoleptic and microbiological quality standards.

3.2. Inspection and quality assurance: Fish inspection in India, process water quality in fishery industry, product quality,

3.3. Water Quality and standards : water analysis, treatments, chlorination, ozonisation, UV radiation, reverse osmosis, techniques to remove pesticides and heavy metals.

3.4. Sensory evaluation of fish and fish products: Basic aspects, different methods of evaluation, taste panel selection and constitution, statistical analysis.

3.5. HACCP and Quality problem in fishery products: Good manufacturing practices, HACCP Principles, Practical aspects of planning and implementation, verification, validation and Audit.

3.6. National and international standards: ISO 9000:2000S series of quality assurance system, Codex alimentarius, USFDA and EU regulations for fish export trade, IDP and SAT formations in certification of export worthiness of fish processing units, regulations for fishing vessels, pre-processing and processing plants, EU regulations, ISO 22000:2006

3.7. Factory sanitation and hygiene: National and international requirements, SSOP, Sanitary and phytosanitary measures.

3.8. Water quality and standards: water analysis, purification and treatment of water.

3.9. Food laws in India, integrated food law.

