PROGRAMME LEARNING OUTCOME (PLO)
&
COURSE LEARNING OUTCOME (CLO)

FOR

B.Sc. (Hons.) Horticulture

[4-Year, 8- Semester]

AS PER THE
ICAR - SIXTH DEANS' COMMITTEE REPORT
&
NEP-2020

Effective from Academic Year, 2026-2027

DEPARTMENT OF HORTICULTURE
H.N.B. GARHWAL UNIVERSITY
(A Central University)
Srinagar – Garhwal
Uttarakhand

Programme Learning Outcome
of
B.Sc. (Hons.) Horticulture (4-Years Degree Programme)

1. **Demonstrate Scientific Knowledge:** Students will acquire detailed knowledge of fundamental plant sciences, horticultural principles, including classification, physiology, genetics, and plant nutrition relevant to horticultural crops.
2. **Critical Thinking and Problem Solving:** Students will be able to identify and overcome challenges in horticulture, such as optimizing resource usage and managing crop-related issues.
3. **Research and Experimental Skills:** Students will be capable of understanding and applying current developments in horticulture, including hi-tech cultivation, and potentially contribute to research in the field.
4. **Effective Communication and Interpersonal Skills:** Students equipped with these skills will be effective communicators and collaborators capable of translating scientific knowledge into practical applications, building networks, and engaging stakeholders in the horticulture sector.
5. **Ethical and Social Responsibility:** Students will expected to demonstrate integrity, sustainability, and accountability towards the environment, community, and the horticultural profession.
6. **Interdisciplinary Competence:** Students will be well-prepared to work in complex, multidisciplinary environments across academia, research, extension, and commercial horticulture sectors.
7. **Employability and Lifelong Learning:** Students will prepared to enter the workforce with the necessary professional skills, adaptability, and a commitment to continuous learning to thrive in the evolving horticulture sector.
8. **Global and Technological Awareness:** Students will be equipped to contribute effectively to the horticultural sector worldwide, leveraging technology and global knowledge for sustainable development.

Course Learning Outcomes of B.Sc. (Hons.) Horticulture (4-Years Degree Programme)

SEMESTER-I

Non-Gradial Course

Course No.	Course Title	Credits
SOA/HNG/UG 01	Deekshaarambh (Induction cum Foundation program)	2 (0+2)

The course will help the learner to:
CO1: Learn about the life and social skills, leadership qualities, team working spirit.
CO2: Understand about different backgrounds for cultural Integration.
CO3: Apply knowledge of social awareness, ethics and values, creativity.
CO4: Analyze the traditional values and indigenous cultures along with diverse potentialities both in indigenous and developed scenario.

The activities to be taken under Deeksharambh, in addition to giving a broad view and application areas of the subject of study, also will aim at creating a platform for:

- Helping students from different backgrounds for cultural Integration.
- Knowing about the operational framework of academic process in University.
- Instilling life and social skills, leadership qualities, team working spirit.
- Developing social awareness, ethics and values, creativity.
- Helping students to identify the traditional values and indigenous cultures along with diverse potentialities both in indigenous and developed scenario.

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

- Discussions on operational framework of academic process in university, as well as interactions with academic and research managers of the University.
- Creating awareness on the subject of study, and the traditional values and indigenous cultures along with diverse potentialities both in indigenous and developed scenario.
- Interaction with alumni, business leaders, perspective employers, outstanding achievers in related fields, and people with inspiring life experiences.
- Group activities to identify the strength and weakness of students (with expert advice for their improvement) as well as to create a platform for students to learn from each other's life experiences.
- Field visits to related fields/ establishments.
- Sessions on personality development (instilling life and social skills, social awareness, ethics and values, team work, leadership, etc.) and communication skills.

Major Courses

Course No.	Course Title	Credits
SOA/HMJ/UG 01	Fundamentals of Horticulture	3 (2+1)

The course will help the learner to:
CO1: Learn about the scope, classification, nutritive value, area, production, and trade (exports/imports) of horticultural crops, along with fruit and vegetable zones in India.
CO2: Understand the nursery management techniques, propagation, soil and climate requirements, and principles of planning and layout of vegetable, kitchen, and specialty gardens.
CO3: Apply knowledge on orchard management including planting systems, planting densities,

pruning, training, and use of growth regulators in fruit crops.
CO4: Analyze marketing and market chain management of horticultural produce to enhance profitability and sustainability.

SOA/HMJ/UG 01 T: Fundamentals of Horticulture (2)

Scope and importance, classification of horticultural crops and nutritive value, area and production, exports and imports, fruit and vegetable zones of India and of different states, nursery techniques and their management, soil and climate, vegetable gardens, nutrition and kitchen garden and other types of gardens – principles, planning and layout, management of orchards, planting systems and planting densities. Methods of pruning and training of fruit crops, types and use of growth regulators in horticulture, water management– irrigation methods, merits and demerits, weed management, fertility management in horticultural crops-manures and fertilizers, different methods of application, cropping systems, intercropping, multi-tier cropping, mulching– objectives, types merits and demerits, Classification of bearing habits of fruit trees, factors influencing the fruitfulness and unfruitfulness. Rejuvenation of old orchards, top working, frame working, principles of organic and Natural farming, market chain management.

SOA/HMJ/UG 01 P: Fundamentals of Horticulture (1)

Features of orchard, planning and layout of orchard, tools and implements, identification of various horticultural crops, layout of nutrition garden, preparation of nursery beds for sowing of vegetable/ flower seeds, digging of pits for fruit plants, planting systems, training and pruning of orchard trees, preparation of fertilizer mixtures and field application, preparation and application of growth regulators, layout of different irrigation systems, identification and management of nutritional disorder in fruits and vegetable crops, maturity standards, harvesting, grading, packaging and storage.

Course No.	Course Title	Credits
SOA/HMJ/UG 02	Plant Propagation and Nursery Management of Fruit and Plantation Crops	3 (1+2)

The course will help the learner to:
CO1: Learn about the importance of plant propagation and nursery production in fruits and plantation crops.
CO2: Understand the sexual and asexual methods of propagation, their advantages and disadvantages.
CO3: Apply knowledge maintenance of mother trees and seed gardens, collection of scion-wood, and bud wood certification.
CO4: Analyze Cost of establishment of a modern nursery.

SOA/HMJ/UG 02 T: Plant Propagation and Nursery Management of Fruit and Plantation Crops (1)

Status and importance of plant propagation and nursery production in fruits and plantation crops. Sexual and asexual methods of propagation, their advantages and disadvantages. Apomixes, seed dormancy, types of dormancy and methods to overcome seed dormancy. Use of vegetative propagation methods viz. division, cutting, layering, budding and grafting. Propagation structures in nursery production: Mist chamber, humidifiers, greenhouses, glasshouses, cold frames, hot beds and poly-houses. Use of growth regulators in nursery production. Components of a nursery, maintenance of mother trees and seed gardens, collection of scion-wood, and bud wood certification. Growing medium and containers used for nursery production. Role of tissue culture techniques viz. micropropagation, micrografting and meristem culture. Nursery registration act. Management of insect-pests and diseases in nursery. Cost of establishment of a modern nursery.

SOA/HMJ/UG 02 P: Plant Propagation and Nursery Management of Fruit and Plantation Crops (2)

Selection of site, soil sterilization and preparation of beds for nursery raising. Preparation of growing media and use of different nursery containers for containerized nursery production in fruits and plantation crops. Seed treatments for breaking dormancy and prevention of nursery diseases. Sowing of seed, raising and maintenance of rootstock/ seedlings. Practicing different vegetative propagation methods, viz. cutting, layering, grafting and budding. Preparation of plant growth regulators for seed germination and vegetative propagation. Digging, labelling and packing of field grown nursery plants. Familiarization with propagation structures mist chamber, greenhouse, glasshouse, polyhouse and net house; and their maintenance. Micropropagation and hardening of plants. Tissue culture media preparation, explant preparation, in vitro culturing and shoot tip culture, primary and secondary hardening of tissue culture plants. Maintenance of nursery records. Identification and management of insect-pests and diseases in nursery. Project formulation for small and high-tech nurseries. Nursery Accreditation.

Course No.	Course Title	Credits
SOA/HMJ/UG 03	Commercial Production of Flower Crops	3 (1+2)

The course will help the learner to:

CO1: Learn about the Scope and importance of flower cultivation.

CO2: Understand about the climatic and soil requirements, commercial varieties/hybrids, sowing/planting times and methods.

CO3: Apply techniques used in nutritional and irrigation requirements, intercultural operations, weed management.

CO4: Analyze about the postharvest management and plant protection measures of major flower crops.

SOA/HMJ/UG 03: Commercial Production of Flower Crops (1)

Scope and importance of flower cultivation. Soil, climate, varieties, propagation, special intercultural operations, fertilizers requirement, irrigation, use of growth regulators, weed management, plant protection measures, harvesting, grading, packaging, and storage of rose, jasmine, carnation, chrysanthemum, gladiolus, marigold, tuberose and cut foliage crops under open/partial shade. Seed production of flowering annuals.

SOA/HMJ/UG 03: Commercial Production of Flower Crops (2)

Introduction of flower crops. Identification of commercial varieties, propagation techniques, bed preparation, soil decontamination, planting and layout, training, pruning, staking, growing media, potting and repotting. Containers for growing flowers for exhibition. Fertilizer calculations and application, growth regulator application. Weed management and plant protection measures. Special horticultural practices in cut flower and cut foliage crops. Determination of harvest indices, harvesting methods and postharvest handling. Commercial Standards, Packing methods. Project preparation. Visit to commercial flower market and progressive growers having high-tech farms.

Course No.	Course Title	Credits
SOA/HMJ/UG 04	Sprinkler and Micro Irrigations Systems	2 (1+1)

The course will help the learner to:

CO1: Learn about the basic knowledge of modern irrigation systems.

CO2: Understand about the sprinkler/micro sprinkler irrigation system design: steps, layout, selection, design of lateral, sub-main and main pipeline, selection of pump and power unit.

CO3: Apply techniques used for proper operation of a drip irrigation system and maintenance of

micro irrigation system:.
CO4: Analyze about cost estimation of sprinkler and micro irrigation system.

SOA/HMJ/UG 04T: Sprinkler and Micro Irrigations Systems (1)

Sprinkler irrigation: adaptability, types, problems and prospects. Sprinkler/micro sprinkler irrigation system design: steps, layout, selection, design of lateral, sub-main and main pipeline, selection of pump and power unit. Performance evaluation of sprinkler irrigation system: uniformity coefficient and pattern efficiency. Micro irrigation system: types, merits and demerits, components. Design of drip irrigation system: general considerations, wetting patterns, irrigation requirement, emitter selection, hydraulics and design steps. Steps for proper operation of a drip irrigation system. Maintenance of micro irrigation system: clogging, filter cleaning, flushing and chemical treatment. Fertigation: advantages, limitations, methods, fertilizers solubility and their compatibility, precautions, frequency, duration and injection rate. Economics: Cost estimation of sprinkler and micro irrigation system.

SOA/HMJ/UG 04P: Sprinkler and Micro Irrigations Systems (1)

Study of different components, design and installation of sprinkler irrigation system. Determination of precipitation pattern, discharge and uniformity coefficient. Study of different components, design and installation of drip irrigation system. Determination of pressure discharge relationship and emission uniformity for emitter. Study of different types of filters and determination of filtration efficiency. Determination of rate of injection and calibration for chemigation / fertigation. Design of irrigation and fertigation schedule for crops. Field visit to micro irrigation system and evaluation of drip system. Cost economics of sprinkler and drip irrigation system.

Multidisciplinary Courses (MDC)

Course No.	Course Title	Credits
SOA/HMDC/UG 01	Farming Based Livelihood Systems	3 (2+1)

The course will help the learner to:
CO1: Learn about the status of agriculture in India and different states and income of farmers and rural people in India.
CO2: Understand about different indicators to study livelihood systems..
CO3: Apply diddrent cropping systems, Livestock, (Dairy, Piggery, Goatry, Poultry, Duckry etc.), Horticultural crops, Agro--forestry systems, Aqua culture Duck/Poultry cum Fish, Dairy cum Fish, Piggery cum Fish etc.
CO4: Analyze the role of farming-based livelihood enterprises in 21st Century in view of circular economy, green economy, climate change, digitalization and changing life style.

SOA/HMDC/UG 01T: Farming Based Livelihood Systems (2)

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

enterprises associated with the farming. Risk and success factors in farming-based livelihood systems, Schemes and programs by Central and State Government, Public and Private organizations involved in promotion of farming based livelihood opportunities. Role of farming-based livelihood enterprises in 21st Century in view of circular economy, green economy, climate change, digitalization and changing life style.

SOA/HMDC/UG 01P: Farming Based Livelihood Systems (1)

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

Ability Enhancement Course (AEC)

Course No.	**Course Title**	**Credits**
SOA/HAEC/UG 01	Communication Skills	2 (1+1)
The course will help the learner to: CO1: Learn about spoken English skills through conversations in different everyday situations, using correct stress, intonation, pronunciation of silent letters, and effective oral expression. CO2: Understand reading comprehension abilities for both general and technical texts, enhancing the ability to summarize, write précis, and create abstracts effectively. CO3: Apply the basic concepts of English grammar including word classes, verb structures, tense usage, voice, conjunctions, prepositions, and sentence patterns. CO4: Analyze the Innovative methods to enhance vocabulary and analogy questions.		

SOA/HAEC/UG 01 T: Communication Skills (1)

Communication Process: The magic of effective communication; Building self-esteem and overcoming fears; Concept, nature and significance of communication process; Meaning, types and models of communication; Verbal and non-verbal communication; Linguistic and non-linguistic barriers to communication and reasons behind communication gap/ miscommunication.

Basic Communication Skills: Listening, Speaking, Reading and Writing Skills; Precis writing/ Abstracting/Summarizing; Style of technical communication: Curriculum vitae/resume writing; Innovative methods to enhance vocabulary, analogy questions.

Structural and Functional Grammar: Sentence structure, modifiers, connecting words and verbals; phrases and clauses; Case: subjective case, possessive case; objective case; Correct usage of nouns, pronouns and antecedents, adjectives, adverbs and articles; Agreement of verb with the subject: tense, mood, voice; Writing effective sentences; Basic sentence faults.

SOA/HAEC/UG 01 P: Communication Skills (1)

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

Course No.	Course Title	Credits
SOA/HAEC/UG 02	NSS-I (National Service Scheme)	1 (0+1)

The course will help the learner to:

CO1: Learn about leadership qualities, teamwork, and discipline through "Service Before Self" initiatives.

CO2: Understand reading comprehension abilities for both general and technical texts, enhancing the ability to summarize, write précis, and create abstracts effectively.

CO3: Apply the competence in mobilizing community participation, disaster management, and social harmony.

CO4: Analyze their role in society and contribute to community development.

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

All the activities related to the National Service Scheme are distributed under four different courses viz., National Service Scheme I, National Service Scheme II, National Service Scheme III and National Service Scheme IV each having one credit load. The entire four courses should be offered continuously for two years.

A student enrolled in NSS course should put in at least 60 hours of social work in different activities in a semester other than five regular one-day camp in a year and one special camp for duration of 7 days at any semester break period in the two years. Different activities will include orientation lectures and practical works. Activities directed by the Central and State Government have to be performed by all the volunteers of NSS as per direction.

Introduction and Basic Components of NSS

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

Skill Enhancement Courses (SEC)

Course No.	Course Title	Credits
SOA/HSEC/UG 01	Apiculture	2 (0+2)

The course will help the learner to:

CO1: Learn about the identification of honeybee species and castes. Hive and other apicultural appliances.

CO2: Understand skills in bee colony maintenance and management including starting new colonies, site selection, transferring colonies, queen replacement and swarm prevention. CO3: Apply knowledge of mass queen bee rearing techniques, identification of bee enemies and diseases management. CO4: Analyze foraging and communication behaviour in honeybees.

SOA/HSEC/UG 01 P: Apiculture (2)

Identification of honeybee species and castes. Hive and other apicultural appliances. Examination of honeybee colonies. Recording of colony performance. Bee pasturage. Migratory routes and migration of colonies. Seasonal management of honeybee colonies. Selection of honeybee colonies for improving bee health and colony productivity. Mass queen bee rearing techniques. Identification of bee enemies and diseases and their management. Foraging and communication behaviour in honeybees. Honey extraction, processing and packaging. Collection of other hive products.

Course No.	**Course Title**	**Credits**
SOA/HSEC/UG 02	Landscape Gardening	2 (0+2)
The course will help the learner to: CO1: Learn about the identification and use of garden tools and equipment. CO2: Understand skills of establishment and maintenance of a lawn and bonsai making. CO3: Apply knowledge of planning, designing and establishment of garden features. CO4: Analyze sites and landscape designing of residential, public buildings and religious places..		

SOA/HSEC/UG 02 P: Landscape Gardening (2)

Identification and use of garden tools and equipment. Study of growth characters, identification and classification of ornamental trees, shrubs, climbers, ground covers and indoor plants. Making and maintenance of edge, hedge and topiary. Establishment and maintenance of a lawn. Bonsai making. Art principles of landscaping. Formal and informal gardens. Planning, designing and establishment of garden features. Landscape design process: Landscape drafting tools. Dimensioning, graphic symbols and notations. Site analysis and landscape designing of residential, public buildings and religious places. Landscape planning of roads and roundabouts. Visit to community parks and Institutional gardens.

SEMESTER-II

Major Courses

Course No.	**Course Title**	**Credits**
SOA/HMJ/UG 05	Introduction to Major Field Crops	2 (1+1)
The course will help the learner to: CO1: Learn about the identification Classification and distribution of field crops. CO2: Understand principles and practices of green manuring. CO3: Apply knowledge of economic importance, soil & climatic requirement and varieties of major field crops. CO4: Analyze the cultural practices for raising major field crops.		

SOA/HMJ/UG 05 T: Introduction to Major Field Crops (1)

Classification and distribution of field crops, definition, concept and principles of multiple cropping, mixed cropping, intercropping, relay and alley cropping, crop rotation. Economic importance, soil and climatic requirement, varieties, cultural practices for raising major cereals (rice, wheat, maize), pulses (gram, soybean, arhar moong), oilseeds (rapeseed and mustard,

sunflower, groundnut), cash crops (cotton, sugarcane) and fodder crops (sorghum, bajra, berseem, oats). Principles and practices of green manuring.

SOA/HMJ/UG 05 P: Introduction to Major Field Crops (1)

Identification of crop plants, seeds, weeds. Preparation of cropping scheme. Method of sowing, fertilizer and herbicide application in field crops. Calculation of fertilizer and herbicide dose.

Course No.	Course Title	Credits
SOA/HMJ/UG 06	Commercial Production of Spices and Plantation Crops	3 (2+1)

The course will help the learner to:

CO1: Learn about the area, production, present status, importance and export potential of spice and plantation crops.

CO2: Understand the soil and climate requirements, commercial varieties, site selection, layout, sowing time and methods of spice and plantation crops.

CO3: Apply knowledge of nutritional and irrigation requirements, intercropping, weed control and physiological disorders of spice and plantation crops.

CO4: Analyze post-harvest management and plant protection measures of spice and plantation crops.

SOA/HMJ/UG 06 T: Commercial Production of Spices and Plantation Crops (2)

Present status and importance of spice crops, soil and climate requirements, commercial varieties, site selection, layout, sowing time and methods, nutritional and irrigation requirements, intercropping, weed control, physiological disorders, harvesting, post-harvest management and plant protection measures of the following crops: Black pepper, turmeric, ginger, garlic, clove, cinnamon, fenugreek, cumin, ajowain, coriander, fennel, cardamom, Vanilla, betelvine and celery.

Area, production and export potential of plantation crops, varietal wealth, cultivation systems, multitier cropping, high density planting, nutritional and irrigation requirements, weed management, training and pruning, physiological disorders, maturity indices, harvesting, postharvest management and plant protection measures of the following crops: Coffee, tea, cashew, rubber, coconut, arecanut, cocoa and oil palm.

SOA/HMJ/UG 06 P: Commercial Production of Spices and Plantation Crops (1)

Identification of seeds and plants, propagation, nursery raising, field layout, planting methods, cultural practices, harvesting and handling, visit to fields and marketing centres.

Course No.	Course Title	Credits
SOA/HMJ/UG 07	Precision Farming and Protected Cultivation	3 (2+1)

The course will help the learner to:

CO1: Learn about the laser levelling, mechanized direct seed sowing; seedling and sapling transplanting and site specific input application.

CO2: Understand the techniques of protected cultivation, types of green houses, plant response to greenhouse environment, planning and design of greenhouses.

CO3: Apply knowledge of passive solar green house, hot air greenhouse heating systems, and greenhouse drying.

CO4: Analyze cost estimation and economic of polyhouse cultivation of horticultural crops.

SOA/HMJ/UG 07 T: Precision Farming and Protected Cultivation (2)

Precision farming – laser levelling, mechanized direct seed sowing; seedling and sapling transplanting, site specific input application. Protected cultivation technology: Introduction, techniques of protected cultivation, types of Green Houses, Plant response to Greenhouse

environment, Planning and design of greenhouses, Design criteria of greenhouse for cooling and heating purposes. Green house equipment, materials of construction for traditional and low- cost green houses. Irrigation systems used in protected cultivation, Typical applications, passive solar green house, hot air greenhouse heating systems, greenhouse drying. Cost estimation and economic analysis. Choice of crops for cultivation under protected structures, problems/constraints of greenhouse cultivation and future strategies. Growing media, soil culture, type of soil required, drainage, flooding and leaching, soil pasteurization in peat moss and mixtures, rock wool and other inert media, nutrient film technique (NFT)/ hydroponics.

SOA/HMJ/UG 07 P: Precision Farming and Protected Cultivation (1)

Laser levelling procedure and field visit. Study and field visit for mechanized direct seed sowing and transplanting. Study of different types of greenhouses based on shape, construction and cladding materials. Studies on different environment control parameters in greenhouses. Estimation of drying rate of agricultural products inside greenhouse. Testing of soil and water to study its suitability for growing crops in protected structures. The study of fertigation requirements for greenhouse crops and estimation of E.C and pH in the fertigation solution. The study of various growing media used in raising of greenhouse crops and their preparation and pasteurization/sterilization. Visit to commercial protected cultivation structures. Economics of protected cultivation.

Multidisciplinary Courses (MDC)

Course No.	**Course Title**	**Credits**
SOA/HMDC/UG 02	Entrepreneurship Development and Business Management	3 (2+1)
The course will help the learner to: CO1: Learn about the concept, need and importance of entrepreneurial development.. CO2: Understand about the infrastructure support systems like good policies, schemes, financial institutions and other agencies for entrepreneurship development. CO3: Apply knowledge of planning of an enterprise, project identification, selection, and formulation of project. CO4: Analyze crisis management like raw material, production, leadership, market, finance, natural etc.		

SOA/HMDC/UG 02 T: Entrepreneurship Development and Business Management (2)

Development of entrepreneurship, motivational factors, social factors, environmental factors, characteristics of entrepreneurs, entrepreneurial attributes/competencies. Concept, need and importance of entrepreneurial development. Evolution of entrepreneurship, objectives of entrepreneurial activities, types of entrepreneurs, functions of entrepreneurs, importance of entrepreneurial development, and process of entrepreneurship development. Environment scanning and opportunity identification need for scanning–spotting of opportunity-scanning of environment– identification of product / service – starting a project; factors influencing sensing the opportunities. Infrastructure and support systems- good policies, schemes for entrepreneurship development; role of financial institutions, and other agencies in entrepreneurship development. Steps involved in functioning of an enterprise. Selection of the product / services, selection of form of ownership; registration, selection of site, capital sources, acquisition of manufacturing know how, packaging and distribution. Planning of an enterprise, project identification, selection, and formulation of project; project report preparation, Enterprise Management. Production management – product, levels of products, product mix, quality control, cost of production, production controls, Material management. Production management – raw material costing, inventory control. Personal management – manpower planning, labour turn over, wages / salaries. Financial management / accounting – funds, fixed capital and working capital, costing and pricing, long term planning and short-term planning, book keeping,

journal, ledger, subsidiary books, annual financial statement, taxation. Marketing management- market, types, marketing assistance, market strategies. Crisis management- raw material, production, leadership, market, finance, natural etc.

SOA/HMDC/UG 02 P: Entrepreneurship Development and Business Management (1)

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

Value Added Courses (VAC)

Course No.	Course Title	Credits
SOA/HVAC/UG 01	Environmental Studies and Disaster Management	3 (2+1)

The course will help the learner to:

CO1: Learn about the multidisciplinary nature, scope, and importance of environmental studies and articulate concepts of sustainability and sustainable development.

CO2: Understand the biodiversity in its genetic, species, and ecosystem dimensions; evaluate threats to biodiversity and discuss in situ and ex situ conservation strategies, with attention to India's mega-diversity status and hotspots.

CO3: Apply biodiversity in its genetic, species, and ecosystem dimensions; evaluate threats to biodiversity and discuss in situ and ex situ conservation strategies, with attention to India's mega-diversity status and hotspots.

CO4: Analyze social issues and environmental ethics related to sustainable development, including urban challenges, water conservation, climate change, global warming, acid rain, ozone depletion, and disaster management.

SOA/HVAC/UG 01 T: Environmental Studies and Disaster Management (2)

Introduction to Environment - Environmental studies - Definition, scope and importance - Multidisciplinary nature of environmental studies - Segments of Environment - Spheres of Earth - Lithosphere - Hydrosphere - Atmosphere - Different layers of atmosphere. Natural Resources: Classification - Forest resources. Water resources. Mineral resources Food resources. Energy resources. Land resources. Soil resources. Ecosystems - Concept of an ecosystem - Structure and function of an ecosystem - Energy flow in the ecosystem. Types of ecosystem. Biodiversity and its conservation: Introduction, definition, types. Biogeographical classification of India. Importance and Value of biodiversity. Biodiversity hot spots. Threats and Conservation of biodiversity.

Environmental Pollution: Definition, cause, effects and control measures of: (a) Air pollution. (b) Water pollution. (c) Soil pollution. (d) Marine pollution. (e) Noise pollution. (f) Thermal pollution. (g) light pollution. Solid Waste Management: Classification of solid wastes and management methods, Composting, Incineration, Pyrolysis, Biogas production, Causes, effects and control measures of urban and industrial wastes. Social Issues and the Environment: Urban problems related to energy. Water conservation, rain water harvesting, watershed management. Environmental ethics: Issues and possible solutions, climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Environment Protection Act. Air (Prevention and Control of Pollution) Act. Water (Prevention and control of Pollution) Act. Wildlife Protection Act. Forest Conservation Act. Human Population and the Environment: Environment and human health: Human Rights, Value Education. Women and Child Welfare. Role of Information Technology in Environment and human health.

Disaster management - Disaster definition - Types - Natural Disasters - Floods, drought, cyclone, earthquakes, landslides, avalanches, volcanic eruptions, Heat and cold waves. Man Made Disasters - Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire, oil fire, road accidents, rail accidents, air accidents, sea accidents. International and

National strategy for disaster reduction. Concept of disaster management, national disaster management framework; financial arrangements; role of NGOs, community-based organizations and media in disaster management. Central, state, district and local administration in disaster control; Armed forces in disaster response; Police and other organizations in disaster management.

SOA/HVAC/UG 01 P: Environmental Studies and Disaster Management (1)

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

Ability Enhancement Compulsory Course (AECC)

Course No.	Course Title	Credits
SOA/HAECC/UG 03	Personality Development	2 (1+1)

The course will help the learner to:

CO1: Learn about the nature of personality, theories of personality and its types.

CO2: Understand about the Maslow's self-actualization theory, Myers-Briggs Typology Indicator, Type A and Type B Behaviours, personality and Organizational Behaviour.

CO3: Apply models of individual behavior, perception and attributes and factors affecting perception.

CO4: Analyze attitude and values intelligence, motivation, teamwork and group dynamics.

SOA/HAECC/UG 03 T: Personality Development (1)

Personality Definition, Nature of personality, theories of personality and its types. The humanistic approach - Maslow's self-actualization theory, shaping of personality, determinants of personality, Myers-Briggs Typology Indicator, Locus of control and performance, Type A and Type B Behaviours, personality and Organizational Behaviour.

Foundations of individual behavior and factors influencing individual behavior, Models of individual behavior, Perception and attributes and factors affecting perception, Attribution theory and case studies on Perception and Attribution. Learning: Meaning and definition, theories and principles of learning, Learning and organizational behavior, Learning and training, learning feedback. Attitude and values, Intelligence- types of Intelligence, theories of intelligence, measurements of intelligence, factors influencing intelligence, intelligence and Organizational behavior, emotional intelligence. Motivation- theories and principles, Teamwork and group dynamics.

SOA/HAECC/UG 03 T: Personality Development (1)

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

Course No.	Course Title	Credits
SOA/HAECC/UG 04	NSS-II (National Service Scheme)	1 (0+1)

The course will help the learner to:

CO1: Learn about importance, role, meaning, types and traits of youth leadership.

CO2: Understand about life competencies, problem-solving, decision-making, interpersonal communication and youth development programs.

CO3: Apply models of sanitation for health; national health programs and reproductive health.

CO4: Analyze development of youth programs and policy at the national level, state level and voluntary sector; youth-focused and youth-led organizations.

SOA/HAECC/UG 04: NSS-II (National Service Scheme)

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

Skill Enhancement Courses (SEC)

Course No.	Course Title	Credits
SOA/HSEC/UG 03	Mushroom Cultivation	2 (0+2)

The course will help the learner to:

CO1: Learn about the scope, important features, nutritional and medicinal value of mushrooms.

CO2: Understand about preparation of media, tissue culture preparation, sub-culturing for culture maintenance and its preservation.

CO3: Apply spawn preparation techniques and collection of wild mushroom flora of Uttarakhand.

CO4: Analyze the economics of mushrooms and preparation of value added products from mushrooms.

SOA/HSEC/UG 03 P: Mushroom Cultivation (2)

Current status and scope of mushroom cultivation in India and Punjab, Important features of edible fungi, Nutritional and medicinal value of mushrooms, Preparation of media, Tissue culture preparation, Sub-culturing for culture maintenance and its preservation, Spawn preparation techniques, Collection of wild mushroom flora of Punjab, Raw material formulations for Agaricus bisporus (button mushroom), Composting (long method and short method), Casing preparation, Crop management practices, Mushroom farm design and infrastructure required for commercial unit, Cultivation techniques of *Pleurotus florida* (dhingri), *Lentunus edodes* (shiitake), *Calocybe indica* (milky) and *Volvoriella volvacea* (paddy straw) mushrooms, Marketing of mushrooms, Mushroom diseases and their control, Preparation of value added products from mushrooms, Economics of mushrooms, Exposure visit to commercial farms.

Course No.	Course Title	Credits
SOA/HSEC/UG 04	Nursery Production in Horticulture Crops	2 (0+2)

The course will help the learner to:

CO1: Learn about the lyout of model nursery, tools and equipment-identification and application.

CO2: Understand about different methods of breaking seed dormancy, stratification, scarification and use of plant growth regulators.

CO3: Apply micropropagation-explant preparation, media preparation, culturing–meristem tip culture, axillary bud culture, micro-grafting and hardening of plants.

CO4: Analyze the Diagnosis and control of important diseases and pests in the nursery, lifting and packing of nursery plants.

SOA/HSEC/UG 04 P: Nursery Production in Horticulture Crops (2)

Layout of model nursery, Tools and equipment-identification and application. Different methods of breaking seed dormancy stratification, scarification and use of plant growth regulators. Extraction and storage of healthy seeds, seed bed preparation, Identification and raising of rootstocks for different fruit plants, soil solarization, preparation of potting mixtures. Selection of healthy scion wood, practices in different methods of plant propagation like cutting, layering, budding and graftingin fruit plants. Micropropagation-explant preparation, media preparation, culturing–meristem tip culture, axillary bud culture, micro-grafting and hardening of plants. Nursery management practices i.e. weed control, irrigation, nutrition, removal of sprouts etc. Protection of nursery plants against adverse climatic conditions. Protected structures. Diagnosis and control of important diseases and pests in the nursery, lifting and packing of nursery plants, Visit to commercial tissue culture laboratories and accredited nurseries.

SEMESTER-III

Major Courses

Course No.	Course Title	Credits
SOA/HMJ/UG 08	Fundamental of Soil Science	3 (2+1)

The course will help the learner to:

CO1: Learn about the composition of Earth's crust and major soil components, and describe eluviation and illuviation processes in soil formation.

CO2: Understand and apply concepts of soil texture including texture analysis methods (feel, hydrometer based on Stokes' law), texture classes, and the use of a textural triangle for soil classification.

CO3: Apply knowledge of soil moisture measurement methods (gravimetric, tensiometer, neutron probe), soil water constants (field capacity, wilting point), and soil water movement principles.

CO4: Analyze the factors influencing soil physical properties such as moisture, organic matter, parent material, and soil management practices.

SOA/HMJ/UG 08 T: Fundamental of Soil Science (2)

Composition of earth's crust, soil as a natural body – major components. Eluviation, Illuviation formation of various soils. Physical parameters; texture – definition, methods of textural analysis, stock's law, assumption, limitations, textural classes, use of textural triangle; absolute specific gravity/ particle density, definition, apparent specific gravity/bulk density – factors influencing, field bulk density. Relation between BD (bulk density), AD – practical problems.

Pore space – definition, factors affecting capillary and non-capillary porosity, soil colour – definition, its significance, colour variable, value hue and chroma. Munsell colour chart, factors influencing, parent material, soil moisture, organic matter, soil structure, definition, classification, clay prism like structure, factors influencing genesis of soil structure, soil consistency, plasticity, Atterberg's constants. Soil air, air capacity, composition, factors influencing, amount of air space, soil air renewal, soil temperature, sources and distribution of heat, factors influencing, measurement, chemical properties, soil colloids, organic, humus, inorganic, secondary silicate, clay, hydrous oxides. Ion exchange, cation-anion importance, soil water, forms, hygroscopic, capillary and gravitational, soil moisture constants, hygroscopic coefficient, wilting point, field capacity, moisture equivalent, maximum water holding capacity, energy concepts, PF scale, measurement, gravimetric – electric and tensiometer methods – pressure plate and pressure membrane apparatus–Neutronprobe–soil water movement– classification– aerial photography– satellite of soil features – their interpretation; soil orders; land capability classification; soil of different eco-systems and their properties, Rock and Minerals classification, Pedogenic process. Objectives of soil science research institute in India (NBSS and LUP, ISSS, LTFE and NSSTL). Management of Soil Crusting, Soil Compaction and Soil Compression. Soil Biology benefits and harmful effects. Methods and objective of soil survey, Remote sensing application in soil and plant Studies, Soil degradation.

SOA/HMJ/UG 08 P: Fundamental of Soil Science (1)

Collection and preparation of soil samples, estimation of moisture, EC, pH and bulk density. Textural analysis of soil by Robinson's pipette method. Description of soil profile in the field. Quantification of minerals and their abundance. Determination of Soil colour using Munsell Chart. Estimation of water holding capacity and hydraulic conductivity of soils. Estimation of Infiltration rate using double ring infiltrometer method. Estimation of soil moisture using gypsum block and neutron probe method. Soil compaction measurement with Pentrometer. Determination of pore space of soil. Determination of field capacity and permanent wilting point of soil. Determination of soil water potential characteristic curves by tensiometer and pressure plate apparatus. Aggregate size distribution analysis of soil. Air capacity of soil by fieldmeth Nursery raising/procurement and transplanting, management and maintenance of the crop, postharvest handling, quality control and marketing.

Course No.	**Course Title**	**Credits**
SOA/HMJ/UG 09	Commercial Fruit Production	3 (2+1)
The course will help the learner to: CO1: Learn about the Area, production and export potential, varieties, soil and climate requirements, propagation techniques, planting density and systems of fruit crops. CO2: Understand training and pruning, high density planting, ultra-high density planting, mechanization, water, nutrient and weeds management of fruit crops. CO3: Apply knowledge of physiological disorders, special production problems, insect-pests, diseases and their control measures. CO4: Analyze the Post-harvest technology, harvest indices, harvesting methods, grading, packaging and storage of fruit crops.		

SOA/HMJ/UG 09 T: Commercial Fruit Production (2)

Area, production and export potential, varieties, soil and climate requirements, propagation techniques, planting density and systems, training and pruning, high density planting, ultra-high density planting, mechanization, management of water, nutrient and weeds, Physiological disorders, Special production problems, insect-pests, diseases and their control measures. Post-harvest technology, harvest indices, harvesting methods, grading, packaging and storage of the

following crops: mango, banana, citrus, guava, litchi, grapes, papaya, pineapple, ber, aonla, pomegranate, sapota, jamun, date palm, apple, pear, peach, plum, cherry, almond, apricot, walnut, kiwifruit, hazelnut, chestnut, pecan nut, plantation crops (coconut, cashew nut, tea, coffee, cocoa, arecanut, palmyrah palm and strawberry.

SOA/HMJ/UG 09 P: Commercial Fruit Production (1)

Description and identification of varieties. Training and pruning, application of manure, fertilizer and irrigation, weed control, maturity standards, harvesting, handling, grading and packaging of fruits. Visit to commercial orchards.

Course No.	Course Title	Credits
SOA/HMJ/UG 10	Plant Propagation and Nursery Management in Vegetables, Flowers and Medicinal Crops	3 (1+2)

The course will help the learner to:

CO1: Learn about the importance of plant propagation and nursery production in fruits and plantation crops.

CO2: Understand the sexual and asexual methods of propagation, their advantages and disadvantages.

CO3: Apply knowledge of propagation from specialized modified plant parts, crop specific plant propagation practices in commercial vegetables and flowers.

CO4: Analyze cost of establishment of a modern nursery.

SOA/HMJ/UG 10 T: Plant Propagation and Nursery Management in Vegetables, Flowers and Medicinal Crops (1)

Nursery management practices for vegetables, flowers and medicinal crops, Biology of plant propagation, Sexual and Asexual plant propagation, physiology of seed, seed storage and dormancy, physiology of cutting, layering, grafting, budding. Tissue culture, Maintenance of elite germplasm and mother stock. Propagation from specialized modified plant parts, crop specific plant propagation practices in commercial vegetables and flowers. Nursery techniques and crop specific propagation methods of medicinal crops.

SOA/HMJ/UG 10 P: Plant Propagation and Nursery Management in Vegetables, Flowers and Medicinal Crops (2)

Identification of planting material, commercial varieties of vegetable, flowers and medicinal crops. Propagation and multiplication, seed production. Potting, repotting and maintenance of houseplants. Practices in manuring, drip and fertigation, foliar nutrition, growth regulator application, pinching, disbudding, staking. Harvesting techniques. Crop-specific plant propagation practices. Visit to local nurseries and florist centers. Marketing requirements and strategies for sale of important crops.

Course No.	Course Title	Credits
SOA/HMJ/UG 11	Seed Production of Vegetables, Tuber and Spice Crops	3 (2+1)

The course will help the learner to:

CO1: Learn about the seed, classes of seed, differences between grain and seed.

CO2: Understand the history of seed industry in India, importance and scope of vegetable seed production in India.

CO3: Apply knowledge of land requirements, climate, season, planting time, nursery management, seed rate, rouging, seed extraction and storage, packaging and labelling of vegetable, tuber and spice crops.

CO4: Analyze seed germination, purity analysis, seed priming and pelleting of vegetable,

tuber and spice crops.

SOA/HMJ/UG 11 T: Seed Production of Vegetables, Tuber and Spice Crops (2)

Introduction and history of seed industry in India. Definition of seed, classes-types of seed. Differences between grain and seed. Importance and scope of vegetable seed production in India. Principles of vegetable seed production. Role of temperature, humidity and light in vegetable seed production, land requirements, climate, season, planting time, nursery management, seed rate, rouging, seed extraction and storage, packaging and labelling of cole crops, root vegetables, solanaceous vegetables, cucurbits, okra, leafy vegetables, bulb crops, tuber crops like potato, spice crops like coriander, fenugreek, leguminous vegetables and exotic vegetables. Seed germination and purity analysis. seed priming and pelleting, Field and seed standards. Seed drying and extraction. Seed legislation.

SOA/HMJ/UG 11P: Seed Production of Vegetables, Tuber and Spice Crops (1)

Study of seed structure, colour size, shape and texture. Field inspection of seed crops. Practices in rouging. Harvesting and seed extraction. Germination and purity analysis. Methods of seed production, Seed certification in cole crops, root vegetables, bulb crops, solanaceous vegetables, cucurbits, okra, leafy vegetables, leguminous vegetables and exotic vegetables. Seed processing machines. Visit to seed production units

Course No.	Course Title	Credits
SOA/HMJ/UG 12	Disease Management of Horticulture Crops	3 (2+1)
The course will help the learner to: CO1: Learn about the etiology, symptoms, mode of spread, epidemiology and integrated management of the diseases under protected conditions and open field conditions of fruits, plantation, medicinal, aromatic, vegetables, ornamental and spice crops. CO2: Understand the important post-harvest diseases of fruit, plantation, medicinal, aromatic, vegetables, ornamental and spice crops and their management. CO3: Apply knowledge of etiology, symptoms and integrated management of important plant parasitic nematodes of fruits, vegetables, tuber, ornamental, spice and plantation crops. CO4: Analyze the role of nematodes in plant disease complex.		

SOA/HMJ/UG 12 T: Disease Management of Horticulture Crops (2)

Etiology, symptoms, mode of spread, epidemiology and integrated management of the diseases under protected conditions and of fruits, plantation, medicinal, aromatic, vegetables, ornamental, and spice crops viz mango, litchi, banana, grape, citrus, guava, sapota, papaya, jack fruit, pineapple, pomegranate, ber, apple, pear, peach, plum, almond, walnut, strawberry, tomato, brinjal, chilli, bhindi, cabbage, cauliflower, radish, knol-khol, pea, beans, beet root, onion, garlic, fenugreek, ginger, potato, areca nut, coconut, oil palm, coffee, tea, cocoa, cashew, rubber, betel vine, senna, neem, hemp, belladonna, pyrethrum, camphor, costus, crotalaria, datura, dioscorea, mint, opium, Solanum khasianum, Tephrosia, turmeric, pepper, cumin, cardamom, nutmeg, coriander, clove, cinnamon, jasmine, rose, crossed, tuberose, gerbera, anthurium, geranium, marigold, gladiolus. Important post-harvest diseases of fruit, plantation, medicinal, aromatic, vegetables, ornamental and spice crops and their management. Etiology, symptoms and integrated management of important plant parasitic nematodes of fruits – (tropical, sub-tropical and temperate) vegetables, tuber, ornamental, spice and plantation crops. Role of nematodes in plant disease complex.

SOA/HMJ/UG 12 P: Disease Management of Horticulture Crops (1)

Observations of disease symptoms, identification of casual organisms and host parasite relationship of important diseases of fruits, plantation, medicinal, aromatic, vegetables, ornamental and spice crops. Collection and preservation of diseased plant specimen.

Minor Courses

Course No.	Course Title	Credits
SOA/HMN/UG 01	Introductory Agrometeorology and Climate Change	2 (1+1)

The course will help the learner to:

CO1: Learn about scope, definitions, and practical utility of agricultural meteorology in relation to crop production and environmental management.

CO2: Understand composition and structure of the atmosphere and key weather and climate elements including temperature, soil temperature, solar radiation, atmospheric pressure, humidity, evaporation, transpiration, rainfall, monsoons, and clouds.

CO3: Apply basic principles of weather forecasting and the use of meteorological data in agriculture.

CO4: Analyze the impact of weather disasters such as droughts and floods, and develop understanding of weather disaster management strategies and atmospheric pollution control.

SOA/HMN/UG 01 T: Introductory Agrometeorology and Climate Change (1)

Agrometeorology – definition, scope. Earth atmosphere - its composition, extent and structure. Atmospheric weather variables. Elements and factors of weather and climate. Atmospheric pressure. Wind, types, daily and seasonal variation. Cyclone, anticyclone. Land and sea breeze. Solar radiation - solar constant, depletion, short and long wave, thermal radiation, net radiation, albedo. Atmospheric temperature, inversion, lapse rate, daily and seasonal variations, vertical profile. Energy balance of earth. Atmospheric humidity, saturation, vapor pressure, condensation. Dew, fog, mist, frost. Precipitation, process, types. Cloud formation and classification. Artificial rainmaking. Monsoon - mechanism and importance in Indian agriculture. Weather hazards. Agriculture and weather relations. Modifications of microclimate. Climatic normal for crop and livestock production. Weather forecasting – types and applications. Climate change and impacts on agriculture.

SOA/HMN/UG 01 P: Introductory Agrometeorology and Climate Change (1)

Visit to agrometeorological observatory. Site selection of observatory and exposure of instruments and weather data recording. Measurement of total, short and long wave radiations and their 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, tabulation, trend and variation analysis. Measurement of soil temperature and computation of soil heat flux. Determination of vapor pressure and relative humidity. Determination of dew point temperature. Measurement of atmospheric pressure and analysis of atmospheric conditions. Measurement of wind speed and wind direction, preparation of wind rose. Measurement, tabulation and critical analysis of rainfall. Computation of drought indices. Measurement of open pan evaporation and evapotranspiration. Computation of PET and AET.

Ability Enhancement Compulsory Course (AECC)

Course No.	Course Title	Credits
SOA/HAECC/UG 05	Physical Education, First Aid, Yoga Practices and Meditation	2 (0+2)

The course will help the learner to:

CO1: Learn about meaning, concept and methods of training and coaching.
CO2: Understand about aerobic and aerobic exercises; calisthenics, weight training, circuit training, interval training and fartlek training.
CO3: Apply the effects of exercise on muscular, respiratory, circulatory and digestive systems; balanced diet and nutrition: effects of diet on performance.
CO4: Analyze the Role of yoga in sports and teaching of Asanas – demonstration, practice, correction and practice.

SOA/HAECC/UG 05 P: Physical Education, First Aid, Yoga Practices and Meditation (2)

Physical education; Training and Coaching - Meaning and Concept; Methods of Training; aerobic and aerobic exercises; Calisthenics, weight training, circuit training, interval training, Fartlek training; Effects of Exercise on Muscular, Respiratory, Circulatory and Digestive systems; Balanced Diet and Nutrition: Effects of Diet on Performance; Physiological changes due to ageing and role of regular exercise on ageing process; Personality, its dimensions and types; Role of sports in personality development; Motivation and Achievements in Sports; Learning and Theories of learning; Adolescent Problems and its Management; Posture; Postural Deformities; Exercises for good posture.

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

- Asanas (Definition and Importance) Padmasan, Gaumukhasan, Bhadrasan, Vajrajasan, Shashankasan, Pashchimotasan, Ushtrasan, Tadasan, Padhastasan, Ardhchandrasan, Bhujangasan, Utanpadasan, Sarvangasan, Parvatasan, Patangasan, Shishupalanasan – left leg- right leg, Pavanmuktasan, Halasan, Sarpasan, Ardhdhanurasan, Sawasan
- Suryanamskar Pranayama (Definition and Importance) Omkar, Suryabhedan, Chandrabhedan, AnulomVilom, Shitali, Shitkari, Bhastrika, Bhramari
- Meditation (Definition and Importance), Yogic Kriyas (Kapalbhati), Tratak, Jalneti and Tribandh
- Mudras (Definition and Importance) Gyanmudra, Dhyanmudra, Vayumudra, Akashmudra,Pruthvimudra, Shunyamudra, Suryamudra, Varunmudra, Pranmudra, Apanmudra, Vyanmudra, Uddanmudra
- Role of yoga in sports
- Teaching of Asanas – demonstration, practice, correction and practice.

History of sports and ancient games, Governance of sports in India; Important national sporting events; Awards in Sports; History, latest rules, measurements of playfield, specifications of equipment, skill, technique, style and coaching of major games (Cricket, football, table Tennis, Badminton, Volleyball, Basketball, Kabaddi and Kho-Kho) and Athletics Need and requirement of first aid. First Aid equipment and upkeep. First AID Techniques, First aid related with respiratory system. First aid related with Heart, Blood and Circulation. First aid related with Wounds and Injuries. First aid related with Bones, Joints Muscle related injuries. First aid related with Nervous system and Unconsciousness. First aid related with Gastrointestinal Tract. First aid related with Skin, Burns. First aid related with Poisoning. First aid related with Bites and Stings. First aid related with Sense organs, Handling and transport of injured traumatized persons. Sports injuries and their treatments.

Skill Enhancement Compulsory (SEC)

Course No.	**Course Title**	**Credits**
SOA/HSEC/UG 05	Post-Harvest Management of Horticultural Produce	2 (0+2)
The course will help the learner to: CO1: Learn about layout and planning of postharvest experiments, maturity and harvesting of		

horticulture produce. CO2: Understand about judging maturity by different methods. CO3: Apply the postharvest treatments for shelf- life extension of fruits and vegetables. CO4: Analyze the cold-chain management, storage requirements and commercial technologies for processing of horticultural produce.

SOA/HSEC/UG 05 P: Post-Harvest Management of Horticultural Produce (2)

Layout and planning of postharvest experiments, Maturity and harvesting of horticulture produce. Judging maturity by different methods. Harvesting tools. Objective measurement of colour, texture and dry matter. Components and equipment used in Postharvest laboratory, Different types of cleaning agents and washing methods for horticultural produce. Layout of packhouse and General packhouse operation. Sorting, surface sanitizing and drying of fruit. Postharvest treatments for shelf- life extension of fruits and vegetables. Packing of fruits in different packaging materials, preparation of different coating materials and their method of applications. Pre-cooling of horticultural produce. Ripening technology for horticultural crops. Significance of sorting and grading in horticulture produce: Types of grading system and standards. Cold-chain management. Storage requirements. Commercial technologies for processing of horticultural produce.

SEMESTER IV

Major Course

Course No.	Course Title	Credits
SOA/HMJ/UG 13	Commercial Vegetable Production	4 (3+1)
The course will help the learner to: CO1: Learn about importance of Olericulture and different vegetable gardens. CO2: Understand about vegetable classification, area, production and varieties of different vegetables. CO3: Apply package of practices of different vegetables. CO4: Analyze the postharvest treatments for shelf- life extension of different vegetables.		

SOA/HMJ/UG 13 T: Commercial Vegetable Production (3)

Importance of Olericulture. Vegetable gardens. Vegetable classification, area, production and varieties. Package of practices of tomato, brinjal, chillies, capsicum, moringa and okra. Cucurbitaceous vegetables- cucumber, ridge gourd, ash gourd, snake gourd, bottle gourd, bitter gourd, pumpkin and melons. Cole crops - cabbage, cauliflower and knol-khol. Bulb crops - onion and garlic. Beans and peas - French beans, cluster beans, dolichos beans, peas and cowpea. Tuber crops - potato, sweet potato, tapioca, colocasia, yams. Root crops - carrot, radish, turnip and beet root. Leafy vegetables – broccoli, lettuce, spinach, chinese cabbage and asparagus.

SOA/HMJ/UG 13P: Commercial Vegetable Production (1)

Identification of vegetable crops and seeds; Planning, layout and maintenance of kitchen garden; Direct sowing of vegetables, Bed preparation and method of nursery sowing; Transplanting of vegetable seedlings; Method of fertilizer application and calculation of different fertilizer doses; Intercultural operations in vegetable crops, Harvesting, grading and packaging of vegetable crops, Economics of vegetable crops, Visit to commercial vegetable farms.

Course No.	Course Title	Credits
SOA/HMJ/UG 14	Farm Power and Machinery for Horticulture	3 (2+1)
The course will help the learner to: CO1: Learn about basic concepts of various forms of energy; tractors, power tillers and their		

types and uses.
CO2: Understand about basic principles of operation of compression, ignition and spark ignition engines; two stroke and four stroke engines.
CO3: Apply broad understanding of performance and efficiency of fuel supply, cooling, lubrication and power transmission systems of IC engine.
CO4: Analyze the different tools, implements and machinery used in horticulture farms.

SOA/HMJ/UG 14 T: Farm Power and Machinery for Horticulture (2)

Basic concepts of various forms of energy; Tractors, power tillers and their types and uses Introduction about IC Engines: Basic principles of operation of compression, ignition and spark ignition engines; two stroke and four stroke engines; Crank system, valve system, fuel supply system, cooling and lubrication systems; power transmission systems; broad understanding of performance and efficiency. Tillage: objectives, method of ploughing. Primary tillage implements: construction and function of improved indigenous ploughs, mould board ploughs, disc and rotary ploughs, offset rotavators. Secondary tillage implements construction and function of cultivators, harrows, levellers, ridgers and bund formers. Adjustments affecting performance in tillage equipment. Calculation of bite length of rotavator. Post-hole digger. Introduction about planting and transplanting equipment: potato planters, small seed planter, nursery sowing machinery, vegetable transplanters, plastic mulch and drip laying machinery. Introduction about intercultural machinery. Sprayers: Types, working principle, manual and tractor operated, gun-type and boom type. Special purpose sprayers: aero- blast sprayers, electrostatic sprayers, sprayer calibration and nozzle spacing. Safety features and safe use, shrub cutters, pick positioner; grafting, pruning and training tools and equipment; sweep, rotary weeders, tractor operated pruners. Crop harvesting equipment: potato diggers, fruit-pluckers, seed extraction machine.

SOA/HMJ/UG 14 P: Farm Power and Machinery for Horticulture (1)

Calculation on force, power and energy. IC engines – showing the components of dismantled engines. Familiarization with engine systems Primary and secondary tillage implements: hitching, adjustments and operations. Operation of post hole digger. Operation of planting and transplanting machinery. Operation of vegetable transplanter, plastic mulch and drip laying machinery. Operation of Inter-culture equipment including offset rotavator in orchard; calibration of plant protection equipment, calculation of dilution ratio and operation; operation of power weeder, shrub cutter. Operation of crop harvesting equipment and seed extraction machine. Operation of shrub cutters, fruit-pluckers, pick positioner.

Course No.	**Course Title**	**Credits**
SOA/HMJ/UG 15	Pest Management of Horticulture Crops	3 (2+1)

The course will help the learner to:
CO1: Learn about classification of insect-pests, dynamics of EIL and ETL.
CO2: Understand about the methods of pest control, host plant resistance, cultural, mechanical, physical, legislative, biological and chemical control.
CO3: Apply recent technologies for insect-pest management..
CO4: Analyze the insecticides residue problems in fruit, vegetable, plantation, ornamental, spice, medicinal and aromatic crops and their maximum residue limits (MRLs).

SOA/HMJ/UG 15 T: Pest Management of Horticulture Crops (2)

Classification of insect-pests. Dynamics of EIL and ETL. Methods of pest control - host plant resistance, cultural, mechanical, physical, legislative, biological and chemical control. Recent technologies for insect-pest management. Insecticides, classification, formulations, first aid and antidotes. IPM – importance and principles. Scientific name, order, family, host range, distribution, biology, ecology, nature of damage and management of important insect-pests of various fruit (tropical, sub-tropical and temperate), vegetable, ornamental, plantation, spice, medicinal, aromatic crops and under protected conditions. Pest surveillance. Storage insects – Scientific name, order, family, host range, distribution, biology, ecology, nature of damage and management of important insect-pests attacking stored fruit, vegetable, plantation, ornamental, spice, medicinal and aromatic crops' produce and their processed products. Insecticides residue problems in fruit, vegetable, plantation, ornamental, spice, medicinal and aromatic crops and their maximum residue limits (MRLs). Waiting periods for insecticides on various crops.

SOA/HMJ/UG 15 P: Pest Management of Horticulture Crops (1)

Identification of insect-pests of various fruit, vegetable, plantation, ornamental, spice, medicinal and aromatic crops in field and their produce during storage, and their symptoms of damage. Identification of biocontrol agents and natural enemies. Insecticide formulations. Pesticide application appliances. Calculation of insecticide quantity for preparing spray material.

Minor Course

Course No.	Course Title	Credits
SOA/HMN/UG 02	Urban and Peri Urban Horticulture	2(1+1)
The course will help the learner to: CO1: Learn about definition, importance, characteristics and scope to urban and peri-urban horticulture. CO2: Understand about types of urban and peri-urban gardens and their characteristics. CO3: Apply Interior and exterior landscaping in urban and peri-urban households. CO4: Analyze the water and waste management, waste water recycling and its use in landscaping.		

SOA/HMN/UG 02 T: Urban and Peri Urban Horticulture (1)

Introduction to urban and peri-urban horticulture: Definition, importance, characteristics and scope. Types of urban and peri-urban gardens and their characteristics: Terrace gardening, vegetable gardening, container gardening, rooftop gardens, community gardens, vertical gardens, hydroponics and aeroponics. Selection of site, planting material, media (soil and soilless) preparation and nutrient management for cultivation of vegetables, herbs, fruits, flowers and ornamental plants. Protected cultivation in urban and peri-urban areas. Making and maintenance of lawns. Interior and exterior landscaping in urban and peri-urban households. Water and waste management, waste water recycling and its use in landscaping. Insect-pest and disease management in urban horticulture.

SOA/HMN/UG 02P: Urban and Peri Urban Horticulture (1)

Site selection and layout of various urban and peri-urban gardens. Preparation of growing media and potting mixtures. Types of containers, nursery raising and planting for rooftop gardens. Irrigation and nutritional management in urban and peri-urban horticulture. Visit to fruit nutrition garden, vegetable kitchen garden and public gardens.

Multidisciplinary Courses (MDC)

Course No.	Course Title	Credits
SOA/HMDC/UG 03	Agriculture Marketing and Trade	3(2+1)
The course will help the learner to: CO1: Learn about different marketing channels and strategies in agriculture.		

CO2: Understand the fundamentals of agricultural marketing and trade.
CO3: Apply government policies and regulations in agricultural markets.
CO4: Analyze the factors influencing supply and demand in agricultural markets.

SOA/HMDC/UG 03 T: Agriculture Marketing and Trade (2)

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; pricing and promotion strategies: pricing considerations and approaches – cost based and competition based pricing; market promotion – advertising, personal selling, sales promotion and publicity – meaning, merits and demerits; marketing process and functions: Marketing process concentration, dispersion and equalization; exchange functions – buying and selling; physical functions – storage, transport and processing; facilitating functions – packaging, branding, grading, quality control and labelling (Agmark); 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 and DMI – their objectives and functions; cooperative marketing in India; Risk in marketing: Types of risk in marketing; speculation and hedging; an overview of futures trading; Agricultural prices and policy: Meaning and functions of price; administered prices; need for innovations in agricultural price policy.

Trade: Concept of International Trade and its need, theories of absolute and comparative advantage. Present status and prospects of international trade in agri-commodities; WTO; Agreement on Agriculture (AoA) and its implications on Indian agriculture; IPR. Role of government in agricultural marketing. Role of APMC and its relevance in the present-day context.

SOA/HMDC/UG 03 P: Agriculture Marketing and Trade (1)

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.

Value Added Courses (VAC)

Course No.	Course Title	Credits
SOA/HVAC/UG 02	Agriculture Informatics and Artificial Intelligence	3 (2+1)
The course will help the learner to: CO1: Learn about computers, anatomy of computers, memory concepts, units of memory, operating system.		

CO2: Understand the applications of MS-office for creating, editing and formatting a document, data presentation, tabulation and graph creation and statistical analysis.
CO3: Apply application of innovative ways to use information and communication technologies (IT) in agriculture.
CO4: Analyze the digital India and schemes to promote digitalization of agriculture in India.

SOA/HVAC/UG 02 T: Agriculture Informatics and Artificial Intelligence (2)

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 applications for computation of water and nutrient requirement of crops, Computer-controlled devices (automated systems) for Agri-input management, Smartphone mobile apps in agriculture for farm advice: Market price, postharvest management etc., Geospatial technology: Concepts, techniques, components and uses for generating valuable agri-information, Decision support systems: Concepts, components and applications in Agriculture, Agriculture Expert System, Soil Information Systems etc. for supporting farm decisions. Preparation of contingent crop-planning and crop calendars using IT tools, Digital India and schemes to promote digitalization of agriculture in India.

SOA/HVAC/UG 02 P: Agriculture Informatics and Artificial Intelligence (1)

Study of computer components, accessories, practice of important DoS Commands, Introduction of different operating systems such as Windows, Unix/ Linux, creating files and folders, File Management. Use of MS-Word and MS Power-point for creating, editing and presenting a scientific 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/Crop Syst/ Wofost, Preparation of inputs file for CSM and study of model outputs, computation of water and nutrient requirements of crop using CSM and IT tools, Use of smart phones and other devices in agro-advisory and dissemination of market information, Introduction of Geospatial Technology, Hands on practice on preparation of Decision Support System, Preparation of contingent crop planning, India Digital Ecosystem of Agriculture (IDEA).

Skill Enhancement Course (SEC)

Course No.	**Course Title**	**Credits**
SOA/HSEC/UG 06	Orchard Floor Management	2(0+2)

The course will help the learner to:
CO1: Learn about planning and establish orchards by selecting suitable locations, designing layouts, and implementing proper planting systems.
CO2: Understand techniques for maturity, harvesting, post-harvest management, storage,

modern packaging, and creating value-added products from fruits. CO3: Apply sustainable methods for soil, water, and nutrient management, including integrated nutrient management (INM) and the use of bio-fertilizers. CO4: Analyze the various irrigation systems, surface irrigation: flood system, basin system, modified basin system, furrow method, sub-surface irrigation systems.

SOA/HSEC/UG 06 P: Orchard Floor Management (2)

Layout of different systems of orchards and Fruit Nutrition Garden. Soil management practices: clean cultivation, sod culture, sod mulch, intercropping, cover cropping and mixed cropping. Use of mulch materials: organic and inorganic, moisture conservation and weed control. Layout of various irrigation systems, surface irrigation: Flood system, basin system, modified basin system, furrow method, sub-surface irrigation systems: drip irrigation and its components, overhead irrigation: sprinkler system, fertigation, Different methods of application of manure and fertilizers, use of organic manures, Biofertilizers, Green manuring and bio-agents. Visit to orchards of Progressive fruit growers.

SEMESTER-V

Major courses

Course No.	Course Title	Credits
SOA/HMJ/UG 16	Fundamentals of Plant Breeding	3(2+1)
The course will help the learner to: CO1: Learn science and art of changing the genetic makeup of plants to improve their economic utility. CO2: Understand techniques for creating high-yielding, high-quality, and resilient plant varieties. CO3: Apply biotechnological tools like DNA markers and marker assisted selection. CO4: Analyze the various breeding methods in asexually propagated crops like clonal selection, wide hybridization and pre-breeding.		

SOA/HMJ/UG 16 T: Fundamentals of Plant Breeding (2)

Historical development, concept, nature and role of plant breeding. Major achievements and future prospects. Genetics in relation to plant breeding. Modes of reproduction. Male sterility - genetic consequences and cultivar options. Domestication, acclimatization and introduction. Centres of origin/diversity. Components of genetic variation, heritability and genetic advance. Genetic basis and breeding methods in self-pollinated crops - mass and pure line selection, hybridization techniques and handling of segregating population. Multiline concept. Concepts of population genetics and Hardy-Weinberg Law. Genetic basis and methods of breeding cross - pollinated crops. Modes of selection. Population improvement schemes - ear to row method, modified ear to row, recurrent selection schemes. Heterosis and inbreeding depression. Development of inbred lines and hybrids, composite and synthetic varieties. Breeding methods in asexually propagated crops - clonal selection. Wide hybridization and pre-breeding. Polyploidy in relation to plant breeding. Mutation breeding - methods and uses. Breeding for important biotic and abiotic stresses. Introduction to biotechnological tools - DNA markers and marker assisted selection. Participatory plant breeding. Plant Breeders' and Farmers' Rights.

SOA/HMJ/UG 16 P: Fundamentals of Plant Breeding (1)

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 and cross- pollinated crops. Consequences of inbreeding on genetic structure of resulting populations. Study of male sterility system. Handling of segregation populations. Maintenance of breeding records and data collection. Methods of calculating mean, range, variance, standard deviation, heritability. Designs used in plant breeding experiments, analysis of Randomized Block Design. Working out the mode of pollination in a given crop and extent of natural out-crossing. Prediction of performance of double cross hybrids.

Course No.	**Course Title**	**Credits**
SOA/HMJ/UG 17	Growth and Development of Horticultural Crops	3(2+1)
The course will help the learner to: CO1: Learn about knowledge of growth and development of plants. CO2: Understand about basic functions, biosynthesis role of auxin, gibberellin, cytokinin, ethylene inhibitors and retardants in crop growth and development. CO3: Apply crop development and dynamics and growth analysis in horticultural crops.. CO4: Analyze the physiology of fruits under post- harvest storage.		

SOA/HMJ/UG 17 T: Growth and Development of Horticultural Crops (2)

Growth and development-definitions, components, photosynthetic productivity, Canopy photosynthesis and productivity, leaf area index (LAI) - optimum LAI in horticultural crops, canopy development; different stages of growth, growth curves, Crop development and dynamics (Case studies of annual/perennial horticultural crops), growth analysis in horticultural crops. Plant bio-regulators- auxin, gibberellin, cytokinin, ethylene inhibitors and retardants, basic functions, biosynthesis, role in crop growth and development, propagation, flowering, fruit setting, fruit thinning, fruit development, fruit drop, and fruit ripening. Flowering-factors affecting flowering, physiology of flowering, photoperiodism-long day, short day and day neutral plants, vernalization and its application in horticulture, pruning and training physiological basis of training and pruning- source and sink relationship, translocation of assimilates. Physiology of seed development and maturation, seed dormancy and bud dormancy, causes and breaking methods in horticultural crops. Physiology of fruit growth and development, fruit setting, factors affecting fruit set and development, physiology of ripening of fruits-climatic and non-climacteric fruits. Physiology of fruits under post- harvest storage.

SOA/HMJ/UG 17P: Growth and Development of Horticultural Crops (1)

Estimation of photosynthetic potential of horticultural crops, leaf area index, growth analysis parameters including harvest index, bioassay of plant hormones, identification of synthetic plant hormones and growth retardants, preparations of hormonal solution and induction of rooting in cuttings, ripening of fruits and control of flower and fruit drop. Important physiological disorders and their remedial measures in fruits and vegetables, seed dormancy, seed germination and breaking seed dormancy with chemicals and growth regulators.

Course No.	**Course Title**	**Credits**
SOA/HMJ/UG 18	Soil Fertility and Nutrient Management	3(2+1)
The course will help the learner to: CO1: Learn about classification and sources of plant nutrients. CO2: Understand about essential and beneficial elements, criteria of essentiality, forms of nutrients in soil, mechanisms of nutrient transport to plants, factors affecting availability of major, secondary and micro-nutrients to plants.		

CO3: Apply different approaches for soil fertility evaluation and soil testing for available nutrients. CO4: Analyze site-specific and plant need-based nutrient management.

SOA/HMJ/UG 18 T: Soil Fertility and Nutrient Management (2)

Plant nutrients - classification and sources; Essential and beneficial elements, criteria of essentiality, forms of nutrients in soil, mechanisms of nutrient transport to plants, factors affecting availability of major, secondary and micro-nutrients to plants. Measures to overcome deficiency and toxicities. Soil fertility- different approaches for soil fertility evaluation; Soil testing for available nutrients; Critical levels of different nutrients in soil. Plant analysis- total and rapid tissue tests- critical levels of nutrients in plants; DRIS method; Deficiency symptoms-indicator plants. Biological method of soil fertility evaluation. Soil test-based fertilizer recommendations to crops. Site-specific and plant need-based nutrient management. Factors influencing nutrient use efficiency (NUE) in respect of N, P, K, S, Fe and Zn fertilizers. Source, method and scheduling of nutrients for different soils and crops grown under rainfed and irrigated conditions. Integrated plant nutrient supply system and its management. Soil quality in relation to sustainable agriculture-acid, salt affected and calcareous soils, characteristics, nutrient availabilities, Reclamation- mechanical, chemical and biological methods.

SOA/HMJ/UG 18 P: Soil Fertility and Nutrient Management (1)

Analytical Instruments- principles, calibration and applications; Estimation of available nitrogen, available phosphorus, available potassium and available sulphur in soil; Estimation of exchangeable calcium and magnesium in soil, Estimation of available micronutrients in soils; Preparation of plant samples for analysis; Estimation of nitrogen, phosphorus and potassium in plants.

Course No.	Course Title	Credits
SOA/HMJ/UG 19	General Microbiology	3(2+1)
The course will help the learner to: CO1: Learn about history, evolution and scope of microbiology. CO2: Understand about microbial classification, nomenclature and identification. CO3: Apply cultivation, nutritional requirements, growth and reproduction of bacteria. CO4: Analyze methods of isolation of pure cultures, maintenance and preservation of pure cultures and culture collections.		

SOA/HMJ/UG 19 T: General Microbiology (2)

Evolution and scope of microbiology. History of microbiology. Microbial classification, nomenclature and identification. Taxonomic groups. General methods of classifying bacteria. Microscopy and microscopes: Smears and staining. Morphology and fine structure of bacteria. Cultivation of bacteria, nutritional requirements. Nutritional classification of bacteria; Phototrophs, chemotrophs, autotrophs and heterotrophs; Obligate parasites; Bacteriological media, Growth of bacteria, Reproduction of bacteria; Introduction to fungi, algae and protozoa and virus, Microbiology of water and food Nutrient transport phenomenon: Passive diffusion, facilitated diffusion; Group translocation, active transport. Metabolism in bacteria –ATP generation Microbial genetics; Bacterial recombination; Bacterial conjugation, transduction; Bacterial transformation; Mutations: Types of mutations, mutagenesis; Mutation rate, repair of mutations; Phenotypes of bacterial mutants; Designation of bacterial mutants; Destruction of microorganisms: Physical agents and chemical agents; Chemotherapeutic agents and chemotherapy; Characteristics of antibiotics; Mode of action of antibiotics; Pure culture:

Methods of isolation of pure cultures; Maintenance and preservation of pure cultures; Culture collections.

SOA/HMJ/UG 19 P: General Microbiology (1)

Microscopy; Micrometry; Cleaning and sterilization of glassware and acquainting with equipment used in microbiology; Preparation of nutrient agar media and techniques of inoculation; Staining methods (monochrome staining, Gram staining, negative staining, capsule-staining, flagella staining and endospore staining); Pure culture techniques (streak plate/pour plate/spread plate); Identification procedures (morphology and cultural characteristics); Growth characteristics of fungi: Determination of microbial numbers, direct plate count, generation time; Factors influencing growth: pH, temperature, growth curves for bacteria.

Course No.	**Course Title**	**Credits**
SOA/HMJ/UG 20	Information and Communication Technology in Horticulture	3 (1+2)
The course will help the learner to: CO1: Learn about IT tools, IT-enabled services and their impact on society. CO2: Understand about computers, hardware and software; input and output devices; word and character representation. CO3: Apply about word processing / spreadsheet /presentation /databases for document creation and editing. CO4: Analyze the use of ICT in horticulture.		

SOA/HMJ/UG 20 T: Information and Communication Technology in Horticulture (1)

IT and its importance. IT tools, IT-enabled services and their impact on society; Introduction to Computers, hardware and software; input and output devices; word and character representation; features of machine language, assembly language, high-level language and their advantages and disadvantages; Operating Systems, definition and types, Applications of Word Processing / Spreadsheet /Presentation /Databases for document creation and Editing, Data presentation, interpretation and graph creation, statistical analysis, mathematical expressions, Database concepts and types, uses of DBMS in Horticulture; Introduction to Local area network (LAN), Wide area network (WAN), Internet and World Wide Web, HTML and IP and Video conferencing, Introduction to e- Horticulture, concepts and applications, Use of ICT in Horticulture.

SOA/HMJ/UG 20P: Information and Communication Technology in Horticulture (2)

Practice with latest operating system for creating Files, Folders, File Management. Use of Word Processing/ Spreadsheet/ Presentation/ Databases with latest software packages; Creating a spreadsheet, Use of statistical tools, writing expressions, creating graphs, analysis of scientific data. Creating Database, preparing queries and reports, creation and operation of E mail account; Demonstration of Agri-information system using Mobile Apps. Internet applications: Web browsing, handling of audio-visual equipment. Planning, preparation, presentation of posters, charts. Introduction of Geospatial Technology of generating valuable information for Agriculture. Hands on Decision Support System. Preparation of contingent crop planning.

Course No.	**Course Title**	**Credits**
SOA/HMJ/UG 21	Basic Statistics and Experimental Designs	3 (2+1)
The course will help the learner to: CO1: Learn about definition, uses and limitations of statistics. CO2: Understand about construction of frequency distribution tables like graphic presentation		

of data, simple, multiple components and percentage, bar diagram etc. CO3: Apply about tests of significance, null hypothesis, alternate hypothesis, type I and II error, one and two tail tests, level of significance and confidence interval. CO4: Analyze the use different statistical design used in agriculture.

SOA/HMJ/UG 21 T: Basic Statistics and Experimental Designs (2)

Definition of statistics, its use and limitations. Variable statistics, types and sources of data, classification and tabulation of data. Construction of frequency distribution tables – graphic presentation of data, simple, multiple component and percentage, bar diagram, pie diagram, histogram, frequency polygon and frequency curve, cumulative frequency curve. Measures of central tendency: mean, median, mode, geometric mean, harmonic mean, percentiles and quartiles for raw and grouped data, Measures of dispersion: range, quartile deviation, mean deviation, standard deviation for raw and grouped data, coefficient of variation. Skewness and kurtosis. Probability- definition, additive and multiplicative law for two events, Normal distribution and its properties. Introduction of sampling. basic concepts, sampling vs. Complete enumeration parameter and statistic. Sampling techniques (simple random sampling: lottery method and random number table method). Tests of significance, Null hypothesis, Alternate hypothesis, Type I and II Error, one and two tail tests, level of significance and confidence interval. Large sample tests for mean (Single sample and two samples), Student's t-test for single sample, two samples and paired t-test, F-test, Chi- square test for application of attributes (contingency table) and test for goodness to fit of Mendalian ratios, Yates' correction for continuity. Correlation-scatter diagram and Karl Pearson coefficient of correlation for ungrouped data and its testing. Linear regression and its properties. Inter-relation between 'r' and the regression coefficient, Introduction to design of experiment- Basic principles of experimental design-replication, randomization and local control, Analysis of variance (ANOVA) and its assumptions, analysis of Completely Randomized Design (CRD), Randomized Block Design (RBD) and Latin Square Design (LSD), Comparisons based on means-critical difference.

SOA/HMJ/UG 21 P: Basic Statistics and Experimental Designs (1)

Construction of frequency distribution tables and frequency curves, Measures of central tendency: mean, median, mode, geometric mean, harmonic mean, percentiles and quartiles. Measures of dispersion: range, quartile deviation, mean deviation, standard deviation for raw and grouped data, coefficient of variation. Skewness and kurtosis. Probability. Large sample tests for mean, Student's t-test, F-test and Chi-square test, Correlation coefficient 'r' and its testing, Fitting of regression equations, Analysis of CRD, RBD and LSD.

Minor Course

Course No.	Course Title	Credits
SOA/HMN/UG 03	Introductory Crop Physiology	2 (1+1)
The course will help the learner to: CO1: Learn about role of water in plant metabolism, osmosis inhibition, diffusion, water potential and its components and measurement of water potential in plants. CO2: Understand about structure, distribution, classification, mechanism of opening and closing of stomata. CO3: Apply photorespiration and its implications, factors affecting photosynthesis. CO4: Analyze the use of different secondary metabolites and plant defense.		

SOA/HMN/UG 03 T: Introductory Crop Physiology (1)

Water Relations in Plants: Role of water in plant metabolism, osmosis inhibition, diffusion, water potential and its components, measurement of water potential in plants, absorption of water, mechanism of absorption and ascent of sap. Stomata: Structure, distribution, classification, mechanism of opening and closing of stomata. Osmotic pressure, guttation, stem bleeding; transpiration methods and mechanism and factors affecting transpiration. Drought: Different types of stresses; water, heat and cold tolerance; mechanism of tolerance. Plant Nutrition: Essentiality, mechanism of absorption and its role in plant metabolism. Biological Nitrogen Fixation. Photosynthesis, structure and function of chloroplast, dark and light reactions, cyclic and on-cyclic electron transfer, CO2 fixation – C3, C4 and CA metabolism, advantages of C4 pathway. Photorespiration and its implications, factors affecting photosynthesis. Mode of herbicide action, Secondary metabolites and plant defense.

SOA/HMN/UG 03 P: Introductory Crop Physiology (1)

Measurement of water potential, osmosis, root pressure, structure of the stomata, distribution, opening and closing of the stomata, measurement, transpiration and calculation of transpirationpull demonstration. Importance of light and chlorophyll in photosynthesis, pigment identification in horticultural crops, measurement of relative water content (RWC), studying plant movements.

Course No.	Course Title	Credits
SOA/HNG/UG 02	Education Tour	2 (0+2)
The course will help the learner to: CO1: Learn about commercial-scale operations in nurseries, greenhouses, and specialized plant production units. CO2: Understand about modern horticultural machinery, protected cultivation systems, and advanced post-harvest technology. CO3: Apply field experimentation, germplasm conservation, and breeding techniques at recognized R&D stations. CO4: Analyze market trends and career opportunities in the field of horticulture.		

Non-Gradial Course

SOA/HNG/UG 02: Education Tour (Non-Gradial 2)

There will be a study tour of 10-14 days' duration during the 5th semester of the UG programme. The students will preferably visit the leading industries/ enterprises/ institutions/ organisations and other places of academic interest outside the state (of location of the institution). This, in addition to exposing the students to the indigenous as well as the latest technologies in their related fields, will also help the students to know about the socio-economic-cultural variations within the country.

SEMESTER-VI

Major Courses

Course No.	Course Title	Credits
SOA/HMJ/UG 22	Introductory Agroforestry	2 (1+1)
The course will help the learner to: CO1: Learn about objective of silviculture, forest classification and Indian forest policies. CO2: Understand about artificial and natural regeneration, its objectives, choice between natural and artificial regeneration. CO3: Apply planning for agroforestry its constraints, diagnosis and design methodology.		

CO4: Analyze economics and marketing of products raised in agroforestry systems.

SOA/HMJ/UG 22 T: Introductory Agroforestry (1)

Forestry – Introduction, related definitions. Objective of silviculture. Forest classification. Indian Forest Policies. Artificial and natural regeneration – objectives, choice between natural and artificial regeneration. Coppicing, pollarding, root suckers. Forest mensuration – objectives, instruments for diameter, height and age measurement. Tree stem form, form factor, form quotient. Measurement of volume of felled and standing trees.

Agroforestry – definition, objectives and potential. Distinction between agroforestry and social forestry. Choice of species with respect to site/economic uses and constraints on tree growing. Agroforestry systems, sub-systems and practices, shifting cultivation, taungya, home gardens, alley cropping, intercropping, wind breaks, shelterbelts and energy plantations. Planning for agroforestry – constraints, diagnosis and design methodology, selection of tree - crop species for agroforestry. Agroforestry projects – national and overseas. National Agroforestry Policy 2014. MPTs (Azadirachta indica, Acacia species, Bamboos, Dalbergia sissoo, Eucalyptus species, Grewia optiva, Gmelina arborea, Leucaena leucocephala, Melia species, Populus deltoides, Tectona grandis, etc.) – nursery and planting management practices.

Major wood-based industries in India – Timber, panel, plywood, paper and pulp, match, etc. – Raw material requirements and their procurement. Economics and marketing of products raised in agroforestry systems.

SOA/HMJ/UG 22 P: Introductory Agroforestry (1)

Identification of seeds and seedlings of tree species. 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 practices for Azadirachta indica, Acacia species, Bamboos, Dalbergia sissoo, Eucalyptus species, Grewia optiva, Gmelina arborea, Leucaena leucocephala, Melia species, Populus deltoides, Tectonagrandis, etc. Layout of agroforestry plantation and study the compatibility of MPTs with agricultural crops. Visit to social forestry/agroforestry plantations and nearby forest-based industries.

Course No.	Course Title	Credits
SOA/HMJ/UG 23	Laboratory Techniques for Horticultural Crops	2 (0+2)

The course will help the learner to:

CO1: Learn about safety measures and maintenance of laboratory and acquaintance with the laboratory equipment's used for quality analysis of fruits and vegetables.

CO2: Understand about preparation of different standard solutions and sampling procedures for quantitative analysis.

CO3: Apply assessment of textural properties of harvested produce.

CO4: Analyze leaf nutrient using Kjeldahl apparatus, spectrophotometer, flame photometer and atomic absorption spectrophotometer.

SOA/HMJ/UG 23 P: Laboratory Techniques for Horticultural Crops (2)

Safety measures and maintenance of laboratory. Acquaintance with the laboratory equipment's used for quality analysis of fruits and vegetables. Preparation of different standard solutions. Sampling procedures for quantitative analysis. Determination of physiological loss in weight, specific gravity, fruit size, shape, juice content, firmness and fruit colour. Assessment of textural properties of harvested produce. Determination of biochemical components in horticultural produce viz. TSS, pH, acidity, sugars, carbohydrates, total antioxidants, starch index (SI), ascorbic acid, chlorophyll, anthocyanin, and carotenoids, phenols. Leaf nutrient analysis using

Kjeldahl apparatus, spectrophotometer, flame photometer and atomic absorption spectrophotometer. Compilation and analysis of data and interpretation of results.

Course No.	Course Title	Credits
SOA/HMJ/UG 24	Principles of Biochemistry	3 (2+1)

The course will help the learner to:
CO1: Learn about the basic concepts of biochemistry.
CO2: Understand about recapitulation of basic chemistry and biology.
CO3: Apply basic concepts of bioenergetics, carbohydrate metabolism and HMP pathway etc.
CO4: Analyze biosynthesis of DNA, RNA and protein- replication, transcription, translation and genetic code.

SOA/HMJ/UG 24 T: Principles of Biochemistry (2)

Recapitulation of basic chemistry and biology. Water, pH and buffers. Acid-base balance. Cellular constituents and their structure and function, amino acid and proteins, carbohydrates, lipids and bio-membranes, nucleic acids. Dissolved molecules– vitamins and minerals. Enzymes-function, properties and mechanism. Metabolism of cellular constituents, basic concepts of bioenergetics. Carbohydrate metabolism-glycolysis and glycogenolysis, HMP pathway, TCA cycle and gluconeogenesis. Electron transport chain. Photosynthesis. Lipid metabolism-β-oxidation, ketone bodies, fatty acid synthesis. Amino acid metabolism - general reactions of nitrogen assimilation and excretion. Biosynthesis of DNA, RNA and protein- replication, transcription, translation and genetic code. Regulation of gene expression.

SOA/HMJ/UG 24 P: Principles of Biochemistry (1)

Preparation of buffers and pH determination. Preparation of colloids. Qualitative and quantitative tests of carbohydrates, lipids and proteins. Tests of enzyme action- potato oxidase, urease, salivary amylase. Paper chromatography of amino acids or carbohydrates ascending and descending. Determination of starch and sugar. Analysis of proximate constituents in food.

Course No.	Course Title	Credits
SOA/HMJ/UG 25	Dryland Horticulture	3 (2+1)

The course will help the learner to:
CO1: Learn about the soil and climatic features of the dry land areas.
CO2: Understand about the knowledge about the soil and water conservation technologies for dry land areas.
CO3: Apply the production technologies for fruit crops of dry land areas.
CO4: Analyze economic and conjunctive use of water, micro irrigation systems and fertigation etc.

SOA/HMJ/UG 25 T: Dryland Horticulture (2)

Definition, importance and limitation of dry land horticulture, present status and future scope. Constraints encounter in dry lands. Agro-climatic features in rainfed areas, scarce water resources, high temperature, soil erosion, run-off losses etc. Techniques and management of dry land horticulture. Watershed development, soil and water conservation methods-terraces, contour bunds etc. Methods of control and impounding of run-off water-farm ponds, trenches, macro catch pits etc. In-situ water harvesting methods, micro catchment, different types of tree basins etc. Methods of reducing evapotranspiration, use of shelter belts, mulches, anti-transpirants, growth regulators, organic amendments etc. water use efficiency-need based, economic and

conjunctive use of water, micro irrigation systems and fertigation etc. Water quality: characterization and use in horticultural crops. Selection of plants having drought resistance. Special techniques, planting and after care-use of seedling races, root stocks, in-situ grafting, deep pitting/planting, canopymanagement etc. Characters and special adaptation of crops: ber, aonla, annona, jamun, wood apple, bael, pomegranate, carissa, date palm, phalsa, fig, west Indian cherry and tamarind.

SOA/HMJ/UG 25 P: Dryland Horticulture (1)

Rainfall patterns. Contour bunding/trenching, micro catchments; rainfall erosivity and soil erodibility indices, measurement of runoff, soil loss and their control. Study of evapotranspiration, mulches and micro irrigation systems. Special techniques of planting and aftercare in dry lands. Morphological and anatomical features of drought tolerant fruit crops.

Course No.	Course Title	Credits
SOA/HMJ/UG 26	Economics and Marketing	3 (2+1)

The course will help the learner to:
CO1: Learn about the concepts, subject matter and importance of study of economics.
CO2: Understand about the about the terms - goods, service, value, price, wealth, welfare.
CO3: Apply the concept of marketing, market, price spread, marketing efficiency, integration, marketing functions, classification of markets and marketing channels.
CO4: Analyze about the market intelligence and constraints in marketing of agricultural produce.

SOA/HMJ/UG 26 T: Economics and Marketing (2)

Economics – Terms and definitions; Consumption, demand, price and supply; Factors of production; Gross Value Added. Role of Biotechnology/Agriculture Sector in National GVA.Marketing – definition; Marketing process; Need for marketing; Role of marketing; Marketing functions; Classification of markets; Marketing of various channels; Price spread; Marketing efficiency; Constraints in marketing of agricultural produce; Market intelligence. Basic guidelines for preparation of project reports; Bank norms; Insurance; SWOT analysis; Crisis management.

SOA/HMJ/UG 26 P: Economics and Marketing (1)

Techno-economic parameters for preparation of projects; Preparation of bankable projects for various biotechnology/ agricultural products and value-added products; Identification of marketing channel; Calculation of price spread; Identification of market structure; Visit to different markets, market institutions; Study of SWC, CWC and STC; Analysis of information of daily prices; Marketed and marketable surplus of different commodities.

Course No.	Course Title	Credits
SOA/HMJ/UG 27	Horticulture Based Integrated Farming System	3 (2+1)

The course will help the learner to:
CO1: Learn about the farm management to deliver more sustainable agriculture.
CO2: Understand about importance, concept and factors affecting types of farming system.
CO3: Apply the sustainable livelihood agriculture its problems and its impact on horticulture.
CO4: Analyze about site specific horticulture- based IFS models; horticulture and vegetable intercropping systems and high density plantation etc.

SOA/HMJ/UG 27 T: Horticulture Based Integrated Farming System (2)

Farming System-scope, importance, concept and factors affecting types of farming system. Farming system components and their maintenance. Evolution and diversity of farming systems; Stone age survival to swidden farming, Nomadic pastoralism and agro-pastoralism in warm and cold deserts of India. Horticulture crop based livestock farming, subsistent livelihoods in rain-fed areas of India. Industrial and semi-industrial agriculture- agro-enterprises, agribusiness systems, their produce for marketing grains, vegetables, fruits, flowers, fibre crops, medicinal and aromatic plants. Value addition for income enhancement. Integrated farming system- objectives, characteristics and its advantages and disadvantages. Site specific development of IFS model for different agro-climatic zones, resource use efficiency and optimization techniques in relation to horticulture crops. Resource cycling and flow of energy in different horticulture- based farming system and environment. Sustainable livelihood agriculture- problems and its impact on horticulture. Indicators of soil health and environment for horticulture- based IFS. Vertical farming definition, their scope and objectives; multilayer farming, hydroponics, aeroponics-their definition, requirements, advantages, disadvantages and opportunities; Site specific horticulture-based IFS models; horticulture and vegetable intercropping systems; high density plantation; bankable IFS models; rooftop farming; Farm typology. Visit of IFS model in different agro-climatic zones of nearby states University/ institutes and farmers' field.

SOA/HMJ/UG 27 P: Horticulture Based Integrated Farming System (1)

Preparation of horticulture based cropping scheme and integrated farming system models for irrigated, rainfed and dryland situations. Preparation of enriched farmyard manure and vermicompost. Visit to urban waste recycling unit and model farmers' field. Preparation of farm lay out plans. Estimating horticulture crop yields. Energy budgeting in different horticulture crops. EC/pH/TDS of water; Hydroponics nutrient management, Designing of polyhouse, Net house and tunnel house; Mushroom farming and its various types; Seeding with soilless media. C- sequestration, budgeting, footprints. Organic fertigation in orchards; use of biorationales. Working out ecological optimum zones. Project making exercises for establishment of horticulture-based production models under different situation.

Course No.	Course Title	Credits
SOA/HMJ/UG 28	Processing and Value Addition of Horticulture Crops	3 (2+1)

The course will help the learner to:

CO1: Learn about the principles of food preservation and processing.

CO2: Understand about food pipeline, losses in postharvest, processing and distribution systems.

CO3: Apply the different suitable food processing methods for value addition of horticultural produce.

CO4: Analyze about government policy on import and export of processed fruits and food laws.

SOA/HMJ/UG 28 T: Processing and Value Addition of Horticulture Crops (2)

Importance and scope of fruit and vegetable processing industry in India. Food pipeline- losses in postharvest, processing and distribution systems. Losses in post-harvest operations. Unit operations in food processing-pasteurization, sterilization, blanching, canning, and bottling. Principles and guidelines for selecting the location and establishment of processing units. Principles and methods of preservation by heat, low temperature, sugar and salt, chemicals. Methods of fruit juice extraction, preparation of RTS, cordials, nectars, squashes, syrups, candies, crystallized fruits, preserves, jam, jelly, marmalade, fermented beverages, vinegar, pickles, chutneys and sauces. Tomato and mushroom products, freezing of fruits and vegetables.

Drying of fruits and vegetables. Processing of plantation crops, their products, spoilage in processed foods, quality control of processed products, Government policy on import and export of processed fruits. Food laws.

SOA/HMJ/UG 28 P: Processing and Value Addition of Horticulture Crops (1)

Equipment used in food processing units. Canning of fruits and vegetables. Preparation and quality evaluation of squash, RTS, syrup, jam, jelly, marmalade, candies, preserves, chutneys. Dehydration of fruits and vegetables, tomato products, refrigeration and freezing, cut out analysis of processed foods. Visit to food processing units.

Minor Course

Course No.	Course Title	Credits
SOA/HMN/UG 04	Principles and Practices of Natural Farming	2 (1+1)

The course will help the learner to:

CO1: Learn about the concept, need and principles of native ecology-based production under natural farming.

CO2: Understand about concept of ecological, water, carbon and nitrogen foot prints and concept and evaluation of ecosystem services.

CO3: Apply the practical knowledge of natural farming and related agricultural practices in Indian and global environmental and economic perspectives.

CO4: Analyze the entrepreneurship opportunities in natural farming.

SOA/HMN/UG 04 T: Principles and Practices of Natural Farming (1)

Indian Heritage of Ancient Agriculture, History of Natural Farming, Importance of natural farming; Definition; Objective of natural farming, Essential characteristics and Principles of natural farming; Scope and importance of natural farming. Main Pillars of natural farming; Methods/ types/ schools of natural farming. Introduction to concept of ecological, water, carbon and nitrogen foot prints, Concept and evaluation of ecosystem services, Rearing practices for animals under natural farming, Nutrient management in natural farming and their sources, Insect, pest, disease and weed management under natural farming; Mechanization in natural farming, Processing, labelling, economic considerations and viability, certification and standards in natural farming, marketing and export potential of natural farming produce and products. Initiatives taken by Government (central/state), NGOs and other organizations for promotion of natural farming and chemical free agriculture, Case studies and success stories in natural farming and chemical free traditional farming, Entrepreneurship opportunities in natural farming.

SOA/HMN/UG 04 P: Principles and Practices of Natural Farming (1)

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

SEMESTER-VII
MINOR COURSE

Fruit Science

Course No.	Course Title	Credits
SOA/HMN/UG 05	Production Technology of Tropical Fruit Crops	4 (3+1)

The course will help the learner to:

CO1: Learn about the origin, systematics, genetic resources, botany and production of tropical fruit crops.

CO2: Understand about commercial cultivation of tropical fruit crops.

CO3: Apply the nutrient and water management, crop regulation, quality improvement by management practices; maturity indices, harvesting, grading, packing, storage and ripening techniques..

CO4: Analyze Physiological disorders, major pests and diseases and their management of tropical fruit crops.

SOA/HMN/UG 05 T: Production Technology of Tropical Fruit Crops (3)

Importance, scope and commercial importance of tropical fruits. Distribution of tropical zones in the world and India. Origin, systematics, distribution, genetic resources, and eco-physiological requirements. Major species, commercial varieties and rootstocks. Propagation, planting, training and pruning. Nutrient and water management. crop regulation, quality improvement by management practices; maturity indices, harvesting, grading, packing, storage and ripening techniques. Physiological disorders, major pests and diseases and their management. Industrial and export potential, Agri. Export Zones (AEZ) and industrial support. Fruit crops- mango, papaya, pineapple, banana, avocado, sapota, guava, jackfruit, tamarind, annonas and minor fruits of tropics viz. carambola, mangosteen, pashion fruit, bilimbi, rambutan, longan and durian.

SOA/HMN/UG 05 P: Production Technology of Tropical Fruit Crops (1)

Description and identification of species and varieties of tropical fruits. Propagation and nursery management of tropical fruit crops. Leaf sampling and nutrient analysis. Rejuvenation of old and unproductive trees. Identification and management of nutritional disorders, insect-pest and diseases. Maturity standards, harvesting, grading, packaging and storage. Visit to commercial orchards.

Course No.	Course Title	Credits
SOA/HMN/UG 06	Production Technology of Sub-tropical and Temperate Fruit Crops	4 (3+1)

The course will help the learner to:

CO1: Learn about the cultural and management practices of subtropical and temperate fruit crops.

CO2: Understand about knowledge and skills on quality production of subtropical and temperate fruit crops.

CO3: Apply the Propagation, planting and HDP, training and pruning and orchard floor management.

CO4: Analyze physiological disorders, major pests and diseases and their management of subtropical and temperate fruit crops.

SOA/HMN/UG 06 T: Production Technology of Sub-tropical and Temperate Fruit Crops (3)

Importance, scope and commercial importance of sub-tropical and temperate fruits. Distribution of sub-tropical and temperate zones in the world and India. Origin, systematics, distribution, genetic resources, and eco-physiological requirements. Major species, commercial varieties and

rootstocks. Propagation, planting and HDP, training and pruning and orchard floor management. Nutrient and water management, flowering and fruit set, compatibility, crop regulation, quality improvement by management practices; maturity indices, harvesting, grading, packing, storage and ripening techniques. Physiological disorders, major pests and diseases and their management. Industrialand export potential, Agri. Export Zones (AEZ) and industrial support. Fruit crops- citrus, grapes, pomegranate, litchi, loquat, grapes, litchi, pomegranate, apple, pear, peach, plum, apricot, cherries, berries, persimmon, kiwifruit, walnut, almond, pecan nut, hazelnut, chestnut, strawberry.

SOA/HMN/UG 06 P: Production Technology of Sub-tropical and Temperate Fruit Crops (1)

Description and identification of varieties based on flower and fruit morphology of sub- tropical and temperate fruits. Canopy management. Selection of site and planting system, Mulching, Manure and fertilizer application including bio-fertilizers in fruit crops. Preparation and application of growth regulators. Crop regulation, maturity indices, ripening of fruits, grading and packaging. Production economics of sub-tropical and temperate fruits. Visit to commercial orchards and diagnosis of maladies.

Course No.	Course Title	Credits
SOA/HMN/UG 07	Breeding of Fruit Crops	3 (2+1)

The course will help the learner to:

CO1: Learn about the breeding objectives and methods of fruit breeding in a prescribed manner.

CO2: Understand about latest principles and practices of crop improvement in different fruit crops.

CO3: Apply different breeding methods improvement of quality traits.

CO4: Analyze biotechnological interventions in fruit crop improvement.

SOA/HMN/UG 07 T: Breeding of Fruit Crops (2)

Fruit breeding-history, importance in fruit production; Major problems in fruit breeding; Plant genetic resources, their conservation and utilization in fruit crops; Breeding objectives for improvement of commercial fruits (mango, citrus, guava, banana, grapes, strawberry, litchi, sapota, pomegranate, pineapple, papaya, apple, pear, peach, plum, cherry, kiwifruit, walnut, apricot, plantation crops-coconut, cocoa, tea, arecanut, coffee), their distribution, domestication and adaptation; Incompatibility, sterility, parthenocarpy and apomixes; Breeding methods-introduction, colonal selection, hybridization, mutation breeding, polyploid manipulation; Rootstock breeding and improvement of quality traits; Breeding for insect-pest and disease resistance and abiotic stresses; Biotechnological interventions in fruit crop improvement.

SOA/HMN/UG 07 P: Breeding of Fruit Crops (1)

Tools and equipment of use in fruit breeding; Studies on bearing habits and flower structure; in-vitro pollen germination test and determination of pollen viability; Methods of emasculation and pollination; Hybrid seed collection, extraction and storage; hybrid seed germination; Raising and evaluation of segregating populations; Induction of mutations through use of physical/chemical mutagens; Polyploidy manipulation; Hand on practice of Emasculation and pollination in major crops of the region.

Course No.	Course Title	Credits
SOA/HMN/UG 08	Canopy Management in Fruit Crops	3 (2+1)

The course will help the learner to:

CO1: Learn about the manipulation of plant growth and development by employing

different training and pruning procedures.
CO2: Understand about scientific principles of tree growth, physiology and understanding of tree response to various pruning cuts.
CO3: Apply different canopy management through plant growth regulators, training and pruning and management practices.
CO4: Analyze canopy development and management in relation to growth, flowering, fruiting and fruit quality in different deciduous and evergreen fruits.

SOA/HMN/UG 08 T: Canopy Management in Fruit Crops (2)

Introduction and importance of canopy management, objectives of canopy management, importance and factors affecting canopy development. Canopy types, tree architecture and different conventional and trellis training systems. Canopy manipulation for optimum utilization of light and its interception. Dwarfing physiology and high-density planting. Physical manipulation and growth regulation: Canopy management through rootstock and scion. Effect of thinning and heading cuts on branch growth. Canopy management through plant growth regulators, training and pruning and management practices. Canopy development and management in relation to growth, flowering, fruiting and fruit quality in different deciduous and evergreen fruits.

SOA/HMN/UG 08 P: Canopy Management in Fruit Crops (1)

Study of different types of canopies, training of plants for different canopy types, Canopy development through pruning, study of different trellis training systems, development of effective canopy with support system, study on effect of different canopy types on production and quality of fruits understanding bearing behaviour and canopy management in different fruits, use of plant growth regulators, effect of pruning on light interception and fruit quality. Canopy management practices in different deciduous and evergreen fruits.

Course No.	Course Title	Credits
SOA/HMN/UG 09	Biotechnological Approaches and Micro-propagation in Fruit Crops	4 (3+1)

The course will help the learner to:
CO1: Learn about the biotechnological interventions and micropropagation methods in a prescribed manner.
CO2: Understand about biotechnological tools in fruit crops to enhance yield, biotic and abiotic stress management and improved quality traits to a considerable extent.
CO3: Apply transgenics and gene technologies.
CO4: Analyze the achievements of biotechnology in fruit crops.

SOA/HMN/UG 09 T: Biotechnological Approaches and Micro-propagation in Fruit Crops (3)

Introduction, history and basic principles of biotechnology; Physical, chemical factors and growth regulators on growth and development of plant cell, tissue and organ culture; In vitro culture and hardening: callus culture – types, cell division, differentiation, morphogenesis, organogenesis, embryogenesis; Hardening and ex vitro establishment of tissue cultured plants; Transgenics and Gene Technologies; Somatic cell hybridization, construction and identification of somatic hybrids and cybrids, wide hybridization; In-vitro pollination and fertilization, haploids, in vitro mutation, artificial seeds, cryopreservation: In- vitro selection for biotic and abiotic stress; use of molecular markers and genomics; Gene silencing, gene tagging, gene editing, achievements of biotechnology in fruit crops.

SOA/HMN/UG 09 P: Biotechnological Approaches and Micro-propagation in Fruit Crops (1)

An exposure to low cost, commercially operated and privately-owned tissue culture laboratories; Tasks include preparing media, inoculating explants for clonal multiplication, inducing and culturing callus, and regenerating plantlets from callus; Methods for sub-culturing on anther, ovule, embryo culture, and somaclonal variation; In vitro mutant selection against abiotic stress; Protoplast culture and fusion process. Development of large-scale mass multiplication; Project development for the establishment of a commercial tissue culture laboratory.

Course No.	Course Title	Credits
SOA/HMN/UG 10	Production Technology of Arid Fruit Crops	3 (2+1)

The course will help the learner to:

CO1: Learn about basic knowledge of arid fruit crops.

CO2: Understand about soil and water conservation methods-terraces, contour bunds etc.

CO3: Apply latest developments and trends in production technology of important arid fruit crops.

CO4: Analyze the special production problems, insect-pests, diseases and their control measures and post- harvest technology.

SOA/HMN/UG 10 T: Production Technology of Arid Fruit Crops (2)

Importance, scope and limitations of arid and semi-arid zones, Distribution of Agro-climatic arid and semi-arid zones, soil and water conservation methods-terraces, contour bunds etc. Methods of control and impounding of run-off water - farm ponds, trenches, macro catch pits etc. In-situ water harvesting methods, micro catchment, different types of tree basins etc. Methods of reducing evapotranspiration, use of shelter belts, mulches, anti transpirants, growth regulators, etc. micro systems of irrigation etc. Characteristic feature of arid fruit crops, bearing habit, flowering and fruit set, improved varieties, planting techniques, propagation, canopy management, nutrient and weed management, Special production problems, insect-pests, diseases and their control measures, Post- harvest technology, harvest indices, harvesting methods, grading, packaging and storage of the following crops: ber, aonla, pomegranate, jamun, bael, date palm, phalsa, fig, custard apple, karonda, prickly pear, lasora, sea buckthorn, pistachio and wood apple.

SOA/HMN/UG 10 P: Production Technology of Arid Fruit Crops (1)

Identification of various arid fruit crops, Planning and layout of orchards, propagation methods in arid fruit crops, training and pruning of orchard trees, preparation of fertilizer mixtures and field application, leaf sampling and nutrient analysis, preparation and application of growth regulators, layout of different irrigation systems, Identification and management of nutritional disorders, insect- pest and disease management, maturity standards, harvesting, grading, packaging and storage.

Course No.	Course Title	Credits
SOA/HMN/UG 11	Postharvest Management for Fruit Crops	3 (2+1)

The course will help the learner to:

CO1: Learn about various physico-chemical changes occurring during postharvest life of fruits.

CO2: Understand about maturity indices, harvesting practices and grading.

CO3: Apply physiology and biochemistry of fruit ripening, ethylene evolution and its management.

CO4: Analyze various techniques to minimize postharvest losses and maintain the

postharvest quality of fruits.

SOA/HMN/UG 11 T: Postharvest Management for Fruit Crops (2)

Importance and scope. Maturity indices, harvesting practices and grading. Influence of pre-harvest practices. Physiology and biochemistry of fruit ripening, ethylene evolution and its management. Pre-cooling. Factors leading to post-harvest losses. Treatments prior to transportation viz. chlorination, waxing, chemicals, natural plant products, hot-water, vapour heat treatment, sulphur fumigation and irradiation. Fruit packaging and transport. Methods of storage.

SOA/HMN/UG 11 P: Postharvest Management for Fruit Crops (1)

Analyzing maturity stages of commercially important fruit crops, harvesting methods, pre-cooling methods, grading. Components of cold and ripening chambers. Ripening of fruits. Pre-harvest and post-harvest application of growth substances, fungicides, nutrients, waxes and hot water treatments. Improved packing and storage of important horticultural commodities, Physiological loss in weight of fruits. Estimation of quality characteristics viz; TSS, titratable acidity, firmness, Vitamin C, sugars in stored fruits.

Vegetable Science

Course No.	Course Title	Credits
SOA/HMN/UG 05	Production Technology of Warm Season Vegetable Crops	4 (3+1)
The course will help the learner to: CO1: Learn about importance, scope, nutritional value, economic value of warm season vegetable crops. CO2: Understand about, climate and soil requirements, commercial varieties/hybrids, sowing/ transplanting time, seed rate and seed treatment of warm season vegetable crops. CO3: Apply the nutritional, irrigation, weed, pest and diseases management. CO4: Analyze poly-house, net- house and low tunnel technology for off-season production of summer vegetables.		

SOA/HMN/UG 05 T: Production Technology of Warm Season Vegetable Crops (3)

Introduction, nutritional value, origin, botany and taxonomy, important countries and states growing vegetables along with area, climate and soil requirements, commercial varieties/hybrids, sowing/ transplanting time, seed rate, seed treatment, nutritional and irrigation requirements, chemical weed control, mulching, physiological disorders, harvesting techniques, postharvest management, plant protection measures and seed production of warm season vegetable crops i.e. solanaceous crops, okra, cucurbitaceous crops, cowpea, sweet potato, cluster beans, amaranth, basella, moringa, tapioca. Poly-house, net- house and low tunnel technology for off-season production of summer vegetables.

SOA/HMN/UG 05 P: Production Technology of Warm Season Vegetable Crops (1)

Seed extraction, sowing practices, nursery management, Use of growth regulators, grafting technique, water and nutrient management. Drip irrigation, fertigation, weed management and mulching. Identification of physiological disorders, pests, diseases and nutrient deficiencies. Study of maturity indices. Forcing techniques for raising summer vegetables. Visit to vegetable nursery unit/ protected cultivation unit.

Course No.	Course Title	Credits
SOA/HMN/UG 06	Production Technology of Cool Season Vegetable Crops	4 (3+1)
The course will help the learner to: CO1: Learn about importance, scope, nutritional value, economic value of cool season		

vegetable crops.
CO2: Understand about, climate and soil requirements, commercial varieties/hybrids, sowing/ transplanting time, seed rate and seed treatment of cool season vegetable crops.
CO3: Apply the nutritional, irrigation, weed, pest and diseases management.
CO4: Analyze about harvesting techniques and postharvest management.

SOA/HMN/UG 06 T: Production Technology of Cool Season Vegetable Crops (3)

Introduction, nutritional value, origin, botany and taxonomy, important countries and states growing vegetables along with area, climate and soil requirements, commercial varieties/hybrids evolved by private and public sector, sowing/ transplanting time, seed rate and seed treatment, nutritional and irrigation requirements, chemical weed control, mulching, physiological disorders, harvesting techniques, postharvest management, plant protection measures and seed production of potato, cole crops; cabbage, cauliflower, knolkhol, broccoli, brussels' sprout, chinese cabbage, root crops; carrot, radish, turnip, beet root, bulb crops; onion and garlic, peas and beans, green leafy cool season vegetables.

SOA/HMN/UG 06 P: Production Technology of Cool Season Vegetable Crops (1)

Seed extraction, sowing practices, nursery management, Use of growth regulators, grafting technique, water and nutrient management. Drip irrigation, fertigation, weed management and mulching. Identification of physiological disorders, pests, diseases and nutrient deficiencies. Study of maturity indices. Forcing techniques for raising cool season vegetables. Visit to vegetable nursery unit/ protected cultivation unit. Layout of kitchen garden.

Course No.	Course Title	Credits
SOA/HMN/UG 07	Production Technology of Tuber Crops	3 (2+1)

The course will help the learner to:
CO1: Learn about importance, scope, nutritional value, economic value of tuber crops.
CO2: Understand about, climate and soil requirements, commercial varieties/hybrids, sowing/ transplanting time, seed rate and seed treatment of tuber crops.
CO3: Apply the nutritional, irrigation, weed, pest and diseases management.
CO4: Analyze about harvesting techniques and postharvest management.

SOA/HMN/UG 07 T: Production Technology of Tuber Crops (2)

Origin, area, production, economic importance and export potential of tropical, sub-tropical and temperate tuber crops; description of varieties and hybrids. Climate and soil requirement, season; seed rate; preparation of field; planting practices; spacing; water, nutrient and weed management; nutrient deficiencies. Use of chemicals and growth regulators; cropping systems. Harvesting practices yield; economic of cultivation. Postharvest handling and storage, marketing. Crops to be covered- potato, sweet potato, arrow root, cassava, *colocasia, xanthosoma, amorphophallus, dioscorea*, Jerusalem artichoke, horse radish, coleus and yam bean and other under exploited tuber crops.

SOA/HMN/UG 07 P: Production Technology of Tuber Crops (1)

Identification and description of potato and tropical, sub-tropical and temperate tuber crops; planting systems and practices; field preparation and sowing/planting. Top dressing of fertilizers and interculture and use of herbicides and growth regulators; identification of nutrient deficiencies, physiological disorders; harvest indices and maturity standards, postharvest handling and storage, marketing. Seed collection, working out cost of cultivation.

Course No.	Course Title	Credits
SOA/HMN/UG 08	Breeding of Vegetable Crops	3 (2+1)

The course will help the learner to:
CO1: Learn about the plant genetic resources and their utilization in improvement of vegetable crops.
CO2: Understand the knowledge and skill regarding breeding procedures of self-pollinated, often cross pollinated, cross-pollinated and vegetatively propagated vegetable crops.
CO3: Apply conventional and modern techniques for improvement of vegetable crops.
CO4: Analyze genetic mechanisms for exploitation of heterosis in vegetable crops.

SOA/HMN/UG 08 T: Breeding of Vegetable Crops (2)

Definition and history of vegetable breeding. Origin, distribution, wild relatives and breeding objective of different vegetable crops viz. tomato, brinjal, chilli, muskmelon, watermelon, cucumber, bitter gourd, pumpkin, squashes, onion, garlic, carrot, radish, cauliflower, cabbage, pea, okra and potato. Plant genetic resources, their utilization and conservation. Breeding procedures of self- pollinated, often cross pollinated, cross-pollinated and vegetatively propagated vegetable crops. Conventional and modern techniques for improvement of vegetable crops. Breeding for biotic, abiotic stress tolerance and quality in vegetable crops. Genetic mechanisms for exploitation of heterosis in vegetable crops.

SOA/HMN/UG 08 P: Breeding of Vegetable Crops (1)

Study of inflorescence and flower structures. Practice for emasculation and artificial pollination. Distinguished morphological characteristics of released varieties/hybrids. Layout of field experiments. Estimation of heterosis. Handling of germplasm and segregating populations by different methods like pedigree, bulk and single seed decent methods. Visit to vegetable seed production field.

Course No.	Course Title	Credits
SOA/HMN/UG 09	Biotechnological Approaches and Micro-propagation in Vegetable Crops	4 (3+1)

The course will help the learner to:
CO1: Learn about the concepts and applications of plant biotechnology.
CO2: Understand the knowledge of transgenics and its importance in crop improvement; PCR techniques and its applications; DNA markers and their application.
CO3: Apply marker assisted breeding in crop improvement.
CO4: Analyze synthetic seeds, embryo rescue and its significance.

SOA/HMN/UG 09 T: Biotechnological Approaches and Micro-propagation in Vegetable Crops (3)

Concepts and applications of plant biotechnology. Introduction to recombinant DNA methods: physical, chemical and Agrobacterium mediated gene transfer methods; Transgenics and its importance in crop improvement; PCR techniques and its applications; DNA markers and their application - RFLP, RAPD, AFLP, CAPS, SSR etc. Marker Assisted Breeding in crop improvement; Biotechnology regulations. Plant Cell and Tissue Culture - organ culture, embryo culture, cell suspension culture, protoplast culture, callus culture, anther culture, pollen culture, 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. Soma-clonal variation and its use in crop improvement. Cryo-preservation. Application of in-vitro techniques.

SOA/HMN/UG 09 P: Biotechnological Approaches and Micro-propagation in Vegetable Crops (1)

Preparation of solution, pH and buffers. Sterilization techniques. Composition of various tissue culture media and preparation of stock solutions for MS nutrient medium. Callus induction from

various explants and plant regeneration. Micro-propagation, hardening and acclimatization. Demonstration on isolation of DNA and PCR technique. Demonstration of gel electrophoresis techniques and DNA finger printing.

Course No.	Course Title	Credits
SOA/HMN/UG 10	Postharvest Management of Vegetable Crops	3 (2+1)

The course will help the learner to:
CO1: Learn about determination of maturity in different vegetable crops.
CO2: Understand the assessment of post-harvest losses, pre- harvest methods and practices affecting post-harvest shelf life of vegetables.
CO3: Apply pre-cooling of vegetables using different techniques, post-harvest chemical and non- chemical treatments to enhance shelf life of vegetables.
CO4: Analyze raw material for processing, transportation and destination handling, marketing, treatments before shipment and storage, fresh-cut vegetables.

SOA/HMN/UG 10 T: Postharvest Management of Vegetable Crops (2)

Determination of maturity in different vegetable crops, assessment of post-harvest losses, pre-harvest methods and practices affecting post-harvest shelf life of vegetables, mechanized harvesting of vegetables, pre-cooling of vegetables using different techniques, post-harvest chemical and non- chemical treatments to enhance shelf life, sorting and grading for packaging, ripening of vegetables, packaging of vegetables including latest techniques like MAP, storage of vegetables including latest techniques like CA storage, food safety and quality, non-destructive methods of quality analysis, quality of raw material for processing, transportation and destination handling, marketing, treatments before shipment and storage, fresh-cut vegetables.

SOA/HMN/UG 10 P: Postharvest Management of Vegetable Crops (1)

Practices in judging the maturity of vegetables, harvesting methods and tools. Methods used for pre-cooling and their efficiency measurements. Post-harvest chemical treatments to extend shelf life. Sorting and grading methods. Ripening techniques used in climacteric vegetables. Traditional and latest safe storage techniques. Respiration measurements in harvested produce. Field visit to post-harvest and processing industry.

Course No.	Course Title	Credits
SOA/HMN/UG 11	Protected Cultivation of Vegetable Crops	3 (2+1)

The course will help the learner to:
CO1: Learn about importance, scope, constraints and status of protected cultivation in India and world.
CO2: Understand the classification and types of protected structures.
CO3: Apply propagation and production of quality planting material of horticultural crops.
CO4: Analyze economics of greenhouse vegetable crop production.

SOA/HMN/UG 11 T: Protected Cultivation of Vegetable Crops (2)

Protected cultivation- importance, scope and constraints, status of protected cultivation in India and world. Soil/substrate preparation and management. Classification and types of protected structures. Irrigation and fertigation management. Propagation and production of quality planting material of horticultural crops. Greenhouse cultivation of important horticultural crops viz., tomato, bell pepper, cucumber, lettuce, brinjal. Off season production of vegetables. Hydroponics, aeroponics system of cultivation, Insect pest and disease management. Use of protected structures for seed production; Economics of greenhouse crop production.

SOA/HMN/UG 11 P: Protected Cultivation of Vegetable Crops (1)

Identification of different protected structures, Use of pro-trays in quality planting material production, Identification of different growing media/ substrates, Raising of seedlings and saplings under protected cultivation, Bed preparation, planting and intercultural operations for crop production, Estimation and management of soil EC, Estimation and management of pH in media/ substrates, Scheduling of irrigation in different horticultural crops, Fertilizer management through drip irrigation, Control of disease and insect pests in protected structures, fumigation techniques. Visit to commercial protected cultivation units.

SEMESTER-VIII

Major courses

Course No.	Course Title	Credits
SOA/HMJ/UG 29	**Student Ready: Rural Horticultural Work Experience (RHWE) Programme** I. Project preparation	4 (4+0)
The course will help the learner to: CO1: Learn about understanding of socio-economic situations prevailing in villages. CO2: Understand the rural life and to acquaint them from the different situations prevailing in villages with special reference to Horticulture. CO3: Apply Horticultural techniques followed by farmers and prepare production plans and improved technologies to suit the local situations in consultation with farmers. CO4: Analyze quality control and value addition to horticultural products by exposure to field and laboratory conditions and professional guidance.		

Course No.	Course Title	Credits
SOA/HMJ/UG 30	**Student Ready: Rural Horticultural Work Experience (RHWE) Programme** II. Placement in Industries	6 (0+6)
The course will help the learner to: CO1: Learn about practical experience, on-field knowledge of industrial technologies used in commercial nurseries, tissue culture labs, polyhouses, and fruit/vegetable processing units. CO2: Understand the competence in facing problem solving situations related to Horticulture. CO3: Apply quality control and value addition to horticultural products by exposure to field and laboratory conditions and professional guidance. CO4: Analyze the economic aspects of horticulture, including market trends, supply chain management.		

Course No.	Course Title	Credits
SOA/HMJ/UG 31	**Student Ready: Rural Horticultural Work Experience (RHWE) Programme** III. Placement in Villages	6 (0+6)
The course will help the learner to:		

CO1: Learn about the socio-economic situations prevailing in villages.
CO2: Understand the rural life and to acquaint them from the different situations prevailing in villages with special reference to Horticulture.
CO3: Apply communication skills in transfer of Horticultural technology.
CO4: Analyze the Horticultural techniques followed by farmers and prepare production plans and improved technologies to suit the local situations in consultation with farmers.

Course No.	Course Title	Credits
SOA/HMJ/UG 32	**Student Ready: Rural Horticultural Work Experience (RHWE) Programme** IV. Report writing, presentation and discussion (Placement in Industries& Villages)	4 (4+0)

The course will help the learner to:
CO1: Learn to maintain detailed work diaries and compile comprehensive reports covering industries and village attachment.
CO2: Understand the ability to record, analyze, and compare biometric observations of crops with recommended package of practices.
CO3: Apply confidence in decision-making and in providing technical advice to farmers in consultation with agricultural experts. .
CO4: Analyze the collected data on socio-economic conditions, conduct farm holding surveys, and analyze the cost of cultivation and profitability of horticultural crops.