

GURU KASHI UNIVERSITY



**M.Sc. Horticulture
(Floriculture and Landscaping)
(FLS)**

Session: 2026-27

**Faculty of Agriculture
(Guru Kashi University,
Talwandi Sabo, Bhatinda)**

Graduate Attributes of the Programme: -

Types of learning outcomes	The learning Outcomes Descriptors
Graduates should be able to demonstrate the acquisition of: -	
Learning outcomes that are specific to discipline/interdisciplinary areas of learning	• "Provide insights into the economic significance and cultivation techniques of cut and loose flower crops." • Contribute to academics, research and development with a focus on societal and environmental benefits.
Generic learning outcomes	• Collaborate in multidisciplinary teams to develop sustainable and innovative horticultural solutions. • Become entrepreneurs in floriculture, nursery management and landscape design. • Serve as an ambassador of horticulture by supporting farming communities and promoting green practices including vertical gardening, roof top gardening etc.

Programme Learning Outcomes: A Postgraduate Certificate is awarded to students who have demonstrated the achievement of the outcomes located at level 6.0:

Element of the Descriptor	Programme learning outcomes relating to Undergraduate Certificate
Graduates should be able to demonstrate the acquisition of: -	
Knowledge and Understanding	Acquire foundational and advanced knowledge of floriculture techniques, plant biology, soil science, nursery management, and landscape design principles. Understand climate-specific cultivation practices for ornamental and flowering plants.
General, technical and professional skills required to perform and accomplish tasks	Develop hands-on skills in propagation (cuttings, grafting, layering), greenhouse management, pest control, irrigation systems, and use of landscaping tools. Learn to design gardens, maintain lawns, and execute floral arrangements for commercial and aesthetic purposes.
Application of knowledge and skills	Apply theoretical knowledge to real-world scenarios such as designing landscape layouts, managing nurseries, cultivating seasonal and perennial flowers, and executing garden projects. Engage in protected cultivation and post-harvest handling of flowers.
Generic learning Outcomes	Demonstrate problem-solving, teamwork, communication, and project management skills

	through garden planning, client consultations, and collaborative landscaping tasks. Exhibit adaptability in diverse horticultural environments.														
Constitutional, humanistic, ethical, and moral values	Promote sustainable practices, biodiversity conservation, and eco-friendly landscaping. Uphold ethical standards in pesticide use, water conservation, and community greening initiatives. Foster respect for nature and civic responsibility through public garden projects.														
Employability and job-ready skills, and entrepreneurship skills and capabilities/qualities and mindset	Prepare for careers as floriculturists, nursery managers, landscape designers or entrepreneurs in flower farming, roof top gardening, vertical farming, seed production and garden services. Gain skills in business planning, cost estimation, marketing of floral products and client engagement.														
Credit requirements	(i) Course Work <table> <tr> <td>Major courses</td> <td>20</td> </tr> <tr> <td>Minor courses</td> <td>08</td> </tr> <tr> <td>Supporting courses</td> <td>06</td> </tr> <tr> <td>Common courses</td> <td>05</td> </tr> <tr> <td>Seminar</td> <td>01</td> </tr> <tr> <td>(ii) Thesis Research</td> <td>30</td> </tr> <tr> <td>Total</td> <td>70</td> </tr> </table>	Major courses	20	Minor courses	08	Supporting courses	06	Common courses	05	Seminar	01	(ii) Thesis Research	30	Total	70
Major courses	20														
Minor courses	08														
Supporting courses	06														
Common courses	05														
Seminar	01														
(ii) Thesis Research	30														
Total	70														
Entry requirements	A student with a Bachelor Degree subject to fulfillment of the eligibility conditions of a programme as specified by the University, shall be eligible for admission to a 2-year PG Programme.														

Program Structure of M.Sc. Floriculture and Landscaping

Semester-I									
Course Code	Course Title	Type of Course	L	T	P	No. of Credits	Int.	Ext.	Total Marks
FLS501	Commercial Production of Cut Flowers	Major	2	0	0	2	30	70	100
FLS502	Commercial Production of Cut Flowers Lab	Major	0	0	2	1	30	70	100
FLS503	Ornamental Gardening and Landscaping	Major	2	0	0	2	30	70	100
FLS504	Ornamental Gardening and Landscaping Lab	Major	0	0	2	1	30	70	100
FLS505	Turf Grass Management	Major	2	0	0	1	30	70	100
FLS506	Turf Grass Management Lab	Major	0	0	2	1	30	70	100
VSC501	Production of Cool season vegetable crops	Minor CBCS (Choose any One)	2	0	0	2	30	70	100
FSC507	Tropical Fruit Production								
VSC502	Production of Cool Season Vegetables Crops lab	Minor CBCS (Choose any One)	0	0	2	1	30	70	100
FSC508	Tropical Fruit Production Lab								
STAT501	Agriculture Statistics	Supporting	3	0	0	3	30	70	100
STAT502	Agriculture Statistics Lab	Supporting	0	0	2	1	30	70	100
PGC501	Library and Information service lab	Common	0	0	2	1	30	70	100
PGC502	Agricultural Research, Research Ethics and Rural Development Programmes	Common	1	0	0	1	30	70	100
FLS600	Master's Research	Research	0	0	0	2	S/US	S/US	S/US
Total						17+2			

Semester-II									
Course Code	Course Title	Type of Course	L	T	P	No. of Credits	Int.	Ext.	Total Marks
FLS507	Breeding of Ornamental Plants	Major	2	0	0	1	30	70	100
FLS508	Breeding of Ornamental Plants Lab	Major	0	0	2	1	30	70	100
FLS509	Commercial Production of loose Flowers	Major	2	0	0	2	30	70	100
FLS510	Commercial Production of Loose Flowers Lab	Major	0	0	2	1	30	70	100
FLS511	Protected Cultivation of Flower Crops	Major	2	0	0	2	30	70	100
FLS512	Protected Cultivation of Flower Crops Lab	Major	0	0	2	1	30	70	100
FSC501	Sub-tropical and temperate fruit production	Minor CBCS (Choose any One)	2	0	0	2	30	70	100
VSC505	Production Technology of Warm Season Vegetables Crops								
FSC502	Sub-tropical and temperate fruit production Lab	Minor CBCS (Choose any One)	0	0	2	1	30	70	100
VSC506	Production Technology of Warm Season Vegetables Crops Lab								
CA551	Fundamentals of Computer Application Lab	Supporting	0	0	4	2	30	70	100
PGC551	Basic Concepts of Laboratory Techniques-Lab	Common	0	0	2	1	30	70	100
FLS600	Master's Research	Research	0	0	0	5	S/US	S/US	S/US
Total						14+5			

Semester-III									
Course Code	Course Title	Type of Course	L	T	P	No. of Credits	Int.	Ext.	Total Marks
FLS513	Seed Production in Flower Crops	Major	1	0	0	1	30	70	100
FLS514	Seed Production of Flower Crops Lab	Major	0	0	2	1	30	70	100
FLS515	Value Addition in Floriculture	Major	2	0	0	1	30	70	100
FLS516	Value Addition in Floriculture Lab	Major	0	0	2	1	30	70	100
VSC513	Organic vegetable production	Minor CBCS (Choose any One)	1	0	0	1	30	70	100
FSC513	Propagation and Nursery Management of Fruit Crops								
VSC514	Organic vegetable production Lab	Minor CBCS (Choose any One)	0	0	2	1	30	70	100
FSC514	Propagation and Nursery Management of Fruit Crops Lab								
PGC504	Technical Writing and Communication Skills Lab	Common	0	0	2	1	30	70	100
FLS557	Master's Seminar	Skill Dev.	0	0	2	1	30	70	100
FLS600	Master's Research	Research	0	0	0	10	S/US	S/US	S/US
Total						8+10			

Semester-IV									
Course Code	Course Title	Type of Course	L	T	P	No. of Credits	Int.	Ext.	Total Marks
PGC505	Intellectual Property and its Management in Agriculture	Common	1	0	0	1	30	70	100
FLS600	Master's Research	Research	0	0	0	13	S/US	S/US	S/US
	Total					1+13			
	Grand Total					40+30=70			

Semester I

Course Title: COMMERCIAL PRODUCTION OF CUT FLOWERS

Course Code: FLS 501

L	T	P	Credits
2	0	0	2

Learning Outcomes:

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.

Course Contents

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, de-shooting, bending, de-suckering, 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, liliu, anthurium, china aster, alstroemeria, bird of paradise, heliconia, alpinia, ornamental ginger, dahlia, gypsophila, solidago, limonium, stock, cut greens and fillers.

Teaching methods/activities

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

Suggested Readings

- 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.

Course Title: COMMERCIAL PRODUCTION OF CUT FLOWERS Lab

Course Code: FLS 502

L	T	P	Credits
0	0	1	1

Learning Outcomes:

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.

Course Contents

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).

Teaching methods/activities

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

Suggested Readings

- 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.

Course Title: ORNAMENTAL GARDENING AND LANDSCAPING

Course Code: FLS 503

L	T	P	Credits
2	0	0	2

Learning Outcomes:

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.

Course Contents

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.

Teaching methods/ activities

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

Suggested Readings

- 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.

Learning Outcomes:

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.

Course Contents**Practical**

- 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).

Teaching methods/ activities

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

Suggested Readings

- 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.

Course Title: TURF GRASS MANAGEMENT
Course Code: FLS 505

L	T	P	Credits
2	0	0	1

Learning Outcomes:

After successful completion of this course, the students are 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.

Course Contents

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), hydroseeding, 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.

Teaching Methods/ Activities

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

Suggested Readings

- 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.

Course Title: TURF GRASS MANAGEMENT Lab
Course Code: FLS 506

L	T	P	Credits
0	0	1	1

Learning Outcomes:

After successful completion of this course, the students are 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.

Course Contents

Practical

- 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).

Teaching Methods/ Activities

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

Suggested Readings

- 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. 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 AJ. 1980. Turf grass Management. Reston Publ. Inc.

Course Title: Production Technology of cool Season Vegetable Crops

Course Code: VSC501

L	T	P	Credits
2	0	0	2

Total Hours-30

Learning Outcomes: After completion of this course, the learner will be able to:

- 1 Identify deficiency symptoms of nutrients in cool season vegetable crops.
- 2 Acquaint with cool season vegetable crops growing in a vegetable garden, their cultural practices and identification.
- 3 Know about the preparation of land for cultivation of cool season vegetable

Crops

- 4 Gain knowledge about innovative nursery raising technique for cool season vegetable crops for raising quality and disease-free seedlings

Course Content (Theory)

Introduction, commercial and nutritional importance, origin and distribution, botany and taxonomy, area, production, productivity and constraints, soil requirements, climatic factors for yield and quality, commercial varieties/ hybrids, seed rate and seed treatment, raising of nursery, sowing/ planting time and methods, hydroponics, precision farming, cropping system, nutritional including micronutrients and irrigation requirements, intercultural operations, special horticultural practices, weed control, mulching, role of plant growth regulators, physiological disorders, maturity indices, harvesting, yield, post-harvest management (grading, packaging and marketing), pest and disease management and production economics of crops.

Unit I

7 Hours

Bulb and tuber crops—Onion, garlic and potato

Unit II

7 Hours

Root crops—Carrot, radish, turnip and beetroot.

Unit III

8 Hours

Cole crops—Cabbage, cauliflower, kohlrabi, broccoli, Brussels sprouts and kale

Unit IV

8 Hours

Peas and beans—Peas and broad bean.

Leafy vegetables—Beet leaf, fenugreek, coriander and lettuce.

Transaction Mode

Lecture, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested Readings

- Hazra P and Banerjee MK and Chattopadhyay A. 2012. *Varieties of vegetable crops in India*, (Second edition), Kalyani publishers, Ludhiana, 199 p.
- Hazra P. 2016. *Vegetable Science*. 2nd edn, Kalyani publishers, Ludhiana.
- Hazra P. 2019. *Vegetable production and technology*. New India publishing agency, New Delhi.
- Hazra P, Chattopadhyay A, Karmakar K and Dutta S. 2011. *Modern technology for vegetable production*, New India publishing agency, New Delhi, 413p
- Rana MK. 2008. *Olericulture in India*. Kalyani publishers, New Delhi.
- Rana MK. 2008. *Scientific cultivation of vegetables*. Kalyani publishers, New Delhi.
- Rana MK. 2014. *Technology for vegetable production*. Kalyani publishers, New Delhi.
- Rubatzky VE and Yamaguchi M. (Eds.). 1997. *World vegetables: principles, production and nutritive values*. Chapman and Hall.
- Saini GS. 2001. *A text book of oleri and flori culture*. Aman publishing house.
- Salunkhe DK and Kadam SS. (Ed.). 1998. *Hand book of vegetable science and technology: production, composition, storage and processing*. Marcel dekker.
- Shanmugavelu KG. 1989. *Production technology of vegetable crops*. Oxford and IBH.
- Singh DK. 2007. *Modern vegetable varieties and production technology*. International bookdistributing Co.
- Singh SP. (Ed.). 1989. *Production technology of vegetable crops*. Agril. comm. res. centre.
- Thamburaj S and Singh N. (Eds.), 2004. *Vegetables, tuber crops and spices*. ICAR.
- Thompson HC and Kelly WC. (Eds.). 1978. *Vegetable crops*. Tata McGraw-Hill.

Course Title: Production Technology of cool Season

Vegetable Crops Lab

Course Code: VSC502

L	T	P	Credits
0	0	2	1

Total Hours-30

Learning Outcomes: After completion of this course, the learner will be able to:

- 1 Identify deficiency symptoms of nutrients in cool season vegetable crops.
- 2 Acquaint with cool season vegetable crops growing in a vegetable garden, their cultural practices and identification.
- 3 Know about the preparation of land for cultivation of cool season vegetable Crops
- 4 Gain knowledge about innovative nursery raising technique for cool season vegetable crops for raising quality and disease-free seedlings

Course Content (Practical)

Total Hours-30

Scientific raising of nursery and seed treatment.

Sowing and transplanting.

Description of commercial varieties and hybrids.

Demonstration on methods of irrigation, fertilizers and micronutrients application.

Mulching practices, weed management.

Use of plant growth substances in cool season vegetable crops.

Study of nutritional and physiological disorders.

Studies on hydroponics and other soilless culture.

Identification of important pest and diseases and their control.

Preparation of cropping scheme for commercial farms.

Visit to commercial farm, protected structure.

Visit to vegetable market.

Analysis of benefit to cost ratio.

Transaction Mode

Lecture, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested Readings

Hazra P and Banerjee MK and Chattopadhyay A. 2012. Varieties of vegetable crops in India, (Second edition), Kalyani publishers, Ludhiana, 199 p.

Hazra P. 2016. Vegetable Science. 2nd edn, Kalyani publishers, Ludhiana.

Hazra P. 2019. Vegetable production and technology. New India publishing agency, New Delhi.

Hazra P, Chattopadhyay A, Karmakar K and Dutta S. 2011. Modern technology for vegetable production, New India publishing agency, New Delhi, 413p

Rana MK. 2008. Olericulture in India. Kalyani publishers, New Delhi.

Rana MK. 2008. Scientific cultivation of vegetables. Kalyani publishers, New Delhi.

Rana MK. 2014. Technology for vegetable production. Kalyani publishers, New Delhi.

Rubatzky VE and Yamaguchi M. (Eds.). 1997. World vegetables: principles, production and nutritive values. Chapman and Hall.

Saini GS. 2001. A text book of oleri and flori culture. Aman publishing house.

Salunkhe DK and Kadam SS. (Ed.). 1998. Hand book of vegetable science and technology: production, composition, storage and processing. Marcel dekker.

Shanmugavelu KG. 1989. Production technology of vegetable crops. Oxford and IBH.

Singh DK. 2007. Modern vegetable varieties and production technology. International bookdistributing Co.

Singh SP. (Ed.). 1989. Production technology of vegetable crops. Agril. comm. res. centre.

Thamburaj S and Singh N. (Eds.), 2004. Vegetables, tuber crops and spices. ICAR.

Thompson HC and Kelly WC. (Eds.). 1978. Vegetable crops. Tata McGraw-Hill.

Course Title: Tropical Fruit Production
Course Code: FSC507

L	T	P	Credits
2	0	0	2

Total Hours-30

Learning Outcomes: After completion of this course, the learner will be able to:

- Equip themselves with know-how on agro-techniques for establishment and management of an orchard leading to optimum and quality fruit production of tropical fruits.
Learn the importance and identification of different agri export zone for fruit crops.
3. Evaluate the importance of flowering, pollination, fruit set and fruiting and harvesting of tropical fruit crops.
 4. Develop knowledge of storage marketing, post-harvest technology with knowhow of export and industrial potential.

Course Content (Theory)

Importance and Background: Importance, origin and distribution, major species, rootstocks and commercial varieties of regional, national and international importance, eco-physiological requirements. Propagation, Planting and Orchard Floor Management: Asexual and sexual methods of propagation, planting systems and planting densities, training and pruning methods, rejuvenation, intercropping, nutrient management, water management, fertigation, use of bio-fertilizers, role of bio-regulators, abiotic factors limiting fruit production. Flowering, Fruit-Set and Harvesting: Physiology of flowering, pollination management, fruit set and development, physiological disorders – causes and remedies, crop regulation, quality improvement by management practices; maturity indices, harvesting, grading, packing, storage and ripening techniques; insect and disease management.

Unit I

8 hours

Fruit crops- Citrus, Mango, Papaya, Pineapple.

Unit II

7 hours

Fruit crops- Banana, Avocado, Sapota, Guava.

Unit III

7 hours

Fruit crops- Ber, Amla, Jack fruit, Custard apple.

Unit IV

8 hours

Fruit crops-Minor Tropical Fruit crops.

Transaction Mode

Lecture, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested Readings

- Bartholomew DP, Paull RE and Rohrbach KG. 2002. *The Pineapple: Botany, Production, and Uses*. CAB International.
- Bose TK, Mitra SK and Sanyal D. 2002. *Fruits of India – Tropical and Sub-Tropical*. 3rd Edn. NayaUdyog, Kolkata.
- Dhillon WS. 2013. *Fruit Production in India*. Narendra Publ. House, New Delhi.
- Iyer CPA and Kurian RM. 2006. *High Density Planting in Tropical Fruits: Principles and Practices*. IBDC Publishers, New Delhi.
- Litz RE. 2009. *The Mango: Botany, Production and Uses*. CAB International.
- Madhawa Rao VN. 2013. *Banana*. ICAR, New Delhi. Midmore D. 2015. *Principles of Tropical Horticulture*. CAB International.
- Mitra SK and Sanyal D. 2013. *Guava*, ICAR, New Delhi. Morton JF. 2013. *Fruits of Warm Climates*. Echo Point Book Media, USA.
- Nakasome HY and Paull RE. 1998. *Tropical Fruits*. CAB International.
- Paull RE and Duarte O. 2011. *Tropical Fruits (Vol. 1)*. CAB International.
- Rani S, Sharma A and Wali VK. 2018. *Guava (Psidium guajava L.)*. Astral, New Delhi.
- Robinson JC and Saúco VG. 2010. *Bananas and Plantains*. CAB International.
- Sandhu S and Gill BS. 2013. *Physiological Disorders of Fruit Crops*. NIPA, New Delhi.
- Schaffer B, Wolstenholme BN and Whiley AW. 2013. *The Avocado: Botany, Production and Uses*. CAB International.
- Sharma KK and Singh NP. 2011. *Soil and Orchard Management*. Daya Publishing House, New Delhi.
- Valavi SG, Peter KV and Thottappilly G. 2011. *The Jackfruit*. Stadium Press, USA

Course Title: Tropical Fruit Production Lab

Course Code: FSC508

L	T	P	Credits
0	0	2	1

Total Hours-30

Learning Outcomes: After completion of this course, the learner will be able to:

- 1 . Equip themselves with know-how on agro-techniques for establishment and management of an orchard leading to optimum and quality fruit production of tropical fruits.
- 2 . Learn the importance and identification of different agri export zone for fruit crops.
3. Evaluate the importance of flowering, pollination, fruit set and fruiting and harvesting of tropical fruit crops.
4. Develop knowledge of storage marketing, post-harvest technology with knowhow of export and industrial potential.

Course content (Practical)

Total Hours-30

1. Distinguished features of tropical fruit species, cultivars and rootstocks.
2. Demonstration of planting systems, training and pruning.
3. Hands on practices on pollination and crop regulation.
4. Leaf sampling and nutrient analysis.
5. Physiological disorders-malady diagnosis.
6. Physico-chemical analysis of fruit quality attributes.
7. Field/ Exposure visits to tropical orchards.
8. Project preparation for establishing commercial orchards.

Transaction Mode

Lecture, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested Readings

- Bartholomew DP, Paull RE and Rohrbach KG. 2002. *The Pineapple: Botany, Production, and Uses*. CAB International.
- Bose TK, Mitra SK and Sanyal D. 2002. *Fruits of India – Tropical and Sub-Tropical*. 3rd Edn. NayaUdyog, Kolkata.
- Dhillon WS. 2013. *Fruit Production in India*. Narendra Publ. House, New Delhi.
- Iyer CPA and Kurian RM. 2006. *High Density Planting in Tropical Fruits: Principles and Practices*. IBDC Publishers, New Delhi.
- Litz RE. 2009. *The Mango: Botany, Production and Uses*. CAB International.

- *Madhawa Rao VN. 2013. Banana. ICAR, New Delhi. Midmore D. 2015. Principles of Tropical Horticulture. CAB International.*
- *Mitra SK and Sanyal D. 2013. Guava, ICAR, New Delhi. Morton JF. 2013. Fruits of Warm Climates. Echo Point Book Media, USA.*
- *Nakasome HY and Paull RE. 1998. Tropical Fruits. CAB International.*
- *Paull RE and Duarte O. 2011. Tropical Fruits (Vol. 1). CAB International.*
- *Rani S, Sharma A and Wali VK. 2018. Guava (Psidiumguajava L.) Astral, New Delhi.*
- *Robinson JC and Saúco VG. 2010. Bananas and Plantains. CAB International.*
- *Sandhu S and Gill BS. 2013. Physiological Disorders of Fruit Crops. NIPA, New Delhi.*
- *Schaffer B, Wolstenholme BN and Whiley AW. 2013. The Avocado: Botany, Production and Uses. CAB International.*
- *Sharma KK and Singh NP. 2011. Soil and Orchard Management. Daya Publishing House, New Delhi.*
- *Valavi SG, Peter KV and Thottappilly G. 2011. The Jackfruit. Stadium Press, USA*

Course Title: Agricultural Statistics
Course Code: STAT501

L	T	P	Credits
3	0	0	3

Total Hours-45

Learning Outcomes: After completion of this course, the learner will be able to:

- 1 Study about statistical principles apply in all the areas of experimental work.
- 2 Understand the requirement at the national level and farm level for agriculture policy making,
3. Study the importance of statistics in agriculture, helps to ascertain the volume of crop that needs to be produced based on output and demand of previous year
4. Acquire knowledge about land utilization and irrigation including the net area sown gross cultivated area, current follow, cultivable waste.

Theory content:

Unit I 15 Hrs.

Frequency distribution, standard error and deviation, correlation and regression analyses, co- efficient of variation.

Unit II 10 Hrs.

Hypothesis testing. Concept of p-value. Tests of significance-t, F and chi square (X²).

Unit III 10Hrs.

Data transformation and missing plot techniques; Design of experiments and their basic principles, completely randomized, randomized block, split plot, strip- plot, factorial and simple confounding designs

Unit IV 10Hrs.

Efficiency of designs; Methods of statistical analysis for cropping systems including intercropping; Pooled analysis.

Transaction Mode:

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

1. Panse, V.G. and Sukhatme, P.V. 1954. *Statistical methods for agricultural workers*. pp. 361.
2. Gupta, S.C. and Kapoor, V.K. 2014. *Fundamentals of Mathematical Statistics*.

3. *Sultan Chand & Sons, New Delhi. pp. 230.*

4. *Snecdecor, G.W. and Cochran, W.G. 1989. Statistical Methods, 8th Edition. Wiley-Blackwell. Pp.524.*

5. *Rangaswamy, R. 2016. Textbook of Agricultural Statistics. New Age International (P) Ltd. New Delhi. pp. 531.*

Course Title: Agricultural Statistics Lab
Course Code: STAT502

L	T	P	Credits
0	0	2	1

Practical Content

Total Hrs. 30

1. Correlation analysis.
2. Regression analysis (exponential, power function, quadratic, multi-variate, selection of variables, validation of models, ANOVA and testing of hypothesis).
3. Tests of significance (Z-test, t-test, F-test and Chi-square test).
4. Analysis of variance.
5. Completely randomized design.
6. Randomized block designs.
7. Latin square designs.
8. Missing plot and analysis of covariance. 23, 24 and 33 simple and confounded experiments. Split plot designs.
9. Factorial in split plot designs.

Transaction Mode:

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

1. Panse, V.G. and Sukhatme, P.V. 1954. *Statistical methods for agricultural workers*. pp. 361.
2. Gupta, S.C. and Kapoor, V.K. 2014. *Fundamentals of Mathematical Statistics*.
3. Sultan Chand & Sons, New Delhi. pp. 230.
4. Snecdecor, G.W. and Cochran, W.G. 1989. *Statistical Methods, 8th Edition*. Wiley-Blackwell. Pp.524.
5. Rangaswamy, R. 2016. *Textbook of Agricultural Statistics*. New Age International (P) Ltd. New Delhi. pp. 531.

Course Title: Library and Information services lab
Course Code:PGC501

L	T	P	Credits
0	0	2	1

TotalHours-30

Learning Outcomes: After completion of this course, the learner will be able to:

1. Identify library services and availability of resources in order to develop a realistic overall plan for research
2. Use general information resources to increase familiarity with the topic and disciplinary vocabulary
Learn about the research topic, question or thesis to achieve a manageable
3. focus appropriate to the assignment criteria, available resources, and evidence needed to support thesis
4. Identify keywords, synonyms and related terms in order to flexibly

Course Content

1. Introduction to Library and its services; five laws of library science; type of documents;
2. Classification and cataloguing; organization of documents;
3. Sources of information primary, secondary and tertiary;
4. Current awareness and SDI services; tracing information from reference sources;
5. Library survey; preparation of bibliography; use of Online Public Access Catalogue;
6. Use of CD-ROM data bases and other computerized library services, CeRA,
7. J-Gate; use of Internet including search engines and its resources; e- resources.

Suggested readings:

- Gita, S. 2012. *Library and Information Services*. LAP Lambert Academic Publishing. USA. pp. 76.
- Kishore, A. 2021. *A Conceptual approach to library and information science A complete self study guide*. 2nd edition. AKB Publication. Jaipur. pp.250.

Course Title: *Agricultural Research, Research Ethics and Rural Development Programmes*

Course Code:PGC502

L	T	P	Credits
1	0	0	1

TotalHours-15

Learning Outcomes: After completion of this course, the learner will be able to:

1. To enlighten the students about the organization and functioning of agricultural research systems at national and international levels
2. To aware the students about research ethics, and rural development programmes and policies of Government.
3. Acquire knowledge on Concept and connotations of rural development
4. Constraints in implementation of rural policies and programmes

UNIT-I

3

Hours

History of agriculture in brief; Global agricultural research system: need, scope, opportunities; Role in promoting food security, reducing poverty and protecting the environment; National Agricultural Research Systems (NARS) and Regional Agricultural Research Institutions; Consultative Group on International Agricultural Research (CGIAR)

UNIT-II

4

Hours

Research ethics: research integrity, research safety in laboratories, welfare of animals used in research, computer ethics, standards and problems in research ethics. International Agricultural Research Centres (IARC), partnership with NARS, role as a partner in the global agricultural research system, strengthening capacities at national and regional levels;

UNIT-III

4

Hours

International fellowships for scientific mobility. Concept and connotations of rural development, rural development policies and strategies. Rural development programmes: Community Development Programme, Intensive Agricultural District Programme, Special group – Area Specific Programme.

UNIT-IV

4

Hours

Integrated Rural Development Programme (IRDP) Panchayati Raj Institutions, Cooperatives, Voluntary Agencies/Non-Governmental Organisations. Critical evaluation of rural development policies and programmes. Constraints in implementation of rural policies and programmes.

Transaction Mode:

Lecture, Seminar, Peer Group Discussion, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested Reading

1. Bhalla GS & Singh G. 2001. *Indian Agriculture-Four Decades of Development*. Sage Publ.
2. Punia MS. *Manual on International Research and Research Ethics*. CCS, Haryana Agricultural University, Hisar.
3. Rao BSV. 2007. *Rural Development Strategies and Role of Institutions-Issues, Innovations and Initiatives*. Mittal Publ.
4. Singh K. 1998. *Rural Development -Principles, Policies and Management*. Sage Publ.

Course Title: Master's Research
Course Code: FLS 600

L	T	P	Credits
0	0	0	2

Learning Outcomes:

On successful completion of this course, the students will able to:

- Conduct an investigation and solve scientific problems using a range of methods, and apply appropriate and/or theoretical techniques
- Negotiate, plan, design and execute a research-based project,
- Analyse data and provide a written report or thesis on the methodology and outcomes in an appropriate format
- Learn the methodology of planning, layout, data recording, analysis, interpretation and report writing of Floriculture and Landscaping experiments
- Familiarize with indexing databases, citation databases: web of science, scopus, etc.

Semester II

Course Title: BREEDING OF ORNAMENTAL CROPS
Course Code: FLS 507

L	T	P	Credits
2	0	0	1

Learning Outcomes:

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.

Course Contents

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, lily, 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.

Teaching methods/ activities

- Lectures

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

Suggested Readings

- 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.

Course Title: BREEDING OF ORNAMENTAL CROPS
Course Code: FLS 508 Lab

L	T	P	Credits
0	0	1	1

Learning Outcomes:

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.

Course Contents

Practical

- 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).

Teaching methods/ activities

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

Suggested Readings

- 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.

**Course Title: COMMERCIAL PRODUCTION OF
LOOSE FLOWERS**

Course Code: FLS 509

L	T	P	Credits
2	0	0	2

Learning Outcomes:

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

Course contents

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

Teaching methods/ activities

- Lectures
- Group discussions
- Flip classes
- Assignment and group seminars

- Hands on traini

Suggested Readings

- 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.

**Course Title: COMMERCIAL PRODUCTION OF
LOOSE FLOWERS Lab**
Course Code: FLS 510

L	T	P	Credits
0	0	1	1

Learning Outcomes:

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

Course contents

Practical

- 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).

Teaching methods/ activities

- Lectures
- Group discussions
- Flip classes
- Assignment and group seminars
- Hands on traini

Suggested Readings

- 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.

**Course Title: PROTECTED CULTIVATION OF
FLOWER CROPS**

Course Code: FLS 511

L	T	P	Credits
2	0	0	2

Learning Outcomes:

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

Course Contents

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.

Teaching Methods/ Activities

- Lectures
- Group discussions
- Flip classes

- Assignment and group seminars
- Hands on training of different techniques
- Exposure visits

Suggested Readings

- 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

Course Title: PROTECTED CULTIVATION OF FLOWER CROPS Lab

Course Code: FLS 512

L	T	P	Credits
0	0	1	1

Learning Outcomes:

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

Course Contents

Practical

- 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).

Teaching Methods/ Activities

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

Suggested Readings

- 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

Course Title: Sub-Tropical and Temperate Fruit

Production

Course Code: FSC501

L	T	P	Credits
2	0	0	2

Total Hours-30

Learning Outcomes: After completion of this course, the learner will be able to:

1. Get familiarize with the basic knowledge of importance, uses, origin, distribution, area and production of subtropical and temperate fruits.

2. Acquire technical knowhow regarding soil, climatic, water quality, biotic/abiotic factors limiting fruit production.
3. Learn the importance and methods of planting, root stock, propagation, fertigation and irrigation, nutrient and water management.

Establish the methodology of training, pruning, quality improvement, pollination, fruit set and plant protection of sub-tropical and temperate fruits.

Course content (Theory)

Origin, distribution, commercial importance and export potential. Eco-physiological requirements. Species and varieties. Rootstocks and propagation. Planting, root zone, training and pruning, Nutrition and water requirements, fertigation, role of bio-regulators, major pests, diseases, physiological disorders and their control measures. Abiotic factors limiting fruit production. Flowering, pollination and fruit set. Quality improvement. Storage and ripening techniques. Industrial and export potential, Agri. Export Zones (AEZ) and industrial support.

Unit I

8 hours

Fruit Crops -Apple, Pear, Quince, Plum, Peach, Cherries, Apricot

Unit II

7 hours

Fruit Crops - Grapes, Hazelnut, Litchi, Loquat, Persimmon.

Unit III

7 hours

Fruit Crops - Kiwifruit, Strawberry, Walnut, Almond, Pistachio, Pecan.

Unit IV

8 hours

Fruit Crops – Mangosteen, Carambola, Bael, Wood apple, Fig, Jamun, Rambutan and Pomegranate.

Transaction Mode

Lecture, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested readings

- Yadav, P.K. 2014. *Production Technology of Tropical and Subtropical Fruits*. New india publishing Agency. pp. 384.
- Chadha, K. L. 2012. *Hand Book of Horticulture*. ICAR, New Delhi. pp.1057.
- Singh, S., Shivankar, V.J., Srivastava, A.K. and Singh, I.P. 2004. *Advances in Citriculture*. Jagminder Book Agency. pp.256.
- Pandey RM and Randey SN. 1996. *The Grape in India*. ICAR, New Delhi..
- Rajput CBS, and Haribabu RS. 2006. *Citriculture*, Kalyani Publishers, New Delhi.
- Sandhu S and Gill BS. 2013. *Physiological Disorders of Fruit Crops*. NIPA, New Delhi.
- Sharma RM, Pandey SN and Pandey V. 2015. *The Pear – Production, Post-harvest Management and Protection*. IBDC Publisher, New Delhi.
- Sandhu S and Gill BS. 2013. *Physiological Disorders of Fruit Crops*. NIPA, New Delhi.
- Schaffer B, Wolstenholme BN and Whiley AW. 2013. *The Avocado: Botany, Production and Uses*. CAB International.

Course Title: Sub-Tropical and Temperate Fruit

Production Lab

Course Code: FSC502

L	T	P	Credits
0	0	2	1

Total Hours-30

Learning Outcomes: After completion of this course, the learner will be able to:

1. Get familiarize with the basic knowledge of importance, uses, origin, distribution, area and production of subtropical and temperate fruits.
 2. Acquire technical knowhow regarding soil, climatic, water quality, biotic/abiotic factors limiting fruit production.
 3. Learn the importance and methods of planting, root stock, propagation, fertigation and irrigation, nutrient and water management.
- Establish the methodology of training, pruning, quality improvement, pollination, fruit set and plant protection of sub-tropical and temperate fruits.

Practical Content

Total Hours: 15

1. Description and identification of species and varieties.
2. Growth and development.
3. Growth regulation.
4. Nutritional and physiological disorders and their control.
5. Rejuvenation of old and unproductive trees.
6. Visit to commercial orchards.
7. Project preparation for establishing commercial orchards.

Transaction Mode

Lecture, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested readings

- Yadav, P.K. 2014. *Production Technology of Tropical and Subtropical Fruits*. New india publishing Agency. pp. 384.
- Chadha, K. L. 2012. *Hand Book of Horticulture*. ICAR, New Delhi. pp.1057.
- Singh, S., Shivankar, V.J., Srivastava, A.K. and Singh, I.P. 2004. *Advances in Citriculture*. Jagminder Book Agency. pp.256.
- Pandey RM and Randey SN. 1996. *The Grape in India*. ICAR, New Delhi..
- Rajput CBS, and Haribabu RS. 2006. *Citriculture*, Kalyani Publishers, New Delhi.
- Sandhu S and Gill BS. 2013. *Physiological Disorders of Fruit Crops*. NIPA, New Delhi.

- *Sharma RM, Pandey SN and Pandey V. 2015. The Pear – Production, Post-harvest Management and Protection. IBDC Publisher, New Delhi.*
- *Sandhu S and Gill BS. 2013. Physiological Disorders of Fruit Crops. NIPA, New Delhi.*
- *Schaffer B, Wolstenholme BN and Whiley AW. 2013. The Avocado: Botany, Production and Uses. CAB International.*

Course Title: Production Technology of warm season

Vegetable Crops

Course Code: VSC505

Total Hours-30

L	T	P	Credits
2	0	0	2

Learning Outcomes: After completion of this course, the learner will be able to:

1. Identify deficiency symptoms of nutrients in warm season vegetable Crops.
2. Acquaint with production technology of warm season vegetable crops.
3. Gain practical knowledge for nursery raising technique and preparation of land for cultivation and for warm season vegetable crops.
4. Compile about crops for raising quality, disease, pest and harvesting induces of warm season vegetable crops.

Unit-I

8 hours

Vegetable crops —Tomato, Brinjal, Hot pepper, Sweet pepper and Okra.

Unit-II

8 hours

Vegetable crops- Beans; French bean, Indian bean, Cluster bean and Cowpea.

Unit-III

7 hours

Vegetable crops- Cucurbits; Cucumber, Melons, Gourds, Pumpkin and Squashes.

Unit-IV

7 hours

Vegetable crops- Tuber crops; Sweet potato, Elephant foot yam, Tapioca, Taro and yam and Leafy vegetables; Amaranth and Drumstick.

Transaction Mode

Lecture, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested readings:

- Swarup, V. 2006. *Vegetable Science and Technology In India: Kalyani Publishers, India. Pp 656.*
- Kabir, J., Maity, T. K., Bose, T. K. 2002. *Vegetable Crops Vol. 1: Naya Prokash, India. Pp 668.*
- Kabir, J., Maity, T. K., Bose, T. K. 2002. *Vegetable Crops Vol. 2: Naya Prokash, India. Pp 489*
- Kabir, J., Maity, T. K., Bose, T. K. 2003. *Vegetable Crops Vol. 3: Naya Prokash, India. Pp 550*

- *Hazra, P., Karmakar, K., Chattopadhyay, A. 2011. Modern Technology in Vegetable Production. New India Publishing Agency, India. Pp 442*

Course Title: Production Technology of warm season

Vegetable Crops Lab

Course Code: VSC506

Total Hours-30

L	T	P	Credits
0	0	2	1

Learning Outcomes: After completion of this course, the learner will be able to:

1. Identify deficiency symptoms of nutrients in warm season vegetable Crops.
2. Acquaint with production technology of warm season vegetable crops.
3. Gain practical knowledge for nursery raising technique and preparation of land for cultivation and for warm season vegetable crops.
4. Compile about crops for raising quality, disease, pest and harvesting induces of warm season vegetable crops.

Course content (Practical)

1. Scientific raising of nursery and seed treatment.
2. Sowing and transplanting.
3. Description of commercial and hybrids varieties.
4. Demonstration on methods of irrigation, fertilizers and micronutrients application.
5. Mulching practices and weed management.
6. Use of plant growth substances in warm season vegetable crops.
7. Study of nutritional and physiological disorders.
8. Studies on hydroponics, aeroponics and other soilless culture.
9. Identification of important pest and diseases and their control.
10. Preparation of cropping scheme for commercial farms.
11. Visit to commercial farm, greenhouse/polyhouse.

Transaction Mode

Lecture, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested readings:

- Swarup, V. 2006. *Vegetable Science and Technology In India: Kalyani Publishers, India. Pp 656.*
- Kabir, J., Maity, T. K., Bose, T. K. 2002. *Vegetable Crops Vol. 1: Naya Prokash, India. Pp 668.*
- Kabir, J., Maity, T. K., Bose, T. K. 2002. *Vegetable Crops Vol. 2: Naya Prokash, India. Pp 489*
- Kabir, J., Maity, T. K., Bose, T. K. 2003. *Vegetable Crops Vol. 3: Naya Prokash, India. Pp 550*

- Hazra, P., Karmakar, K., Chattopadhyay, A. 2011. *Modern Technology in Vegetable Production*. New India Publishing Agency, India. Pp 442

Course Title: Fundamentals of Computer application Lab

Course Code: CA551

L	T	P	Credits
0	0	4	02

Learning Outcomes: After completion of this course, the learner will be able to:

1. Learn and understand about basics of MS-Word, Excel, preparation of Graphs
2. Read, understand, and interpret material on technology. They will have an appreciation for some of the ideas, issues, and problems involved in writing about technology and in workplace writing.
3. Understand the operating systems, peripheral devices, networking, multimedia and internet
4. Familiarize with basic sources and methods of research and documentation on topics in technology, including on-line research, integrate material from primary and secondary sources with their own ideas in research papers.

Practical content:

1. Ms-word: creating a document and saving and editing,
2. Use of options from tool bars, format, insert and tools (spelling and grammar), alignment of text.
3. Creating a table, merging cells, column and row width.
4. Ms-excel: entering expressions through the formula tool.
5. Use of inbuilt functions, sum, average, max, min.
6. Creating graphs and saving with and without data in Ms-excel.
7. Ms-access: creating database, structuring with different types of fields.
8. Ms-power point: preparation of slides on power point.
9. Internet Browsing: browsing a web page and creating of E-Mail ID. Agri. Net (ARIS).

Suggested Readings:

1. Salaria, R.S. 2017. *Computer Fundamentals*. Darya Ganj, New Delhi. pp. 486.
2. Manish, S. and Bhatt, A. 2016. *Computers in Agriculture: Fundamentals and Applications*. New India Publishing Agency. New Delhi. pp. 190.
3. Manjunath, B.E. 2010. *Computer Basics*. Vasan Publications, Bengaluru, Karnataka. Pp. 356.

Course Title: Master's Research
Course Code: FLS 600

L	T	P	Credits
0	0	0	05

Learning Outcomes:

On successful completion of this course, the students will able to:

- Conduct an investigation and solve scientific problems using a range of methods, and apply appropriate and/or theoretical techniques
- Negotiate, plan, design and execute a research-based project,
- Analyse data and provide a written report or thesis on the methodology and outcomes in an appropriate format
- Learn the methodology of planning, layout, data recording, analysis, interpretation and report writing of Floriculture and Landscaping experiments
- Familiarize with indexing databases, citation databases: web of science, scopus, etc.

Course Title: Basic concepts in Laboratory

L	T	P	Credits
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techniques Lab**Course Code: PGC551**

0	0	2	01

Course outcomes:

On successful completion of this course, the students will be able to:

1. To acquaint the students about the basics of commonly used techniques in laboratory.
2. Preparation of solutions of acids
3. Get knowledge on Drying of solvents/chemicals
4. Electric wiring and earthing

Course Content:

1. Safety measures while in Lab
2. Handling of chemical substances
3. Use of burettes, pipettes, measuring cylinders, flasks, separatory funnel, condensers, micropipettes and vials; washing, drying and sterilization of glassware
4. Drying of solvents/chemicals
5. Weighing and preparation of solutions of different strengths and their dilution
6. Handling techniques of solutions; Preparation of different agro-chemical doses in field and pot applications
7. Preparation of solutions of acids
8. Neutralization of acid and bases
9. Preparation of buffers of different strengths and pH values
10. Use and handling of microscope, laminar flow, vacuum pumps, viscometer, thermometer, magnetic stirrer, micro-ovens, incubators, sand bath, water bath, oil bath.
11. Electric wiring and earthing. Preparation of media and methods of sterilization
12. Seed viability testing, testing of pollen viability Tissue culture of crop plants; Description of flowering plants in botanical

Transaction Mode

Lecture, Seminar, Peer Group Discussion, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested Reading

- Furr AK. 2000. CRCH and Book of Laboratory Safety. CRC Press.
- Gabb MH & Lat chem. WE. 1968. A Handbook of Laboratory Solutions. Chemical Publ. Co.

Semester III

Course Title: SEED PRODUCTION IN FLOWER CROPS
Course Code: FLS 513

L	T	P	Credits
1	0	0	1

Learning Outcomes:

After successful completion of this 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.

Course Contents

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, agro-techniques 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 behavior 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.

Teaching Methods/ Activities

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

Suggested Readings

- 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.

Course Title: SEED PRODUCTION IN FLOWER CROPS LAB
Course Code: FLS 514

L	T	P	Credits
0	0	1	1

Learning Outcomes:

After successful completion of this 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.

Course Contents

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).

Teaching Methods/ Activities

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

Suggested Readings

- 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.

Course Title: VALUE ADDITION IN FLORICULTURE
Course Code: FLS 515

L	T	P	Credits
2	0	0	1

Learning Outcomes:

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

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

Course Contents

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

Teaching Methods/ Activities

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

Suggested Readings

- 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.

Course Title: VALUE ADDITION IN FLORICULTURE
Course Code: FLS 516 LAB

L	T	P	Credits
0	0	1	1

Learning Outcomes:

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

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

Course Contents

Practical

- 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, potpourri, 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).

Teaching Methods/ Activities

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

Suggested Readings

- 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.

Course Title: Propagation and nursery management of fruit crops

Course Code: FSC513

L	T	P	Credits
0	0	2	1

Total Hours-30

Learning Outcomes: After completion of this course, the learner will be able to:

1. Understand the plant life cycle, cellular basis of propagation, Asexual and sexual propagation, chimeras, apomixes etc.
2. Attain the knowledge of seed germination factor affecting and hormonal control of seed germination, seedling growth, seed quality packing and storing of seed.
3. Learn the importance of root stocks, rooting of cutting its anatomical and physiological basis.
4. Acquire the basic knowledge about establishment of bud wood bank, stock, scion, inter stock relationship and incompatibility.

Course Content (Theory)

Unit I**7 hours**

Introduction, life cycles in plants, cellular basis for propagation. Sexual propagation-apomixis, polyembryony, chimeras.

Unit II**8 hours**

Factors influencing seed germination and seedling growth, Seed quality, treatment, packing, storage, certification and testing. Rooting of cuttings under mist and hot beds.

Unit III**7 hours**

Physiological, anatomical and biochemical aspects of root induction in cuttings. Selection of elite mother plants. Establishment of bud wood bank. Stock, scion and inter stock relationship and Incompatibility. Uses of dwarfing rootstocks. Rejuvenation. Progeny orchard and scion bank.

Unit IV**8 hours**

Micro-Propagation-in vitro clonal propagation, direct organogenesis, embryogenesis, micro grafting and meristem culture. Hardening, packing and transport of micro- propagules. Nursery structures.

Course content (Practical)**Total Hours-****30**

1. Hands on practices on rooting of dormant and summer cuttings.
2. Anatomical studies in rooting of cutting and graft union.
3. Hands on practices on various methods of budding
4. Hands on practices on various methods of grafting.
5. Propagation by layering and stooling.
6. Visit to commercial tissue culture laboratories and accredited nurseries.

Transaction Mode

Lecture, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested readings

- *Hartman, H.T., Kester, D.E., Davies, F.T. and Geneve, R.L. 2015. Plant propagation principles and practices. Pearson Education India. pp.928.*

- *Sandhu, M.K. 2020. Plant Propagation. New age international Ltd. pp.296.*
- *Sharma, R.R. 2019. Propagation of Horticultural crops. Kalyani Publishers.pp.304*

**Course Title: Propagation and nursery
management of fruit crops Lab**

L	T	P	Credits

Course Code: FSC514

0	0	1	1
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Course content (Practical)**Total Hours-30**

7. Hands on practices on rooting of dormant and summer cuttings.
8. Anatomical studies in rooting of cutting and graft union.
9. Hands on practices on various methods of budding
10. Hands on practices on various methods of grafting.
11. Propagation by layering and stooling.
12. Visit to commercial tissue culture laboratories and accredited nurseries.

Transaction Mode

Lecture, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested readings

- Hartman, H.T., Kester, D.E., Davies, F.T. and Geneve, R.L. 2015. *Plant propagation principles and practices*. Pearson Education India. pp.928.
- Sandhu, M.K. 2020. *Plant Propagation*. New age international Ltd. pp.296.
- Sharma, R.R. 2019. *Propagation of Horticultural crops*. Kalyani Publishers. pp.304

Course Title: Organic Vegetable Production
Course Code: VSC513

L	T	P	Credits
1	0	0	1

Learning outcome:

After completion of this course, the learner will be able to:

1. Appreciate the scope and scenario of organic vegetable production in India.
2. Acquire knowledge about the organic vegetable production technology.
3. Manage soil fertility, crop rotation and post-harvest of organic vegetables.
4. Adopt production of organic vegetable crops as an entrepreneur.

Theory Content

Unit I	3 Hours
Importance, principles, perspective, concepts and components of organic farming in vegetable crops	
II	4Hours
Organic production of vegetable crops, viz. Solanaceous, Cucurbitaceous, Cole, root and tuber crops	
Unit III	4Hours
Managing soil fertility, mulching, raising green manurecrops, weed management in organic farming system; Crop rotation in organic production; Processing and quality control of organic vegetable produce	
Unit IV	4Hours
Indigenous methods of composting, Panchyagavva, Biodynamics preparations and their application; ITKs in organic vegetable farming; Role of botanicals and bio-control agents in the management of pests and diseases in vegetable crops Certification and export—Techniques of natural vegetable farming, GAP and GMP certification of organic products; Export- opportunity and challenges.	

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested Reading

- Dahama AK. 2005. Organic farming for sustainable agriculture. 2nd Ed. Agrobios.
- Gehlot G. 2005. Organic farming; standards, accreditation certification and inspection. Agrobios.
- Palaniappan SP and Annadorai K. 2003. Organic farming, theory and practice. Scientific publ.
- Pradeepkumar T, Suma B, Jyothibhaskar and Satheesan KN. 2008. Management of horticultural crops. New India Publ. Agency.

Course Title: Organic Vegetable Production Lab
Course Code: VSC514

L	T	P	Credits
0	0	2	1

Learning outcome:

After completion of this course, the learner will be able to:

1. Appreciate the scope and scenario of organic vegetable production in India.
2. Acquire knowledge about the organic vegetable production technology.
3. Manage soil fertility, crop rotation and post-harvest of organic vegetables.
4. Adopt production of organic vegetable crops as an entrepreneur.

Practical Content

Total Hours: 15

1. Methods of preparation and use of compost, vermicompost, biofertilizers and biopesticides.
2. Soil solarisation.
3. Use of green manures.
4. Waste management; Organic soil amendments in organic production of vegetable crops.
5. Weed, pest and disease management in organic vegetable production.
6. Visit to organic fields and marketing centres.

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested Reading

- Dahama AK. 2005. Organic farming for sustainable agriculture. 2nd Ed. Agrobios.
- Gehlot G. 2005. Organic farming; standards, accreditation certification and inspection. Agrobios.
- Palaniappan SP and Annadorai K. 2003. Organic farming, theory and practice. Scientific publ.
- Pradeepkumar T, Suma B, Jyothibhaskar and Satheesan KN. 2008. Management of horticultural crops. New India Publ. Agency.

Course Title: Technical Writing and Communication Skills

Course Code: PGC504

L	T	P	Credits
0	0	2	1

Learning Outcomes: After completion of this course, the learner will be able to:

1. Understand and know how to follow the stages of the writing process (prewriting/writing/rewriting) and
2. Apply them to technical and workplace writing tasks
3. Produce a set of documents related to technology and writing in the workplace and will have improved their ability to write clearly and accurately
4. Establish the basic components of definitions, descriptions, process explanations, and other common forms of technical writing.

Practical Content

1. Various forms of scientific writings: theses, technical papers, review, manuals etc.
2. Various parts of thesis and research communications: title page, authorship contents page, preface, introduction, review of literature,

Course Title: Mater's Seminar
Course Code: FLS 557

L	T	P	Credits
0	0	1	01

Learning Outcomes:

On successful completion of this course, the students will able to:

1. Show competence in identifying relevant information, defining and explaining topics under discussion
2. Present the classical and innovative work related to Floriculture and Landscaping subject.
3. Reach across diverse disciplines to apply theories, methods and knowledge bases from multiple fields to a single question or problem
4. Judge when to speak and how much to say, speak clearly and audibly in a manner appropriate to the subject
5. To ask appropriate questions, use evidence to support claims, respond to a range of questions
6. **Course Content:** Seminar topic will be suggested by the faculty of Floriculture and Landscaping.

Course Title: Master's Research
Course Code: FLS 600

L	T	P	Credits
0	0	0	10

Learning Outcomes:

On successful completion of this course, the students will be able to:

- Conduct an investigation and solve scientific problems using a range of methods, and apply appropriate and/or theoretical techniques
- Negotiate, plan, design and execute a research-based project,
- Analyse data and provide a written report or thesis on the methodology and outcomes in an appropriate format
- Learn the methodology of planning, layout, data recording, analysis, interpretation and report writing of Floriculture and Landscaping experiments
- Familiarize with indexing databases, citation databases: web of science, scopus, etc.

Semester IV

Course Title: Intellectual Property and its management in Agriculture

Course Code: PGC505

L	T	P	Credits
1	0	0	01

Total hours 15

Learning Outcomes: After completion of this course, the learner will be able to:

1. Recognize the importance of IP and to educate the pupils on basic concepts of Intellectual Property Management in Agriculture.
2. Identify the significance of practice and procedure of Patents.
3. Make the students to understand the statutory provisions of different forms of Intellectual Property Management in simple forms.
4. Develop the procedure of obtaining Patents, Copyrights, Trade Marks, Industrial Design and to keep their IP rights alive.

Theory content:

Unit-I

2 Hrs

Historical perspectives and need for the introduction of Intellectual Property Right regime; TRIPs and various provisions in TRIPS Agreement; Intellectual Property and Intellectual Property Rights (IPR).

Unit-II

4Hrs

Benefits of securing IPRs; Indian Legislations for the protection of various types of Intellectual Properties; Fundamentals of patents, copyrights, geographical indications, designs and layout, trade secrets and traditional knowledge, trademarks. protection of plant varieties and farmers' rights and biodiversity protection.

Unit-III

5 Hrs.

Protection of plant varieties and farmers' rights and biodiversity protection; protectable subject matters, protection in biotechnology, protection of other biological materials, ownership and period of protection; national biodiversity protection initiatives; convention on biological diversity.

Unit-IV

4Hrs.

International treaty on plant genetic resources for food and agriculture; licensing of technologies, material transfer agreements, research collaboration agreement, license agreement.

Suggested readings:

- Erbisch FH and Maredia K.1998. *Intellectual Property Rights in Agricultural Biotechnology*. CABI.
- Ganguli P. 2001. *Intellectual Property Rights: Unleashing Knowledge Economy*. McGraw-Hill.
- *Intellectual Property Rights: Key to New Wealth Generation*. 2001. NRDC and Aesthetic Technologies.
- Ministry of Agriculture, Government of India. 2004. *State of Indian Farmer*. Vol. V. Technology Generation and IPR Issues. Academic Foundation.
- Rothschild M and Scott N. (Ed.). 2003. *Intellectual Property Rights in Animal Breeding and Genetics*. CABI.
- Saha R. (Ed.). 2006. *Intellectual Property Rights in NAM and Other Developing Countries: A Compendium on Law and Policies*. Daya Publ. House.

Course Title: Master's Research
Course Code: FLS 600

L	T	P	Credits
0	0	0	13

Learning Outcomes:

On successful completion of this course, the students will be able to:

- Conduct an investigation and solve scientific problems using a range of methods, and apply appropriate and/or theoretical techniques
- Negotiate, plan, design and execute a research-based project,
- Analyse data and provide a written report or thesis on the methodology and outcomes in an appropriate format
- Learn the methodology of planning, layout, data recording, analysis, interpretation and report writing of Floriculture and Landscaping experiments
- Familiarize with indexing databases, citation databases: web of science, scopus, etc.