

DEPARTMENT OF HORTICULTURE

H.N.B. Garhwal University, Srinagar (Garhwal), Uttarakhand, India-246 174

Course Curriculum for M. Sc. Horticulture/ M. Sc. (Ag.) Horticulture, 2011-12

Course offered

Core Courses

Course No.	Course Title	Credits
SOA/HC 501	Plant Propagation and Nursery Management	3 (2-0-1)
SOA/HC 502	Advances in Orchard Management	3 (2-0-1)
SOA/HC 503	Systematic Horticulture	3 (2-0-1)
SOA/HC 504	Advances in Pomology : Tropical and Subtropical Fruits	3 (2-0-1)
SOA/HC 505	Statistical Methods and Experimental Designs	4 (3-0-1)
SOA/HC 506	Advances in Temperate- Zone Pomology	3 (2-0-1)
SOA/HC 507	Advances in Olericulture	3 (2-0-1)
SOA/HC 508	Canopy Management in Fruits Crops	3 (2-0-1)
SOA/HC 509	Biotechnology of Horticultural Crops	3 (2-0-1)
SOA/HC 510	Advances in Breeding of Fruits and Plantation Crops	3 (2-0-1)
SOA/HC 511	Advances in Post- Harvest Technology and Management of Fruits and Vegetables	3 (2-0-1)
SOA/HC 512	Protected Cultivation of Horticultural Crops	3 (2-0-1)
SOA/HC 513	Advances in Floriculture and Landscaping	3 (2-0-1)
SOA/HC 514	Seminar	01 (0-0-1)
SOA/HC 515	Thesis Research	15(0-0-15)
	Total	56(27-0-29)

Elective Courses

Course No.	Course Title	Credits
SOA/HE 516	Growth and Development of Plants	3 (2-0-1)
SOA/HE 517	Advances in Breeding of Vegetable Crops	3(2-0-1)
SOA/HE 518	Dry Land Horticulture	3(2-0-1)
SOA/HE 519	Biotic and Abiotic Stress Management in Horticultural Crops	3 (2-0-1)
SOA/HE 520	Advances in Breeding of Ornamental Crops	3 (2-0-1)
SOA/HE 521	Organic Horticulture	3(2-0-1)
	Total	18(12-0-6)

Self Study Courses

Course No.	Course Title	Credits
SOA/HS 522	Self Study Courses	3
	Total	3

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Course offered

Course no.	Paper Title	Total marks	Theory marks		Practical marks	credits
			I	E		
Semester I						
SOA/HC 501	Plant Propagation and Nursery Management	100	80 (20	+ 60)	20	2+1
SOA/HC 502	Advances in Orchard Management	100	80 (20	+ 60)	20	2+1
SOA/HC 503	Systematic Horticulture	100	80 (20	+ 60)	20	2+1
SOA/HC 504	Advances in Pomology : Tropical and Subtropical Fruits	100	80 (20	+ 60)	20	2+1
SOA/HC 505	Statistical Methods and Experimental Designs	100	80 (20	+ 60)	20	3+1
	Total	500	400(100	+ 300)	100	16(11+5)
Semester II						
SOA/HC 506	Advances in Temperate- Zone Pomology	100	80 (20	+ 60)	20	2+1
SOA/HC 507	Advances in Olericulture	100	80 (20	+ 60)	20	2+1
SOA/HC 508	Canopy Management in Fruits Crops	100	80 (20	+ 60)	20	2+1
SOA/HC 509	Biotechnology of Horticultural Crops	100	80 (20	+ 60)	20	2+1
SOA/HC 510	Advances in Breeding of Fruits and Plantation Crops	100	80 (20	+ 60)	20	2+1
	Total	500	400(100	+ 300)	100	18(13+05)
Semester III						
SOA/HC 511	Advances in Post- Harvest Technology and Management of Fruits and Vegetables	100	80 (20	+ 60)	20	2+1
SOA/HC 512	Protected Cultivation of Horticultural Crops	100	80 (20	+ 60)	20	2+1
SOA/HC 513	Advances in Floriculture and Landscaping	100	80 (20	+ 60)	20	2+1
SOA/HE 516	Growth and Development of Plants	100	80 (20	+ 60)	20	2+1
SOA/HE 517	Advances in Breeding of Vegetable Crops	100	80 (20	+ 60)	20	2+1
SOA/HE 518	Dry Land Horticulture	100	80 (20	+ 60)	20	2+1
SOA/HS 522	Self Study Courses					3
	Total	500	400(100	+ 300)	100	18(12+06)

Course no.	Paper Title	Total marks	Theory marks			Practical marks	credits
			I		E		
Semester IV							
SOA/HE 519	Biotic and Abiotic Stress Management in Horticultural Crops	100	80 (20	+	60)	20	2+1
SOA/HE 520	Advances in Breeding of Ornamental Crops	100	80 (20	+	60)	20	2+1
SOA/HE 521	Organic Horticulture	100	80 (20	+	60)	20	2+1
SOA/HC 514	Seminar	100					0+1
SOA/HC 515	Thesis	200					0+15
	Total	600	240(60	+	180)	60	25(06+19)

I - Internal Assessment

E - External Assessment

Syllabus for M.Sc. Horticulture/ M.Sc.(Ag.) Horticulture 2011-

12

SOA/HC 501: Plant Propagation and Nursery Management

Introduction, life cycle in plants, cellular basis for propagation, apomixis, polyembryony, germination process and environmental factors affecting it, quality of seeds, seed dormancy, treatments to facilitate germination, seed testing, diseases control during germination.

Clone and phase variation, genetic variation in asexually propagated plants, production and maintenance of pathogen free clones, cutting- anatomical, physiological and biochemical aspects of root initiation in cuttings, types of cuttings, use of bioregulators, mist systems of rooting cuttings, planting and care, layering- principles and methods.

Reasons for grafting and budding, categories of root-stock, formation of graft and bud union, factors influencing the healing of graft union, limits of grafting, graft incompatibility, scion-stock relationship, techniques of grafting, budding and layering.

Micro propagation: Introduction, objectives, merits and demerits, facilities and equipments, aseptic techniques and use of antibiotics, media preparation, micro propagation techniques- clonal propagation, direct organogenesis, embryogenesis, meristem culture culture, micro grafting, hardening, packing and transport of micropropagules.

Nursery Management: types of nursery, location, components planning and layout of a commercial nursery, structures, media mixtures, nursery management practices

Practicals- Practice of grafting, budding, cutting and layering, anatomical studies of rooting of cuttings and grafting union, planning and layout for commercial nursery, sample seed testing, use of bioregulators in propagation, sterilization of equipments and laboratory, media preparation, selection and preparation of explants, meristem culture and micro grafting, planning and layout of experiments on various aspects of propagation. Visit to tissue culture labs and nurseries.

SOA/HC 502: Advances in Orchard Management

Importance and scope of orchard management, constraint in fruit production, concept of high density planting.

Orchard soil management systems, water requirement of fruit trees, factors affecting water requirement, classification of soil moisture, effect of soil moisture on fruit trees, disorders due to excess and deficient moisture, various factors affecting moisture supply to plants, drip and sprinkler irrigation, fertigation, multistory cropping, drainage systems, organic manures, fertilizers and bio fertilizers, role of elements in fruit production, disorders due to excess and deficiency of elements, evaluating need for nutrients/tissue analysis; integrated nutrient management(INM),

Recent techniques of training and pruning, fruit thinning, splitting of fruits, preharvest fruit drop, rejuvenation of old orchards. Internal and external factors of unfruitfulness, practices to induce flowering; irregular bearing of fruit trees.

Hardiness, winter killing, injuries and their protection, IPM, protection from important insects and diseases.

Practicals- Study of different systems of layout, planting, study of drip and sprinkler irrigation, identification and control of important diseases and insects, soil and foliar application of fertilizers, study of deficiency symptoms of elements, practice of pruning and training, rejuvenation of old orchards, tissue analysis, physical practices to induce flowering, use of bioregulators, cost of cultivation of an orchard, visit to important orchards and Fruit Research Stations.

SOA/HC 503: Systematic Horticulture

Introduction, importance and scope, botanical terminology. Plant classification history and systems- artificial, natural and modern systems. Nomenclature: importance, binomial classification and its salient features.

Morphological description of (vegetative, floral and fruit features) of the following important families of fruits, vegetables and ornamental crops:-

Anacardiaceae - Mango, Cashewnut; Rutaceae- Citrus, . Murrayas, Kamini; Musaceae- Banana; Myrtaceae- Guava, Bottle brush, Rosaceae- Apple, Pear, Plum, Peach, Apricot, Loquat, Rose; Apocyanaceae- Karonda, Kaner, Chandini; Vitaceae- Grapes; Sepindaceae- Litchi; Caricaceae- Papaya; Brassicaceae- cauliflower, cabbage, Radish, Turnip; Cucurbitaceae- Cucurbits; Solanaceae- Brinjal, Tomato, Chillies, Potato, Rat-ki-rani; Leguminaceae- Peas, Beans, Kachnar, Ashok, Cassia; Malvaceae- Bhindi, Hibiscus; Euphorbiaceae- Achalipha, Poinsettia, Croton; Nyctaginiaeeae-Bougainvillea; Rubiaceae- Hamelia, Mussanda, Ixoraparviflora; Ramnaceae- Ber; Amaryllidaceae- Onion, Garlic.

Practicals- Identification and botanical description (vegetative and floral features) of available fruits, vegetables and ornamental plants.

SOA/HC 504: Advances in Pomology: Tropical and Subtropical Fruits

Introduction, prospects and scope, constraints of fruit industry.

Origin and distribution, area and production, taxonomy, classification and description of important cultivars, nutrition, bearing habit, pollination and fruit set, use of bioregulators, special problems and physiological disorders in the production of the following fruits:

Tropical and subtropical fruits- Mango, Citrus fruits, Banana, Guava, Grape, Litchi, Papaya, Pine-apple, Jack-fruit.

Minor fruits- Ber, Aonla, Pomegranate, Loquat, Sapota, Phalsa, Bael, Karonda,

Practicals- Identification and morphological features of important cultivars of fruit, effect of bioregulators, practice of commercial propagation techniques, moisture conservation techniques, pollen germination, study of mango malformation, guava wilt, citrus decline, blossom biological studies, visit to Fruit Research Centres.

SOA/HC 505: Statistical Methods and Experimental Designs

Sampling theory- introduction, simple random sampling, estimates of sampling variance, stratified random sampling, two stage sampling, systematic sampling, estimate of proportions.

Test of hypothesis- introduction, one sample t-test and two sample t- test. Chisquare test- properties, testing significance of properties, testing independence of tributes Bartlett test, (F- Test).

Correlation- coefficient of correlation, test of significant, Fisher's Z- transformation, rank correlation, intraclass correlation. Regression- regression curve, fitting of line regression.

Need for an experiments, designing of an experiment, experimental error, principles of experimental design, analysis of designed experiments- analysis of variance, mathematical details, assumptions, transformation and anova table, pairwise comparisons and specific comparisons of treatments.

Completely randomized design- layout, application, merits and demerits, analysis of equal and unequal observations. Randomized block design- layout, application, merits and demerits, analysis, efficiency of blocking. Latin square design- layout, application, merits and demerits, analysis, change over design. Analysis of covariance for reduction of experimental error in CRD, RBD and L. S. designs. Split plot and related designs layout, application, merits and demerits, analysis, efficiency, variants of split plot design, strip plot design. Factorial experiments- concept of factorial treatments, definition of main effects and interrelations, analysis of series using Yates method.

Practicals- Practicals based on above topics.

SOA/HC 506: Advances in Temperate-Zone Pomology

Introduction, scope, area and production, temperate regions, contour planting, rest period and chilling requirement.

Origin and distribution, area and production, taxonomy, classification and description of important cultivars, clonal rootstocks, training techniques, bearing habit, pollination and fruit set, use of bioregulators, special problems and physiological disorders of the following fruits:

Pome Fruits- Apple and Pear

Stone Fruits- Peach, Plum, Apricot, Cherry and Almond

Nut Fruits- Walnut, Pecannut, Hazelnut and Pistachio etc.

Berries- Strawberry, Raspberry, Gooseberry

Kiwi fruit

Exposure to wild fruits of Uttarakhand hills.

Practicals- Identification and morphological features of temperate fruits, practice of contour planting, commercial propagation methods, pollen collection and germination, pruning and training, use of bioregulators, visit to Temperate Fruit Research Stations.

SOA/HC 507: Advances in Olericulture

Introduction, types of vegetable farming, vegetable forcing, bioregulators in vegetable production, principles of vegetable seed production.

Origin and distribution, area and production, taxonomy, classification and description of cultivars, use of bioregulators, seed production, specific problems and physiological disorders of the following vegetables:

Solanaceous Vegetables- Potato, Tomato, Brinjal, Chilli, Capsicum

Root Vegetables- Radish, Turnip, Carrot

Cole Vegetables- Cauliflower, Cabbage, Knol-khol

Legume Vegetables- Peas and French bean

Bulb Vegetables- Onion, Garlic

Cucurbits- Cucumber, Water melon, Bottle gourd, Sponge gourd, Musk melon, Pumpkin

Leafy Vegetables- Spinach, Amaranthus

Okra and Sweet Potato

Practicals- Identification and morphological features of vegetables, seed production techniques, study of disorders, use of bioregulators, basal and foliar application of nutrients, cost of vegetable cultivation, experimental trials, visit to vegetable seed production centres and processing units.

SOA/HC 508: Canopy Management in Fruits Crops

Canopy management - importance and advantages; factors affecting canopy development.

Canopy types and structures with special emphasis on geometry of planting, canopy manipulation for optimum utilization of light. Light interception and distribution in different types of tree canopies.

Spacing and utilization of land area - Canopy classification; Canopy management through rootstock and scion.

Canopy management through plant growth inhibitors, training and pruning and management practices.

Canopy development and management in relation to growth, flowering, fruiting and fruit quality in temperate fruits, grapes, passion fruits, mango, sapota, guava, citrus and ber.

Practicals- Study of different types of canopies, training of plants for different canopy types, canopy development through pruning, use of plant growth inhibitors, geometry of planting; study on effect of different canopy types on production and quality of fruits.

SOA/HC 509: Biotechnology of Horticultural Crops

Harnessing bio-technology in horticultural crops, influence of plant materials, physical, chemical factors and growth regulators on growth and development of plant cell, tissue and organ culture.

Callus culture – types, cell division, differentiation, morphogenesis, organogenesis, embryogenesis.

Use of bioreactors and in vitro methods for production of secondary metabolites, suspension culture, nutrition of tissues and cells, regeneration of tissues, ex vitro, establishment of tissue cultured plants.

Physiology of hardening - hardening and field transfer, organ culture – meristem, embryo, anther, ovule culture, embryo rescue, somaclonal variation, protoplast culture and fusion.

Construction and identification of somatic hybrids and cybrids, wide hybridization, in vitro pollination and fertilization, haploids, in vitro mutation, artificial seeds, cryopreservation, rapid clonal propagation, genetic engineering in horticulture crops, use of molecular markers. In vitro selection for biotic and abiotic stress, achievements of biotechnology in horticultural crops.

Practicals- An exposure to low cost, commercial and homestead tissue culture laboratories, media preparation, inoculation of explants for clonal propagation, callus induction and culture, regeneration of plantlets from callus, sub-culturing, techniques on anther, ovule, embryo culture, somaclonal variation, in vitro mutant selection against abiotic stress, protoplast culture, fusion technique, development of protocols for mass multiplication, project development for establishment of commercial tissue culture laboratory.

SOA/HC 510: Advances in Breeding of Fruits and Plantation Crops

Importance, objectives of fruit breeding; principles, prospects and problems, methods of improvement-introductions, clonal selection, hybridization, mutation, polyploidy, heterosis and back cross.

Centre of diversity, germplasm resource, breeding objectives, early development, inheritance of characters, problems and advances made in the following fruits and plantation crops:

Fruits- Mango, Citrus fruits, Jackfruit, Grape, Apricot, Apple, Cherry, Banana, Litchi, Peach, Almond, Papaya, Guava, Aonla, Pomegranate, Plum and Strawberry.

Plantation crops- Tea, Coffee, Coconut, Arecanut, Cocoa, Rubber and Cashewnut

Practicals- Studies on floral biology, practice of pollination procedures, hybridization, and use of mutagens.

SOA/HC 511: Advances in Post- Harvest Technology and Management of Fruits and Vegetables

Introduction, post harvest physio-biochemical changes; causes of post harvest losses, control of post harvest losses- proper cultural operations, pre-storage treatments, transportation, storage, environmental control, ionizing radiation, post harvest chemical treatments, storage of fresh fruits and vegetables, factor affecting storage quality, storage disorders, marketing of fruits and vegetables and their products.

History, objectives and scope of fruit and vegetable preservation, spoilage of fruits and vegetables, principles of preservation- temporary and permanent; vitamins and other nutrients in preserved products, food additives and their use in preservation. Principles and guidelines for establishing processing unit.

Containers: Types, merits and demerits, composition and manufacturing of tin and glass containers, failures in glass containers, general principles and procedures of canning and bottling, spoilage of canned products.

Principles and methods of jam, jelly and marmalade; theories of jelly formation, failures of jelly; unfermented fruit and vegetable beverages, juice extraction equipments, general methods of preparation and preservation, preservation of unfermented beverages.

General methods of making preserve and candy from some suitable fruits and vegetables, preparation of pickles, chutneys, sauces, ketchup, soup and cocktail from suitable fruits and vegetables, causes of spoilage.

Vinegar- quality standards, types, material processing and fermentation, methods of preparation, post-production processes, spoilage; pectin preparation.

Sun drying- merits and demerits, procedure; mechanical dehydration of fruits and vegetables, home and commercial dehydrators, packing and storage.

Preservation by freezing- objectives, freezing and growth of micro-organisms, freezing process, storage of frozen products; exposure on preservation by radiation.

Government policies, regulation and specifications for fresh and processed products.

Practicals- Identification of equipments used in preservation, canning of fruits and vegetables, cut out test for canned products, preparation of jam, jelly, squash, juice, preserve, chutney, ketchup, sauce, pickle; dehydration of potato, estimation of acidity, vitamin C, sugar, juice content and T.S.S., visit to processing factories.

SOA/HC 512: Protected Cultivation of Horticultural Crops

Introduction, history, present status, importance, problems and prospects of protected cultivation. Types and designs of protected structures and their management. Environment control in protected structures. Growing media and sterilization. Soilless cultivation, hydroponics and aeroponics. Irrigation and fertigation. Integrated insect pest and disease management

Vegetable seedlings production under protection. Protected cultivation of crops (media, bed preparation, varieties, planting, irrigation and fertigation, harvesting, specific operation for different crops and economics) rose, carnation, gerbera, orchids, anthurium, lily, chrysanthemum, capsicum, tomatoes, exotic vegetables, potted ornamental plants.

Post harvest management of flowers and vegetable (sorting, grading, packing, storage, transportation and marketing).

Practicals- Study of different protected structures, cladding materials used, installation and their management. Study of environment control devices used in protected structures and measurement of temperature, RH, light and CO₂. Study of growing media and sterilization. Study of irrigation and fertigation system and their management. Soilless cultivation. Hydroponics and aeroponics. Vegetable seedlings production under protection. Cultivation of Crops under protected environment: Rose, Carnation, Gerbera,

Orchid and Anthurium, Liliium and chrysanthemum, Capsicum, Tomatoes, Exotic vegetables. Post harvest management of flowers and vegetable. Study of insect pests and diseases and their control. Visit to commercial green house projects.

SOA/HC 513: Advances in Floriculture and Landscaping

History, importance and scope, problems and prospects, styles of gardening, formal garden and its important parts.

Landscaping- general principles, planning and designing, important elements, landscaping public buildings, educational institutions, factories, historical places.

Bio-aesthetic planning , bonsai culture, flower forcing, role of colour in floriculture, exhibition, post harvest management.

Origin and distribution, area and production, taxonomy and morphological features, classification and description of some important cultivars, propagation, special practices and problems, use of bioregulators:

Rose	Gladious	Carnation	Tuberose	Marigold
Gerbera	Chrysanthemum	Dahlia	Bougainvillea	Jaismines

Practicals- Identification of ornamental species, preparation of bonsai, use of bioregulators, judging, practice to conserve the life of cut flowers, morphological features of some ornamental plants, wintering in roses, preparation of shrubbery and herbaceous borders, propagation techniques, planning and layout for a garden, cost of cultivation of commercial flowers, visit to Ornamental Gardens.

SOA/HE 516: Growth and Development of Plants

Introduction- terminology, importance and scope, growth and its phases, growth curve, growth regions, environmental affecting growth, apical organization and meristems in growth, apical dominance. Seed germination, seed dormancy- types and causes, growth substances and seed dormancy, environmental controls, breaking dormancy; bud dormancy- hormonal control, morphological aspects; juvenility and vegetative growth

Study of Auxin, Gibberellins, Cytokinins, Ethylene, Inhibitors (ABA) under the following heads:

(i) Origin and history (ii) Natural and synthetic forms(iii) Biosynthesis and chemical nature(iv) Extraction and identification(v) Mode of action(vi) Transport of growth regulators (vii) Functions or effects on plants.

Flower initiation and development: photoperiodism and its effects, florigen concept; vernalization- kinetics, response, types, vernalization stimulus, devernalization; physiology and chemical induction of flowering, sex expression and alteration; tuber, bulb and corm formation. Pollination and fruit-set, growth and development of fruits, parthenocarpy and seedlessness, maturity and ripening. Climacteric and non-climacteric fruits.

Senescence- chemical changes, causes, plant and organ senescence, regulating system in senescence; abscissions. Tropism: phototropism and geotropism.

Practicals- Study of growth and its measurements, preparation and mode of application of bioregulator solutions, effect of bioregulators on morphological and anatomical changes in plants, growth regulators in fruit set and development, bioregulators in breaking dormancy, induction of parthenocarpic fruits, fruit ripening, bioassays.

SOA/HE 517: Advances in Breeding of Vegetable Crops

History, principles, problems and prospects of vegetable improvement. Biodiversity and conservation. Introduction, selection including clonal selection and hybridization, mutation breeding, polyploidy and heterosis breeding for specific purposes like productivity, resistance to biotic and abiotic stresses and processing. Recent advances in breeding including biotechnological approaches. Cytogenetics, breeding objectives, inheritance, early achievement and advances made in the following vegetables:

Solanaceous, cole crops, legumes, bulb crops, root vegetables, tuber crops, leafy vegetables and cucurbits.

Practicals- Floral biology, pollination mechanism, selfing and crossing procedures, hybridization techniques working out phenotypic and genotypic variability, pcv, gcv heritability, genetic advance, preparation and use of chemicals and physical mutagens, polyploidy breeding, techniques of F₁ hybrid seed production, maintenance of breeding record.

SOA/HE 518: Dry Land Horticulture

Definition, importance and limitations of dry land horticulture, present status and future scope.

Constraints encountered in dry lands. Agro-climatic features in rain shadow areas, scarce water resources, high temperature, soil erosion, run-off losses etc.

Techniques of development 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 - microcatchments, different types of tree basins etc.

Methods of reducing evapo-transpiration - use of shelter belts, mulches, anti-transpirants, growth regulators etc. Water use efficiency - need-based, economic and conjunctive use of water, micro systems of irrigation etc.

Selection of plants/crops having drought resistance/ tolerance characteristics. Special techniques of planting and after care - use of seedling races, root stocks, in situ grafting, deep pitting/planting, canopy reduction etc.

Practicals- Study of rainfall patterns. Contour bunding/trenching, micro catchments, soil erosion and its control. Study of evapo-transpiration, mulches and micro irrigation systems. Special techniques of planting and after care in dry lands. Study of morphological and anatomical features of drought tolerant crops.

SOA/HE 519: Biotic and Abiotic Stress Management in Horticultural Crops

Stress – definition, classification, stresses due to water (high and low), temperature (high and low), radiation, wind, soil conditions (salinity, alkalinity, ion toxicity, fertilizer toxicity, etc.).

Pollution - increased level of CO₂, industrial wastes, impact of stress in horticultural crop production, stress indices, physiological and biochemical factors associated with stress, horticultural crops suitable for different stress situations.

Crop modeling for stress situations, cropping system, assessing the stress through remote sensing, understanding adaptive features of crops for survival under stress, interaction among different stress and their impact on crop growth and productivity.

Greenhouse effect and methane emission and its relevance to abiotic stresses, use of anti transpirants and PGRs in stress management, mode of action and practical use, HSP inducers in stress management techniques of soil moisture conservation, mulching, hydrophilic polymers.

Rain water harvesting, increasing water use efficiency, skimming technology, contingency planning to mitigate different stress situations, cropping systems, stability and sustainability indices.

Practicals- Seed treatment /hardening practices, container seedling production, analysis of soil moisture estimates (FC, ASM, PWP), analysis of plant stress factors, RWC, chlorophyll fluorescence, chlorophyll stability index, ABA content, plant waxes, stomatal diffusive resistance, transpiration, photosynthetic rate etc. under varied stress situations, influence of stress on growth and development of seedlings and roots, biological efficiencies, WUE, solar energy conversion and efficiency, crop growth sustainability indices, economics of stress management, visit to orchards and water shed locations.

SOA/HE 520: Advances in Breeding of Ornamental Crops

Principles-Evolution of varieties, origin, distribution, genetic resources, genetic divergence- Patents

Genetic inheritance of flower colour, doubleness, flower size, fragrance, post harvest life.

Breeding methods suitable for sexually and asexually propagated flower crops and ornamental plants-- introduction, selection, domestication, polyploid and mutation breeding for varietal development, Role of heterosis, Production of hybrids, Male sterility, incompatibility problems, seed production of flower crops.

Breeding constraints and achievements made in commercial flowers - rose, jasmine, chrysanthemum, marigold, tuberose, crossandra, carnation, dahlia, gerbera, gladioli, orchids, anthurium, aster, heliconia, liliiums, nerium.

Breeding constraints and achievements made in ornamental plants – petunia, hibiscus, bougainvillea, Flowering annuals (zinnia, cosmos, dianthus, snap dragon, pansy) and ornamental foliage-- Introduction and selection of plants for waterscaping and xeriscaping.

Practicals- Description of botanical features-- Cataloguing of cultivars, varieties and species in flowers, floral biology, selfing and crossing, evaluation of hybrid progenies, seed production-Induction of mutants through physical and chemical mutagens, induction of polyploidy, screening of plants for biotic, abiotic stresses and environmental pollution, *in vitro* breeding in flower crops and ornamental plants.

SOA/HE 521: Organic Horticulture

Organic horticulture – definition, synonyms and misnomers, principles, methods, merits and demerits.

Organic farming systems, components of organic horticultural systems, different organic inputs, their role in organic horticulture, role of biofertilizers, biodynamics and the recent developments.

EM technology and its impact in organic horticulture, indigenous practices of organic farming, sustainable soil fertility management, and weed management practices in organic farming, biological/natural control of pests and diseases, organic horticulture in quality improvement. GAP - Principles and management, HACCP exercise, certification of organic products and systems, agencies involved at national and international levels, standards evolved by different agencies.

Constraints in certification, organic horticulture and export, IFOAM and global scenario of organic movement, post-harvest management of organic produce.

Practicals- Features of organic orchards, working out conversion plan, Input analysis manures, nutrient status assessment of manures, biocomposting, biofertilizers and their application, pancha gavya preparation and other 20 organic nutrients application, methods of preparation of compost, vermicompost, green manuring, preparation of neem products and application, BD preparations and their role, EM technology and products, biological/natural control of pests and diseases, soil solarization, frame work for GAP, case studies, HACCP analysis, residue analysis in organic products, documentation for certification, visit to fields cultivated under organic practices.

Thesis: Objective and evaluation

Aim of introducing thesis in M. Sc.(Ag.) Horticulture is to give the students preliminary exposure for conducting the research and presenting its findings systematically and scientifically in a manuscript shape. To fulfill this goal, a specific topic for thesis research shall be assigned to each M. Sc. student by the teacher(s)/supervisor(s) of the department, in the first semester. The student will carry out the research for thesis under the respective supervisor(s) and finally present it in a book shape called thesis.

Each student will submit the thesis to the department/university towards the end of fourth semester of M. Sc. (Ag.) Horticulture degree.

Evaluation of Thesis:

The procedure will be as under:

- i. Critical examination of thesis by the external expert appointed by the university as per specialization of thesis work.
- ii. Each student shall give open presentation of thesis work before external/internal examiners, faculty members and students in the department.