FACULTY OF AGRICULTURAL SCIENCES

COURSE ORDINANCE

M.Sc. Agriculture

Horticulture (Floriculture and Landscaping)

SHREE GURU GOBIND SINGH TRICENTENARY UNIVERSITY
GURUGRAM (DELHI-NCR)

Preamble

Indian floriculture which remained homestead farming till late 80's assumed commercial significance during 90's owing to the favourable environment created by a series of reforms in economy and seed sector. This has paved the way for the import of new plant material, introduction of protected cultivation technology in the country. The area under flower crops got almost tripled from 1,06,000 ha during 2001–02 to 3,39,000 ha during 2018–19. Similar trend was also noticed in production of flowers in India with an overall production of 19.91 lakh tonnes. India's total export of floriculture was ` 571.38 Crores/ 81.94 USD Millions in 2018–19. The major importing countries were United States, Netherlands, United Kingdom, Germany and United Arab Emirates.

Contrary to belief, floriculture encompasses a large number of sub sectors that include loose flowers, cut flowers, cut foliage, specialty flowers, cut greens and fillers, pot plants, bedding plants, landscaping and interiorscaping, vertical gardening, dry flowers, lawns, arboriculture, essential oils, nutraceutical pigments, dyes, value addition, etc., Keeping in pace with the latest developments in these sectors, there is a need to update the knowledge among the students. An effort is therefore made to encompass the advances made in the sector by revising the post-graduate curriculum.

New courses like Systematics of ornamental plants; Indoor plants and Interioscaping, Nursery Management of ornamental plants; Turf grass management; Seed production in flower crops; Crop regulation in ornamental crops; Speciality flowers, fillers and cut greens; Vertical gardening; Modern approaches in breeding of floricultural crops; Current trends in production of floricultural crops; Recent developments in protected cultivation of floricultural crops are introduced in the new syllabus while retaining some of the old courses.

Keeping in view of the National Initiatives and priorities like Skill India and emphasis on Stratus to encourage students to become job creators rather than job seekers, new courses are added in different avenues of floriculture like Indoor plants and Interioscaping, Nursery management, Turfgrass management, Vertical gardening. These courses will help and encourage students to develop their skills and would pave way for different StartUps in these areas.

New courses like seed production in flower crops, Crop regulation in ornamental crops, Specialty flowers, fillers and cut greens are introduced in line with requirement to improve profitability of farmers/ growers. Seed production in flowers which is a high value, low volume segment was focussed upon which will boost our exports and help in improving profitability and improving farmers income. Crop regulation is an important aspect and need of the hour to avoid market glut, improve profitability and income of growers.

Rapid changes and development have occurred in global arena particularly in the field of biochemistry, molecular biology and biotechnology. Many advances took place in the area of application of biotechnology approaches in flower crops. A segment on genome editing systems/ tools like CRISPR-CAS is introduced into the syllabus keeping in view of the recent developments. Several new developments in the area of protected cultivation like automation, sensors, lighting, AI, robotics, retractable greenhouses, IPR, flower labels, etc. are given due emphasis in the new syllabus.

Flowers are highly perishable and fluctuation of prices is very high and marketing is a very crucial step where growers and entrepreneurs face problems. Topics on marketing, Agri export Zones, value chain and cold chain management and crop insurance were given

importance. Government of India has introduced a number of schemes and mechanisms to support the farming community. To make the students aware about the recent steps taken by Government, topic on Institutional support is introduced. Farming community is rapidly diversifying in to areas like FPO's and contract farming and these areas are introduced.

Course Title with Credit Load

M.Sc. Agriculture - Horticulture (Floriculture and Landscaping)

Major Courses (20 Credits)

Course Code (ICAR)	SGTU Code	Course Title	Credits
FLS 501*	11200103	Systematics of Ornamental Plants	3(2+1)
FLS 502*	11200302	Breeding of Ornamental Plants	3(2+1)
FLS 503*	11200104	Commercial Production of Cut Flowers	3(2+1)
FLS 504*	11200203	Commercial Production of Loose Flowers	3(2+1)
FLS 505*	11200105	Ornamental Gardening and Landscaping	3(2+1)
FLS 506	11200106	Indoor Plants and Interiorscaping	2(1+1)
FLS 507	11200107	Nursery Management in Ornamental Plants	3(2+1)
FLS 508	11200204	Turf Grass Management	3(2+1)
FLS 509	11200205	Value Addition in Floriculture	3(2+1)
FLS 510	11200303	Protected Cultivation of Flower Crops	3(2+1)
FLS 511	11200304	CAD for Landscaping	3(1+2)
FLS 512	11200108	Seed Production in Flower Crops	2(1+1)
FLS 591	11200206	Seminar	1(0+1)
FLS 599	11200401	Research	0+30
Total Credits			**70**

***** Compulsory among major course

COURSE CONTENTS

I. Course Title: **Systematics of Ornamental Plants**
II. Course Code: **11200103**
III. Credit Hours: **3 (2+1)**

IV. Why this course?

Systematics of ornamental plants will give an in depth knowledge on nomenclature, description of genera, floral biology and use of molecular techniques in systematics of flower crops and ornamental crops.

V. Aim of the course

To familiarize students about the taxonomy, classification, nomenclature and descriptors of different ornamental crops.

The course is organized as follows:

No.	Blocks	Units
1	Nomenclature	Unit 1: History, origin, hotspots, classification and nomenclature systems Unit 2: International Code, Identification features, descriptors. Unit 3: Red Book, Registration with
2	Families	Unit 1: Rosaceae, Asteraceae, Caryophyllaceae, Orchidaceae, Aracaeae, Liliacaeae, Unit 2: Acanthaceae, Palmaceae, Asparagaceae, Malvaceae, Musaceae, Oleaceae, Iridaceae
3	Molecular techniques	Unit 1: Molecular techniques in modern systematics

VI. 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, Liliacae.

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

Block 3: **Molecular techniques**

Unit I: Molecular techniques in modern systematics

VII. Practicals

- Different nomenclature systems of plants (2);

- Floral biology and taxonomic description of rose, chrysanthemum, orchids, carnation, gerbera, anthurium, marigold, tuberose, Jasmine, China aster, lilium, gypsophila (6);
- Cyropreservation and tissue culture repository (4);
- Molecular techniques (4).

VIII. Teaching Methods/ Activities

- Lectures
- Group discussions
- Flip classes
- Assignment and student presentation
- Hands on training of different procedures

IX. Learning outcome

After successful completion of this course,

The students will have an in depth knowledge of nomenclature, description of important genera and use of molecular techniques in systematics of flower crop

X. Suggested Reading

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

I. Course Title: Breeding of Ornamental Crops
II. Course Code: 11200302
III. Credit Hours: 3(2+1)

IV. Why this course?

Breeding novel and desired varieties is very important for growth of floriculture Industry. Students should have a thorough understanding of principles of plant breeding, genetic mechanisms and breeding methods in ornamental crops for making improvement in these crops.

V. Aim of the course

To impart comprehensive knowledge about the principles and practices of breeding of ornamental plants.

The course is organised as follows:

No.	Blocks	Units
1	Principles of Plant Breeding	I. Principles of plant breeding II. Intellectual Property and Plant Breeders Rights III. Genetic mechanisms and inheritance
2	Breeding methods	I. Breeding methods II. Role of biotechnology

VI. 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, lilium, 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.

VII. Practicals

- Floral biology of important ornamental crops (2);
- Cytology and cytogenetics (2);
- Selfing and crossing procedures for important ornamental crops (2);
- Evaluation of hybrid progenies (2);
- Induction of mutants through physical and chemical mutagens (2);
- In-vitro selection, genetic engineering (2);
- Induction of polyploidy (2);
- DUS testing (2).

VIII. Teaching Methods/ Activities

- Lectures
- Group discussions
- Flip classes
- Assignment and student presentation
- Hands on training of different procedures

IX. Learning outcome

After successful completion of course, the students are expected to have

- Thorough understanding of principles of plant breeding and genetic mechanisms in different ornamental plants and flowers.
- Application of different breeding methods for improvement of ornamental crops

- Develop the required skills in conventional and advanced breeding

X. Suggested Reading

- Bhattacharjee SK. 2018. Advances in Ornamental Horticulture. Pointer Publ., Reprint, 6 vols, pp. 2065.
- Bose TK and Yadav LP. 1989. Commercial flowers. Naya Prokash, Kolkata, India.
- Callaway DJ and Callaway MB. 2009. Breeding Ornamental Plants. Timber Press. Revised edition, pp. 359.
- Chadha KL and Bhattacharjee SK. 1995. Advances in Horticulture: Ornamental Plants. Vol. XII, Parts 1 & 2. pp. 533, pp. 574. Malhotra Publ. House, New Delhi, India.
- Chadha KL and Choudhury B. 1992. Ornamental Horticulture in India. ICAR, New Delhi, India.
- Chaudhary RC. 1993. Introduction to Plant Breeding. Oxford & IBH Publ.
- Misra RL and Misra S. 2017. Commercial Ornamental Crops: Cut Flowers. Kruger Brentt Publisher UK Ltd. pp.584.
- Misra RL and Misra S. 2017. Commercial Ornamental Crops: Traditional and Loose Flowers. Kruger Brentt Publisher UK Ltd.
- Singh BD. 2016. Plant Breeding Principles and Methods. Kalyani Publishers, New Delhi-Ludhiana, India.
- Vainstein A. (Ed). 2002. Breeding for ornamental crops: Classical and Molecular Approaches.
- Springer-Science-Business Media, B.V. Edition 1. pp. 392.
- Watts L. 1980. Flower and Vegetable Plant Breeding. Unilever Research, Sharnbrook, Bedford, UK. pp 182. Grower Books, London, UK.

I. Course Title: Commercial Production of Cut Flowers
II. Course Code: 11200104
III. Credit Hours: 3(2+1)
IV. Why this course?

Cut flowers are grown in a wide variety of environments and agroclimatic regions. The students of floriculture need to have an understanding of production and post harvest management of important cut flower crops on a commercial scale.

V. Aim of the course

To impart basic knowledge about the importance and production dynamics of cut flowers grown in India.
The course is organized as follows:

No.	Blocks	Units
1	Production management	I. Scope and scenario II. Growing environment III. Crop Management IV. Flower regulation
2	Post harvest management and marketing	I. Post Harvest Management II. Marketing

VI. 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: Soli 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, lilium, anthurium, china aster, alstroemeria, bird of paradise, heliconia, alpinia, ornamental ginger, dahlia, gypsophila, solidago, limonium, stock, cut greens and fillers.

VII. Practical

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

VIII. Teaching Methods/ Activities

- Lectures
- Group discussions
- Flip classes
- Assignment and student presentation
- Hands on training of different procedures
- Exposure visits

IX. Learning outcome

After successful completion of this course, the students are expected to–

- Understand the scope and scenario of floriculture
- A thorough understanding of production and post harvest management of flower crops.

- Acquire the required skills to prepare project reports on different crops for financing

X. Suggested Reading

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

I. Course Title: Commercial Production of Loose Flowers
II. Course Code: 11200203
III. Credit Hours: 3(2+1)
IV. Why this course?

Loose flowers are grown in a wide range of agroclimatic regions. The students of floriculture need to have an understanding of production and post harvest management of important loose flower crops.

V. Aim of the course

To impart basic knowledge about the importance and management of loose flowers grown in India.

The course organization is as under:

No.	Blocks	Units
1	Production management	I. Scope and scenario II. Growing environment III. Crop management IV. Flower regulation

2	Post harvest management and marketing	I. II.	Post Harvest management Marketing

VI. 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: Soli 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), tabernaemontana (Chandni), lotus, water lily, michelia (Champa), gardenia, ixora and balsam

VII. Practicals

- 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)

VIII. Teaching Methods/ Activities

- Lectures
- Group discussions
- Flip classes
- Assignment and group seminars
- Hands on training of different techniques

- Exposure visits

IX. Learning outcome

After successful completion of this course, the students would have

- A thorough understanding of production and post harvest management of loose flowers.
- Develop the required skills on commercial production management

X. Suggested Reading

- Arora JS. 2010. Introductory Ornamental Horticulture. Kalyani Publi. 6th Edition, pp. 230. Bhattacharjee SK. 2018. Advances in Ornamental Horticulture. Vols. I-VI. Pointer Publ.
- Reprint, pp. 2065.
- Bose T K, Maiti RG, Dhua RS and Das P. 1999. Floriculture and landscaping. Naya Prokash, Kolkata, India.
- Bose TK and Yadav LP. 1989. Commercial Flowers. Naya Prokash, Kolkata, India.
- Chadha KL and 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 KL and Chaudhury B.1992. Ornamental Horticulture in India. ICAR, New Delhi, India. Laurie A and Rees VH. 2001. Floriculture-Fundamentals and Practices. Agrobios Publ., Jodhpur.
- pp.534.
- Prasad S and Kumar U. 2003. Commercial Floriculture. Agrobios Publ., Jodhpur. Randhawa GS and Mukhopadhyay A. 2001. Floriculture in India. Allied Publ. pp 660.
- Sheela VL. 2008. Flowers for Trade. Horticulture Science Series, vol.10, pp. 392. New India Publ. Agency, New Delhi, India.

I. Course Title: **Ornamental Gardening And Landscaping**
II. Course Code: **11200105**
III. Credit Hours: **3(2+1)**

IV. Why this course?

Ornamental gardening and landscaping is an important course which gives a thorough understanding of different types of gardens and their components. The students need to imbibe the principles of landscaping and should develop skills for planning under different situations.

V. Aim of the course

Familiarization with principles and practices of landscaping
The course is organised as under:

No.	Blocks	Units
1	Gardens and components	I. Styles and types of gardens II. Garden components III. Specialized gardens
2	Landscape planning	I. Principles and elements of landscaping II. Landscaping for different situations

VI. 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: Specialised 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.

VII. Practicals

- 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)

VIII. Teaching Methods/ Activities

- Lectures
- Group discussions
- Flip classes
- Assignment and group seminars
- Hands on training on different models of landscaping
- Exposure visits

IX. Learning outcome

After successful completion of this course, the students are expected to be

- The students will be apprised of different types of gardens and have a thorough understanding

of principles of landscape gardening
- Develop skills for landscaping under different situations and layout of garden components.

X. Suggested Reading

- Bose TK, Chowdhury B and Sharma SP. 2011. Tropical Garden Plants in Colour. Hort. and Allied Publ.
- Bose TK, Maiti RG, Dhua RS and Das P. 1999. Floriculture and Landscaping. Naya Prokash, Kolkata, India.
- Grewal HS and Singh P. 2014. Landscape Designing and Ornamental Plants. Kalyani Publishers, New Delhi.
- Lauria A and Victor HR. 2001. Floriculture-Fundamentals and Practices.Agrobios Publ., Jodhpur.
- Misra RL and Misra S. 2012. Landscape Gardening. Westville Publ. House, New Delhi, India. Nambisan KMP. 1992. Design Elements of Landscape Gardening. Oxford & IBH Publ. Co.,
- New Delhi, India.
- Randhawa GS and Mukhopadhyay A. 1986. Floriculture in India. Allied Publ.
- Sabina GT and Peter KV. 2008. Ornamental Plants for Gardens. New India Publ. Agency, New Delhi, India.
- Singh A and Dhaduk BK. 2015. A Colour Handbook: Landscape Gardening. New India Publ. Agency, New Delhi, India
- Valsalakumari PK, Rajeevan PK, Sudhadevi PK and Geetha CK. 2008. Flowering Trees. New India Publ. Agency, New Delhi, India.
- Woodrow MG.1999. Gardening in India. Biotech Books, New Delhi, India.

I. Course Title: **Indoor Plants and Interiorscaping**
II. Course Code: **11200106**
III. Credit Hours: **2(1+1)**

IV. Why this course?

Indoor plants are an important component of floriculture. They not only improve the aesthetic environment of indoors but are also known to improve indoor air quality. The students in floriculture need up to date knowledge on factors affecting indoor growing, types, cultural operations and different principles of interiorscaping.

V. Aim of the course

To facilitate deeper understanding of the benefits of indoor plants, selection, designing and their management.

The course organization is as follows:

No.	Blocks	Units
1	Scope, principles and operations	I. Importance and scope II. Classification and principles III. Cultural operations
2	Presentations and marketing	I. Special gardens II. Vertical gardens III. Marketing

VI. 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 III: Marketing: Marketing channels, Business models including plant rentals.

VII. Practicals

- Identification of important house plants (2);
- Media and containers (1);
- Propagation (1);
- Cultural operations, maintenance and economics of indoor plants (2);
- Models for Interiorscaping (2);
- Familiarization with different indoor gardens (2);
- Making of terrariums, bottle garden, dish garden and their economics (2);
- Making of vertical gardens and economics (2);
- Exposure visits (2)

VIII. Teaching Methods/ Activities

- Lectures
- Group discussions
- Flip classes
- Assignment and group seminars
- Hands on training of different techniques
- Exposure visits

IX. Learning outcome

After successful completion of this course, the students are expected to develop

- Deep understanding and knowledge of principles affecting indoor cultivation including vertical gardens
- Develop required skills in interiorscaping
- Develop required entrepreneurial acumen

X. Suggested Reading

- Barbara P. 2005. The Complete Houseplant Survival Manual. Storey Publ., New Adams. Randhawa GS and Mukhopadhyay A. 1986. Floriculture in India. Allied Publ.
- Wallach C. 1995. Interior Decorating with Plants. McMillan Seed Production Co. Inc., New York.

I. Course Title: **Nursery Management for Ornamental Plants**
II. Course Code: **11200107**
III. Credit Hours: **3(2+1)**

IV. Why this course?

Nursery management is very essential for production of quality planting material in ornamental plants. The course gives a thorough understanding of propagation of different ornamental plants, nursery

management, standards, law and certification.

V. Aim of the course

Familiarization with principles and practices of propagation and nursery management for Ornamental plants.
The course is structured as under:-

No.	Blocks	Units
1	Nursery Industry and Propagation	I Scenario of nursery industry and sexual propagation II Asexual propagation III Micropropgation
2	Nursery Management	I Growing structures II Sanitary and phytosanitary issues Standards

VI. 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

VII. Practicals

- 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);
- Case studies (2)

- Micropropagation of ornamental crops and hardening (3);
- Visit to tissue culture labs and nurseries (2);
- Economics (1).

VIII. Teaching Methods/ Activities

- Lectures
- Group discussions
- Flip classes
- Assignment and group seminars
- Hands on training of different techniques
- Exposure visits

IX. Learning outcome

After successful completion of this course,

- The students will develop thorough understanding of nursery management in flower crops.
- Empower the students with the knowledge to start an enterprise
- Adequate skill in propagation and management

X. Suggested Reading

- Adriance GW and Brison FR. 2000. Propagation of Horticultural Plants. Biotech Books, New Delhi, India.
- Bose TK, Mitra SK and Sadhu M K. 1991. Propagation of Tropical and Subtropical Horticultural Crops. Naya Prokash, Kolkata, India.
- Chadha KL, Ravindran PL and Leela Sahijram. 2000. Biotechnology in Horticulture and Plantation Crops. Malhotra Publ. House, New Delhi, India.
- Davies Fred T Jr., Geneve RL, Wilson SB, Hartmann HT and Kester DL. 2018. Hartmann and Kester's Plant Propagation: Principles and Practices. Pearson Publ. 9th Edition.
- Peter KV. 2008. Basics of Horticulture. New India Publ. Agency, New Delhi, India.
- Rajan S and Baby LM. 2007. Propagation of Horticultural Crops. New India Publ. Agency, New Delhi, India. pp. 251.
- Singh SP. 1989. Mist Propagation. Metropolitan Book Co., New Delhi, India

I. Course Title: **Turfgrass Management**
II. Course Code: **11200204**
III. Credit Hours: **3(2+1)**

IV. Why this course?

Turf grass management deals with establishment and maintenance of different turf grasses for aesthetic, recreational and sports purposes. The course deals with basic types, requirement of turf grasses, management and development of turf for different purposes.

V. Aim of the course

To understand the science, principles and management of turf grasses.
The course is organised as under:-

No.	Blocks	Units
1	Turf Industry and turf management	I Prospects and basic requirement II Types of turf grasses III Operations and management
2	Turf for different ground	I Making of different sports arenas II Automation in turf management

VI. 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. and Corporate office gardens, event specific preparation, turf colourants.

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

VII. Practicals

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

VIII. Teaching Methods/ Activities

- Lectures
- Group discussions
- Flip classes
- Assignment and group seminars
- Hands on training of different techniques
- Exposure visits

IX. Learning outcome

After successful completion of the course, the students would be expected to

- Deep understanding and knowledge of different types of grasses and their management
- Developing skills for turfing of different arenas
- Develop required entrepreneurial acumen

X. Suggested Reading

- Aldous D.1999. International Turf Management Handbook. CRC Press. pp.368. Beard JB. 1972. Turf Grass Science and Culture. Pearson. 1st edition, pp. 672.
- Chawla SL, Patil S, Patel MA, Patel RB and Patel RM. 2013. Turf grass Management. Publised 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 AJ. 1980. Turf grass Management. Reston Publ. Inc.

I. Course Title: **Value Addition in Floriculture**
II. Course Code: **11200205**
III. Credit Hours: **3(2+1)**

IV. Why this course?

Value addition is done to increase the economic value of any floriculture commodity. Students need to develop thorough understanding of scope, scenario and different methods of value addition so that they can improve the income of the stakeholders by value addition.

V. Aim of the course

To understand the avenues for value addition in floriculture

Structure of the course is as under:

No.	Blocks	Units
1	Value added products	I Scope and scenario II Value addition of loose flowers III Floral Arrangements
2	Extraction of value added products	I Essential oils II Pigments and nutraceuticals

VI. 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- Gulkhand, 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,

VII. Practicals

- Practices in preparation of different type of flower arrangements including bouquets, button-holes, flower baskets, corsages, floral wreaths, garlands with fresh flowers (4);

- Techniques in flower arrangement and floral decoration (2);
- Identification of plants for dry flower making (2);
- Practices in dry flower making; Preparation of dry flower baskets, bouquets, pot- pourri, wall hangings, button holes, greeting cards, wreaths, etc. (2);
- Essential oil extraction units (1);
- Extraction of pigments (2);
- Visit to dry flower units (2);
- Economics of value added products (1).

VIII. Teaching Methods/ Activities

- Lectures
- Group discussions
- Flip classes
- Assignment and group seminars
- Hands on training of different techniques
- Exposure visits

IX. Learning outcome

After the successful completion of the course, the students are expected to know

- Understand and prepare different value added products from flowers
- Develop entrepreneurial acumen
- Imbibe the skills for making various value added products

X. Suggested Reading

- Bhattacharjee SK. 2018. Advances in Ornamental Horticulture. Vols. I-VI. Pointer Publ.
- Reprint, pp. 2065.
- Chadha KL and Bhattacharjee SK. 1995. Advances in Horticulture: Ornamental Plants. Vol.
- XII, Parts 1 & 2. pp.533 and pp.574. Malhotra Publ. House, New Delhi, India.
- Lauria A and Victor HR. 2001. Floriculture-Fundamentals and Practices.Agrobios Publ., Jodhpur.
- Nowak J and Rudnicki RM. 1990. Postharvest handling and storage of cut flowers, florist greens, and potted plants. Timber Press, USA. pp. 210.
- Prasad S and Kumar U. 2003. Commercial Floriculture. Agrobios Publ., Jodhpur.
- Reddy S, Janakiram T, Balaji T, Kulkarni S and Misra RL. 2007. Hi- Tech Floriculture. Indian Society of Ornamental Horticulture, New Delhi, India.

I. Course Title: **Protected Cultivation of Flower Crops**
II. Course Code: **11200303**
III. Credit Hours: **3(2+1)**

IV. Why this course?

Protected cultivation is more rewarding in production of high value cut flowers. With appropriate structures and plant environment control measures, the constraints of environment prevalent in the region can be overcome allowing almost year- round cultivation. The students need a thorough understanding of principles, types, designs, crops for different environments and management of environment in protected cultivation.

V. Aim of the course

Understanding the principles, theoretical aspects and developing skills in protected cultivation of flower crops.

The course is structured as under:-

No.	Blocks	Units
1	Principles and types	I Prospects and types of protected structures II Principles and designs

2	Growing Environment	I Control of environment II Crop management and crop regulation III Automation and standards

VI. 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, Lilium, Limonium, Lisianthus, heliconia, Cala lily, Alstromeria, etc

VII. Practicals

- 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).

VIII. Teaching Methods/ Activities

- Lectures
- Group discussions
- Flip classes
- Assignment and group seminars
- Hands on training of different techniques
- Exposure visits

IX. Learning outcome

After successful completion of this course, the students are expected to be acquire

- Knowledge on types, design and principles of protected structures
- Thorough understanding of principles of microclimate management and crop management.
- Develop the required skills for designing a greenhouse
- Acquire skills on microclimate management, production management

X. Suggested Reading

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

I. Course Title: **CAD for Landscaping**
II. Course Code: **11200304**
III. Credit Hours: **3(1+2)**

IV. Why this course?

CAD is widely used in landscaping planning and design. The students need to develop in depth knowledge of CAD software so that they can modify raw data into plans, drawing and models for landscape planning.

V. Aim of the course

To impart basic knowledge about the Computer Aided Designing (CAD) of landscape.
The course is organised as under:-

No.	Blocks	Units
1	CAD	I CAD basics and applications
		II 2D drawing
2	ARCHICAD	I 3D drawing
		II Dimensioning and visualization

VI. 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

VII. Practicals

- 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).

VIII. Teaching Methods/ Activities

- Lectures
- Group discussions
- Flip classes
- Assignment and group seminars
- Hands on training of different techniques
- Exposure visits

IX. Learning outcome

After successful completion of this course, the students are expected to develop

- The students will be able to use CAD and ARCHICAD for landscape planning and designing.
- Develop the adequate skills to create 3 D model to showcase interaction of different factors in landscape gardening.
- Develop the entrepreneurial acumen

X. Suggested Reading

- Christine, Wein-Ping Yu. 1987. Computer-aided Design: Application to Conceptual Thinking in Landscape Architecture. amazon.com.
- Misra RL and Misra S. 2012. Landscape Gardening. Westville Publ. House, New Delhi, India.

I. Course Title: **Seed Production in Flower Crops**
II. Course Code: **11200108**
III. Credit Hours: **2(1+1)**

IV. Why this course?

Seed production of flowers is a highly remunerative enterprise. The students need to have knowledge of seed industry, seed production methods and seed certification. This course provides hands on training on seed production of important flower crops.

V. Aim of the course

To impart basic knowledge about the importance of seed production in important flower crops.
The course is structured as under:-

No.	Blocks	Units
1	Seed Industry	I Scenario of Seed industry
2	Hybrid Seed Production	I Seed Production methods II Population improvement III F1 Hybrid production
3	Regulations	I Seed certification and standards

VI. Theory

Block 1: Seed Industry

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: Hybrid Seed Production

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 phytosanitaty issues, custom clearance and quarantine

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

Practical

- 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)

VII. Teaching Methods/ Activities

- Lectures
- Group discussions
- Flip classes
- Assignment and group seminars
- Hands on training of different techniques
- Exposure visits

VIII. Learning outcome

After the successful completion of the course

- The students will get a thorough knowledge on seed industry, principles and methods of seed production in flower crops.
- Students will get awareness on seed standards, certification and law in flower crops.

IX. Suggested Reading

- Bhattacharjee SK. 2018. Advances in Ornamental Horticulture. Vols. I-VI. Pointer Publ.
- Reprint, pp. 2065.
- Bose TK, Yadav LP, Pal P, Parthasarathy VA and Das,P. 2003. Commercial Flowers. Vol. I &
- II. Naya Udyog, Kolkata, India.
- Davies, Fred T Jr., Geneve RL, Wilson SB, Hartmann HT. Kester DL. 2018. Hartmann and Kester's Plant Propagation: Principles and Practices. Pearson Publ.9th Edition.
- Larson RA and Armitage AM. 1992. Introduction of Floriculture. International Book Distributing Co., Lucknow, India.