GURU KASHI UNIVERSITY

M.Sc. (Fruit Science)

Session: 2024-25

Department of Horticulture

Graduate Attributes

Provide knowledge of economic importance, cultivation practices of temperate, tropical, sub-tropical and dry land fruit crops. Impart a deep insight of nutrition, canopy, plant physiology, disease and insect pest management; determination and identification of nutrient from soil and plant in order to assess deficiencies and toxicity; plant protection measures, utilization of different structures such as poly and green houses to enhance crop yield in orchards; water requirement of different fruit crops.

Programme Learning Outcomes

After completing the programme, the learner will be able to:

1. Study the climatic requirements of various fruit crops of Temperate, Tropical and Sub- tropical regions of India. Besides, their economic importance, uses, distribution, varieties and propagation techniques.

2. Pursue analysis of symptoms and disorders preceded by their dearth along with physiological role in fruit plants.
3. Provide acquaintance regarding methodology for fruit harvesting, harvest indices, grading for specific market and influences of pre-harvest practice on marketing of fruit crops.
4. Imbibe coherent knowledgeof textural changes occurred during harvesting aided by respiration and transpiration.
5. Impart basic knowledge of plant life cycle, cellular basis of propagation and plant physiology related to germination, pollination, plant growth & development, hormones and growth regulators.

6. Provide profound knowledge of fruit crop improvement assisted by training, pruning and thinning either manually or with growth regulators, use of bio-technology in fruit and resistance breeding to surmount biotic and abiotic stresses in fruit crops.

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Course Structure of M.Sc. Fruit Science

SEMESTER 1ST						
Course Code	**Course Name**	**Type of Course**	**L**	**T**	**P**	**No. of Credits**
MFS103	Sub- Tropical and Temperate Fruit Production	Major	2	0	0	2
MFS133	Canopy Management of Fruit Crops	Major	2	0	0	2
MFS134	Organic Fruit Culture	Minor	1	0	0	1
MFS104	Sub- Tropical and Temperate Fruit Production lab	Major	0	0	2	1
MFS136	Canopy Management of Fruit Crops lab	Major	0	0	2	1
MFS137	Organic Fruit Culture lab	Minor	0	0	2	1
MFS135	Commercial Production of Cut Flowers	Minor (CBCS)	2	0	0	2
MFS138	Commercial Production of Cut Flowers lab	Minor (CBCS)	0	0	2	1
MVS132	Production of Cool Season Vegetables Crops	Minor (CBCS)	2	0	0	2
MVS134	Production of Cool Season Vegetables Crops lab	Minor (CBCS)	0	0	2	1
MAR121	Agriculture Statistics	Supporting	3	0	0	3
MAR122	Agriculture Statistics lab	Supporting	0	0	2	1
MAR125	Library and Information Services lab	Common	0	0	2	1
MFS100	Master Research	Research	-	-	-	NC
Total			**10**	**0**	**14**	**19**

SEMESTER 2ND						
Course Code	**Course Name**	**Type of Course**	**L**	**T**	**P**	**No. of Credits**
MFS201	Tropical Fruit Production	Major	2	0	0	2
MFS202	Breeding Of Fruit Crops	Major	2	0	0	2
MFS205	Tropical Fruit Production lab	Major	0	0	2	1
MFS206	Breeding Of Fruit Crops lab	Major	0	0	2	1
MFS203	Commercial Production of Loose Flowers	Minor (CBCS)	2	0	0	2
MFS207	Commercial Production of Loose Flowers lab	Minor (CBCS)	0	0	2	1
MVS208	Production Technology of Warm Season Vegetables Crops	Minor (CBCS)	2	0	0	2
MVS204	Production Technology of Warm Season Vegetables Crops lab	Minor (CBCS)	0	0	2	1
MAR206	Fundamentals of Computer Applications lab	Supporting	0	0	4	2
MFS204	Seminar	Seminar	-	-	-	1
MFS100	Master Research	Research	-	-	-	NC
Total			**6**	**0**	**10**	**12**

SEMESTER 3RD						
Course Code	**Course Name**	**Type of Course**	**L**	**T**	**P**	**No. of Credits**
MFS301	Growth and Development of Fruit of Fruit Crops	Major	2	0	0	2
MFS302	Propagation and Nursery Management of Fruit Crops	Major	1	0	0	1
MFS304	Growth and Development of Fruit of Fruit Crops lab	Major	0	0	2	1
MFS305	Propagation and Nursery Management of Fruit Crops lab	Major	0	0	2	1
MAR304	Technical Writing and Communication Skills lab	Common	0	0	2	1
MFS100	Master Research	Research	-	-	-	NC
Total			**3**	**0**	**8**	**6**

SEMESTER 4TH						
Course Code	**Course Name**	**Type of Course**	**L**	**T**	**P**	**No. of Credits**
MFS401	Nutrition Of Fruit Crops	Major	2	0	0	2
MFS403	Nutrition Of Fruit Crops lab	Major	0	0	2	1
MAR402	Intellectual Property and its management in Agriculture	Common	1	0	0	1
MFS100	Master Research	Research	-	-	-	NC
Total			**3**	**0**	**2**	**4**
MFS100	Master Research	Research	-	-	-	30
Total			**3**	**0**	**2**	**41+30=71**

*****CBCS (Choice Based Credit System)

*NC (Non-Credit)

Evaluation Criteria for Theory Courses

A. Continuous Assessment: [25Marks]

   i. CA1 (10 Marks)
   ii. CA2 (10 Marks)
   iii. CA3 (05 Marks)

B. Attendance (5 marks)
C. Mid Semester Test: [30 Marks]
D. End-Term Exam: [40 Marks]

For the CAs the teacher shall take surprised test/term paper/quiz/assignments.

Evaluation Criteria for practical Courses
The syllabus of subject is divided into five experiments, each experimentcontains 20 marks (10 lab performance, 5 viva-voce, 5 lab record)- Total marks 100

Evaluation Criteria for Seminar
It is of total Marks-100
Collection of review of literature - 20marks
Data Analysis -20 marks
Power Point Presentation - 20 marks
Presentation skills - 20 marks
Viva voce - 20 marks

Evaluation Criteria for Master Research
The evaluation is Satisfactory or Unsatisfactory on the basis of the performance of the candidate.

Semester –I

Course Title: Sub-Tropical and Temperate Fruit Production	**L**	**T**	**P**	**Credits**
Course Code: MFS103	**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.
4. 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. Expert 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. Jagmander 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.*
- *Sharma KK and Singh NP. 2011. Soil and Orchard Management. Daya Publishing House, New Delhi.*
- Singh, Sanjay, H. P., Singh Singh, A. K.and Sisodia P. S. 2011. The Jamun (fruit for future). Pub. Agro-tech Publishing Agency, Udaipur, Rajasthan.

Course Title: Canopy Management in Fruit Crops
Course Code: MFS133

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. Understand the basic principles of canopy management to modify plant architecture
2. Inculcate skills on training and pruning of fruit crops, and growth regulation.
3. Comprehend about canopy management, training through root stocks, pruning, training management practices and land use, spacing, utilization, light interception, flowering and fruiting of important fruit crop.
4. Compose the importance of spacing and use of land area.

Course content (Theory)

Unit I **8 hours**

Introduction, Types and Classification: Canopy management – importance and factors affecting canopy development. Canopy types and structures, canopy manipulation for optimum utilization of light and its interception.

Unit II **8 hours**

Spacing and utilization of land area – Canopy classification. Physical Manipulation and Growth Regulation: Canopy management through rootstock and scion.

Unit III **7 hours**

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

Unit IV **7hours**

Canopy development and management in relation to growth, flowering, fruiting and fruit quality.

Transaction Mode

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

Suggested readings

- *Bakshi JC, Uppal DK and Khajuria HN. 1988. The Pruning of Fruit Trees and Vines. Kalyani Publishers, New Delhi.*
- *Chadha KL and Shikhamany SD. 1999. The Grape, Improvement, Production and Post Harvest Management. Malhotra Publishing House, Delhi.*
- *Iyer CPA and Kurian RM. 2006. High Density Planting in Tropical Fruits: Principles and Practices. IBDC Publishers, New Delhi.*
- *Pradeepkumar T. 2008. Management of Horticultural Crops. NIPA, New Delhi.*
- *Singh G. 2010. Practical Manual on Canopy Management in Fruit Crops. Dept. of Agriculture and Co-operation, Ministry of Agriculture (GoI), New Delhi.*
- *Srivastava KK. 2012. Canopy Management in Fruits. ICAR, New Delhi*

- Mahala, K., Bhateshwar, M. C. and Solanki, S. K. (2022). Advances In Canopy Management in Fruit Crops. Recent Innovative Approaches in Agricultural Science.
- Wani, R. A., Din, S., Khan, M., Hakeem, S. A., Jahan, N., Lone, R. A. and Khan, J. A. (2021). Canopy management in fruit crops for maximizing productivity.

Course Title: Organic Fruit Culture

Course Code: MFS134

L	T	P	Credits
1	0	0	1

Total Hours-15

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

1. Study the different types of soil and its management for fruit crops and effect of soil organic matter on physicochemical characteristics of soils.
2. Familiarize with the concepts and practices of organic and other natural farming systems.
3. Generate know-how on procedures, policies and regulation for inspection and certification of organic produce
4. Construct the basic and advanced of organic farming practices and its management.

Course content (Theory)

Unit I **4hours**

Principles and Current Scenario: Organic horticulture, scope, area, production and world trade, definition, principles, methods and SWOT analysis.

Unit II **4 hours**

Farming System and Practices: Organic farming systems including biodynamic farming, natural farming, homa organic farming, rishi krishi, EM technology, cosmic farming; on-farm and off-farm production of organic inputs.

Unit III **4 hours**

Role of bio-fertilizers, bio enhancers, legumes, inter cropping, cover crops, green manuring, zero tillage, mulching and their role in organic nutrition management.

Unit IV **3 hours**

Organic seeds and planting materials, soil health management in organic production, weed management practices in organic farming, biological management of pests and diseases, trap crops, quality improvement in organic production of fruit crops.

Transaction Mode

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

Suggested readings

- *Claude A. 2004. The Organic Farming Sourcebook. Other India Press, Mapusa, Goa, India.*
- *Dabholkar SA. 2001. Plenty for All. Mehta Publishing House, Pune, Maharashtra.*
- *Das HC and Yadav AK. 2018. Advances in Organic Production of Fruit Crops. Westville Publishing House, New Delhi.*
- *Deshpande MS. 2003. Organic Farming with respect to Cosmic Farming. Mrs. Pushpa Mohan Deshpandey, Kolhapur, Maharashtra.*
- *Deshpande WR. 2009. Basics of Organic Farming. All India Biodynamic and Organic Farming Association, Indore.*
- *MP. Gaur AC, Neblakantan S and Dargan KS. 1984 Organic Manures. ICAR, New Delhi.*
- *Lampkin, N. and Ipswich, S. 1990. Organic Farming. Farming Press. London, UK.*
- *Lind K, Lafer G, Schloffer K, Innershofer G and Meister H. 2003. Organic Fruit Growing. CAB International.*
- *P.Parvatha Reddy 2024.*Organic Farming for Sustainable Horticulture. Scientific Publishers.
- Georg innerhofer, Gottfried lafer, Hans meister, Karl Lind, Karl schloffer2003.Organic Fruit Growing,CABI Publishing.

Course Title: Sub-Tropical and Temperate Fruit Production lab

Course Code: MFS104

L	T	P	Credits
0	0	2	1

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

1. Distinguished features of fruit species, cultivars and rootstocks.
2. Demonstration of planting systems, training and pruning.
3. Hands on practices on pollination and crop regulation.
4. Physiological disorders-malady diagnosis.
5. Physico-chemical analysis of fruit quality attributes.
6. Field/ Exposure visits to subtropical and temperate 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. Jagmander 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.*
- *Sharma KK and Singh NP. 2011. Soil and Orchard Management. Daya Publishing House, New Delhi.*

Course Title:Canopy Management in Fruit Crops lab
Course Code: MFS136

L	T	P	Credits
0	0	2	1

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

1. Study of different types of canopies.
2. Training of plants for different canopy types.
3. Canopy development through pruning.
4. Understanding bearing behavior and canopy management in different fruits.
5. Use of plant growth regulators.
6. Geometry of planting.
7. Development of effective canopy with support system.
8. Study on effect of different canopy types on production and quality of fruits.

Transaction Mode

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

Suggested readings

- *Bakshi JC, Uppal DK and Khajuria HN. 1988. The Pruning of Fruit Trees and Vines. Kalyani Publishers, New Delhi.*
- *Chadha KL and Shikhamany SD. 1999. The Grape, Improvement, Production and Post Harvest Management. Malhotra Publishing House, Delhi.*
- *Iyer CPA and Kurian RM. 2006. High Density Planting in Tropical Fruits: Principles and Practices. IBDC Publishers, New Delhi.*
- *Pradeepkumar T. 2008. Management of Horticultural Crops. NIPA, New Delhi.*

- *Singh G. 2010. Practical Manual on Canopy Management in Fruit Crops. Dept. of Agriculture and Co-operation, Ministry of Agriculture (GoI), New Delhi.*
- *Srivastava KK. 2012. Canopy Management in Fruits. ICAR, New Delhi*

Course Title:Organic Fruit Culture lab

Course Code: MFS137

L	T	P	Credits
0	0	2	1

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

1. Design of organic orchards/ farms management.
2. Conversion plan.
3. Nutrient management and microbial assessment of composts and bio-enhancers.
4. Preparation and application of composts, bio-enhancers and bio-pesticides.
5. Organic nursery raising.
6. Application of composts, bio-enhancers, bio-fertilisers and bio-pesticides, green manure, cover, mulching.
7. Preparation and use of neem-based products.
8. Biodynamic preparations and their role in organic agriculture, EM technology and products, biological/ natural management of pests and diseases.
9. Frame work for GAP.
10. Documentation for certification.

Transaction Mode

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

Suggested readings

- *Claude A. 2004. The Organic Farming Sourcebook. Other India Press, Mapusa, Goa, India.*
- *Dabholkar SA. 2001. Plenty for All. Mehta Publishing House, Pune, Maharashtra.*
- *Das HC and Yadav AK. 2018. Advances in Organic Production of Fruit Crops. Westville Publishing House, New Delhi.*
- *Deshpande MS. 2003. Organic Farming with respect to Cosmic Farming. Mrs. Pushpa Mohan Deshpandey, Kolhapur, Maharashtra.*
- *Deshpande WR. 2009. Basics of Organic Farming. All India Biodynamic and Organic Farming Association, Indore.*
- *MP. Gaur AC, Neblakantan S and Dargan KS. 1984 Organic Manures. ICAR, New Delhi.*
- *Lampkin, N. and Ipswich, S. 1990. Organic Farming. Farming Press. London, UK.*
- *Lind K, Lafer G, Schloffer K, Innershofer G and Meister H. 2003. Organic Fruit Growing. CAB International.*
- *Palaniappan SP and Annadurai K. 2008. Organic Farming- Theory and Practice. Scientific Publishers, Jodhpur, Rajasthan, India.*

- *Palekar S. 2004. The Technique of Spritual Farming.*
- *Chandra Smaritee, Sai Nagar, Amrawati, Maharashtra.*
- *Proctor P. 2008. Biodynamic Farming and Gardening. Other India Press, Mapusa, Goa.*
- *Ram RA and Pathak RK. 2017. Bioenhancers. Lap Lambert Academic Publishing, AP.*

Course Title: Commercial Production of Cut Flowers
Course Code: MFS135

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. Establish understanding of production and post-harvest management of flower crops.
2. Acquire the required skills to prepare project reports on different crops for financing.
3. Know about the preparation of land and nursery raising technique for cut flower crops for raising quality and disease-free seedlings.
4. Recommend the use of growth regulators, physiological disorders and remedies, IPM and IDM.

Course Content (Theory)

Scope and scenario: National and International scenario, importance and scope of cut flower trade, constraints for cut flower production in India. Growing environment: Soli analysis, soil health card, growing environment, open cultivation, protected cultivation, soil/ media requirements, land preparation, planting methods, influence of light, temperature, moisture, humidity and microclimate management on growth and flowering. Crop management: Commercial Flower production – Commercial varieties, water and nutrient management, fertigation, weed management, crop specific practices, ratooning, training and pruning, pinching, deshooting, bending, desuckering, disbudding. Use of growth regulators, physiological disorders and remedies, IPM and IDM. Flower regulation: Flower forcing and year-round/ offseason flower production through physiological interventions, chemical regulation, environmental manipulation.

Unit I **8 hours**

Flower crops-. Rose, Chrysanthemum, Gladiolus, Gerbera, Orchids,

Unit II **7 hours**

Flower crops-Tuberose, Carnation,Lilium, Anthurium, China aster.

Unit III **7 hours**

Flower crops- Alstroemeria, Bird of paradise, Heliconia, Solidago, Limonium,

Unit IV **8 hours**

Flower crops- Alpinia, Ornamental ginger,Dahlia, Gypsophila, stock, Cut greens and Fillers.

Transaction Mode

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

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. NayaProkash, 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: MFS138

L	T	P	Credits
0	0	2	1

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

1. Identification of varieties.
2. Propagation. Microclimate management.
3. Training and pruning techniques.
4. Pinching, deshooting, disbudding, desuckering.
5. Practices in manuring, drip and fertigation, foliar nutrition, growth regulator application.
6. No Blocks Units Horticultural Sciences–Floriculture and Landscaping.
7. Harvesting techniques, post-harvest handling, and cold chain.
8. Economics, Project preparation for regionally important cut flowers, crop specific guidelines for project financing (NHB guidelines).
9. Visit to commercial cut flower units.

Transaction Mode

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

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. NayaProkash, 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: Production Technology of cool Season Vegetable Crops
Course Code: MVS101

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 coolseason 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 **7Hours**

Bulb and tuber crops—Onion, garlic and potato

Unit II **7Hours**

Root crops—Carrot, radish, turnip and beetroot.

Unit III **8Hours**

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

Unit IV **8Hours**

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: MVS104

L	T	P	Credits
0	0	2	1

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

1. Scientific raising of nursery and seed treatment.
2. Sowing and transplanting.
3. Description of commercial varieties and hybrids.
4. Demonstration on methods of irrigation, fertilizers and micronutrients application.
5. Mulching practices, weed management.
6. Use of plant growth substances in cool season vegetable crops.
7. Study of nutritional and physiological disorders.
8. Studies on hydroponics 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, protected structure.
12. Visit to vegetable market.
13. 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: Agriculture Statistics

Course Code: MAR121

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. Understand the application of statistical methods in all the areas of experimental work and they have a very important role in agriculture.
2. Acquire Knowledge regarding requirement at the national level and farm level for agriculture policy making, decision making, agriculture development and estimates agriculture and national income.
3. Apply statistics in area of agriculture. One of the most important is to a certain the volume of crop that needs to be produced based on output and demand of previous year.
4. Generalize land utilization and irrigation including the net area sown gross cultivated area, current follow, and cultivable waste.

Course Content (Theory)

Unit I **10 hours**

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

Unit II **15 hours**

Concept of p-value. Tests of significance-t, F and chi-square (X^2); Data transformation and missing plot techniques.

Unit III **15 hours**

Design of experiments and their basic principles, completely randomized, randomized block, split plot, strip-plot, factorial and simple confounding designs; Efficiency of designs.

Unit IV **5 hours**

Methods of statistical analysis for cropping systems including intercropping; pooled analysis.

Transaction Mode

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

Suggested readings

- *Panse, V.G. and Sukhatme, P.V. 1967. Statistical methods for Agricultural workers. Indian Council of Agricultural Research, New Delhi. pp. 361.*
- *Gupta, S.C.and Kapoor, V.K. 2019.Mathematical statistics. Sultan Chand & Sons. pp. 1303.*
- *Snedocor, G. W. and. Cochran, W. G .1967: Statistical Methods 8th edition. Iowa State University Press. pp. 524.*
- *Gupta, S.C. and Kapoor, V.K. 2007. Fundamentals of Applied Statistics.Sultan Chand & Sons. pp.1303.*
- *Cochran, G.W. and, Cox, G.W. 1986: Experimental Designs 2nd edition. John Wiley & Sons, New York. pp.617*

Course Title: Agriculture Statistics lab

Course Code: MAR122

L	T	P	Credits
0	0	2	1

Course content (Practical) **Total Hours-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. Completely randomized design.
5. Randomized block and Latin square designs.
6. Missing plot and analysis of covariance.
7. 23, 24 and 33 simple and confounded experiments.
8. Split plot designs.
9. Factorial in split plot designs.

Transaction Mode

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

Suggested readings

- *Panse, V.G. and Sukhatme, P.V. 1967. Statistical methods for Agricultural workers. Indian Council of Agricultural Research, New Delhi. pp. 361.*
- *Gupta, S.C.and Kapoor, V.K. 2019.Mathematical statistics. Sultan Chand & Sons. pp. 1303.*
- *Snedocor, G. W. and. Cochran, W. G .1967: Statistical Methods 8th edition. Iowa State University Press. pp. 524.*
- *Gupta, S.C. and Kapoor, V.K. 2007. Fundamentals of Applied Statistics.Sultan Chand & Sons. pp.1303.*
- *Cochran, G.W. and, Cox, G.W. 1986: Experimental Designs 2nd edition. John Wiley & Sons, New York. pp.617.*

Course Title: Library and Information services lab

Course Code: MAR125

L	T	P	Credits
0	0	4	2

Total Hours-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
3. Learn about the research topic, question or thesis to achieve a manageable 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 databases 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: Master Research
Course Code: MFS100

L	T	P	Credits
NA	NA	NA	2(NC)

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

1. Conduct an investigation and solve scientific problems using a range of methods, and apply appropriate and/or theoretical techniques.
2. Familiarize with Negotiate, plan, design and execute a research-based project.
3. Analyse data and provide a written report or thesis on the methodology and outcomes in an appropriate format.
4. Learn the methodology of planning, layout, data recording, analysis, interpretation and report writing of plant pathology experiments.

Semester- II

Course Title: Tropical Fruit Production
Course Code: MFS201

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. 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 (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: Principlesand 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: Breeding of Fruit Crops

Course Code: MFS202

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. Learn the importance of origin, distribution, genetic recourse, gene banks and taxonomic status of fruit crop species and varieties.
2. Study the blossom biology and breeding systems and breeding objectives.
3. Understand the methods of fruit crop improvement through introduction, selection, hybridization, mutation breeding, polyploidy breeding and root-stock breeding.
4. Hypothesize the role of bio-technology in fruit breeding and resistance breeding for biotech and a biotech stresses of fruit crops.

Course Content (Theory)

Unit I **9 hours**

Origin and distribution, Taxonomical status of species and cultivars. Cytogenetics and geneticresources.

Unit II **8 hours**

Blossom biology, breeding objectives, systems and ideotypes. Crop improvement through introduction, selection, hybridization, mutation breeding.

Unit III **7 hours**

Polyploid breeding and rootstock breeding.Improvement of quality traits. Resistance breeding for biotic and abiotic stresses.

Unit IV **6 hours**

Biotechnological interventions, achievements and future thrust. The important temperate, sub- tropical and tropical fruit crops will be covered.

Transaction Mode

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

Suggested readings

- *Abraham Z. 2017. Fruit Breeding. Agri-Horti Press, New Delhi.*
- *Badenes ML and Byrne DH. 2012. Fruit Breeding.*
- *Springer Science, New York. Dinesh MR. 2015. Fruit Breeding, New India Publishing Agency, New Delhi.*
- *Ghosh SN, Verma MK and Thakur A. 2018. Temperate Fruit Crop Breeding-Domestication to Cultivar Development. NIPA, New Delhi.*
- *Hancock JF. 2008. Temperate Fruit Crop Breeding: Germplasm to Genomics.Springer Science, New York.*
- *Jain SN and Priyadarshan PM. 2009. Breeding Plantation and Tree Crops: Tropical Species.*
- *Springer Science, New York.*
- *Jain S and Priyadarshan PM. 2009. Breeding Plantation and Tree Crops: Temperate Species. Springer Science, New York.*
- *Janick J and Moore JN. 1996. Fruit Breeding. Vols. I–III. John Wiley & Sons, USA.*
- *Kumar N. 2014. Breeding of Horticultural Crops:Principles and Practices. NIPA, N. Delhi.*
- *Moore JN and Janick J. 1983. Methods in Fruit Breeding. Purdue University Press, USA.*
- *Ray PK. 2002. Breeding Tropical and Subtropical Fruits. Narosa Publ. House, New Delhi.*

Course Title: Tropical Fruit Production lab
Course Code: MFS205

L	T	P	Credits
0	0	2	1

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: Principlesand 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: Breeding of Fruit Crops lab

Course Code: MFS206

L	T	P	Credits
0	0	2	1

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

1. Exercises on bearing habit, floral biology.
2. Pollen viability and fertility studies.
3. Hands on practices in hybridization.
4. Raising and handling of hybrid progenies.
5. Induction of mutations and polyploidy.
6. Evaluation of biometrical traits and quality traits.
7. Screening for resistance against abiotic stresses.
8. Developing breeding programme for specific traits.
9. Visit to research stations working on fruit breeding.

Transaction Mode

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

Suggested readings

- *Abraham Z. 2017. Fruit Breeding. Agri-Horti Press, New Delhi.*
- *Badenes ML and Byrne DH. 2012. Fruit Breeding.*

- *Springer Science, New York. Dinesh MR. 2015. Fruit Breeding, New India Publishing Agency, New Delhi.*
- *Ghosh SN, Verma MK and Thakur A. 2018. Temperate Fruit Crop Breeding-Domestication to Cultivar Development. NIPA, New Delhi.*
- *Hancock JF. 2008. Temperate Fruit Crop Breeding: Germplasm to Genomics.Springer Science, New York.*
- *Jain SN and Priyadarshan PM. 2009. Breeding Plantation and Tree Crops: Tropical Species.*
- *Springer Science, New York.*
- *Jain S and Priyadarshan PM. 2009. Breeding Plantation and Tree Crops: Temperate Species. Springer Science, New York.*
- *Janick J and Moore JN. 1996. Fruit Breeding. Vols. I–III. John Wiley & Sons, USA.*
- *Kumar N. 2014. Breeding of Horticultural Crops:Principles and Practices. NIPA, N. Delhi.*
- *Moore JN and Janick J. 1983. Methods in Fruit Breeding. Purdue University Press, USA.*
- *Ray PK. 2002. Breeding Tropical and Subtropical Fruits. Narosa Publ. House, New Delhi.*

Course Title: Commercial Production of Loose Flowers
Course Code: MFS203

L	T	P	Credits
2	0	0	2

Total Hours-30

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

1. Learn thoroughly about production and post-harvest management of loose flowers.
2. Develop the required skills on commercial production management.
3. Identify deficiency symptoms of nutrients in loose flower crops.
4. Acquaint with the preparation of land and production technology for cultivation of loose flower crops

Course Content (Theory)

Scope and scenario: Scope, scenario and importance of loose flowers, constraints and opportunities in loose flower production. Growing environment: Nursery management, pro-tray nursery under shade nets, soil and climate requirement, Field preparation, systems of planting. Crop management: Soli analysis, soil health card, water and nutrient management, weed management, training and pruning, special horticultural practices such as pinching and disbudding, use of growth regulators, physiological disorders and remedies, INM,

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

Unit-I **8 hours**

Flower Crops- Rose, Jasmine, Chrysanthemum, Marigold, Tuberose, China aster,

Unit-II **7 hours**

Flower Crops-Crossandra, Gaillardia, Spider lily, Hibiscus, Nerium,

Unit-III **7 hours**

Flower Crops-Barleria, Celosia, Gomphrena, Madar (Calotropisgigantea), Nyctanthes (Harsingar),

Unit-IV **8hours**

Flower Crops-Tabernaemontana (Chandni), Lotus, Water lily, Michelia (Champa), Gardenia, Ixora and Balsam.

Transaction Mode

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

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. NayaProkash, 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 Loose Flowers lab
Course Code: MFS207

L	T	P	Credits
0	0	2	1

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

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

Transaction Mode

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

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. NayaProkash, 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: Production Technology of warm season Vegetable Crops
Course Code: MVS208

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 warm season vegetable crops
2. Acquaint with production technology of warm season vegetable crops
3. Gain practical knowledge fornursery raising techniqueand 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 (Theory)

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

Unit-I **8 hours**

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

Unit-II **8hours**

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: NayaProkash, India. Pp 668.*
- *Kabir, J., Maity, T. K., Bose, T. K. 2002. Vegetable Crops Vol. 2: NayaProkash, India. Pp 489*
- *Kabir, J., Maity, T. K., Bose, T. K. 2003. Vegetable Crops Vol. 3: NayaProkash, 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: MVS204

L	T	P	Credits
0	0	2	1

Total Hours-30

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/polyhousese.

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: NayaProkash, India. Pp 668.*
- *Kabir, J., Maity, T. K., Bose, T. K. 2002. Vegetable Crops Vol. 2: NayaProkash, India. Pp 489*
- *Kabir, J., Maity, T. K., Bose, T. K. 2003. Vegetable Crops Vol. 3: NayaProkash, 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 Applications lab
Course Code: MAR206

L	T	P	Credits
0	0	4	2

Total Hours-60

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

1. Learn and understand about basics of MS-Word, Excel, and 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.

Course Content (Practical)

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

Suggested Readings:

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

Course Title: Seminar
Course Code: MFS204

L	T	P	Credits
-	-	-	1

Total Hours-30

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

1. Show competence in identifying relevant information, defining and explaining topics under discussion
2. Present the classical and innovative work related to plant pathology 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

Course Title: Master Research
Course Code: MFS100

L	T	P	Credits
-	-	-	7(NC)

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

1. Conduct an investigation and solve scientific problems using a range of methods, and apply appropriate and/or theoretical techniques.
2. Familiarize with Negotiate, plan, design and execute a research-based project.
3. Analyse data and provide a written report or thesis on the methodology and outcomes in an appropriate format.
4. Learn the methodology of planning, layout, data recording, analysis, interpretation and report writing of plant pathology experiments.

Semester- III

Course Title: Growth and Development of Fruit Crops

Course Code: MFS301

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. Understand the growth and development dynamics, parameters morphogenesis, effect of light, temperature, water and mineral nutrients on growth and development.
2. Get acquainted with knowledge of annual and semi perennial fruit crops, assimilates partitioning during growth and development.
3. Learn the basics of biosynthesis and role of growth regulator on growth and development along with uses and importance of dormancy.
4. Develop the concept of juvenility, vegetative to reproductive inter phase, flowering, pollination, fertilization, fruit set fruit growth, ripening, seed development and stress physiology.

Course Content (Theory)

Unit I **10 hours**

Parameters of growth and development. Growth dynamics and morphogenesis. Annual, Biennial and perennial fruit crops. Effect of light and temperature. Assimilate partitioning during growth and development.

Unit II **7 hours**

Effect of water and mineral nutrition. Biosynthesis and role of growth promoters and inhibitors.

Unit III **8 hours**

Physiology of dormancy, bud break, juvenility, vegetative to reproductive inter phase, flowering, pollination, fertilization, fruit set, fruit drop, fruit growth, ripening and seed development.

Unit IV **5 hours**

Growth and developmental processes during stress. Impact of pruning, training and chemical manipulations in fruit crops.

Transaction Mode

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

Suggested readings

- *Bhatnagar P. 2017. Physiology of Growth and Development of Horticultural Crops. Agrobios (India).*
- *Buchanan B, Gruiessam W and Jones R. 2002. Biochemistry and Molecular Biology of Plants.John Wiley & Sons, NY, USA.*
- *Dhillon WS and Bhatt ZA. 2011. Fruit Tree Physiology. Narendra Publishing House, New Delhi.*
- *Durner E. 2013. Principles of Horticultural Physiology. CAB International. Horticultural Sciences–Fruit Science 295*
- *Epstein E. 1972. Mineral Nutrition of Plants: Principles and Perspectives. John Wiley & Sons, NY, USA.*
- *Faust M. 1989. Physiology of Temperate Zone Fruit Trees. John Willey & Sons, NY, USA.*
- *Fosket DE. 1994. Plant Growth and Development: a Molecular Approach. Academic Press, USA.*
- *Leopold AC and Kriedermann PE. 1985. Plant Growth and Development. 3rd Ed. McGraw-Hill, New Delhi.*
- *Roberts J, Downs S and Parker P. 2002. Plant Growth Development. In: Salisbury FB and Ross CW. (Eds.) Plant Physiology. 4th Ed.Wadsworth Publications, USA.*
- *Schafeer, B. and Anderson, P. 1994. Handbook of Environmental Physiology of Fruit Crops. Vol. 1 & 2. CRC Press. USA.*
- *Seymour GB, Taylor JE and Tucker GA. 1993. Biochemistry of Fruit Ripening. Chapman & Hall, London.*

Course Title: Propagation and nursery management of fruit crops
Course Code: MFS302

L	T	P	Credits
1	0	0	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.

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.Plantpropagation 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: Growth and Development of Fruit Crops lab

Course Code: MFS304

L	T	P	Credits
0	0	2	1

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

1. Understanding dormancy mechanisms in fruit crops and seed stratification.
2. Techniques of growth analysis.
3. Practical'son use of growth regulators.
4. Understanding ripening phenomenon in fruits.
5. Study on impact of physical manipulations on growth and development.
6. Study on chemical manipulations on growth and development.

7. Understanding stress impact on growth and development.

Transaction Mode

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

Suggested readings

- *Bhatnagar P. 2017. Physiology of Growth and Development of Horticultural Crops. Agrobios (India).*
- *Buchanan B, Gruiessam W and Jones R. 2002. Biochemistry and Molecular Biology of Plants.John Wiley & Sons, NY, USA.*
- *Dhillon WS and Bhatt ZA. 2011. Fruit Tree Physiology. Narendra Publishing House, New Delhi.*
- *Durner E. 2013. Principles of Horticultural Physiology. CAB International. Horticultural Sciences–Fruit Science 295*
- *Epstein E. 1972. Mineral Nutrition of Plants: Principles and Perspectives. John Wiley & Sons, NY, USA.*
- *Faust M. 1989. Physiology of Temperate Zone Fruit Trees. John Willey & Sons, NY, USA.*
- *Fosket DE. 1994. Plant Growth and Development: a Molecular Approach. Academic Press, USA.*
- *Leopold AC and Kriedermann PE. 1985. Plant Growth and Development. 3rd Ed. McGraw-Hill, New Delhi.*
- *Roberts J, Downs S and Parker P. 2002. Plant Growth Development. In: Salisbury FB and Ross CW. (Eds.) Plant Physiology. 4th Ed.Wadsworth Publications, USA.*
- *Schafeer, B. and Anderson, P. 1994. Handbook of Environmental Physiology of Fruit Crops. Vol. 1 & 2. CRC Press. USA.*
- *Seymour GB, Taylor JE and Tucker GA. 1993. Biochemistry of Fruit Ripening. Chapman & Hall, London.*

Course Title: Propagation and nursery management of fruit crops lab

Course Code: MFS305

L	T	P	Credits
0	0	2	1

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 ofgrafting.
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.Plantpropagation 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: Technical writing and communication skills lab

Course Code: MAR304

L	T	P	Credits
0	0	4	2

Total Hours-60

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).
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. Develop the concepts about basic components of definitions, descriptions, process explanations, and other common forms of technical writing.

Course Content

Various forms of scientific writings: theses, technical papers, review, manuals etc., various parts of thesis and research communications: title page, authorship contents page, preface, introduction, review of literature, material and methods, experimental results and discussion; writing of abstracts, summaries, precise, citations etc. commonly used abbreviations in the theses and research communications; illustrations, photographs and drawings with suitable captions; paginations, numbering of tables and illustrations; writing of numbers and dates in scientific write-ups; editing and proof reading; writing a review article, access methods.

Suggested readings:

- *Day, R.A. and Gastel, B. 2011. How to Write and Publish a Scientific Paper, 7th Edition. Greenwood Press, United States. pp. 300.*

- *Laplante, P.A. 2011. Technical Writing: A Practical Guide for Engineers and Scientists.CRC Press, London. pp. 250.*
- *Greenlaw,R. 2012. Technical Writing, Presentational Skills and Online Communication: Professional Tools and Insights. Idea Group,U.S. pp. 247.*

Course Title: Master Research
Course Code: MFS100

L	T	P	Credits
-	-	-	9(NC)

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

1. Conduct an investigation and solve scientific problems using a range of methods, and apply appropriate and/or theoretical techniques.
2. Familiarize with Negotiate, plan, design and execute a research-based project.
3. Analyse data and provide a written report or thesis on the methodology and outcomes in an appropriate format.
4. Learn the methodology of planning, layout, data recording, analysis, interpretation and report writing of plant pathology experiments.

Semester- IV

Course Title: Nutrition of Fruit Crops
Course Code: MFS401

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. Know the importance and various types of nutrients and their uptake mechanisms.
2. Analyse soil and plant status with respect to various nutrients.
3. Make use of corrective measures to overcome deficiency or toxicity.
4. Recognizethesignificance of essential nutrient elements, their natural resource, fertilizers and physiological role in plant, determination of nutrient from soil and plant.

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Course Content (Theory)

Unit I **7 hours**

General Concepts and Principles: Importance and history of nutrition in fruit crops, essential plant nutrients, factors affecting plant nutrition; nutrient uptake and their removal from soil.

Unit II **7 hours**

Diagnostics, Estimation and Application: Nutrient requirements, root distribution in fruit crops and fertilizer use efficiency. Methods and techniques for evaluating the requirement of macro- and micro-elements, Diagnostic and interpretation techniques including DRIS.

Unit III **8 hours**

Role of different macroand micro-nutrients, their deficiency and toxicity disorders, corrective measures to overcome deficiency and toxicity disorders.

Unit IV **8 hours**

Integrated Nutrient Management (INM): Fertigation in fruit crops, bio-fertilizers and their use in INM systems.

Transaction Mode

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

Suggested readings

- *Atkinson D, Jackson JE and Sharples RO. 1980. Mineral Nutrition of Fruit Trees. Butterworth – Heinemann.*
- *Bould C, Hewitt EJ and Needham P. 1983. Diagnosis of Mineral Disorders in Plants Vol.1 Principles.*
- *Her Majesty's Stationery Office, London. Cooke GW. 1972. Fertilizers for maximizing yield. Grenada Publishing Ltd, London.*
- *Epstein E. 1972. Mineral Nutrition of Plants: Principles and Perspectives. Wiley Eastern Ltd*
- *Kanwar JS. 1976. Soil Fertility-Theory and Practice. ICAR, New Delhi.*
- *Marchner Horst. 1995. Mineral Nutrition of Higher Plants, 2nd Ed. Marschner, Academic Press Inc. San Diego, CA.*
- *Mengel K and Kirkby EA. 1987. Principles of Plant Nutrition. 4th Ed. International Potash Institute, Worblaufen-Bern, Switzerland.*
- *Prakash M. 2013. Nutritional Disorders in Fruit Crops: Diagnosis and Management. NIPA, New Delhi.*
- *Tandon HLS. 1992. Management of Nutrient Interactions in Agriculture. Fertilizer Development and Consultation Organization, New Delhi.*
- *Westerman RL. 1990. Soil Testing and Plant Analysis, 3rd Ed. Soil Science Society of America, Inc., Madison, WI.*
- *Yawalkar KS, Agarwal JP and Bokde S. 1972. Manures and Fertilizers. 3rd Ed. Agri Horticultural Publishing House, Nagpur.*

Course Title: Nutrition of Fruit Crops lab
Course Code: MFS403

L	T	P	Credits
0	0	2	1

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

1. Visual identification of nutrient deficiency symptoms in fruit crops.
2. Identification and application of organic, inorganic and bio-fertilizers.
3. Soil/ tissue collection and preparation for macro- and micro-nutrient analysis.
4. Analysis of soil physical and chemical properties- pH, EC, Organic carbon.
5. Determination of N,P,K and other macro- and micronutrients.
6. Fertigation in glasshouse and field grown horticultural crops.
7. Preparation of micro-nutrient solutions, their spray and soil applications.

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

Suggested readings

- *Atkinson D, Jackson JE and Sharples RO. 1980. Mineral Nutrition of Fruit Trees. Butterworth – Heinemann.*
- *Bould C, Hewitt EJ and Needham P. 1983. Diagnosis of Mineral Disorders in Plants Vol.1 Principles.*
- *Her Majesty's Stationery Office, London. Cooke GW. 1972. Fertilizers for maximizing yield. Grenada Publishing Ltd, London.*
- *Epstein E. 1972. Mineral Nutrition of Plants: Principles and Perspectives. Wiley Eastern Ltd*
- *Kanwar JS. 1976. Soil Fertility-Theory and Practice. ICAR, New Delhi.*
- *Marchner Horst. 1995. Mineral Nutrition of Higher Plants, 2nd Ed. Marschner, Academic Press Inc. San Diego, CA.*
- *Mengel K and Kirkby EA. 1987. Principles of Plant Nutrition. 4th Ed. International Potash Institute, Worblaufen-Bern, Switzerland.*
- *Prakash M. 2013. Nutritional Disorders in Fruit Crops: Diagnosis and Management. NIPA, New Delhi.*
- *Tandon HLS. 1992. Management of Nutrient Interactions in Agriculture. Fertilizer Development and Consultation Organization, New Delhi.*
- *Westerman RL. 1990. Soil Testing and Plant Analysis, 3rd Ed. Soil Science Society of America, Inc., Madison, WI.*
- *Yawalkar KS, Agarwal JP and Bokde S. 1972. Manures and Fertilizers. 3rd Ed. Agri Horticultural Publishing House, Nagpur.*

Course Title: Intellectual Property and its management in Agriculture
Course Code: MAR402

L	T	P	Credits
1	0	0	1

Total Hours-30

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. Establish the procedure of obtaining Patents, Copyrights, Trade Marks &Industrial Design

Course Content

Unit-I **4 hours**

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 **4 hours**

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 **4 hours**

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 **3 hours**

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 Research
Course Code: MFS100

L	T	P	Credits
-	-	-	12(NC)

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

1. Conduct an investigation and solve scientific problems using a range of methods, and apply appropriate and/or theoretical techniques
2. Familiarize with Negotiate, plan, design and execute a research-based project.
3. Analyse data and provide a written report or thesis on the methodology and outcomes in an appropriate format
4. Learn the methodology of planning, layout, data recording, analysis, interpretation and report writing of plant pathology experiments