FRT.1.1: Fundamentals of Horticulture 3(2+1)

Economic importance and classification of horticultural crops and their culture and nutritive value, area and production, exports and imports, fruit and vegetable zones of India and of different states, nursery management practices, 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. Production and practices for fruit, vegetable and floriculture crops, nursery techniques and their management. Principles and methods of pruning and training of fruit crops, types and use of growth regulators in horticulture, water management, weed management, fertility management in horticultural crops, cropping systems, intercropping, multi-tier cropping, mulching, bearing habits, factors influencing the fruitfulness and unfruitfulness. Rejuvenation of old orchards, top working, frame working, principles of organic farming.

Practical:
Features of orchard, planning and layout of orchard, tools and implements, layout of nutrition garden, preparation of nursery beds for sowing of vegetable 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 vegetables, assessment of bearing habits, maturity standards, harvesting, grading, packaging and storage.

FRT.2.2: Plant Propagation and Nursery Management 2(1+1)


Practical:
Media for propagation of plants in nursery beds, pot and mist chamber. Preparation of nursery beds, pre-sowing treatments and sowing of seeds of different size - small, medium and large. Raising of rootstock. Seed treatments for breaking dormancy and inducing vigorous seedling growth. Preparation of plant material for potting and repotting. Hardening plants in the nursery. Practicing different types of cuttings, layering, graftings and buddings including opacity and grafting, etc. Use of mist chamber in propagation and hardening of plants. Preparation of plant growth regulators for seed germination and vegetative propagation. Visit to a tissue culture laboratory. Digging, labeling and packing of fruit and other plants. Maintenance of nursery records. Use of different types of nursery tools and implements for general nursery and virus tested plant material in the nursery.

Cost of establishment of a mist chamber, greenhouse, glasshouse, polyhouse and their maintenance. Top grafting, bridge grafting and nursery management. Nutrient and plant protection applications during nursery.

**FRT.2.3: Tropical and Sub-Tropical Fruits**

Horticultural classification of fruits including genome classification. Horticultural zones of India, detailed study of area, production and export potential, varieties, climate and soil requirements, propagation techniques, planting density and systems, after care, training and pruning. Management of water, nutrient and weeds, special horticultural techniques including plant growth regulators, their solution preparation and use in commercial orchards. Physiological disorders. Post-harvest technology, harvest indices, harvesting methods, grading, packaging and storage of the following crops. Mango, banana, bael, banana, grapes, citrus, papaya, sapota, guava, pineapple, jackfruit, avocado, mangosteen, litchi, carambola, durian and passion fruit. Bearing in mango and citrus, causes and control measures of special production problems, alternate and irregular bearing overcome, control measures. Seediness and kokkan disease in banana, citrus decline and casual factors and their management. Bud forecasting in grapes, sex expression and seed production in papaya, latex extraction and crude papain production, economic of production. Rainfed horticulture, importance and scope of arid and semi-arid zones of India. Characters and special adaptation of crops: ber, aonla, annona, jamun, wood apple, bael, pomegranate, carissa, date palm, phalsa, fig, west Indian cherry and tamarind.

**Practical:**

Description and identification of varieties based on flower and fruit morphology in above crops. Training and pruning of grapes, mango, guava and citrus. Selection of site and planting system, pre-treatment of banana suckers, desuckering in banana, sex forms in papaya. Use of plastics in fruit production. Visit to commercial orchards and diagnosis of maladies. Manure and fertilizer application including bio-fertilizer in fruit crops, preparation and application of growth regulators in banana, grapes and mango. Seed production in papaya, latex extraction and preparation of crude papain. Ripening of fruits, grading and packaging, production economics for tropical and sub-tropical fruits. Mapping of arid and semi-arid zones of India. Botanical description and identification of ber, fig, jamun, pomegranate, carissa, phalsa, wood apple, West Indian cherry, tamarind, aonla, bael and annona.
FRT.3.4: Temperate Fruits
Classification of temperate fruits, detailed study of areas, production, varieties, climate and soil requirements, propagation, planting density, cropping systems, after care training and pruning, self incompatibility and pollinizers, use of growth regulators, nutrient and weed management, harvesting, post-harvest handling and storage of apple, pear, peach, apricot, cherry, persimmon, strawberry, kiwi, Queens land nut (Macadamia nut), almond, walnut, pecan nut, hazel nut and chest nut. Re-plant problem, rejuvenation and special production problems like pre-mature leaf fall, physiological disorders, important insect – pests and diseases and their control measures.

Practical:
Nursery management practices, description and identification of varieties of above crops, manuring and fertilization, planting systems, preparation and use of growth regulators, training and pruning in apple, pear, plum, peach and nut crops. Visit to private orchards to diagnose maladies. Working out economics for apple, pear, plum and peach.

FRT.3.5: Weed Management in Horticultural Crops
Weeds: Introduction, harmful and beneficial effects, classification, propagation and dissemination; Weed biology and ecology, crop weed association, crop weed competition and allelopathy Concepts of weed prevention, control and eradication; Methods of weed control: physical, cultural, chemical and biological methods. Integrated weed management; Herbicides: advantages and limitation of herbicide usage in India, Herbicide classification, formulations, methods of application; Introduction to Adjuvants and their use in herbicides; Introduction to selectivity of herbicides; Compatibility of herbicides with other agro chemicals; Weed management in major field and horticultural crops, shift of weed flora in cropping systems, aquatic and problematic weeds and their control.

Practical:
Identification of weeds; Survey of weeds in crop fields and other habitats; Preparation of herbarium of weeds; Calculations on weed control efficiency and weed index; Herbicide label information; Computation of herbicide doses; Study of herbicide application equipment and calibration; Demonstration of methods of herbicide application; Preparation of list of commonly available herbicides; Study of phytotoxicity symptoms of herbicides in different crops; Biology of nut sedge, bermuda grass, parthenium and celosia; Economics of weed control practices; Tours and visits of problem areas.

FRT.3.6: Principles of Genetics and Cytogenetics
as genetic material. Mutation and its classification. Chromosomal aberrations: Changes in chromosome structure and number

Practical:
Study of fixatives and stains; Preparation of slides showing various stages of mitosis; Preparation of slides showing various stages of meiosis; Testing the viability and germination of pollen grains; Solving the problems on monohybrid and dihybrid crosses; Estimation of linkages/chromosome mapping.

FRT.4.7: Orchard Management 2(1+1)
Orchard management, importance, objectives, merits and demerits, clean cultivation, sod culture, Sod mulch, herbicides and inorganic and organic mulches. Tropical, sub-tropical and temperate horticultural systems, competitive and complimentary effect of root and shoot systems. Biological efficiency of cropping systems in horticulture, systems of irrigation. Soil management in relation to nutrient and water uptake and their effect on soil environment, moisture, organisms and soil properties. Integrated nutrient and pest management. Utilization of resources constraints in existing systems. Crop model and crop regulation in relation to cropping systems.

Practical:
Layout of different systems of orchard soil management, clean, inter, cover and mixed cropping, fillers. Use of mulch materials, organic and inorganic, moisture conservation, weed control. Layout of various irrigation systems.

FRT.4.8: Plantation Crops 3(2+1)
History and development, scope and importance, area and production, export and import potential, role in national and state economy, uses, industrial importance, by products utilization, soil and climate, varieties, propagation: principles and practices of seed, vegetative and micro-propagation, planting systems and method, gap filling, systems of cultivation, mulching, shade regulation, weed and water management, training, pruning and handling, nutrition, foliar feeding, role of growth regulators, soil management, liming practices, tipping practices, top working, physiological disorders, harvesting, post-harvest handling and processing, packaging and marketing, yield and economics of coconut, arecanut, oil palm, palmyrah palm, cacao, cashew nut, coffee, tea and rubber.

Practical:
Description and identification of coconut varieties, selection of coconut and arecanut mother palm and seed nut, planting of seed nuts in nursery, layout and planting of coconut, arecanut, oil palm, cashew nut, cacao gardens, manuring, irrigation; mulching, raising masonry nursery for palm, nursery management in cacao. Description and identification of species and varieties in coffee, harvesting, grading, pulping, fermenting, washing, drying and packing of coffee, seed berry collection, seed extraction, treatment and sowing of coffee, epicotyl, softwood, grafting and top working in cashew, working out the economics and project preparation for coconut, arecanut, oil palm, cashew nut, cacao, etc. Mother plant selection, preparation of cuttings and rooting of tea under specialized structure, training, centering, pruning, tipping and harvesting of tea.

FRT.4.9: Breeding of Fruit and Plantation Crops 3 (2+1)
Fruit breeding - History, importance in fruit production, distribution, domestication and adaptation of commercially important fruits, variability for economic traits, breeding strategies, clonal selection, bud mutations, mutagenesis and its application in crop improvement – policy manipulations – in vitro breeding tools (important fruit and plantation crops).

Practical:
Exercises on floral biology, pollen viability; emasculation and pollination procedures; hybrid seed germination; raising and evaluation of segregating populations; use of mutagens to induce mutations and polyploidy.

FRT.4.10: Principles of Plant Breeding 3 (2+1)

Plant breeding as a dynamic science, genetic basis of Plant Breeding – classical, quantitative and molecular, Plant Breeding in India – limitations, major achievements, goal setting for future. Sexual reproduction (cross and self pollination), asexual reproduction, pollination control mechanism (incompatibility and sterility and implications of reproductive systems on population structure). Genetic components of polygenic variation and breeding strategies, selection as a basis of crop breeding. Hybridization and selection – goals of hybridization, selection of plants; population developed by hybridization – simple crosses, bulk crosses and complex crosses. General and special breeding techniques. Heterosis – concepts, estimation and its genetic basis.

Practical:
Breeding objectives and techniques in major field crop plants. Floral biology – its measurement, emasculation, crossing and selfing techniques in major crops. Determination of mode of reproduction in crop plants, handling of breeding material and maintenance of experimental records in self and cross pollinated crops. Demonstration of hybrid variation and production techniques.
VEG.2.1: Tropical and Sub-Tropical Vegetables

Area, production, economic importance and export potential of tropical and sub-tropical vegetable crops. Description of varieties and hybrid, climate and soil requirements, seed rate, preparation of field, nursery practices; transplanting of vegetable crops and planting for directly sown/transplanted vegetable crops. Spacing, planting systems, water and weed management; nutrient management and deficiencies, use of chemicals and growth regulators. Cropping systems, harvest, yield and seed production. Economic of cultivation of tropical and sub-tropical vegetable crops; post-harvest handling and storage. Marketing of tomato, brinjal, chillies, okra, amaranthus, cluster beans, cowpea, lab-lab, snap bean, cucurbits, moringa, curry leaf, portulaca and basella.

Practical:
Identification and description of tropical and sub-tropical vegetable crops; nursery practices and transplanting, preparation of field and sowing/planting for direct sown and planted vegetable crops. Herbicide use in vegetable culture; top dressing of fertilizers and intercultural; use of growth regulators; identification of nutrient deficiencies. Physiological disorder. Harvest indices and maturity standards, post-harvest handling and storage, marketing, seed extraction (cost of cultivation for tropical and sub-tropical vegetable crops), project preparation for commercial cultivation.

VEG.3.2: Temperate Vegetables

Importance of cool season vegetable crops in nutrition and national economy. Area, production, export potential, description of varieties and hybrids, origin, climate and soil, production technologies, seed production, post-harvest technology. Marketing of cabbage, cauliflower, knol-khol, sprouting broccoli, Brussels’ sprout, lettuce, palak, Chinese cabbage, spinach, garlic, onion, leek, radish, carrot, turnip, beet root, peas, broad beans, rhubarb, asparagus, globe artichoke.

Practical:
Identification and description of varieties/hybrids; propagation methods, nursery management; preparation of field, sowing/transplanting; identification of physiological and nutritional disorders and their corrections; post-harvest handling; cost of cultivation and field visits to commercial farms.

VEG.4.3: Spices and Condiments

History, scope and importance, area and production, uses, export potential and role in national economy. Classification, soil and climate, propagation-seed, vegetative and micropropagation systems and methods of planting. Nutritional management, irrigation practices, weed control, mulching and cover cropping. Training and pruning practices, role of growth regulators, shade crops and shade regulation. Harvesting, post-harvest technology, packaging, storage, value added products, methods of extraction of essential oil and oleoresins. Economics of cultivation, role of Spice Board and Pepper Export Promotion Council, institutions and research centers in R&D. Crops: Cardamom, pepper,
ginger, turmeric, clove, nutmeg, cinnamon, all spice, curry leaf, coriander, fenugreek, fennel, cumin, dill, celery, bishops weed, saffron, vanilla, thyme and rosemary.

**Practical:**
Identification of varieties: propagation, seed treatment – sowing; layout, planting; hoeing and earthing up; manuring and use of weedicides, training and pruning; fixing maturity standards, harvesting, curing, processing, grading and extraction of essential oils and oleoresins. Visit to commercial plantations.

**VEG.5.4: Breeding of Vegetable, Tuber and Spice Crops 3(2+1)**


**Practical:**
Floral biology and pollination mechanism in self and cross pollinated vegetables, tuber crops and spices. Working out phenotypic and genotypic heritability, genetic advance. Preparation and uses of chemical and physical mutagens. Polyploidy breeding and chromosomal studies. Techniques of F1 hybrid seed production. Maintenance of breeding records.

**VEG.5.5: Potato and Tuber Crops 2(1+1)**

Origin, area, production, economic importance and export potential of potato and 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; seed production, economic of cultivation. Post-harvest handling and storage, field and seed standards, marketing. Crops to be covered – potato, tapioca, sweet potato, arrow root, cassava, colocasia, xanthosoma, amorphophallus, dioscorea, Jerusalem artichoke, horse radish and other under exploited tuber crops.

**Practical:**
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, post-harvest handling and storage, marketing. Seed collection, working out cost of cultivation, project preparation of commercial cultivation.
Introduction and history of seed industry in India. Definition 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. Methods of seed production of cole crops, root vegetables, solanaceous vegetables, cucurbits, leafy vegetables, bulb crops, leguminous vegetables and exotic vegetables. Seed germination and purity analysis. Field and seed standards. Seed drying and extraction. Seed legislation.

Practical:
PHT.2.1: Fundamentals of Food Technology 2 (1+1)


Practical:
Methods of measuring food ingredients, effect of cooking on volume and weight, determination of percentage of edible portion. Browning reactions of fruits and vegetables. Microscopic examination of starches, estimation of energy, value proteins and fats of foods. Planning diet for various age groups.

PHT.5.2: Post Harvest Management of Horticultural Crops 3 (2+1)


Practical:
Practice in judging the maturity of various horticultural produce, determination of physiological loss in weight and quality. Grading of horticultural produce, post-harvest treatment of horticultural crops, physical and chemical methods. Packaging studies in fruits, vegetables, plantation crops and cut flowers by using different packaging materials, methods of storage, post-harvest disorders in horticultural produce. Identification of storage pests and diseased in spices. Visit to markets, packaging houses and cold storage units.
Importance and scope of fruit and vegetable preservation industry in India, food pipe line, losses in post-harvest operations, unit operations in food processing. Principles and guidelines for the location of processing units. Principles and methods of preservation by heat pasteurization, canning, bottling. Methods of preparation of juices, squashes, syrups, cordials and fermented beverages. Jam, jelly and marmalade. Preservation by sugar and chemicals, candies, crystallized fruits, preserves chemical preservatives, preservation with salt and vinegar, pickling, chutneys and sauces, tomato and mushrooms, freezing preservation. Processing of plantation crops, products, spoilage in processed foods, quality control of processed products, Govt. policy on import and export of processed fruits. Food laws.

**Practical:**

Equipment used in food processing units. Physico-chemical analysis of fruits and vegetables. Canning of fruits and vegetables, preparation of squash, RTS, cordial, syrup, jam, jelly, marmalade, candies, preserves, chutneys, sauces, pickles (hot and sweet). Dehydration of fruits and vegetables – tomato product dehydration, refrigeration and freezing, cut out analysis of processed foods. Processing of plantation crops. Visit to processing units.
FLR.1.1: Ornamental Horticulture 3 (2+1)

History, scope of gardening, aesthetic values. Classification and identification of landscape plant material, Gardens in India, types of gardens. Landscaping, historical background, definition. Landscaping, basic principles and basic components. Principles of gardening, garden components, adornments, lawn making, methods of designing rockery, water garden, etc. Special types of gardens, their walk-paths, bridges, constructed features. Special types of gardens, trees, their design, values in landscaping, propagation, planting shrubs and herbaceous perennials. Importance, design values, propagation, plating, climbers and creepers, palms, ferns, grasses and cacti succulents. Flower arrangement: importance, production details and cultural operations, constraints, post-harvest practices. Bio-aesthetic planning, definition, need, round country planning, urban planning and planting avenues, schools, villages, beautifying railway stations, dam sites, hydroelectric stations, colonies, river banks, planting material for play grounds. Vertical gardens, roof gardens. Culture of bonsai, art of making bonsai. Parks and public gardens.

Practical:
Identification and description of annuals, herbaceous, perennials, climbers, creepers, foliage flowering shrubs, trees, palms, ferns, ornamental grasses; cacti succulents. Description and design of garden structures, layout of rockery, water garden, terrace garden, and Japanese gardens, recreational and children's corner. Layout of terrarium, traffic islands, bottle garden, dish garden. Flower arrangement, bonsai practicing and training. Visit to nearby gardens.

FLR.3.2: Commercial Floriculture 3(2+1)

Scope and importance of commercial floriculture in India, Floriculture industry: importance, area and production, industrial importance in India. Greenhouse and its types. Production techniques of ornamental plants like rose, marigold, chrysanthemum, orchid, carnation, gladiolus, jasmine, dahlia, tuberose, bird of paradise, china aster and gerbera for domestic and export market, growing of flowers under protected environments such as glass house, plastic house etc., post harvest technology of cut flowers in respect of commercial flower crops, dehydration technique for drying of flowers, production techniques for bulbous.

Practical:
FLR.4.3: Principles of Landscape Gardening 1 (0+1)

Practical:
Principles and elements of landscape design, plant material for landscaping, symbols, tools and implements used in landscape design, Planning and designing gardens, layout of location of components of garden study, functional uses of plants in the landscape. Planning design of house garden, roadside planting, avenues for new colonies, traffic islands, preparation of land for lawn and planting. layout of formal gardens, informal gardens, special type of gardens (bog garden, sunken garden, terrace garden, rock garden) and designing of conservatory and lathe house. Landscape design for specific areas.

FLR.6.4: Breeding and Seed Production of Ornamental Crops 3(2+1)


Practical:
Study of floral biology and pollination in important species and cultivars. Techniques of inducing polyploidy and mutation. Production of pure and hybrid seeds. Harvesting, conditioning and testing of seeds. Practice in seed production methods
PPT.3.1: Fundamentals of Plant Pathology 3 (2+1)


Practical:

PPT.3.2: Fundamentals of Entomology 3 (2+1)


Practical:

PPT.3.3: Nematode Pests of Horticultural Crops and their Management 2 (1+1)

History of development of nematology - definition, economic importance. General characters of plant parasitic nematodes, their morphology, taxonomy, classification, biology, symptomatology and control of important plant parasitic nematodes of fruits – (tropical, subtropical and temperate) vegetables, tuber, ornamental, spice and plantation crops. Role of nematodes in plant disease complex.

Practical:
Methods of sampling and extraction of nematodes from soil and plant parts, killing, fixing and preparation of temporary and permanent nematode mounts. Nematicides and their use. Collection and preservation of 20 plant species/parts damaged by plant parasitic nematodes.

PPT.4.4: Mushroom Culture 1(0+1)

PPT.4.5: Insect Pests of Fruit, Plantation, Medicinal and Aromatic Crops 3(2+1)

General – economic classification of insects; ecology and insect-pest management with reference to fruit, plantation, medicinal and aromatic crops; pest surveillance. Distribution, host range, bio-ecology, injury, integrated management of important insect pests affecting tropical, sub-tropical and temperate fruits, plantation, medicinal and aromatic crops like coconut, areca nut, oil palm, cashew, cacao, tea, coffee, cinchona, rubber, betel vine senna, neem, hemp, belladonna, pyrethrum, camphor, costus, crotalaria, datura, dioscorea, mint, opium, Solanum khasianum and Tephrosia.. Storage insects – distribution, host range, bioecology, injury, integrated management of important insect pests attacking stored fruits, plantation, medicinal and aromatic crops and their processed products. Toxicology – insecticide residue problems in fruit, plantation, medicinal and aromatic crops and their tolerance limits.

Practical:
Study of symptoms of damage, collection, identification, preservation, assessment of damage and population of important insect – pests affecting fruits, plantation, medicinal and aromatic crops in field and storage

PPT.5.6: Diseases of Fruits, Plantation and Medicinal and Aromatic Crops 3(2+1)

Etiology, symptoms, mode of spread, epidemiology and integrated management of the diseases of fruits, plantation, medicinal and aromatic crops viz mango, banana, grape, citrus, guava, sapota, papaya, jack fruit, pineapple, pomegranate, ber, apple, pear, peach, plum, almond, walnut, strawberry, 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 and Tephrosia. Important post-harvest diseases of fruit, plantation and medicinal and aromatic crops and their management.

Practical:
Observations of disease symptoms, identification of casual organisms and host parasite relationship of important diseases. Examination of scrapings and cultures of important pathogens of fruits, plantation, medicinal and aromatic crops.

PPT.5.7: Diseases of Vegetable, Ornamental and Spice Crops 3(2+1)
Etiology, symptoms, mode of spread, epidemiology and integrated management of diseases of the following vegetables, ornamental and spice crops: tomato, brinjal, chilli, bhindi, cabbage, cauliflower, radish, knol-khol, pea, beans, beet root, onion, garlic, fenugreek, ginger, potato, turmeric, pepper, cumin, cardamom, nutmeg, coriander, clove, cinnamon, jasmine, rose, crossandra, tuberose, geranium. Important post-harvest diseases of vegetables and ornamental crops and their management.

**Practical:**
Observations of symptoms, causal organisms and host parasitic relationship of important diseases, examination of cultures of important pathogens of vegetables, ornamental and spice crops.

**PPT.6.8: Apiculture**

**Practical:**

**PPT.6.9: Insect Pests of Vegetable, Ornamental and Spice Crops**

Economic importance of insects in vegetable, ornamental and spice crops - ecology and pest management with reference to these crops. Pest surveillance in important vegetable, ornamental and spice crops. Distribution, host range, bio-ecology, injury, integrated management of important insect-pests affecting vegetable, ornamental and spice crops. Important storage insect-pests of vegetable, ornamental and spice crops, their host range, bioecology, injury and integrated management. Insect –pests of processed vegetables and ornamental crops, their host range, bio-ecology, injury and integrated management. Insecticidal residue problems in vegetables and ornamental crops, tolerance limits etc.

**Practical:**
Study of symptoms, damage, collection, identification, preservation, assessment of damage/population of important insect-pests affecting vegetable, ornamental and spice crops in field and during storage.
NRMH.1.1: Fundamentals of Soil Science


Practical:
Collection and preparation of soil samples, estimation of moisture, EC, pH and bulk density. Textural analysis of soil by Robinson’s pipette method, chemical analysis of soil – Fe2O3, P, K, Ca, Mg and S, total N, organic carbon and cation exchange capacity.

NRMH.2.2: Soil Fertility and Nutrient Management


Practical:

**NRMH.2.3: Environmental Science**


**Practical:**
Visit to local areas - river/forest/ grassland/catchment etc. to document components of ecosystem. Study of common plants, insects, birds and animals. Visit to industries to study pollution abatement techniques.

**NRMH.2.4: Water Management in Horticultural Crops**


**Practical:**
Measurements of irrigation water by using water measuring devices, use of common formula in irrigation practices, practicing of land leveling and land shaping implements, layout for different methods of irrigation. Estimation of soil moisture constants and soil moisture by using different, methods and instruments, scheduling of irrigation, different approaches, practicing use of instruments, estimation of irrigation efficiency and water requirements of horticultural crops, irrigation planning and scheduling, soil moisture conservation practices.
NRMH.3.5: Organic Farming

Introduction, concept, relevance in present context; Organic production requirements; Biological intensive nutrient management-organic manures, vermicomposting, green manuring, recycling of organic residues, biofertilizers; Soil improvement and amendments; Integrated diseases and pest management – use of biocontrol agents, biopesticides pheromones, trap crops, bird perches; Weed management; Quality considerations, certification, labeling and accreditation processors, marketing, exports.

Practical:
Raising of vegetable crops organically through nutrient, diseases and pest management; vermicomposting; vegetable and ornamental nursery raising; macro quality analysis, grading, packaging, post harvest management.

NRMH.4.6: Soil and Plant Analysis


Practical:

NRMH.6.7: Farm Power and Machinery

Basic concepts of various forms of energy, unit and dimensions of force, energy and power, calculations with realistic examples. IC Engines: Basic principles of operation of compression, ignition and spark ignition engines, two stroke and four stroke engines, cooling and lubrication system, power transmission system, broad understanding of performance and efficiency, tractors, power tillers and their types and uses. Electric motors: types, construction and performance comparison. Tillage: objectives, method of ploughing. Primary tillage implements: construction and function of indigenous ploughs, improved indigenous ploughs, mould board ploughs, disc and rotary ploughs. Secondary tillage implements: construction and function of tillers, harrows, levelers, ridgers and bund formers. Sowing and transplanting equipment: seed drills, potato planters, seedling

Practical:
Calculation on force, power and energy. IC engines – showing the components of dismantled engines and motors. Primary and secondary tillage implements, hitching, adjustments and operations. Spraying equipment, calibration and operation. Plant protection equipment, calculation of dilution ratio and operation.
BSC.1.1: Computer Application

Theory: Introduction to computers and personal computers. Characteristics of computer. Basic concepts – structure and basic works of computer. Hardware – input and output devices, primary and secondary memory. Classification of computer. Software and its types. Windows operating system – its basic, mouse operation, understanding the desktop, understanding the window, managing files and folders. Introduction to Internet and email. Introduction to MS Office.


Practical:


BSC.1.2: Introductory Crop Physiology


Practical:

Measurement of water potential by different methods, Osmosis – demonstration, Plasmolysis – demonstration, Root pressure – demonstration, Transpiration rate, Studying the structure of stomata, studying the opening and closing of stomata,
Demonstration of importance of light in photosynthesis, Estimation of plant pigments, Studying the activity of catalase, Detection of phenols in plants, Studying the plant movements,

**BSC. 1.3 : Introductory Economics** 2(2+0)


**BSC.1.4: Structural Grammar and Spoken English** 2 (1+1)

**Structural Grammar**: Introduction to Word Classes, Structure of the Verb in English, Uses of Tenses, Study of Voice, Use of Conjunctions and Prepositions, Sentence Structures and Patterns in English, Articles, Concord, Vocabulary and Composition, Use of Dictionaries-Thesauri and Theory of Translation.

**Spoken English**: Conversations of Different Situations in Everyday Life, the Concept of Stress, Stress Shift in Words and Sentences, Words with Silent Letters and Their Pronunciations, Concepts of Debate, Group Discussion, Elocution and Extempore.

**Practical:**


**Spoken English**: Short Talks, Dialogues, Conversations related to Everyday Situations, Preparation for Debate- Group Discussion, Elocution and Extempore Speeches, Reading Newspapers- Books and magazines.

**BSC.1.5: Introductory Microbiology** 2(1+ 1)

History and Scope of Microbiology: The discovery of micro-organism, spontaneous generation conflict, germ theory of diseases, microbial effect on organic and inorganic matter. Development of microbiology in India and composition of microbial world.

Microscopy and Specimen Preparation: The bright field microscope, fixation, dyes and simple staining, differential staining. Difference between prokaryotic and eucaryotic cells. Procaryotic cell structure and functions. Types of culture media and pre-culture techniques. Microbial growth in models of bacterial, yeast and mycelial growth curve.

Practical:
Examination of natural infusion and living bacteria; examination of stained cells by simple staining and Gram staining. Methods for sterilization and nutrient agar preparation. Broth culture, agar slopes, streak plates and pour plates, turbidometric estimation of microbial growth

BSC.1.6: Introductory Botany


Practical:
Morphological studies of roots, stems, leaves and flowers. Studies of permanent slides of histology and anatomy. Morphological studies of gametophytes and sporophytes of the plants pertaining to the life cycle. General survey of the local vegetation. A field trip during the semester.

BSC. 2.7 Elementary Statistics

Basic concepts : variable, statistics, types and sources of data. Classification and tabulation of data, construction of frequency distribution tables. Graphic representation of data, simple, multiple, component and percentage bar diagram; pie diagram, histogram, frequency polygon and frequency curve. Average and measures of location : mean, mode, median, geometric mean, harmonic mean and quadrilles for raw and grouped data. Dispersion : range, standard deviation, variance, coefficient of variation and stand error of mean for raw and grouped data. Probability : basic concept, additive and multiplicative laws. Theoretical distribution - normal distribution. Sampling : basic concepts, sampling vs. complete enumeration, parameter and statistic. Sampling methods : simple random sampling and stratified random sampling. Tests of Significance: Basic concepts. Tests for equality of means: one sample and two(independent) sample; paired t-tests. Chi-square test for independence of attributes and test for goodness of fit for Mendalian ratios. Correlation : scatter diagram, correlation co-efficient and its properties. Regression : fitting of simple linear regression. Test of significance of correlation and regression coefficient. Introduction to experimental designs. Basic concepts(layout and structure of ANOVA table) for completely randomized design, randomized block design and Latin square design.

Practical:
Construction of frequency distribution table. Graphical representation of data : histogram, frequency polygon, frequency curve; bar chart - simple, multiple, component and percentage bar charts; pie chart. Mean, median, mode and quadrille for row and grouped
data. Standard deviation and coefficient of variation for row and grouped data. Tests for equality of means: one sample and two (independent) sample; paired t-tests. Chi-square test for contingency tables and theoretical ratios. Correlation and linear regression.

**BSC.2.8: Growth and Development of Horticultural Crops**

Growth and development—definitions, components, photosynthetic productivity, leaf area index (LAI) - optimum LAI in horticultural crops, canopy development; different stages of growth, growth curves, growth analysis in horticultural crops. Plant bioregulators- 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, vernalisation 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 nonclimacteric fruits.

**Practical:**

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, rapid tissue test, seed dormancy, seed viability by tetrazolium test, seed germination and breaking seed dormancy with chemicals and growth regulators.

**BSC.4.9: Fundamentals of Extension Education**


**Practical:**
Visits to study structure, functions, linkages and extension programmes of ICAR institutes/voluntary organizations/Mahila Mandal, Village Panchayat, State Deptt. of Horticulture. Exercises on distortion of message, script writing for farm broadcasts and telecasts, planning, preparation & use of NPVA like poster, chart, flash cards, folders etc. and AVA like OHP. Identification of local leaders to study their role in extension work. Preparing rural leaders training programme for Horticulture and study of organizations of Youth Clubs in Rural Area. Preparation of Village Agricultural productions plan.

**BSC.5.10: Elementary Plant Biochemistry and Biotechnology**


**Practical:**


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

Practical:
Listening and note taking, writing skills, oral presentation skills; field diary and lab record; indexing, footnote and bibliographic procedures. Reading and comprehension of general and technical articles, precis writing, summarizing, abstracting; individual and group presentations.
OTH. 1.1 : NCC / NSS / Physical Education (NC) 1(0+1)

Orientation of students in national problems, study of philosophy of NSS, fundamentals rights, directive principles of state policy, socio-economic structure of Indian society, population problems, brief of five year plan. Functional literacy, non-formal education of rural youth, eradication of social evils, awareness programmes, consumer awareness, highlights of consumer act. Environment enrichment and conservation, health, family welfare and nutrition. NCC: Introduction to NCC, defense services, system of NCC training, foot drill, sizing, forming up in three ranks, open and close order march, dressing, getting on parade, dismissing and falling out, saluting, marching, arms drill, shoulder arm, order arm, present arm, guard of honour, ceremonial drill, weapon training – rifle bayonet, light machine gun, sten machine carbine, introduction and characteristic stripping, assembling and cleaning, loading, unloading and firing. Field craft, visual training, targets, judging distance, fire discipline and fire control orders, battle craft, field signals, description of ground, section formation, section battle drill, scouts and patrols, ambush, field engineering, map reading, conventional signs, grid systems, use of service protractor, prismatic compass and its use, self defense, general principles, precautions and training, attacks and counter attacks, marching and searching, first aid, hygiene and sanitation, civil defense, leadership and NCC song. Physical Education: Introduction to physical education. Posture, exercise for good posture, physical fitness exercises for agility, strength, coordination, endurance and speed. Rules are regulations of important games, skill development in any one of the games – football, hockey, cricket, volleyball, ball badminton, throw ball, tennikoit. Participation in one of the indoor games – shuttle badminton, chess and table tennis. Rules and regulations of athletic events, participation in any one of the athletic events – broad jump, high jump, triple jump, javelin throw, discuss throw, shot put, short and long distance running, Safety education, movement education, effective way of doing day-today activities. First-aid training, coaching for major games and indoor games. Asans and indigenous ways for physical fitness and curative exercises. Exercises and games for leisure time, use and experience.

OTH.5.2: Introductory Agroforestry 2 (1+1)

Agroforestry – definition, objectives and potential. Distinction between agroforestry and social forestry. Status of Indian forests and role in India farming systems. Agroforestry system, sub-system and practice: agri-silviculture, silvipastoral, horti-silviculture, hortisilvipastoral, 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, overseas, MPTS – their management practices, economics of cultivation – nursery and planting (Acacia catechu, Dalbergia sissoo,, Tectona, Populus, Morus, Grewia, Eucalyptus, Quercus spp. and bamboo, tamarind, neem etc.)
Practical:
Identification and seeds and seedlings of multipurpose tree species. Nursery practices for poplar, Grewia optiva, Morus alba, Acacia catechu, Dalbergia sissoo, robinia, leucaena etc. Visit to agro-forestry fields to study the compatibility of MPTS with agricultural crops: silvipastoral, alley cropping, horti-silviculture, agro-silviculture, fuel and fodder blocks. Visit to social forestry plantations – railway line plantations, canal plantations, roadside plantations, industrial plantations and shelterbelts. Rapid assessment of farmers needs for green manure, fodder, fuel wood in selected villages. Economics and marketing of products raised in agro-forestry systems.

OTH.5.3 : Introduction to Major Field Crops 2 (1+1)
Classification and distribution of field crops, definitions and concept of multiple cropping, mixed cropping, intercropping, relay and alley cropping, cultural practices for raising major cereals, pulses, oil seeds and fodder crops, green manuring, crop rotation.

Practical:
Identification of crop plants, seeds and weeds. Preparation of cropping scheme. Application of herbicides in field crops

OTH.6.4: Medicinal and Aromatic Crops 3 (2+1)
History, scope, opportunities and constraints in the cultivation and maintenance of medicinal and aromatic plants in India. Importance, origin, distribution, area, production, climatic and soil requirements, propagation and nursery techniques, planting and after care, cultural practices, training and pruning, nutritional and water requirements. Plant protection, harvesting and processing of under mentioned important medicinal and aromatic plants. Study of chemical composition of a few important medicinal and aromatic plants, extraction, use and economics of drugs and essential oils in medicinal and aromatic plants. Therapeutic and pharmaceutical uses of important species. Medicinal Plants: Betelvine, periwinkle, Rauvolfia, Dioscorea, Isabgol, myrobalans (aonla, harde, baheda), pepper, cardamom, clove, ginger, turmeric, Ammi majus, Belladonna, Cinchona, Pyrethrum, Kalmegh/Kariyatu, Mucuna, Senna, Datura, Liquorice, Ashwagandha, Guggal and other species relevant to local conditions. Aromatic Plants: Citronella grass, khus grass, Sweet flag (baje), lavender, geranium, patchouli, bursera, mentha, musk, Ocimum, rose, jasmine, palmarosa, patchouli and other species relevant to the local conditions.

Practical:
Collection of medicinal and aromatic plants from their natural habitat and study their morphological description, nursery techniques, harvesting, curing and processing techniques and extraction essential oils, visit to medicinal and aromatic plant units.

Note: Warming up and conditioning exercises are compulsory before the commencement of each class.
Details for Horticultural Work Experience for Semesters VII and VIII

It was felt that the graduates coming out must have adequate hands on experience on different aspects of horticulture for which it was decided that the final year programme be restructured to provide for six months of experiential learning and six months of attachment with industry/modern horticulture farm. In order to provide experiential learning it is necessary to have adequate infra structure. It is important to instill entrepreneurship and confidence in taking horticulture as a vocation. The experiential learning need to cover different aspects of horticulture and therefore four areas were identified but institutions would have freedom to have add more areas relevant to their region. Following four areas for experiential learning have been detailed as a model with different activities for learning and evaluation. The identification of areas needs to be based on present day needs, horticulture development scenario in the region and University, industry, private partnership potential. There would also be flexibility in choosing experiential learning areas. Committee recommends undertaking two areas for hands on training. For this purpose the students would be required to prepare a work plan in the area selected with an end-to-end approach i.e. from purchasing the input to producing a product and marketing. It would also have components of project development, monitoring and accounting. Students at the end of completion of project will submit report for evaluation. For this programme an advisor will guide students and the Committee appointed by the Dean of the College should do the evaluation of the project. The evaluation will comprise of skills learnt, proficiency in project execution, project report and viva-voce.

HWE. 7.1 : Horticultural Work Experience 20 (0+20)

The students will spend one full semester in VII Semester working with State Department of Horticulture; Horticulture based industries, commercial horticulture farms, plantation industries including Educational Tour of All India etc. to gain first hand information and experiential learning. Report writing, presentation and viva-voce.
### Experiential Learning:

**HWE 7.1**

<table>
<thead>
<tr>
<th>I. Educational Tour</th>
<th>(0+3)</th>
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</thead>
<tbody>
<tr>
<td>II. Experiential Learning</td>
<td></td>
</tr>
<tr>
<td>1. Farmers’ attachment</td>
<td>(0+2)</td>
</tr>
<tr>
<td>2. State/SAUs Horti. Res. Stns.</td>
<td>(0+3)</td>
</tr>
<tr>
<td>3. NGO working on Horticulture</td>
<td>(0+1)</td>
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<tr>
<td>4. Industrial Placement</td>
<td>(0+3)</td>
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<tr>
<td>Dehydration units, Fertilizer Company,</td>
<td></td>
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<tr>
<td>Pesticides Company, Irrigation Company,</td>
<td></td>
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<tr>
<td>Ayurvedic Pharmaceutical units, Fruit and</td>
<td></td>
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<tr>
<td>Vegetable processing units, Bio-fertilizer and</td>
<td></td>
</tr>
<tr>
<td>Bio-pesticides units.</td>
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<tr>
<td>5. Commercial Horticultural Farms</td>
<td>(0+4)</td>
</tr>
<tr>
<td>Commercial Fruit Orchard/</td>
<td></td>
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<tr>
<td>Commercial Vegetable Farms/</td>
<td></td>
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<tr>
<td>Commercial Floriculture Farms/Nurseries(Green House)</td>
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<tr>
<td>6. Public and Private Units of Medicinal and Aromatic Units</td>
<td>(0+2)</td>
</tr>
<tr>
<td>7. Report Writing, presentation and viva-voce</td>
<td>(0+2)</td>
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</tbody>
</table>

**HWE. 8.1 : Horticultural Work Experience**

The students will spend one full semester in VIII Semester working with hands-on-training in chosen area of interest (any 2 out of 4 area) including professional package and placement in industry. Report writing, presentation and viva-voce.

**Hands On Training/ Experiential Learning:**

Final year B.Sc. (Hort.) students to select any two areas of the following to undergo specialized training.

<table>
<thead>
<tr>
<th>I. Protected cultivation of high value crops</th>
<th>II. Nursery production and management</th>
</tr>
</thead>
<tbody>
<tr>
<td>III. Post harvest technology and value addition</td>
<td>IV. Floriculture and landscape gardening</td>
</tr>
</tbody>
</table>
### Professional Packages: 14 weeks duration

#### I. Protected Cultivation of High Value Horticultural Crops 10 (0+10)

<table>
<thead>
<tr>
<th></th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Visit to commercial poly houses, Project preparation and planning. Specialized lectures by commercial export house</td>
</tr>
<tr>
<td>2</td>
<td>Study of designs of greenhouse structures for cultivation of crops</td>
</tr>
<tr>
<td>3</td>
<td>Land preparation and soil treatment</td>
</tr>
<tr>
<td>4</td>
<td>Planting and production:</td>
</tr>
<tr>
<td></td>
<td>i. Cultural management including soil/media management in poly houses</td>
</tr>
<tr>
<td></td>
<td>ii. Fertigation and irrigation management</td>
</tr>
<tr>
<td></td>
<td>iii. Integrated Pest Management</td>
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<tr>
<td></td>
<td>iv. Harvesting and post harvest management; certification and Distribution</td>
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<tr>
<td></td>
<td>v. Cost of production</td>
</tr>
<tr>
<td>5</td>
<td>Visit to export houses; Market intelligence; Marketing of produce; cost analysis; institutional management</td>
</tr>
<tr>
<td>6</td>
<td>Report writing and viva-voce</td>
</tr>
</tbody>
</table>

#### II Nursery Production and Management 10(0+10)

<table>
<thead>
<tr>
<th></th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Project preparation</td>
</tr>
<tr>
<td>2</td>
<td>Nursery registration, methodology and certification</td>
</tr>
<tr>
<td>3</td>
<td>Establishment and management of plant propagating structures</td>
</tr>
<tr>
<td>4</td>
<td>Establishment of progeny blocks, identification of mother plants and maintenance of bud wood bank</td>
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<tr>
<td>5</td>
<td>Procurement of inputs (pots, polythene, FYM etc.)</td>
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<tr>
<td>6</td>
<td>Techniques and environmental management for large scale production</td>
</tr>
<tr>
<td>7</td>
<td>Packaging and selling of plant material</td>
</tr>
<tr>
<td>8</td>
<td>Working out economics</td>
</tr>
</tbody>
</table>

#### III Post Harvest Technology and Value-Addition 10(0+10)

<table>
<thead>
<tr>
<th></th>
<th>Activity</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Design and project formulation</td>
</tr>
<tr>
<td>2</td>
<td>Design and lay out of pilot plant, cold store, grading – packing line, cool chain</td>
</tr>
<tr>
<td>3</td>
<td>Pre harvest practices to extend shelf life</td>
</tr>
<tr>
<td>4</td>
<td>Quality standards of fruits and vegetables for processing</td>
</tr>
<tr>
<td>5</td>
<td>Procurement of raw material, inventory control</td>
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<tr>
<td>6</td>
<td>Post harvest handling; grading; packaging; cool chain transportation and storage of fresh Produce</td>
</tr>
<tr>
<td>7</td>
<td>Processing (juice/pulp extraction, concentration, product preparation; dehydration; waste Management; In-plant quality control)</td>
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<tr>
<td>8</td>
<td>Packaging (bottling, corking, sealing, labeling, aseptic packaging, storage)</td>
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<td>9</td>
<td>Maintenance, HACCP, International standards, FPO License, PFA standards, codex Laws</td>
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<tr>
<td>10</td>
<td>Sales promotion, certification, distribution and marketing, banking, finance and Institutional management</td>
</tr>
<tr>
<td>11</td>
<td>Work experience in food processing plant</td>
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<tr>
<td></td>
<td>Description</td>
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<td>-------------</td>
</tr>
<tr>
<td>1</td>
<td>Preparation of project report, soil and water analysis, preparation of land and layout.</td>
</tr>
<tr>
<td>2</td>
<td>Production and Management of commercial flowers</td>
</tr>
<tr>
<td>3</td>
<td>Harvesting and post harvest handling of produce</td>
</tr>
<tr>
<td>4</td>
<td>Marketing of produce</td>
</tr>
<tr>
<td>5</td>
<td>Cost Analysis</td>
</tr>
<tr>
<td>6</td>
<td>Institutional Management</td>
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<tr>
<td>7</td>
<td>Visit to Flower growing areas and Export House</td>
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<tr>
<td>8</td>
<td>Attachment with private landscape agencies</td>
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<tr>
<td>9</td>
<td>Planning and designing, site analysis, selection and use of plant material for landscaping</td>
</tr>
<tr>
<td>10</td>
<td>Formal and informal garden, features, styles, principles and elements of landscaping</td>
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<tr>
<td>11</td>
<td>Preparation of landscape plans of home gardens, farm complexes, public parks, institutions, high ways, dams and avenues.</td>
</tr>
<tr>
<td>12</td>
<td>Making of lawns, use of software in landscape,</td>
</tr>
<tr>
<td>13</td>
<td>Making of bouquets, button hole, wreath, veni and gazaras, car and marriage palaces</td>
</tr>
<tr>
<td>14</td>
<td>Dry flower Technology (identification of suitable species, drying, packaging and forwarding techniques)</td>
</tr>
</tbody>
</table>

* For those colleges which fall in the regions where spices and plantation crops are the major crops

** These could be in agriculture faculty in uni-campus universities It is recommended that a student could be allowed to clear the backlog courses after completing experiential learning.

**Features of the New Curriculum**

1. Experiential learning for one year in two specific areas.
2. Increased practical skills through experiential learning.
3. Entrepreneurship development
4. Inclusion of new courses on organic farming, farming systems, IPR international treaties, communication skill development, Horti business management, biotechnology, etc.
5. Providing flexibility in the curriculum in the final year.