

GURU KASHI UNIVERSITY



M.Sc. (Fruit Science)

Session : 2022-23

Department of Fruit Science

PROGRAMME OUTCOME

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. Know the essential nutrient elements required for plant growth their natural and synthetic resource. Symptoms and disorders proceeded by their dearth along with physiological role in plant.
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. In addition, textural changes occurred during harvesting aided by respiration and transpiration.
4. Impart basic knowledge of plant life cycle, cellular basis of propagation and plant physiology related to germination, pollination, juvenility and senescence.
5. Provides profound knowledge of fruit crop improvement assisted by training, pruning and thinning either manually or with growth regulators.
6. Impart advanced knowledge on soil type and its management for fruit crops
7. Help students in identification of pattern of plant growth and development, hormones and growth regulators.
8. Provide expertise on use of bio-technology in fruit and resistance breeding to surmount biotic and abiotic stresses in fruit crops.
9. Bring forth awareness regarding need and importance of post-harvest technology in fruit crops.
10. Provide deep insight of theoretical and practical aspects of organic horticulture, management of orchard and its canopy.

PROGRAMME SPECIFIC OUTCOMES

1. Provide knowledge of economic importance, cultivation practices of temperate, tropical, sub-tropical and dryland fruit crops.
2. Impart a deep insight of nutrition, canopy, plant physiology, disease and insect pest management. To familiarize students with skilled lab work for determination and identification of nutrient from soil and plant in order to assess deficiencies and toxicity.
3. Study about 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 Structure

Semester: Flexible Study Scheme (01)							
Sr. No.	New Course Code	Course Name	Type of Course	L	T	P	No. of Credits
1.	MFS101	Tropical & Dryland Fruit Production *	T	2	0	0	2
2.	MFS103	Sub- Tropical and Temperate Fruit *Production	T	2	0	0	2
3.	MFS105	Nutrition and Canopy Management in Fruit Crops.*	T	2	0	0	2
4.	MFS107	Post-Harvest Technology in Fruit Crops*	T	2	0	0	2
5.	MFS109	Principles and Practices of Plant Propagation.*	T	2	0	0	2
6.	MFS111	Growth and Development of Horticulture Crops*	T	2	0	0	2
7.	MFS113	Breeding of Fruit Crops*	T	2	0	0	2
8.	MFS115	Orchard Management and Organic Horticulture*	T	1	0	0	1
9	MFS117	Soil Fertility and Fertilizer Use	T	2	0	0	2
10.	MFS119	Plant Physiology	T	2	0	0	2
11.	MFS121	Agriculture Statistics	T	3	0	0	3

12.	MFS102	Lab- Tropical & Dryland Fruit Production *	P	0	0	2	1
13.	MFS104	Lab-Sub- Tropical and Temperate Fruit Production*	P	0	0	2	1
14.	MFS106	Lab- Nutrition and Canopy Management in Fruit Crops*	P	0	0	2	1
15.	MFS108	Lab- Post Harvest Technology in Fruit Crops*	P	0	0	2	1
16.	MFS110	Lab- Principles and Practices of Plant Propagation*	P	0	0	2	1
17.	MFS112	Lab- Growth and Development of Horticulture Crops*	P	0	0	2	1
18.	MFS114	Lab- Breeding of Fruit Crops*	P	0	0	2	1
19.	MFS116	Lab- Orchard Management and Organic Horticulture*	P	0	0	2	1
20.	MFS120	Lab- Soil Fertility and Fertilizer Use	P	0	0	2	1
21.	MFS122	Lab-Plant Physiology	P	0	0	2	1
22.	MFS123	Lab- Agricultural Statistics.	P	0	0	2	1
23.	MFS124	Lab- Fundamentals of Computer Applications	P	0	0	2	1(NC)
24.	MFS125	Lab- Library and Information Services	P	0	0	2	1(NC)
25.	MFS128	Lab- Technical Writing and	P	0	0	2	1(NC)

		Communication Skills					
26.	MFS126	Seminar-I	P	NA	NA	NA	1
27.	MFS127	Seminar-II	P	NA	NA	NA	1
28.	MFS118	Masters Research	P	0	0	48	24(NC)
Discipline Elective							
29.	MFS129	Production Technology of Summer Season Vegetable Crops*	T	2	0	0	2
30.	MFS131	Production Technology of Winter Season Vegetable Crops*	T	2	0	0	2
31.	MFS130	Lab- Production Technology of Summer Season Vegetable Crops*	P	0	0	2	1
32.	MFS132	Lab- Production Technology of Winter Season Vegetable Crops*	P	0	0	2	1
Total No. of Credits							38+27 (NC)

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-1: [30 Marks]

- D. MST-2: [20Marks]
E. End-Term Exam: [20 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 experiment contain 20 marks (10 lab performance, 5 viva, 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.

Course Title: Tropical & Dryland Fruit Production
Course Code: MFS101

L	T	P	Credits
2	0	0	2

Learning Outcomes: After successful completion of the course, the students will be able to:

- 1 Acquire the basic knowledge of root-stocks, scion varieties and propagation techniques of Tropical and dry land fruit crops.
- 2 Learn the importance and identification of different agri export zone for fruit crops.
- 3 Study the importance of flowering, pollination, fruit set and fruiting and harvesting of tropical and dry land fruit crops.
- 4 Have the knowledge of storage marketing, post-harvest technology with knowhow of export and industrial potential.
- 5 Examine the physiology of tropical and dry land fruits.

Course content

Unit I

8 hours

Origin, distribution, commercial importance and export potential. Eco-physiological requirements. Species and varieties. Rootstocks and propagation. Planting, root zone, training and pruning.

Unit II **7 hours**

Nutrition and water requirements, fertigation, role of bio-regulators, major pests, diseases, physiological disorders and their control measures.

Unit III **7 hours**

Abiotic factors limiting fruit production. Flowering, pollination and fruit set. Quality improvement. Storage and ripening techniques.

Unit IV **8 hours**

Industrial and export potential, Agri. Export Zones (AEZ) and industrial support. Fruit crops- citrus, mango, papaya, pineapple, banana, avocado, sapota, guava, ber, amla, jack fruit, annonas and minor fruits of tropics.

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. Chadha, K. L. 2012. Hand Book of Horticulture. ICAR, New Delhi. pp. 1057.
2. Paull, R. E. and Duarte, O. 2012. Tropical Fruits. Volume 2. 2nd edition CABI UK. pp.303.
3. Chattopadhyay, T.K. A textbook on Pomology.2015.Volume 3.Kalyani Publishers. pp.348.

Web sources

- <https://icar.org.in/files/English-Unit/Horticulture/TROPICAL%20AND%20DRY%20LAND%20FRUIT%20PRODUCTION.html>
- <https://images.shiksha.com/mediadata/pdf/1652690318php2kyjtb.pdf>
- <http://ecoursesonline.iasri.res.in/course/view.php?id=136>
- <https://agritech.tnau.ac.in/horticulture/pdf/Management%20of%20Production%20Problems%20in%20Tropical%20Fruit%20Crops.pdf>

- <https://www.doc-developpement-durable.org/file/Culture/Arbres-Fruitiers/livres-et-guides/Tropical-Fruits-Volume-1-Crop-Production-Science-in-Horticulture2.pdf>
- <https://www.iaritoppers.com/2019/06/tropical-and-subtropical-fruits-icar-ecourse-pdf-download-e-krishi-shiksha.html>

Course Title: Sub-Tropical and Temperate Fruit Production

Course Code: MFS103

L	T	P	Credits
2	0	0	2

Learning Outcomes: After successful completion of the course, the students 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, fruit growth and development, fertigation, fertilization, nutrient and water management.
- 4 Understand the methodology of training, pruning, quality improvement, pollination, fruit set and plant protection of subtropical and temperate fruits.
- 5 Examine the physiology of tropical and temperate fruits.

Course content

Unit I 8 hours

Origin, distribution, commercial importance and export potential. Eco-physiological requirements. Species and varieties. Rootstocks and propagation. Planting, root zone, training and pruning.

Unit II 7 hours

Nutrition and water requirements, fertigation, role of bio-regulators, major pests, diseases, physiological disorders and their control measures.

Unit III 7 hours

Abiotic factors limiting fruit production. Flowering, pollination and fruit set. Quality improvement. Storage and ripening techniques.

Unit IV**8 hours**

Industrial and export potential, Agri. Expert Zones (AEZ) and industrial support. Fruit crops- Apple, pear, quince, grapes, plum, peach, apricot, cherries, hazelnut, litchi, loquat, persimmon. Kiwifruit, strawberry, walnut, almond, pistachio, pecan, mangosteen, carambola, bael, wood apple, fig, jamun, rambutan and pomegranate.

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. Yadav, P.K.2014. Production Technology of Tropical and Subtropical Fruits. New india publishing Agency. pp. 384.
2. Chadha, K. L. 2012. Hand Book of Horticulture. ICAR, New Delhi. pp.1057.
3. Singh, S., Shivankar, V.J., Srivastava, A.K. and Singh, I.P. 2004. Advances in Citriculture. Jagmander Book Agency. pp.256.

Web sources

- <https://eternaluniversity.edu.in/docs/SubtropicalandTemperateFruitProduction.pdf>
- <https://icar.org.in/files/English-Unit/Horticulture/TROPICAL%20AND%20DRY%20LAND%20FRUIT%20PRODUCTION.html>
- https://kvk.icar.gov.in/API/Content/PPupload/k0039_1.pdf
- <https://www.cabidigitallibrary.org/doi/book/10.1079/9781845935016.0000>
- <https://www.iaritoppers.com/2019/06/tropical-and-subtropical-fruits-icar-ecourse-pdf-download-e-krishi-shiksha.html>

Course Title: Nutrition and Canopy Management in Fruit Crops

Course Code: MFS105

L	T	P	Credits
2	0	0	2

Learning Outcomes: After successful completion of the course, the students will be able to:

- 1 Understand significance of essential nutrient elements, their natural resource, fertilizers and physiological role in plant, deficiencies, symptoms and physiological disorders caused by nutrients.
- 2 Get accustomed with lab work for determination of nutrient from soil, plant and identification their deficiencies.
- 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 Learn the importance of spacing and use of land area.
- 5 Practice the space management through plant density manipulations.

Course content

Unit I 9 hours

Essential elements, criteria of essentiality. Natural sources and fertilizers. Role of essential elements in fruit plants. Interaction of nutrients.

Unit II 8 hours

Canopy types and structures. Light interception and distribution in different types of tree canopies. Spacing and utilization of land area.

Unit III 7 hours

Canopy management through the use of rootstock and scion, plant growth inhibitors, training and pruning and management practices.

Unit IV 6 hours

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

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. Chadha, K. L. 2012. Hand Book of Horticulture. ICAR, New Delhi. pp. 1057
2. Singh, S., Shivankar, V.J., Srivastava, A.K. and Singh, I.P. 2004. Advances in Citriculture. Jagminder Book Agency. pp. 256.

3. Yadav, P.K.2014. Production Technology of Tropical and Subtropical Fruits. New India publishing Agency. pp. 384.

Web sources

- https://www.researchgate.net/publication/351491779_Canopy_management_in_fruit_crops_for_maximizing_productivity
- https://kvk.icar.gov.in/API/Content/PPupload/k0039_1.pdf
- <https://www.cabidigitallibrary.org/doi/book/10.1079/9781845935016.0000>
- <https://www.yumpu.com/en/document/view/16839007/canopy-management-in-fruit-crops-department-of-agriculture-co->

Course Title: Post Harvest Technology in Fruit Crops

Course Code: MFS107

L	T	P	Credits
2	0	0	2

Learning Outcomes: After successful completion of the course, the students will be able to:

- 1 Attain expertise in knowledge of need and importance of post-harvest technology.
- 2 Study the techniques of harvesting, harvest indices, grading for specific market and influences of pre-harvest practice, textural changes, respiration and transpiration.
- 3 Examine the importance post-harvest practices like pre cooling, chlorination, waxing, bio-control agents, fungicides, hot water and vapour heat treatment, sulphur fumigation, irradiation, storage method, packing methods etc.
- 4 Understand the physiology and bio-chemistry of ripening and post-harvest losses.
- 5 Compare and contrast the quality characteristics of fruits and vegetables.

Course content

Unit I

10 hours

Importance and scope. Maturity indices, harvesting practices and grading for specific market requirements. Influence of pre- harvest practices, enzymatic and textural changes, respiration and transpiration.

Unit II

8 hours

Physiology and biochemistry of fruit ripening, ethylene evolution and its management. Pre-cooling. Factors leading to post-harvest losses.

Unit III **8 hours**

Treatments prior to transpiration and transpiration viz. Chlorination, waxing, chemicals, bio-control agents, natural plant products fungicides, hot-water, vapour heat treatment, sulphur fumigation and irradiation.

Unit IV **4 hours**

Methods of storage. Physical injuries and. Disorders during storage. Packing methods and transport, Quality evaluation.

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. Singh, R. and Singh, B.K. 2020. Basic horticulture and fruit production technology. New India publishing Agency . pp.214.
2. Rajarathnam, S. 2011. Advances in Preservation and Processing Technologies of Fruits and Vegetables. New Indian Publishing Agency-NIPA, Ahmadabad, Gujarat. pp 758.
3. Rahman, M.S. 1999. Handbook of Food Preservation, Food science and technology. CRC Press, Florida, US. pp 809.

Web sources

- <https://agriculturistmusa.com/post-harvest-technology-definition-objective/#:~:text=Post%2Dharvest%20technology%20is%20the,the%20shelf%20life%20of%20food.>
- http://www.agritech.tnau.ac.in/expert_system/paddy/phtc.html
- <https://www.iihr.res.in/division-post-harvest-technology-and-agricultural-engineering>
- <https://www.iaritoppers.com/2019/06/tropical-and-subtropical-fruits-icar-ecourse-pdf-download-e-krishi-shiksha.html>

Course Title: Principles and Practices of Plant Propagation.

Course Code: MFS109

L	T	P	Credits
2	0	0	2

Learning Outcomes: After successful completion of the course, the students 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 effecting 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.
- 5 Prioritize seed quality, treatment, certification and testing.

Course content

Unit I 5 hours

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

Unit II 5 hours

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

Unit III 10 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. Physiology of dwarfing rootstocks. Rejuvenation. Progeny orchard and scion bank.

Unit IV 10 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, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested readings

1. Hartman, H.T., Kester, D.E., Davies, F.T. and Geneve, R.L. 2015. Plant propagation principles and practices. Pearson Education India. pp.928.
2. Sandhu, M.K. 2020. Plant Propagation. New age international Ltd. pp.296.

3. Sharma, R.R. 2019. Propagation of Horticultural crops. Kalyani Publishers.pp.304

Web sources

- <https://agriculturistmusa.com/post-harvest-technology-definition-objective/#:~:text=Post%2Dharvest%20technology%20is%20the,the%20shelf%20life%20of%20food.>
- http://www.agritech.tnau.ac.in/expert_system/paddy/phtc.html
- <https://www.iihr.res.in/division-post-harvest-technology-and-agricultural-engineering>
- <https://www.iaritoppers.com/2019/06/tropical-and-subtropical-fruits-icar-ecourse-pdf-download-e-krishi-shiksha.html>

Course Title: Growth and Development of Horticulture Crops

Course Code: MFS111

L	T	P	Credits
2	0	0	2

Learning Outcomes: After successful completion of the course, the students 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 Study the concept of juvenility, vegetative to reproductive inter phase, flowering, pollination, fertilization, fruit set fruit growth, ripening, seed development and stress physiology.
- 5 Demonstrate role and action of plant growth regulators in horticulture.

Course content

Unit I

10 hours

Parameters of growth and development. Growth dynamics and morphogenesis. Annual, semi-perennial 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, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested readings

1. .Chadha, K. L. 2012. Hand Book of Horticulture. ICAR, New Delhi. pp.1057.
2. .Singh, S., Shivankar, V.J., Srivastava, A.K. and Singh, I.P. 2004. Advances in Citriculture. Jagminder Book Agency. pp.256.
3. Sharma, K. and Singh, P.S. 2011. Soil and Orchard Management. Daya Publishing House. pp.270.

Web sources

- http://www.agritech.tnau.ac.in/expert_system/paddy/phtc.html
- <https://www.iihr.res.in/division-post-harvest-technology-and-agricultural-engineering>
- <https://eternaluniversity.edu.in/docs/SubtropicalandTemperateFruitProduction.pdf>
- <https://icar.org.in/files/English-Unit/Horticulture/TROPICAL%20AND%20DRY%20LAND%20FRUIT%20PRODUCTION.html>

Course Title: Breeding of Fruit Crops

Course Code: MFS113

L	T	P	Credits
2	0	0	2

Learning Outcomes: After successful completion of the course, the students 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 Study the role of bio-technology in fruit breeding and resistance breeding for biotech and a biotech stresses of fruit crops.
- 5 Course imparts comprehensive knowledge about principles and practices of breeding of fruit crops

Course content

Unit I 9 hours

Origin and distribution, taxonomical status of species and cultivars. Cytogenetics and genetic resources.

Unit II 8 hours

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

Unit III 7 hours

Improvement of quality traits. Resistance breeding for biotic and abiotic stresses. Biotechnological interventions, achievements and future thrust.

Unit IV 6 hours

The important temperate, sub- tropical and tropical fruit crops will be covered.

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. Singh, R. and Singh, B.K.2021. Breeding of Horticultural crops Principles and Practices. Daya Publishing House.pp.313.

2. Singh, B.D.2014.biotechnology expanding horizons.Kalyani publishers.pp.972.
3. .Chadha, K. L. 2012. Hand Book of Horticulture. ICAR, New Delhi. pp. 1057.

Web sources

- <http://ecoursesonline.iasri.res.in/course/view.php?id=147>
- <https://agrimoon.com/wp-content/uploads/Breeding-of-Fruit-and-Plantation-Crops.pdf>
- <https://www.thepharmajournal.com/archives/2022/vol11issue4/PartAC/11-4-324-126.pdf>
- <https://www.frontiersin.org/articles/10.3389/fpls.2020.01234/full>

Course Title: Orchard Management and Organic Horticulture

Course Code: MFS115

L	T	P	Credits
1	0	0	1

Learning Outcomes: After successful completion of the course, the students 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 Techniques of moisture conservation and water management.
- 3 Understand the techniques and methods of irrigation in fruit crops along with importance of drip irrigation
- 4 Learn the basic and advanced of organic farming practices and its management.
- 5 Describe then importance and advantages of organic horticulture.

Course content

Unit I

8 hours

Soil quality and its management for orchard plantation. Effect of soil organic matter on physicochemical characteristics of the soil.

Unit II

7 hours

Moisture conservation and water requirement for fruit crops. Principles, methods and scheduling of irrigation. Principles and status of organic horticulture. Organic farming systems. Organic inputs and their role.

Unit III **8 hours**

EM technology and its impact. Indigenous practices of organic farming, sustainable soil fertility, weed management and biological/ natural control of pests and diseases. Fruit quality improvement.

Unit IV **7 hours**

Good Agricultural practices (GAP), HACCP and certification of organic products. Standard evolved by different agencies. Constraints in certification, organic horticulture and export.

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. Reddy, S.R.2017. Principles of organic farming. Kalyani publishers.pp.
2. Somasundaram, E., Nandhini D.U. and Meyyappan.2019. Principles of organic farming. New India Publishing Agency-NIPA. pp.412.
3. Sharma, K. and Singh, P.S. 2011. Soil and Orchard Management. Daya Publishing House. pp.270.

Web sources

- https://www.researchgate.net/publication/351491779_Canopy_management_in_fruit_crops_for_maximizing_productivity
- https://kvk.icar.gov.in/API/Content/PPupload/k0039_1.pdf
- <https://www.cabidigitallibrary.org/doi/book/10.1079/9781845935016.0000>
- <https://www.yumpu.com/en/document/view/16839007/canopy-management-in-fruit-crops-department-of-agriculture-co->

Course Title: Soil Fertility and Fertilizer Use

Course Code: MFS117

L	T	P	Credits
2	0	0	2

Learning Outcomes: After successful completion of the course, the students will be able to:

- 1 Understand the basics concept of soil fertility and soil Productivity.
- 2 Attain knowledge of different types of nutrients sources and their type from major to minor.
- 3 Examine the soil based on soil testing methods, its analysis and reclamation according to fruit crop
- 4 Learn the management and availability of micro and macro nutrients along with their transformation.
- 5 Provide knowledge about the sources and characteristics of nutrients for maintaining the soil health.

Course content

Unit I 8 hours

Soil fertility and soil productivity. Nutrient sources - fertilizers and manures. Soil N - sources and N transformations. Biological nitrogen fixation. Nitrogenous fertilizers - their fate in soils and enhancing N use efficiency.

Unit II 8 hours

Soil P - forms, reactions in soils and factors affecting availability. Management of P fertilizers. Potassium- forms, mechanism of fixation, Q/I relationships. Management of K fertilizers. Sulphur, Ca and Mg - source, forms, fertilizers and their behaviour in soils and management.

Unit III 7 hours

Micronutrients- critical limits in soils and plants, factors affecting their availability, sources and management. Common soil test methods for fertilizer recommendations.

Unit IV 7 hours

Site-specific and plant need based nutrient management. Integrated nutrient management. Blanket fertilizer recommendations- usefulness and limitations. Soil fertility evaluation. Soil quality in relation to sustainable agriculture.

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. ISSS. 2009. *Fundamentals of Soil Science*. 2nd Ed. Indian Society of Soil Science, New Delhi- 110 012. pp. 728.
2. Das D. K. 2011. *Introductory Soil Science*, 3rd revised and Enlarged Ed, Kalyani Publisher, Ludhiana. pp. 645.
3. Brady, N. C. 2016. *The Nature and Properties of Soils*. 15th edition Publisher: Pearson Education, ISBN: 978-0133254488
4. Daji J A; Daji J A; Kadam J R; Patil N D.1996. *Textbook of Soil Science* Bombay Media Promoters and publishers Pvt. Ltd.
5. Biswas, T.D.; Mukherjee, S.K... 1995. *Text Book of Soil Science* 2nd sEd. Tata McGraw Hill Publisher, Delhi pp 433.

Web sources

- <https://www.iaea.org/topics/improving-soil-fertility#:~:text=Soil%20fertility%20is%20the%20ability,while%20minimizing%20the%20environmental%20impact>.
- <https://icar.org.in/files/English-Unit/Physical%20Science/SOIL%20FERTILITY%20AND%20FERTILIZER%20USE.html>
- <https://forages.oregonstate.edu/oregon/topics/forage-production/fertilization-and-soil-fertility>
- <https://www.fao.org/global-soil-partnership/areas-of-work/soil-fertility/en/>

Course Title: Plant Physiology

Course Code: MFS119

L	T	P	Credits
2	0	0	2

Learning Outcomes: After successful completion of the course, the students will be able to:

- 1 Understand various plant metabolic processes, namely photosynthesis, respiration and translocation of metabolites.
- 2 Studies on plant growth and development, hormones and growth regulators.
- 3 Physiology of seed and fruit development in plants, including germination and dormancy in seeds.
- 4 Acquainted with plant water relationships, processes of osmosis and plasmolysis, water pressure – potential.
- 5 Provide knowledge of physiological aspects of crops.

Course content

Unit I

10 hours

Photosynthesis, pigments, CO₂ fixation and reduction. Carbohydrate synthesis in C₃,C₄ and CAM plants. Translocation of metabolites. Photo respiration. Environmental and agricultural aspects of photosynthetic efficiency, source-sink relationship and productivity. Respiration. Concept of growth, differentiation and pattern formation.

Unit II **8 hours**

Factor affecting growth and general aspects of development. Hormones and growth regulators -auxins, gibberellins, cytokinin, ethylene and ABA. Other inhibitors. Retardants. Polyamines. Aliphatic alcohols. Brassins.

Unit III **7 hours**

Hormonal regulation of growth & development. Photoperiodism. Flowering hormones, Vernalization abscission. Aging. Senescence. Physiology of seed and fruit development. Seed germination. Seed and bud dormancy.

Unit IV **5 hours**

Plant water relationship. Osmotic potential, water potential. Pressure potential and their relationship. Plasmolysis. Imbibition. Absorption and translocation of water. Stomata, stomata mechanism. Factor affecting water loss. Physiological role of nutrients.

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. Dhaliwal, M. S. 2017. *Handbook of Vegetable Crops*. Kalyani Publishers, India. Pp 358
2. Hazra, P. 2019. *Vegetable Science and Technology*. New India Publishing Agency, India. pp. 630.
3. Arora, J. S. 2013. *Introductory Ornamental Horticulture*. India: Kalyani Publishers. pp. 469.

Web sources

- <https://academic.oup.com/plphys>
- <https://www.sciencedirect.com/topics/medicine-and-dentistry/plant-physiology>

- <http://www.esalq.usp.br/lepse/imgs/conteudo/Plant-Physiology-by-Vince-Ordog.pdf>
- <https://www.frontiersin.org/journals/plant-science/sections/plant-physiology>
- <https://www.vedantu.com/biology/plant-physiology>

Course Title: Agriculture Statistics

Course Code: MFS121

L	T	P	Credits
3	0	0	3

Learning Outcomes: After successful completion of the course, the students will be able to:

- 1 Application of statistical methods in all the areas of experimental work and they have a very important role in agriculture.
- 2 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 Importance of 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 Significance in land utilization and irrigation including the net area sown gross cultivated area, current follow, and cultivable waste.
- 5 Define the basics of statistical theory used in agriculture.

Course content

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

Web sources

- <https://eands.dacnet.nic.in/>
- <https://mospi.gov.in/4-agricultural-statistics>
- https://agricoop.nic.in/sites/default/files/pocketbook_0.pdf
- <https://iasri.icar.gov.in/>
- <https://desagri.gov.in/en/document-report-category/agriculture-statistics-at-a-glance/>

Course Title: Lab- Tropical & Dryland Fruit Production.

Course Code: MFS102

L	T	P	Credits
0	0	2	1

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

- 1 Acquire the knowledge of economic importance, uses distribution and soil, climatic requirement, root-stocks, scion varieties and propagation techniques of Tropical and dry land fruit crops.
- 2 Learn the technical know for cultivation, plant protection measures, biotic and abiotic factors limiting tropical fruit production.
- 3 Study the importance and types of flowering, pollination, fruit set and fruiting and harvesting of tropical and dry land fruit crops.
- 4 Learn the significance of storage marketing, post-harvest technology with knowhow of export and industrial potential.
- 5 Examine the physiology of tropical and dryland fruits.

Course content

Description and identification of species and varieties. Growth and development. Growth regulation. Nutritional and physiological disorders and their control. Rejuvenation of old and unproductive trees. Visit to commercial orchards. Project preparation for establishing commercial orchards.

Suggested readings

1. Chadha, K. L. 2012. Hand Book of Horticulture. ICAR, New Delhi. pp. 1057.
2. Paull, R. E. and Duarte, O. 2012. Tropical Fruits. Volume 2. 2nd edition CABI UK. pp.303.
3. Chattopadhyay, T.K. A textbook on Pomology.2015.Volume 3.Kalyani Publishers. pp.348.

Course Title: Lab-Sub- tropical and Temperate Fruit Production.

Course Code: MFS104

L	T	P	Credits
0	0	2	1

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

- 1 Learn the importance, uses, origin, distribution, area and production of subtropical and temperate fruit crops.
- 2 Acquire the technical know-how regarding soil, climatic, water quality, biotic/abiotic factors limiting fruit production.

- 3 Get expertise in planting, root stock, propagation, fruit growth and development, fertigation, fertilization, nutrient and water management etc.
- 4 Learn the methods and techniques of training, pruning, quality improvement, pollination, fruit set and plant protection of sub-tropical and temperate fruit production.
- 5 Examine the physiology of tropical and temperate fruits.

Course content

Description and identification of species and varieties. Growth and development. Growth regulation. Nutritional and physiological disorders and their control. Rejuvenation of old and unproductive trees. Visit to commercial orchards. Project preparation for establishing commercial orchards.

Suggested readings

1. Yadav, P.K.2014. Production Technology of Tropical and Subtropical Fruits. New india publishing Agency. pp. 384.
2. Chadha, K. L. 2012. Hand Book of Horticulture. ICAR, New Delhi. pp.1057.
3. Singh, S., Shivankar, V.J., Srivastava, A.K. and Singh, I.P. 2004. Advances in Citriculture. Jagmander Book Agency. pp.256.

Course Title: Lab-Nutrient and Canopy Management in Fruit Crops

Course Code: MFS106

L	T	P	Credits
0	0	2	1

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

- 1 Understand significance of essential nutrient elements, their natural resource, fertilizers and physiological role in plant, deficiencies, symptoms and physiological disorders caused by nutrients.
- 2 Get accustomed with lab work for determination of nutrient from soil, plant and identification their deficiencies.
- 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 Learn the importance of spacing and use of land area.
- 5 Practice the space management through plant density manipulations.

Course content

Leaf sampling techniques, Determination of nutrient status through soil and plant analysis. Study of different types of canopies. Training of plants for different canopy types. Canopy development through pruning, use of plant growth inhibitors and, geometry of planting. Effect of canopy types on production and quality of fruits.

Suggested readings

1. Chadha, K. L. 2012. Hand Book of Horticulture. ICAR, New Delhi. pp. 1057
2. Singh, S., Shivankar, V.J., Srivastava, A.K. and Singh, I.P. 2004. Advances in Citriculture. Jagmander Book Agency. pp. 256.
3. Yadav, P.K.2014. Production Technology of Tropical and Subtropical Fruits. New india publishing Agency. pp. 384.

Course Title: Lab- Post- harvest Technology for Fruit Crops

Course Code: MFS108

L	T	P	Credits
0	0	2	1

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

- 1 Learn the requirement and importance of post-harvest technology.
- 2 Study the theoretical and practical aspects of fruit harvest, harvest indices, grading for specific market and influences of pre-harvest practice, textural changes, respiration and transpiration.
- 3 Understand the concept of physiology and bio-chemistry of ripening and post-harvest losses.
- 4 Learn the importance of post-harvest practices like pre cooling, chlorination, waxing, bio-control agents, fungicides, hot water and vapour heat treatment, sulphur fumigation, irradiation, storage method, packing methods etc.
- 5 Compare and contrast the quality characteristics of fruits and vegetables.

Course content

Analyzing maturity stages of commercially important fruit crops, harvesting methods, pre-cooling methods, grading. Pre- harvest and post- harvest application of growth substances, fungicides, nutrients , waxes and hot water treatments, sulphuring. Improved packing and storage of important horticultural commodities. Physiological loss in weight of fruits. Estimation of transpiration, respiration rate, ethylene release. Estimation of quality characteristics in stored fruits. Cold chain management- visit to cold storage and CA storage unit.

Suggested readings

1. Singh, R. and Singh, B.K. 2020. Basic horticulture and fruit production technology. New india publishing Agency . pp.214.
2. Rajarathnam, S. 2011. Advances in Preservation and Processing Technologies of Fruits and Vegetables. New Indian Publishing Agency-NIPA, Ahmedabad, Gujarat. pp 758.
3. Rahman, M.S. 1999. Handbook of Food Preservation, Food science and technology. CRC Press, Florida, US. pp 809.

Course Title: Lab- Principles and Practices of Plant Propagation

Course Code: MFS110

L	T	P	Credits
0	0	2	1

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

- 1 Acquire the knowledge of plant life cycle, cellular basis of propagation, A sexual and sexual propagation, chimeras, apomixes etc.
- 2 Get acquainted with concepts of seed germination factor effecting and hormonal control of seed germination, seedling growth, seed quality packing and storing of seed.
- 3 Get equipped with practical knowledge and importance of root stocks, rooting of cutting its anatomical and physiological basis.
- 4 Learn the application of biotechnology in fruit propagation along with organogenesis, embryogenesis, micro grafting, meristem culture, hardening, packing and transport of micro propagules.
- 5 Prioritize seed quality, treatment, certification and testing.

Course content

Anatomical studies in rooting of cutting and graft union. Propagation structures. Use of media and PGR. Micro propagation and hardening of plants. Explant preparation, media preparation, culturing in vitro, clonal propagation, meristem culture, shoot tip culture, axillary bud culture, Micro grafting and hardening. Visit to TC labs and nurseries.

Suggested readings

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

Course Title: Lab- Growth and Development of Horticulture Crops.

Course Code: MFS112

L	T	P	Credits
0	0	2	1

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

- 1 Study the growth and development dynamics, parameters morphogenesis, effect of light, temperature, water and mineral nutrients on growth and development.
- 2 Learn the different type of annual semi perennial fruit crops, assimilates partitioning during growth and development.
- 3 Understand the significance and role of biosynthesis and role of growth regulator on growth and development and break and dormancy.
- 4 Acquire the basic information of juvenility, vegetative to reproductive inter phase, flowering, pollination, fertilization, fruit set fruit growth, ripening, seed development and stress physiology.
- 5 Demonstrate role and action of plant growth regulators in horticulture.

Course content

Dormancy mechanisms and stratification of seeds. Visit to different fruit zones to identify growth and development patterns. Techniques of growth analysis. Evaluation of photosynthetic efficiency. Study of growth regulator functions, hormone assays and ripening phenomenon in fruits

Suggested readings

1. Chadha, K. L. 2012. Hand Book of Horticulture. ICAR, New Delhi. pp.1057.
2. Singh, S., Shivankar, V.J., Srivastava, A.K. and Singh, I.P. 2004. Advances in Citriculture. Jagmander Book Agency. pp.256.
3. Sharma, K. and Singh, P.S. 2011. Soil and Orchard Management. Daya Publishing House. pp.270.

Course Title: Lab- Breeding of Fruit Crops Crops.

Course Code: MFS114

L	T	P	Credits
0	0	2	1

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

- 1 Understand the concept of origin, distribution, genetic recourse, gene banks and taxonomic status of fruit crop species and varieties.
- 2 Study the vital information on blossom biology and breeding systems and breeding objectives.
- 3 Learn the techniques of fruit crop improvement through introduction, selection, hybridization, mutation breeding, polyploidy breeding root-stock breeding.
- 4 Utilize the techniques of bio-technology in fruit breeding and resistance breeding for biotech and a biotech stresses of fruit crops.
- 5 Course imparts comprehensive knowledge about principles and practices of breeding of fruit crops

Course content

Characterization of germplasm. Blossom biology and anthesis. Estimating fertility status. Practices in hybridization, ploidy breeding, mutation breeding, evaluation of biometrical 168 and quality traits. Screening for resistance, developing breeding programme for specific traits. Visit to research stations.

Suggested readings

1. Singh, R. and Singh, B.K.2021. Breeding of Horticultural crops Principles and Practices. Daya Publishing House.pp.313.
2. Singh, B.D.2014.biotechnology expanding horizons.Kalyani publishers.pp.972.
3. .Chadha, K. L. 2012. Hand Book of Horticulture. ICAR, New Delhi. pp. 1057.

Course Title: Lab- Orchard Management and Organic Horticulture

Course Code: MFS116

L	T	P	Credits
0	0	2	1

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

- 1 Study about soil type and its management for fruit crops and effect of soil organic matter on physicochemical characteristics of soils.
- 2 Different techniques for moisture conservation and water management.
- 3 Importance and knowledge of organic cultivation in horticulture.
- 4 Acquire basic information regarding organic farming and management practices.
- 5 Describe then importance and advantages of organic horticulture.

Course content

Different methods of irrigation. Mulching and weed control in orchards. Determination of soil organic matter. Inter-cropping exercises. Input analysis of manures. Bio-composting, biofertilizers and their application. Methods of preparation of organic manures. EM technology and products. Biological/natural control of pests and diseases. Soil solarization. Case studies. Residue analysis in organic products and documentationits. Stress impact on growth and development.

Suggested readings

1. Reddy, S.R.2017. Principles of organic farming. Kalyani publishers.pp.
2. Somasundaram, E., Nandhini D.U. and Meyyappan.2019. Principles of organic farming. New India Publishing Agency-NIPA. pp.412.
3. Sharma, K. and Singh, P.S. 2011. Soil and Orchard Management. Daya Publishing House. pp.270.

Course Title: Lab- Soil Fertility and Fertilizer Use**Course Code: MFS118**

L	T	P	Credits
0	0	2	1

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

- 1 Acquire the basic knowledge regarding the laboratory and greenhouse experiment and evaluation of indices of nutrient availability.
- 2 Acquire the knowledge about calculation of critical values of nutrients in soil and plants.
- 3 Determine the total and available nutrients in soils.
- 4 Attain expertise in skill development regarding analysis of nutrients in plants
- 5 Provide knowledge about the sources and characteristics of nutrients for maintaining the soil health.

Course content

Laboratory and greenhouse experiments for evaluation of indices of nutrient availability and their critical values in soils and plants. Chemical analysis of soil for total and available nutrients. Analysis of plants for essential elements.

Suggested readings

1. ISSS. 2009. *Fundamentals of Soil Science*. 2nd Ed. Indian Society of Soil Science, New Delhi- 110 012. pp. 728.
2. Das D. K. 2011. *Introductory Soil Science*, 3rd revised and Enlarged Ed, Kalyani Publisher, Ludhiana. pp. 645.
3. Brady, N. C. 2016. *The Nature and Properties of Soils*. 15th edition Publisher: Pearson Education, ISBN: 978-0133254488
4. Daji J A; Daji J A; Kadam J R; Patil N D.1996. *Textbook of Soil Science* Bombay Media Promoters and publishers Pvt. Ltd.
5. Biswas, T.D.; Mukherjee, S.K.. 1995. *Text Book of Soil Science* 2nd sEd. Tata McGraw Hill Publisher, Delhi pp 433.

Course Title: Lab - Plant Physiology**Course Code: MFS120**

L	T	P	Credits
0	0	2	1

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

- 1 Demonstrating mechanism of photosynthesis in plants.
- 2 Experimenting processes of respiration, osmosis, Imbibition, plasmolysis.
- 3 Measuring permeability of water and solutes in plants.
- 4 Conducting experiments on water transpiration, nutrient status and catalysis.
- 5 Provide knowledge of physiological aspects of crops.

Course content

Experiments related to photosynthesis. Chlorophyll and other pigment determination. Experiments related to respiration, Osmosis, Imbibition, Plasmolysis. Measurements of μ_w and μ_s . Membrane permeability. Transpiration experiments. catalase, peroxidase and nitrate reductase activities as indicators of Nutrient status of crop. Experiment on growth measurements. Experiment on quality of light on seed germination. Breaking of dormancy. Experiment on photoperiodism. Experiment on hormonal regulation and development.

Suggested readings

1. Dhaliwal, M. S. 2017. *Handbook of Vegetable Crops*. Kalyani Publishers, India. Pp 358
2. Hazra, P. 2019. *Vegetable Science and Technology*. New India Publishing Agency, India. pp. 630.
3. Arora, J. S. 2013. *Introductory Ornamental Horticulture. India*: Kalyani Publishers. pp. 469.

Course Title: Lab- Agricultural Statistics

Course Code: MFS122

L	T	P	Credits
0	0	2	1

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

- 1 Statistical principles apply in all the areas of experimental work and they have a very important role in agriculture.

- 2 It is required at the national level and farm level for agriculture policy making, decision making, agriculture development and estimates agriculture and national income.
- 3 Statistics in agriculture are great importance in variety of area. One of the most important is to certain the volume of crop that needs to be produced based on output and demand of previous year.
- 4 It is helpful in land utilization and irrigation including the net area sown gross cultivated area, current follow, cultivable waste
- 5 Define the basics of statistical theory used in agriculture.

Course content

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

Suggested readings

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

Course Title: Fundamentals of Computer Applications Lab
Course Code: MFS123

L	T	P	Credits
0	0	2	1NC

Learning Outcomes: On successful completion of this course, the students will 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.
- 5 Students will be able to synthesize and integrate material from primary and secondary sources with their own ideas in research papers.

Course Content

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

Suggested Readings:

1. Salaria, R.S. 2017. *Computer Fundamentals*. Daryaganj, 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: Library and Information services Lab
Course Code: MFS124

L	T	P	Credits
0	0	2	1NC

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

- Statement
- 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 focus appropriate to the assignment criteria, available resources, and evidence needed to support thesis
- 3
- 4 Identify keywords, synonyms and related terms in order to flexibly
- 5 Effectively search information resources

Course Content

Introduction to Library and its services; five laws of library science; type of documents; classification and cataloguing; organization of documents; sources of information primary, secondary and tertiary; current awareness and SDI services; tracing information from reference sources; library survey; preparation of bibliography; use of Online Public Access Catalogue; use of CD-ROM databases and other computerized library services, CeRA, J-Gate; use of Internet including search engines and its resources; e-resources.

Suggested readings:

1. Gita, S. 2012. *Library and Information Services*. LAP Lambert Academic Publishing, USA. pp. 76.
2. 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: Technical writing and communication skills Lab

Course Code: MFS125

L	T	P	Credits
0	0	2	1NC

Learning Outcomes: On successful completion of this course, the students will 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 Understand the basic components of definitions, descriptions, process explanations, and other common forms of technical writing
- 5 Familiarise with basic technical writing concepts and terms, such as audience analysis, jargon, format, visuals, and presentation

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:

1. Day, R.A. and Gastel, B. 2011. *How to Write and Publish a Scientific Paper*, 7th Edition. Greenwood Press, United States. pp. 300.
2. Laplante, P.A. 2011. *Technical Writing: A Practical Guide for Engineers and Scientists*.CRC Press, London. pp. 250.
3. Greenlaw,R. 2012. *Technical Writing, Presentational Skills and Online Communication: Professional Tools and Insights*. Idea Group,U.S. pp. 247.

Course Title: Credit Seminar I**Course Code: MFS126**

L	T	P	Credits
NA	NA	NA	1

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 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
- 5 To ask appropriate questions, use evidence to support claims, respond to a range of questions

Course Content

Seminar topic will be suggested by faculty

Course Title: Credit Seminar II**Course Code: MFS127**

L	T	P	Credits
NA	NA	NA	1

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 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
- 5 To ask appropriate questions, use evidence to support claims, respond to a range of questions

Course Title: Master Research

Course Code: MPP128

L	T	P	Credits
NA	NA	NA	24N C

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 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
- 5 Familiarize with indexing databases, citation databases: web of science, scopus, etc.

Elective Subject

Course Title: Production Technology of Summer Vegetable Crops

Course Code: MFS129

L	T	P	Credits
2	0	0	2

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

- 1 Identify deficiency symptoms of nutrients in summer vegetable crops
- 2 Acquaint with production technology of summer vegetable crops.
- 3 Gain practical knowledge for the preparation of land for cultivation of vegetable crops
- 4 Know about innovative nursery raising technique for summer vegetable
Crops for raising quality, disease, pest and harvesting induces
- 5 Schedule the cropping scheme for successful cultivation of summer season vegetables

Course Content

Unit-I 5 hours

Introduction, nutritional value, origin, botany and taxonomy, important countries and states growing vegetables along with area, climate and soil requirements

Unit-II 8 hours

Commercial varieties/hybrids evolved by private and public sector, sowing/transplanting time, seed rate, seed treatment, nutritional and irrigation requirements, chemical weed control, mulching, physiological disorders

Unit-III 7 hours

Harvesting techniques, post-harvest management, plant protection measures and seed production of warm season vegetable crops i.e. solanaceous crops, okra, cucurbitaceous crops, cowpea, sweet potato, cluster beans, amaranth, basella, kang-kong, tapioca.

Unit-IV 10 hours

Poly-house, net-house and low tunnel technology for off-season production of summer vegetables.

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. Swarup, V. 2006. Vegetable Science and Technology In India: Kalyani Publishers, India. Pp 656.

2. Kabir, J., Maity, T. K., Bose, T. K. 2002. Vegetable Crops Vol. 1: Naya Prokash, India. Pp 668.
3. Kabir, J., Maity, T. K., Bose, T. K. 2002. Vegetable Crops Vol. 2: Naya Prokash, India. Pp 489
4. Kabir, J., Maity, T. K., Bose, T. K. 2003. Vegetable Crops Vol. 3: Naya Prokash, India. Pp 550
5. Hazra, P., Karmakar, K., Chattopadhyay, A. 2011. Modern Technology in Vegetable Production. New India Publishing Agency, India. Pp 442

Web sources

- https://agricoop.nic.in/sites/default/files/ICAR_2.pdf
- <https://www.agrifarming.in/growing-vegetables-in-summer-a-full-guide>
- <https://agrimoon.com/wp-content/uploads/Production-Technology-of-Vegetables.pdf>
- <https://www.egyankosh.ac.in/bitstream/123456789/73327/1/Bloc k-2.pdf>
- <https://diragriju.nic.in/Vegetable%20PoP%202020.pdf>
- https://rajneeshrajaoria.weebly.com/uploads/4/9/0/6/49069889/production_technology_of_vegetables_and_flowers.pdf

Course Title: Production Technology of Winter Season Vegetable Crops
Course Code: MFS131

L	T	P	Credits
2	0	0	2

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

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

- 5 Schedule the cropping scheme for successful cultivation of Winter season vegetables

Course Content

Unit I 8 hours

Introduction, nutritional value, origin, botany and taxonomy, important countries and states growing vegetables along with area, climate and soil requirements.

Unit II 7 hours

Commercial varieties/hybrids evolved by private and public sector, sowing/transplanting time, seed rate and seed treatment.

Unit III 7 hours

Nutritional and irrigation requirements, chemical weed control, mulching, physiological disorders, harvesting techniques,

Unit IV 8 hours

Post-harvest management, plant protection measures and seed production of potato, Cole crops; cabbage, cauliflower, knol-khol, broccoli, brussels' sprout, Chinese cabbage, root crops; carrot, radish, turnip, beet root, bulb crops; onion and garlic, peas and beans, green leafy cool season vegetables.

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

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

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- <https://www.agrifarming.in/growing-vegetables-in-summer-a-full-guide>
- <https://agrimoon.com/wp-content/uploads/Production-Technology-of-Vegetables.pdf>
- <https://www.egyankosh.ac.in/bitstream/123456789/73327/1/Bloc k-2.pdf>
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- https://rajneeshrajaoria.weebly.com/uploads/4/9/0/6/49069889/production_technology_of_vegetables_and_flowers.pdf

Course Title: Lab-Production Technology of Summer Vegetable Crops Course
Course Code: MFS130

L	T	P	Credits
0	0	2	1

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

- 1 Know about the different roles of nutrients, fertigation and growth regulators and methods of weed control in summer season vegetables
- 2 Gain practical knowledge about different methods of hybrid seed production and seed extraction summer season vegetables.
- 3 Identify different diseases in summer season vegetable crops and their control.
- 4 Acquaint with different methods of summer season vegetable production specially by forcing techniques.
- 5 Describe the problems associated with flowering and fruit set during cultivation of summer season vegetables.

Course Content

Experiments to demonstrate the role of mineral elements. Fertigation. Chemical weed control. Hybrid seed production of summer vegetables. Use of growth regulators. Seed extraction techniques. Identification of pests and diseases and their control. Forcing techniques for raising summer vegetables. Pruning, grafting and staking. Quality determination for sugar, capsaicin and minerals using atomic absorption.

Suggested readings

1. Swarup, V. 2006. Vegetable Science and Technology In India: Kalyani Publishers, India. Pp 656.
2. Kabir, J., Maity, T. K., Bose, T. K. 2002. Vegetable Crops Vol. 1: Naya Prokash, India. Pp 668.
3. Kabir, J., Maity, T. K., Bose, T. K. 2002. Vegetable Crops Vol. 2: Naya Prokash, India. Pp 489
4. Kabir, J., Maity, T. K., Bose, T. K. 2003. Vegetable Crops Vol. 3: Naya Prokash, India. Pp 550
5. Hazra, P., Karmakar, K., Chattopadhyay, A. 2011. Modern Technology in Vegetable Production.: New India Publishing Agency, India. Pp 442

Course Title: Lab- Production Technology of Winter**Season Vegetable Crops****Course Code: MFS132**

L	T	P	Credits
0	0	2	1

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

- 1 Know about raising winter season vegetables by different methods of irrigation and Mulching.
- 2 Asses the quality of winter season vegetables.
- 3 Have knowledge about different cropping schemes on commercial vegetable farms.
- 4 Gain knowledge about efficient use of fertilizers and pesticides
- 5 Describe the problems associated with flowering and fruit set during cultivation of Winter season vegetables.

Course Content

Study of nutrient efficiency symptoms. Experiments on improved water use efficiency through mulching and different irrigation methods. Different methods of weed control and herbicide sprays. Preparation of cropping scheme for commercial farms. Quality evaluation for carotene, protein and ascorbic acid. Visit to an established vegetable farm in the region.

Suggested readings

1. Swarup, V. 2006. Vegetable Science and Technology In India: Kalyani

- Publishers, India. Pp 656
2. Kabir, J., Maity, T. K., Bose, T. K. 2002. Vegetable Crops Vol. 1: Naya Prokash, India. Pp 668
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