

**(iii) M.Sc. (Hort.) Floriculture and Landscaping
Major Courses**

Course Code	Course Title	Credit hours
Major Courses (20 Credits)		
Semester-I		
FLS-511*	Systematic of Ornamental Plants	2+1
FLS-512*	Commercial Production of Loose Flowers	2+1
FLS-513*	Ornamental Gardening and Landscaping	2+1
FLS-514	Turf Grass Management	2+1
Semester-II		
FLS-521*	Commercial Production of Cut Flowers	2+1
FLS-522*	Breeding of Ornamental Plants	2+1
FLS-523	Protected Cultivation of Flower Crops	2+1
FLS-524	Nursery Management in Ornamental Plants	2+1
Semester-III		
FLS-531	Seed Production in Flower Crops	1+1
FLS-532	CAD for Landscaping	1+2
FLS-533	Value Addition in Floriculture	2+1
FLS-534	Indoor Plants and Interiorscaping	1+1
FLS-591	Seminar	1+0
Semester-IV		
FLS-599	Research	0+30

* **Core and compulsory courses.**

Note: A student has to opt total 20 credit hours from Major Courses.

Syllabus of Major courses of Floriculture and Landscaping

FLS-511 SYSTEMATICS OF ORNAMENTAL PLANTS (2+1)

THEORY

Block I: Nomenclature

UNIT I: Nomenclature: History, origin, hotspots, classification and nomenclature systems
UNIT II: International systems: International Code, Treaties, International and National Organisations, Biodiversity Act, Identification features, descriptors.

UNIT III: Red Book, Registration (NBPGR, PPVFRA, NBA)

Block 2: Families

UNIT I: Families: Description and families and important genera Rosaceae, Asteraceae, Caryophyllaceae, Orchidaceae, Aracaceae, Liliaceae,

UNIT II: Acanthaceae, Palmaceae, Asparagaceae, Malvaceae, Musaceae, Oleaceae, Iridaceae.

Block 3: Molecular techniques

UNIT I: Molecular techniques in modern systematics

PRACTICALS (16)

1. Different nomenclature systems of plants (2)
2. Floral biology and taxonomic description of rose, chrysanthemum, orchids, carnation, gerbera, anthurium, marigold, tuberose, Jasmine, China aster, liliium, gypsophila (6).
3. Cyropreservation and tissue culture repository (4)
4. Molecular techniques (4)

RESOURCES

- Bhattacharya, B. & Johri, B.M. 2004. *Flowering Plants: Taxonomy and Phylogeny*. Narosa Publ. House, New Delhi, India. pp.753.
- Dutta, A.C. 1986. *A Class Book of Botany*. Oxford Univ. Press, Kolkata, India. Pandey, B.P. 2013. *Taxonomy of Angiosperms*. S. Chand & Co. pp. 608
- Rajput, C.B.S. & Haribabu, R.S. 2014. *Citriculture*, Kalyani Publ., New Delhi, India. Spencer, R.R., Cross, R. & Lumley, P. 2007. *Plant Names*. 3rd Ed. *A Guide to Botanical Nomenclature*. CSIRO Publ., Australia., 176 p.
- Vasistha, B.B. 1998. *Taxonomy of Angiosperms*. Kalyani Publ., New Delhi, India.

FLS-512 COMMERCIAL PRODUCTION OF LOOSE FLOWERS (2+1)

THEORY

Block 1: Production management

UNIT I: Scope and scenario: Scope, scenario and importance of loose flowers, constraints and opportunities in loose flower production

UNIT II: Growing environment: Nursery management, pro-tray nursery under shade nets, soil and climate requirement, Field preparation, systems of planting.

UNIT III: Crop management: Soil analysis, soil health card, water and nutrient management, weed management, training and pruning, special horticultural practices such as pinching and disbudding, use of growth regulators, physiological disorders and remedies, INM, IPM and IDM.

UNIT IV: Crop regulation: Flower forcing and year round flowering, production for special occasions through physiological interventions, chemical regulation.

Block 2: Post harvest management and marketing

UNIT I: Post harvest management: Harvest indices, harvesting techniques, post-harvest handling and grading, pre-cooling, packaging and storage

UNIT II: Marketing: Important local markets, Export potential, transportation and marketing, APMC and online trading, institutional support, Crop Insurance

Crops: Rose, jasmine, chrysanthemum, marigold, tuberose, China aster, crossandra, gaillardia, spider lily, hibiscus, Nerium, barleria, celosia, gomphrena, Madar (*Calotropis gigantea*), nyctanthes (Harsingar), Ervatamia (Chandani), ixora, lotus, water lily, Michelia (Champa), gardenia, Ixora and balsam.

PRACTICALS (16)

- Identification of species and varieties (1)
- Propagation and nursery management (1)
- Training and pruning techniques (1)
- Fertigation, foliar nutrition, growth regulator application (2)
- Crop protection (2)
- Pinching, disbudding, staking, harvesting techniques (1)
- Post-harvest handling, storage and cold chain (2)
- Project preparation for regionally important commercial loose flowers. crop specific guidelines for project financing (NHB guidelines) (2)
- Cost Economics (2)
- Exposure Visits to fields (2)

RESOURCES

Arora, J. S. 2010. *Introductory Ornamental Horticulture*. Kalyani Publi. 6th Edition, pp. 230.

Bhattacharjee, S. K. 2018. *Advances in Ornamental Horticulture*. Vols. I-VI. Pointer Publ. Reprint, pp. 2065.

Bose, T. K. Maiti, R.G., Dhua, R.S. & Das, P. 1999. *Floriculture and landscaping*. Naya Prokash, Kolkata, India.

Bose, T. K. & Yadav, L. P. 1989. *Commercial Flowers*. Naya Prokash, Kolkata, India. Chadha, K.

L. & Bhattacharjee, S. K. 1995. *Advances in Horticulture: Ornamental Plants*.

- Vol. XII, Parts 1 & 2. pp. 533, pp. 574. Malhotra Publ. House, New Delhi, India.
- Chadha, K. L. & Chaudhury, B.1992. *Ornamental Horticulture in India*. ICAR, New Delhi, India.
- Laurie, A. & Rees, V. H. 2001. *Floriculture-Fundamentals and Practices*. Agrobios Publ., Jodhpur. pp.534.
- Prasad, S. & Kumar, U. 2003. *Commercial Floriculture*. Agrobios Publ., Jodhpur. Randhawa, G. S. & Mukhopadhyay, A. 2001. *Floriculture in India*. Allied Publ. pp 660.
- Sheela, V. L. 2008. *Flowers for Trade*. Horticulture Science Series, vol.10, pp. 392. New India Publ. Agency, New Delhi, India.

FLS-513 ORNAMENTAL GARDENING AND LANDSCAPING (2+1)

THEORY

Block 1: Gardens and components

UNIT I: Styles and types of gardens: Historical background of gardening, Importance and scope of ornamental gardening, styles and types of gardens, formal and informal style gardens. English, Mughal, Japanese, Persian, Spanish, Italian, French, Hindu and Buddhist gardens.

UNIT II: Garden components: Garden components (living and non-living): arboretum, shrubbery, fernery, palmatum, arches and pergolas, edges and hedges, climbers and creepers, cacti and succulents, herbs, annuals, flower borders and beds, ground covers, carpet beds, colour wheels, clock garden, bamboo groves, bonsai; Non-living components like- path, garden gate, fencing, paving and garden features like fountains, garden seating, swings, lanterns, basins, bird baths, sculptures, waterfalls, bridge, steps, ramps, Lawn -genera and species, establishment and maintenance.

UNIT III: Specialized gardens: Specialized gardens such as vertical garden, roof garden, terrace garden, water garden, sunken garden, rock garden, shade garden, temple garden, sacred gardens (with emphasis on native plants), Zen garden.

Block 2: Landscape planning

UNIT I: Principles and elements of landscaping: Basic drawing skills, use of drawing instruments garden symbols, steps in preparation of garden design, programmes phase, design, phase, etc.

Elements and principles of landscape design. Organization of spaces, visual aspects of plan arrangement-view, vista and axis. Principles of circulation, site analysis and landscape, water requirement, use of recycled water

UNIT II: Landscaping for different situations: Urban landscaping, Landscaping for specific situations such as residential, farm houses, institutions, corporate sector, industries, hospitals, roadsides, traffic islands, Children parks, public parks, xeriscaping, airports, railway station and tracks, river banks and dam sites and IT/ SEZ parks. Bio-aesthetic planning, eco- tourism, theme parks, indoor gardening, therapeutic gardening,

PRACTICALS (16)

- Graphic language and symbols in landscaping, study of drawing instruments viz., 'T' square, setsquare, drawing board, etc. (1)
- Identification of various types of ornamental plants for different gardens and occasions (1)
- Preparation of land, planning, layout and planting, deviations from landscape principles (1)
- Case study (1)
- Site analysis, interpretation of map of different sites, use of GIS for selection (1)
- Enlargement from blue print. Landscape design layout and drafting on paper as per the scale (2)
- Preparation of garden models for home gardens, farm houses, industrial gardens, institutional gardens, corporate, avenue planting, practices in planning and planting of special types of gardens.(3)
- Burlapping, lawn making, planting of edges, hedges, topiary, herbaceous and shrubbery borders (2)
- Project preparation on landscaping for different situations, creation of formal and informal gardens (2)
- Visit to parks and botanical gardens (2)

RESOURCES

- Bose, T. K., Chowdhury, B. & Sharma, S. P. 2011. *Tropical Garden Plants in Colour*. Hort. and Allied Publ.
- Bose, T. K., Maiti, R.G., Dhua, R.S. & Das P. 1999. *Floriculture and Landscaping*. Naya Prokash, Kolkata, India.
- Grewal, H. S. & Singh, P. 2014. *Landscape Designing and Ornamental Plants*. Kalyani Publ. Lauria, A. & Victor, H.R. 2001. *Floriculture-Fundamentals and Practices*. Agrobios Publ., Jodhpur.
- Misra, R. L. & Misra, S. 2012. *Landscape Gardening*. Westville Publ. House, New Delhi, India.
- Nambisan, K.M.P. 1992. *Design Elements of Landscape Gardening*. Oxford & IBH Publ. Co., New Delhi, India.
- Randhawa, G.S. & Mukhopadhyay, A. 1986. *Floriculture in India*. Allied Publ.
- Sabina ,G.T. & Peter, K.V. 2008. *Ornamental Plants for Gardens*. New India Publ. Agency, New Delhi, India.
- Singh, A. & Dhaduk, B. K. 2015. *A Colour Handbook: Landscape Gardening*. New India Publ. Agency, New Delhi, India.
- Valsalakumari, P. K., Rajeevan, P. K., Sudhadevi, P. K. & Geetha C.K. 2008. *Flowering Trees*. New India Publ. Agency, New Delhi, India.
- Woodrow, M. G. 1999. *Gardening in India*. Biotech Books, New Delhi, India.

FLS-514 TURFGRASS MANAGEMENT (2+1)

THEORY

Block 1: Turf industry and turf grasses

UNIT I: Prospects and basic requirement: History, present status and prospects of turf industry; basic requirements, site selection and evaluation, concepts of quality of soil pertaining to turf grass establishment, criteria for evaluation of turf quality.

UNIT II: Types of turf grasses: Types, species, varieties, important breeders, grasses for different locations and conditions and their compatible groupings as per climatic conditions; Turfing for roof gardens.

UNIT III: Operations and management: Preparatory operations; Turf establishment methods such as seeding, sprigging/dibbling, plugging, sodding/turfing, turf plastering, instant turfing (portable), hydro-seeding, synthetic turfing. Turf management – Irrigation, drainage, nutrition, special practices like aerating, rolling, coring, dethatching, verticutting, soil top dressing, use of plant growth regulators and micronutrients, Turf mowing - mowing equipments, techniques to minimize wear and compaction, weed control, biotic and abiotic stress management in turfs, standards for turf, use of recycled water etc.,

Block 2: Turf for different grounds

UNIT I: Making of different sports arenas: Establishment and maintenance of turfs for playgrounds, viz. golf, football, hockey, cricket, tennis, rugby, residential and public parks, turfing of Govt. & Corporate office gardens, event specific preparation, turf colourants.

UNIT II: Automation: Exposure to different tools, gadgets, machinery used in turf industry.

PRACTICALS (16)

1. Identification of turf grasses and turf machinery (1)
2. Soil preparation, turf establishment methods, provision of drainage (2)
3. Layout of macro and micro irrigation systems (1)
4. Water and nutrient management (2)
5. Special practices – mowing, raking, rolling, soil top dressing, weed management (2)
6. Biotic and abiotic stress management (2)
7. Project preparation for turf establishment (2)
8. Visit to parks, model cricket grounds and golf courses, airports, corporates, Govt. organizations (2)
9. Rejuvenation of lawns (1)

10. Turf economics (1)

RESOURCES

- Aldous, D.1999. *International Turf Management Handbook*. CRC Press. pp.368.
- Beard, J. B. 1972. *Turf Grass Science and Culture*. Pearson. 1st edition, pp.672.
- Chawla, S. L., Patil, S., Patel, M. A., Patel, R. B. & Patel, R. M. 2013. *Turf grass Management*. Published by NAU, Navsari.
- Emmons, R. 2007. *Turf grass Science and Management*. Cengage Learning Publ. 4th edition, pp. 592.
- Nick-Christians. 2011. *Fundamentals of Turf grass Management*. Wiley; 4th Edition, pp. 424.
- Turgeon, A.J.1980. *Turf grass Management*. Reston Publ. Inc.

FLS-521 COMMERCIAL PRODUCTION OF CUT FLOWERS (2+1)

THEORY

Block 1: Production management

UNIT I: Scope and scenario: National and International scenario, importance and scope of cut flower trade, constraints for cut flower production in India.

UNIT II: Growing environment: Soil analysis, soil health card, Growing environment, open cultivation, protected cultivation, soil/media requirements, land preparation, planting methods, influence of light, temperature, moisture, humidity and microclimate management on growth and flowering.

UNIT III: Crop management: Commercial Flower production – Commercial varieties, water and nutrient management, fertigation, weed management, crop specific practices, ratooning, training and pruning, pinching, deshooting, bending, desuckering, disbudding. Use of growth regulators, physiological disorders and remedies, IPM and, IDM

UNIT IV: Flower regulation: Flower forcing and year round/offseason flower production through physiological interventions, chemical regulation, environmental manipulation.

Block 2: Post harvest management and marketing

UNIT I: Post harvest management: Cut flower standards and grades, harvest indices, harvesting techniques, post-harvest handling, Methods of delaying flower opening, Pre- cooling, pulsing, packing, storage and transportation.

UNIT II: Marketing: Marketing, export potential, institutional support, Agri Export Zones, 100% Export Oriented units, Crop Insurance

Crops :Rose, chrysanthemum, gladiolus, tuberose, carnation, gerbera, orchids, liliun, anthurium, China aster, alstroemeria, bird of paradise, heliconia, alpinia, ornamental ginger, dahlia, gypsophila, solidago, limonium, stock, cut greens and fillers.

PRACTICALS

1. Identification of varieties (1)
2. Propagation (2)
3. Microclimate management (2)
4. Training and pruning techniques (1)
5. Pinching, deshooting, disbudding, desuckering (1)
6. Practices in manuring, drip and fertigation, foliar nutrition, growth regulator application (2)
7. Harvesting techniques, post-harvest handling, cold chain (2)
8. Economics, Project preparation for regionally important cut flowers, crop specific guidelines for project financing (NHB guidelines) (2)
9. Visit to commercial cut flower units (2)
10. Case studies (1)

RESOURCES

- Arora, J.S. 2010. *Introductory Ornamental Horticulture*. Kalyani Publishers. 6th edition, pp. 230.
- Bhattacharjee, S. K. 2018. *Advances in Ornamental Horticulture*. Vols. I-VI. Pointer Publ. Reprint, pp. 2065.
- Bose, T. K., Maiti, R. G., Dhua, R. S. & Das, P. 1999. *Floriculture and Landscaping*. Prokash, Kolkata, India.
- Bose, T. K. & Yadav, L.P. 1989. *Commercial Flowers*. Naya Prokash, Kolkata, India. Chadha, K. L. & Bhattacharjee, S.K. 1995. *Advances in Horticulture: Ornamental Plants*. Vol. XII, Parts 1 & 2. pp. 533, pp. 574. Malhotra Publ. House, New Delhi, India
- Chadha, K. L. & Chaudhury, B. 1992. *Ornamental Horticulture in India*. ICAR, New Delhi, India.
- Dole, J. M. & Wilkins, H. F. 2004. *Floriculture-Principles and Species*. Prentice Hall. 2nd edition, pp. 1048.
- Larson, R. A. 1980. *Introduction to Floriculture*. New York Academic Press. pp. 628.
- Laurie, A. & Rees V, H. 2001. *Floriculture-Fundamentals and Practices*. Agrobios Publications, Jodhpur. pp.534.
- Prasad, S. & Kumar, U. 2003. *Commercial Floriculture*. Agrobios Publications, Jodhpur.
- Randhawa, G. S. & Mukhopadhyay, A. 2001. *Floriculture in India*. Allied Publ. pp 660.
- Reddy S, Janakiram T, Balaji , Kulkarni S. & Misra RL. 2007. *Hi- Tech Floriculture*. Indian Society of Ornamental Horticulture, New Delhi, India.
- Singh, A. K. 2006. *Flower Crops: Cultivation and Management*. New India Publ. Agency, New Delhi, India. pp. 475.

FLS-522 BREEDING OF ORNAMENTAL CROPS (2+1)

THEORY

Block 1: Principles of Plant Breeding

UNIT I: Principles of plant breeding: Principles of plant breeding; Origin, evolution, distribution, introduction, domestication and conservation of ornamental crops

UNIT II: Intellectual Property and Plant Breeders Rights: Introduction and initiatives in IPR and PBR of ornamental crops.

UNIT III: Genetic mechanisms and inheritance: Breeding objectives, reproductive barriers (Male sterility, incompatibility) in major ornamental crops. Inheritance of important traits, Genetic mechanisms associated with flower colour, size, form, doubleness, fragrance, plant architecture, post-harvest life, abiotic and biotic stress tolerance/ resistance.

Block 2: Breeding methods

UNIT I: Breeding methods: Breeding methods suitable for sexually, asexually propagated flower crops, self and cross pollinated crops- pedigree selection, backcross, clonal selection, polyploidy and mutation breeding, heterosis and F₁ hybrids.

UNIT II: Role of biotechnology: Role of biotechnology in improvement of flower crops including somaclonal variation, *in vitro* mutagenesis, *in vitro* selection, genetic engineering, molecular markers etc.,

Crops: Rose, chrysanthemum, carnation, gerbera, gladiolus, orchids, anthurium, liliun, marigold, jasmine, tuberose, dahlia, gaillardia, crossandra, aster etc., Flowering annuals: petunia, zinnia, snapdragon, stock, pansy, calendula, balsam, dianthus etc. Important ornamental crops like aglaonema, diffenbachia, hibiscus, bougainvillea, kalanchoe *etc.*

PRACTICALS

1. Floral biology of important ornamental crops (2)
2. Cytology and cytogenetics (2)
3. Selfing and crossing procedures for important ornamental crops (2)
4. Evaluation of hybrid progenies (2)
5. Induction of mutants through physical and chemical mutagens (2)

6. In vitro selection, genetic engineering (2)
7. Induction of polyploidy (2)
8. DUS testing (2)

RESOURCES

- Vainstein, A. (Ed). 2002. *Breeding for ornamental crops: Classical and Molecular Approaches*. Springer-Science-Business Media, B.V. Edition 1. pp. 392.
- Bhattacharjee, S.K. 2018. *Advances in Ornamental Horticulture*. Pointer Publ., Reprint, 6 vols, pp. 2065.
- Bose, T.K. & Yadav, L.P. 1989. *Commercial flowers*. Naya Prokash, Kolkata, India. Callaway, D. J. & Callaway, M. B. 2009. *Breeding Ornamental Plants*. Timber Press. Revised edition, pp. 359
- Chadha, K. L. & Bhattacharjee, S.K. 1995. *Advances in Horticulture: Ornamental Plants*. Vol. XII, Parts 1 & 2. pp. 533, pp. 574. Malhotra Publ. House, New Delhi, India.
- Chadha, K. L. & Choudhury, B.1992. *Ornamental Horticulture in India*. ICAR, New Delhi, India.
- Chaudhary, R.C. 1993. *Introduction to Plant Breeding*. Oxford & IBH Publ.
- Misra, R.L. & Misra, S. 2017. *Commercial Ornamental Crops: Cut Flowers*. Kruger Brentt Publisher UK Ltd. pp.584.
- Misra, R.L. & Misra, S. 2017. *Commercial Ornamental Crops: Traditional and Loose Flowers*. Kruger Brentt Publisher UK Ltd.
- Singh, B. D. 2016. *Plant Breeding Principles and Methods*. Kalyani Publishers, New Delhi-Ludhiana, India.
- Watts, L. 1980. *Flower and Vegetable Plant Breeding*. Unileve

FLS-523 PROTECTED CULTIVATION OF FLOWER CROPS (2+1)

THEORY

Block 1: Principles and types

UNIT I: Prospects and types of protected structures: Prospects of protected floriculture in India; Types of protected structures – Glasshouse/polyhouse, shadenet houses, mist chambers, lath houses, orchidarium, fernery, rain shelters etc., ,

UNIT II: Principles and design: Principles of designing and erection of protected structures; Low cost/Medium cost/High cost structures; Location specific designs; Structural components; Suitable flower and foliage plants for protected cultivation.

Block 2: Growing environment

UNIT I: Control of environment: Microclimate management and manipulation of temperature, light, humidity, air and CO₂; Heating and cooling systems, ventilation, naturally ventilated greenhouses, fan and pad cooled greenhouses, light regulation, water harvesting, UNIT II: Intercultural operations and crop regulation: Containers and substrates, media, soil decontamination, layout of drip and fertigation system, water and nutrient management, IPM and IDM, Crop regulation by chemical methods and special horticultural practices (pinching, disbudding, deshooting, deblossoming, etc.); Staking and netting, Photoperiod regulation.

UNIT III: Automation and standards: Automation in greenhouses, sensors, solar greenhouses and retractable greenhouses, GAP/Flower labels, Export standards, EXIM policy, APEDA regulations for export, Non-tariff barriers.

Crops: Rose, Chrysanthemum, Carnation, Gerbera, Orchids, Anthuriums, Liliium, Limonium, Lisianthus, heliconia, Cala lily, Alstroemeria, etc.,

PRACTICALS (16)

- Study of various protected structures (1)
- Design, layout and erection of different types of structures (2)

- Practices in preparatory operations, growing media, soil decontamination techniques (2).
- Microclimate management (2)
- Practices in drip and fertigation techniques, special horticultural practices (2).
- Determination of harvest indices and harvesting methods (1)
- Postharvest handling, packing methods (1)
- Economics of cultivation, Project preparation (2)
- Project Financing guidelines (1)
- Visit to commercial greenhouses (2)

RESOURCES

- Bhattacharjee, S. K. 2018. *Advances in Ornamental Horticulture*. Vols. I-VI. Pointer Publ. Reprint, pp. 2065.
- Bose, T.K., Maiti, R.G., Dhua, R.S. & Das, P. 1999. *Floriculture and Landscaping*. Naya Prokash, Kolkata, India.
- Bose, T. K. & Yadav, L. P. 1989. *Commercial Flowers*. Naya Prokash, Kolkata, India. Chadha, K. L. & Bhattacharjee, S.K. 1995. *Advances in Horticulture: Ornamental Plants*. Vol. XII, Parts 1 & 2. pp.533 & pp.574. Malhotra Publ. House, New Delhi, India.
- Lauria, A. & Victor, H.R. 2001. *Floriculture-Fundamentals and Practices*. Agrobios Publ., Jodhpur.
- Nelson PV. 2011. *Green House Operation and Management*. Pearson Publ. 7th edition, pp. 624.
- Prasad, S. & Kumar, U. 2003. *Commercial Floriculture*. Agrobios Publ., Jodhpur. Randhawa, G.S. & Mukhopadhyay, A. 1986. *Floriculture in India*. Allied Publ.
- Reddy, S., Janakiram, T., Balaji T., Kulkarni, S. & Misra, R. L. 2007. *Hi- Tech Floriculture*. Indian Society of Ornamental Horticulture, New Delhi, India

FLS-524 NURSERY MANAGEMENT FOR ORNAMENTAL PLANTS (2+1) THEORY

Block 1: Nursery Industry and Propagation

UNIT I: Scenario of nursery industry and sexual propagation: Importance and present scenario and status of nursery industry in India and in the world , life cycles in plants, Propagation methods, Factors influencing seed germination of flower crops, dormancy, seed quality, packing, storage, certification, testing. Hormonal regulation of germination and seedling growth.

UNIT II: Asexual propagation: Methods of asexual propagation, rooting of soft and hard wood cutting under mist. Role of Plant growth regulators. Physiological, anatomical and biochemical aspects of root induction in cuttings. Layering – principles and methods, budding and grafting – selection of elite mother plants. Stock, scion and inter stock, relationship – Incompatibility,

UNIT III: Micropropagation: Micro-propagation – principles and concepts, commercial exploitation in flower crops. Techniques - *in vitro* clonal propagation, direct organogenesis, embryogenesis, micrografting, meristem culture. Hardening, packing and transport of micro- propagules.

Block 2: Nursery Management

UNIT I: Growing structures: Growing structures like mist chambers, tunnels, lath house, net house, growing media types, soil less culture and containers. Automation in nursery management.

UNIT II: Sanitary and phyto-sanitary issues: Nursery – types, components, planning and layout. Nursery management practices for healthy propagule production. Nursery Act, PPV&FR act and Quarantine system in India. Important quarantine pests and diseases, sanitary and phyto-sanitary issues threats to nursery Industry.

UNIT III: Standards: Nursery standards, Hi-tech nurseries, garden centers.

PRACTICALS (16)

- Anatomical studies in rooting of cutting and graft union (2)
- Identification and production of plug plants, seedlings and saplings (2).
- Preparation of growing media and use of PGRs (2).
- Practice of propagation through specialized structures cuttings, layering, budding and

- grafting (2)
- v. Case studies (2).
- vi. Micropropagation of ornamental crops and hardening (3).
- vii. Visit to tissue culture labs and nurseries (2)
- viii. Economics (1)

RESOURCES

- Adriance, G.W. & Brison, F. R. 2000. *Propagation of Horticultural Plants*. Biotech Books, New Delhi, India.
- Bose, T. K., Mitra, S. K. & Sadhu, M. K. 1991. *Propagation of Tropical and Subtropical Horticultural Crops*. Naya Prokash, Kolkata, India.
- Chadha, K. L., Ravindran, P. L. & Leela Sahijram. 2000. *Biotechnology in Horticulture and Plantation Crops*. Malhotra Publ. House, New Delhi, India.
- Davies, Fred T. Jr., Geneve, R. L., Wilson, S. B., Hartmann, H. T. & Kester, D. L. 2018. *Hartmann and Kester's Plant Propagation: Principles and Practices*. Pearson Publ. 9th Edition.
- Peter, K.V. 2008. *Basics of Horticulture*. New India Publ. Agency, New Delhi, India.
- Rajan, S. & Baby, L.M. 2007. *Propagation of Horticultural Crops*. New India Publ. Agency, New Delhi, India. pp. 251.
- Singh, S.P. 1989. *Mist Propagation*. Metropolitan Book Co., New Delhi, India.

FLS-531 SEED PRODUCTION IN FLOWER CROPS (1+1)

THEORY

Block 1

UNIT I: Scenario of Seed Industry: Scope, scenario and importance of seed production in flower crops. Constraints in flower seed production. Marketing and economics of flower seeds.

Block 2

UNIT I: Seed production-Methods: Methods of seed production, agrotechniques for production of nucleus, breeder and certified seeds. Harvesting, seed processing, seed priming, seed chain, packaging and storage.

UNIT II: Population improvement: Mass selection, progeny selection. Use of incompatibility and male sterility, maintenance of variety and seed production in flower crops. UNIT III: F1 hybrids: F1 hybrid seed production advantages, steps involved in hybrid seed production, pollination behaviour and isolation, pollination management methods in production of F1/ hybrids in different flower crops

Block 3: Regulations

UNIT I: Seed certification and standards: Seed certification, Seed standards, seed act, plant breeders rights and farmers' rights, Bio safety, handling of transgenic seed crops, importing of seeds and OGL, trade barriers in seed business, sanitary and phytosanitary issues, custom clearance and quarantine.

Crops: Marigold, petunia, antirrhinum, zinnia, pansy, lupin, calendula, phlox, vinca, dianthus, sunflower, annual chrysanthemum, poppy, corn flower, rice flower,

PRACTICALS (16)

- Seed production of open pollinated varieties (2)
- Seed production of cross pollinated varieties (2)
- Steps involved in hybrid seed production (2)
- Hybrid seed production in different flower crops like marigold, petunia, antirrhinum, zinnia, pansy, lupin, calendula, phlox, vinca, dianthus, sunflower, annual chrysanthemum etc. (6)
- Visit to seed industry (3)
- Visit to quarantine facility (1)

RESOURCES

- Bhattacharjee, S. K. 2018. *Advances in Ornamental Horticulture*. Vols. I-VI. Pointer Publ.

Reprint, pp. 2065.

Bose, T.K., Yadav, L.P., Pal, P., Parthasarathy, V.A. & Das, P. 2003. *Commercial Flowers*. Vol. I & II. Naya Udyog, Kolkata, India.

Davies, Fred T. Jr., Geneve R. L., Wilson S. B., Hartmann, H. T., Kester, D. L. 2018. *Hartmann and Kester's Plant Propagation : Principles and Practices*. Pearson Publ.9th Edition.

Larson, R.A. & Armitage A. M. 1992. *Introduction of Floriculture*. International Book Distributing Co., Lucknow, India.

FLS-532 CAD FOR LANDSCAPING (1+2)

THEORY

Block 1: CAD

UNIT II: CAD basics and applications: Principles of integrating the architecture and landscaping, Exposure to CAD (Computer Aided Designing) – Applications of CAD in landscape garden designing, 2D drawing by AUTOCAD, Creating legends for plant and non- plant components, Basics of Photoshop software in garden designing.

UNIT II: 2D drawing: 2D drawing methods, AUTOCAD Basics, Coordinate systems in AUTOCAD LT 2007, Point picking methods, Toolbars and Icons, File handling functions, Modifying tools, Modifying comments, Isometric drawings, Drafting objects. Using patterns in AUTOCAD drawing, Dimension concepts, Hyperlinking, Script making, Using productivity tools, e-transmit file, making sample drawing for outdoor and indoor garden by AUTOCAD 2D Drawing techniques, Drawing web format design, Making layout.

Block 2: ARCHICAD

UNIT I: 3D drawing: 3D drawing methods, 3D drawing by ARCHICAD, 3D drawing by 3D MAX software, ARCHICAD file system, Tools and Infobox, modification tools, structural elements, GDL objects (Grid Dimensional Linking), Creation of garden components through ARCHICAD.

UNIT II: Dimensioning and visualization: ARCHICAD organization tools, Dimensioning and detailing of designs, Landscape designing softwares and CD ROM for ornamental plant material (TRES, HIMFLORA, CAPSSA, etc), Attribute settings of components, Visualization tools for landscape preview, Data management, plotting and accessories for designing, Inserting picture using photoshop, Making sample drawing for outdoor and indoor gardens.

PRACTICALS (32)

- Practices in point picking methods, Using tool bars and icons, Using modifying tools and modifying comments (4).
- Isometric drawings, Using productivity tools (2).
- Drawing designs by AUTOCAD for home garden, institutional garden and special types of garden (4).
- Using tools and info-box for 3D drawing, Creation of garden components with ARCHICAD (4).
- Organization, dimensioning, detailing and visualization tools with ARCHICAD (4)
- Using Photoshop package for 3D picture insertion (2)
- Drawing designs with ARCHICAD for home garden, interior garden designing, IT parks, Corporates, Theme parks and Ecotourism spots (6).
- Exposure visits (4)

RESOURCES

Christine, Wein-Ping Yu. 1987. *Computer-aided Design: Application to Conceptual Thinking in Landscape Architecture*. amazon.com.

Misra, R. L. & Misra, S. 2012. *Landscape Gardening*. Westville Publ. House, New Delhi, India

FLS-533 VALUE ADDITION IN FLORICULTURE (2+1)

THEORY

Block 1: Value added products

UNIT I: Scope and scenario: Scope and prospects of value addition, National and global scenario, production and exports. Types of value added products, techniques of value addition including tinting.

UNIT II: Value addition in loose flowers: Value addition in loose flowers and product development- Gulkand, floral tea, rose oil, rose water, Pankhuri, floral dyes, rose sherbet, floral ice creams, sweets, etc.

UNIT III: Floral Arrangements: Selection of containers and accessories for floral products and decorations. Flower arrangement, styles, Ikebana schools (*ikenobo, ohara, sogetsu* etc), Ikebana-moribana, nagiere, contemporary style.

UNIT IV: Dry flowers: Dry flowers– Identification and selection of flowers and plant parts; Raw material procurement, preservation and storage; tips for collecting dry flower making, selection of stages for picking of flowers for drying, Techniques in dry flower making – Drying, glycerising, bleaching, dyeing, embedding, pressing; Accessories; Designing and arrangement – dry flower baskets, bouquets, pot-pourri, wall hangings, button holes, greeting cards, wreaths; petal embedded handmade papers, Packaging and storage. Post drying management including moisture, pests and molds.

Block 2: Extraction of value added products

UNIT I: Essential oils: Essential oils; Selection of species and varieties (including non- conventional species), extraction methods, Packing and storage, Aromatherapy.

UNIT II: Pigments and nutraceuticals: Types of pigments, carotenoids, anthocyanins, chlorophyll, betalains; Significance of natural pigments as nutraceuticals, Extraction methods and applications in food, pharmaceutical and poultry industries.

UNIT III: Dying: Synthetic and Natural dyes, dying techniques, colour retention,

PRACTICALS (16)

1. Practices in preparation of different type of flower arrangements including bouquets, button-holes, flower baskets, corsages, floral wreaths, garlands with fresh flowers (4)
2. Techniques in flower arrangement and floral decoration (2)
3. Identification of plants for dry flower making (2)
4. Practices in dry flower making; Preparation of dry flower baskets, bouquets, pot-pourri, wall hangings, button holes, greeting cards, wreaths, etc. (2)
5. Essential oil extraction units (1)
6. Extraction of pigments (2)
7. Visit to dry flower units (2)
8. Economics of value added products (1)

RESOURCES

Bhattacharjee, S. K. 2018. *Advances in Ornamental Horticulture*. Vols. I-VI. Pointer Publ. Reprint, pp. 2065.

Chadha, K. L. & Bhattacharjee, S.K. 1995. *Advances in Horticulture: Ornamental Plants*. Vol. XII, Parts 1 & 2. pp.533 & pp.574. Malhotra Publ. House, New Delhi, India.

Lauria, A. & Victor, H.R. 2001. *Floriculture-Fundamentals and Practices*. Agrobios Publ., Jodhpur.

Nowak, J. & Rudnicki, R. M. 1990. *Postharvest handling and storage of cut flowers, florist greens, and potted plants*. Timber Press, USA. pp. 210.

Prasad, S. & Kumar, U. 2003. *Commercial Floriculture*. Agrobios Publ., Jodhpur.

Reddy, S., Janakiram, T., Balaji T., Kulkarni, S. & Misra, R. L. 2007. *Hi-Tech Floriculture*. Indian Society of Ornamental Horticulture, New Delhi, India.

FLS-534 INDOOR PLANTS AND INTERIORSCAPING (1+1)

THEORY

Block 1: Scope, principles and operations

UNIT I: Importance and scope: Importance and scope of indoor plants and Interiorscaping, Indoor plants and Indoor air quality.

UNIT II: Classification and principles: Factors affecting growth, development and flowering of Indoor plants. Classification of indoor plants based on light, temperature, humidity and pollution tolerance, Description and cultivation of various indoor plants. Principles of Interiorscaping, Role in pollution mitigation

UNIT III: Cultural operations: Containers and substrates, preparation of growing media, propagation, training, grooming, nutrition, management of disease, pests and weeds. Maintenance of plants including repotting, foliar nutrition, light exposure and plant rotation. Media standards, Nursery and Export standards for potted plants, Nursery standards.

Block 2: Presentations and marketing

UNIT I: Special gardens: Special gardens including miniature gardens and plant stand. Presentations like dish, terrarium, bottle gardens, hanging baskets, window boxes and Bonsai. UNIT II: Vertical gardens: Vertical gardens- History, planting material, structures, containers, substrate, water and nutrient management, supplemental lighting.

Unit 3: Marketing: Marketing channels, Business models including plant rentals.

PRACTICALS (16)

- a) Identification of important house plants (2)
- b) Media and containers (1)
- c) Propagation (1)
- d) Cultural operations, maintenance and economics of indoor plants (2)
- e) Models for Interiorscaping (2)
- f) Familiarization with different indoor gardens (2)
- g) Making of terrariums, bottle garden, dish garden and their economics (2).
- h) Making of vertical gardens and economics (2)
- i) Exposure visits (2)

RESOURCES

Barbara, P. (2005). *The Complete Houseplant Survival Manual*. Storey Publ., New Adams. Randhawa, G.S. & Mukhopadhyay, A. 1986. *Floriculture in India*. Allied Publ.

Wallach, C. (1995). *Interior Decorating with Plants*. McMillan Seed Production Co. Inc., New York.