

School of Agriculture

Galgotias University

M.Sc. (Horticulture) Fruit Science
2023-2024

PEOs

The students will:

- Get the in-depth knowledge of plants with good production potential and rootstock tolerance.
- Demonstrate scientific skills for maintaining high yielding varieties and nutrient management in horticultural crops.
- Possess interpersonal abilities, professionalism in their creative work, a sense of moral obligation, and a dedication to society on both local and global scale.

POs

The student will be able to

- Employ horticultural science expertise to the resolution of farming-related problems.
- Have knowledge and aptitude for problem-solving and critical thinking towards horticulture production
- Develop and use the most appropriate fruit production methods, resources, and IT tools while being aware of their constraints.
- Assess societal, health, safety, legal, and cultural issues, as well as the resulting duties, in relation to the professional practice of horticulture.
- Recognize the effects of expert horticultural solutions in the context of society and the environment for sustainable development.
- Develop into tenacious individuals who challenge, practice, and use the knowledge gained to develop solutions to problems in horticultural production.
- Effectively perform on a personal level, as a team player or leader in a varied agribusiness organization, and in multidisciplinary situations.
- Incorporate moral principles to teaching and research in the various agricultural science fields.

PSOs

1. To demonstrate written and oral communication (PSO1).
2. To understand basic concept of crop production technologies in fruit crops (PSO2).
3. To collect data, analyze data in solving problems of farmers by conducting applied research in horticulture (PSO3).
4. Apply their research expertise in recommending good agriculture practices in fruits for enhancing production and income of the farming communities (PSO4)

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CURRICULUM

Framework of the Master's Programme

(i)	Master's Course work	Total Credits
	Core Courses	20
	Minor Courses	08
	Supporting Courses	06
	Common courses	05
	Master's Seminar	01
(ii)	Master's Thesis Research	30
	Total	70

SEMESTER-WISE COURSE STRUCTURE

Programme Structure - M.Sc. (Horti.) Fruit Science						
Total Credits-70						
First Semester						
No.	Course Code	Title of course	L	T	P	Credit
1	FSC 501	Tropical and Dryland Fruit Production	3	0	0	3
2	FSC 502	Sub-Tropical and Temperate Fruit Production	2	0	2	3
3	FSC 503	Propagation and Nursery Management of Fruit Crops	2	0	2	3
4	FSC 504	Breeding of Fruit Crops	2	0	2	3
5	PGS 501	Library And Information Services	0	0	2	1
6	PGS 503	Intellectual Property and Its Management in Agriculture	1	0	0	1
7	FSC 603	Advances in Growth Regulators of Fruit Crops	2	0	2	3
		Total				17
Second Semester						
No.	Course Code	Title of course	L	T	P	Credit
1	FSC 505	Post harvest technology for fruit crops	2	0	2	3
2	FSC 506	Canopy Management in Fruit Crops	1	0	2	2
3	FSC 507	Growth and Development of Fruit Crops	2	0	2	3
4	FSC 508	Nutrition of Fruit Crops	2	0	2	3
5	FSC 511	Protected Cultivation and Secondary Agriculture	2	0	2	3
6	PGS 502	Technical Writing and Communications Skills	0	0	2	1
7	PGS 504	Basic concepts in laboratory techniques	0	0	2	1
8	FSC 599	Master's Research	0	0	10	5
		Total				21
Third Semester						
No.	Course Code	Title of course	L	T	P	Credit
1	FSC 512	Climate Change and Fruit Crops	1	0	0	1
2	FSC 513	Hi Tech Horticulture	2	0	2	3
3	STAT 512	Experimental Designs	1	0	2	2
4	FSC 591	Seminar	0	0	1	1
5	FSC 599	Master's Research	0	0	10	5
		Total				12
Fourth Semester						
No.	Course Code	Title of course	L	T	P	Credit
1	FSC 599	Master's Research	0	0	40	20
		Total				20

Course Contents (Syllabus)

M.Sc. (Hort.) in Fruit Science

Core Courses

FSC 501 TROPICAL AND DRY LAND FRUIT PRODUCTION 3+0

Objective

To impart basic knowledge about the importance and management of Tropical and dry land fruits grown in India.

Theory

Commercial varieties of regional, national and international importance, ecophysiological requirements, recent trends in propagation, rootstock influence, planting systems, cropping systems, root zone and canopy management, nutrient management, water management, fertigation, role of bioregulators, abiotic factors limiting fruit production, physiology of flowering, pollination fruit set and development, honeybees in cross Pollination, physiological disorders- causes and remedies, quality improvement by management practices; maturity indices, harvesting, grading, packing, storage and ripening techniques; industrial and export potential, Agri. Export Zones (AEZ) and industrial supports.

Crops

UNIT I: Mango and Banana

UNIT II: Citrus and Papaya

UNIT III: Guava, Sapota and Jackfruit

UNIT IV: Pineapple, Annonas and Avocado

UNIT V: Aonla, Pomegranate, Phalsa and Ber, minor fruits of tropics

Practical

1. Identification of important cultivars of tropical & dry land fruit crop
2. Observations on growth and development of tropical & dry land fruit crop.
3. Practices in growth regulation of tropical & dry land fruit crops.
4. Analyses of quality attributes of tropical & dry land fruit crop.
5. Project preparation for establishing commercial orchards.

Book & Reference:

Bose TK, Mitra SK & Rathore DS. (Eds.). 1988. *Temperate Fruits -Horticulture*. Allied Publ. Bose TK, Mitra SK & Sanyal D. 2001. (Eds.). *Fruits -Tropical and Subtropical*. Naya Udyog. Chadha KL & Pareek OP. 1996. (Eds.). *Advances in Horticulture*. Vols. IIIV. Malhotra Publ. House. Nakasone HY & Paul RE. 1998. *Tropical Fruits*. CABI.

Peter KV. 2008. (Ed.). *Basics of Horticulture*. New India Publ. Agency. Pradeepkumar T, Suma B, Jyothibhaskar & Satheesan KN. 2008.

Management of Horticultural Crops. Parts I, II. New India Publ. Agency. Radha T & Mathew L. 2007. *Fruit Crops*. New India Publ. Agency.

Singh HP, Negi JP & Samuel JC. (Eds.). 2002. *Approaches for Sustainable Development of Horticulture*. National Horticultural Board.

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

	Course Outcomes (COs)	Mapped Programme Outcomes
CO1	Concepts of tropical and dryland fruit production and their management	PO1
CO2	Description of head- origin, description, and cultural practices; types of propagation and rootstocks of tropical and dryland fruit	PO2
CO3	Description of abiotic factors limiting tropical and dryland fruit production	PO3
CO4	Description of physiology of flowering, fruit set and development, physiological disorders and quality improvement by management practices	PO2
CO5	To know about the post-harvest technology, industrial and export potential.	PO1

Modes of Evaluation: Quiz/Assignment/ Seminar/Written Examination Examination Scheme:

Components	MSE	Quiz/Assignment/ Seminars etc.	Practical	ESE
Weightage (%)	30	05	15	50

CourseCode	Course Title	PO1 Employ expertise to	PO2 Have knowledge	PO3 Develop and use the most	PO4 Assess societal,	PO5 Recognize the effects of	PO6 Develop into tenacious	PO7 Effectively perform on a	PO8 Incorporate moral
FSC 501	TROPICAL AND DRY LAND FRUIT PRODUCTION	3	3	3	2	2	2	2	2

1= weakly mapped 2= moderately mapped 3= strongly mapped

FSC 502 SUBTROPICAL AND TEMPERATE FRUIT PRODUCTION 2+2

Objective

To impart basic knowledge about the importance and management of subtropical and temperate fruits grown in India.

Theory

Commercial varieties of regional, national and international importance, Eco physiological requirements, recent trends in propagation, rootstock influence, planting systems, cropping systems, root zone and canopy management, nutrient management, water management, fertigation, bioregulation, abiotic factors limiting fruit production, physiology of flowering, fruit set and development, abiotic factors limiting production, physiological disorders-causes and remedies, quality improvement by management practices; maturity indices, harvesting, grading, packing, precooling, storage, transportation and ripening techniques; industrial and export potential, Agri Export Zones(AEZ) and industrial support.

Crops

UNIT I: Apple, pear, grapes.

UNIT II: Plums, peach, apricot, cherries, hazelnut.

UNIT III: Litchi, loquat, persimmon, kiwifruit, strawberry.

UNIT IV: Nuts- walnut, almond, pistachio, pecan.

UNIT V: Minor fruits-carambola, bael, wood apple, fig, jamun, rambutan, pomegranate

Practical

1. Identification of important cultivars SUBTROPICAL AND TEMPERATE FRUIT.
2. Observations on growth and development of Sub tropical and Temperate Fruit..
3. Analyses of quality attributes
4. Project preparation for establishing commercial orchards.

Book & Reference:

Bose TK, Mitra SK & Sanyol D. (Ed.). 2002. *Fruits of India – Tropical and Sub-tropical*. 3rd Ed. Vols. I, II. Naya Udyog.

Chadha KL & Pareek OP. 1996. (Eds.). *Advances in Horticulture*. Vol. I. Malhotra Publ. House.

Chadha KL & Shikhamany SD. 1999. *The Grape: Improvement, Production and Post-Harvest Management*. Malhotra Publ. House.

Janick J & Moore JN. 1996. *Fruit Breeding*. Vols. I-III. John Wiley & Sons. Nijjar GS. 1977. (Eds.). *Fruit Breeding in India*. Oxford & IBH.

Radha T & Mathew L. 2007. *Fruit Crops*. New India Publ. Agency.

Singh S, Shivankar VJ, Srivastava AK & Singh IP. (Eds.). 2004. *Advances in Citriculture*. Jagminder Book Agency.

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

	Course Outcomes (COs)	Mapped Programme Outcomes
CO1	Concepts of temperate fruit production and their management	PO1
CO2	Description of head- origin, description, and cultural practices; types of propagation and rootstocks of temperate fruit	PO2
CO3	Description of abiotic factors limiting temperate fruit production	PO3
CO4	Description of physiology of flowering, fruit set and development, physiological disorders and quality improvement by management practices	PO2
CO5	Know about the post-harvest technology, industrial and export potential of temperate fruit	PO1

Modes of Evaluation: Quiz/Assignment/ Seminar/Written Examination Examination Scheme:

Components	MSE	Quiz/Assignment/ Seminars etc.	Practical	ESE
Weightage (%)	30	05	15	50

Course Code	Course Title	Employ expertise to PO1	Have knowledge PO2	Develop and use the most PO3	Assess societal, PO4	Recognize the effects of PO5	Develop into tenacious PO6	Effectively perform on a PO7	Incorporate moral PO8
FSC 502	SUBTROPICAL AND TEMPERATE FRUIT PRODUCTION	2	2	3	2	3	3	2	2

1= weakly mapped 2= moderately mapped 3= strongly mapped

FSC 503 PROPAGATION AND NURSERY MANAGEMENT FOR FRUIT CROPS 2+2

Objective

Familiarization with principles and practices of propagation and nursery management for fruit crops.

Theory

UNIT I: Introduction, life cycles in plants, cellular basis for propagation, sexual propagation, apomixis, polyembryony, chimeras. Principles factors influencing seed germination of horticultural crops, dormancy, hormonal regulation of germination and seedling growth.

UNIT II: Seed quality, treatment, packing, storage, certification, testing. Asexual propagation – rooting of soft and hard wood cutting under mist by growth regulators. Rooting of cuttings in hotbeds. Physiological, anatomical and biochemical aspects of root induction in cuttings. Layering – principle and methods.

UNIT III: Budding and grafting – selection of elite mother plants, methods. Establishment of bud wood bank, stock, scion and inter stock, relationship – Incompatibility. Rejuvenation through top working –Progeny orchard and scion bank.

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

UNIT V: Nursery – types, structures, components, planning and layout. Nursery management practices for healthy propagule production.

Practical

1. Anatomical studies in rooting of cutting and graft union.
2. Construction of propagation structures.
3. Study of media and PGR.
4. Hardening – case studies, micro propagation, explants preparation, media preparation.
5. Visit to TC labs and nurseries

Book & Reference:

Hartmann HT & Kester DE. 1989. *Plant Propagation – Principles and Practices*. Prentice Hall of India. Bose TK, Mitra SK & Sadhu MK. 1991. *Propagation of Tropical and Subtropical Horticultural Crops*. Naya Prokash.

Peter KV. (Ed.). 2008. *Basics of Horticulture*. New India Publ. Agency. Singh SP. 1989 *Mist Propagation*. Metropolitan Book Co.

Rajan S & Baby LM. 2007. *Propagation of Horticultural Crops*. New India Publ. Agency.

Radha T & Mathew L. 2007. *Fruit Crops*. New India Publ. Agency.

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

	Course Outcomes (COs)	Mapped Programme Outcomes
CO1	Concepts of principles and practices of propagation and nursery management	PO1
CO2	Know about the plant growth regulators and principles and methods of cutting and layering	PO2
CO3	Impart knowledge about the asexual propagation methods like grafting and budding	PO1
CO4	Concepts and principles of micropropagation and commercial exploitation in horticultural crops	PO2
CO5	Understand the knowledge of nursery management, planning and lay out	PO3

Modes of Evaluation: Quiz/Assignment/ Seminar/Written Examination Examination Scheme:

Components	MSE	Quiz/Assignment/ Seminars etc.	Practical	ESE
Weightage (%)	30	05	15	50

		Employ expertise to	Have knowledge	Develop and use the most	Assess societal,	Recognize the effects of	Develop into tenacious	Effectively perform on a	Incorporate moral
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
FSC 503	PROPAGATION AND NURSERY MANAGEMENT FOR FRUIT CROPS	2	3	3	2	2	2	3	2

1= weakly mapped 2= moderately mapped 3= strongly mapped

Objective

To impart comprehensive knowledge about the principles and practices of breeding of fruit crops.

Theory

Origin and distribution, taxonomical status - species and cultivars, cytogenetics, genetic resources, blossom biology, breeding systems, breeding objectives, ideotypes, approaches for crop improvement - introduction, selection, hybridization, mutation breeding, polyploidy breeding, rootstock breeding, improvement of quality traits, resistance breeding for biotic and abiotic stresses, biotechnological interventions, achievements and future thrust in the following selected fruit crops.

Crops

UNIT I: Mango, banana and pineapple

UNIT II: Citrus, grapes, guava and sapota

UNIT III: Jackfruit, papaya, custard apple, aonla, avocado and ber

UNIT IV: Litchi, jamun, phalsa, mulberry, raspberry, and nuts.

UNIT V: Apple, pear, plums, peach, apricot, cherries and strawberry

Practical

1. Characterization of germplasm, blossom biology.
2. Study of anthesis, estimating fertility status.
3. Practices in hybridization, ploidy breeding. mutation breeding,
4. Evaluation of biometrical traits and quality traits.
5. Visit to research stations working on tropical, subtropical and temperate fruit improvement

Book & Reference:

Bose TK, Mitra SK & Sanyal D. (Eds.). 2002. *Fruits of India – Tropical and Sub-tropical*. 3rd Ed. Vols. I, II. Naya Udyog.

Chadha KL & Pareek OP. 1996. (Eds.). *Advances in Horticulture*. Vol. I. Malhotra Publ. House.

Chadha KL & Shikhamany SD. 1999. *The Grape: Improvement, Production and Post-Harvest Management*. Malhotra Publ. House.

Janick J & Moore JN. 1996. *Fruit Breeding*. Vols. I-III. John Wiley & Sons. Nijjar GS. 1977. (Eds.). *Fruit Breeding in India*. Oxford & IBH.

Radha T & Mathew L. 2007. *Fruit Crops*. New India Publ. Agency.

Singh S, Shivankar VJ, Srivastava AK & Singh IP. (Eds.). 2004. *Advances in Citriculture*.

Jagmander Book Agency.

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

	Course Outcomes (COs)	Mapped Programme Outcomes
CO1	Concepts of origin and distribution and taxonomical status of fruit crops	PO2
CO2	Formulate the concept of genetic resources, breeding objectives and different breeding methods of fruit crops	PO1
CO3	Examine the knowledge of improvement of quality traits, resistance breeding for biotic and abiotic stresses	PO3
CO4	Deduct the role of biotechnological interventions	PO2
CO5	Propose the achievements and future thrust in the following selected fruit crops	PO3

Modes of Evaluation: Quiz/Assignment/ Seminar/Written Examination Examination Scheme:

Components	MSE	Quiz/Assignment/ Seminars etc.	Practical	ESE
Weightage (%)	30	05	15	50

Course Code	Course Title	Employ expertise PO1	Have knowledg PO2	Develop and use PO3	Assess societal, PO4	Recognize the effects PO5	Develop into PO6	Effectivel y perform PO7	Incorporat e moral PO8
FSC 504	BREEDING OF FRUIT CROPS	2	2	3	2	3	3	2	3

1= weakly mapped 2= moderately mapped 3= strongly mapped

FSC 505 POST HARVEST TECHNOLOGIES FOR FRUIT CROPS 2+2

Objective

To facilitate deeper understanding on principles and practices of post-harvest management of fruit crops.

Theory

UNIT I: Maturity indices, harvesting practices for specific market requirements, influence of pre-harvest practices, enzymatic and textural changes, respiration, and transpiration.

UNIT II: Physiology and biochemistry of fruit ripening, ethylene evolution and ethylene management, factors leading to post-harvest loss, pre-cooling.

UNIT III: Treatments prior to shipment, viz., chlorination, waxing, chemicals, biocontrol agents and natural plant products. Methods of storage ventilated, refrigerated, MAS, CA storage, physical injuries and disorders.

UNIT IV: Packing methods and transport, principles and methods of preservation, food processing, canning, fruit juices, beverages, pickles, jam, jellies, Candies.

UNIT V: Dried and dehydrated products, nutritionally enriched products, fermented fruit beverages, packaging technology, processing waste management, food safety standards.

Practical

1. Analyzing maturity stages of commercially important horticultural crops.
2. Improved packing and storage of important horticultural commodities.
3. Physiological loss in weight of fruits and vegetables.
4. Estimation of transpiration, respiration rate, ethylene release.
5. Estimation of quality characteristics in stored fruits.
6. Cold chain management -visit to cold storage and CA storage units,
7. Visit to fruit and vegetable processing units,

Book & Reference:

Bhutani RC. 2003. *Fruit and Vegetable Preservation*. Biotech Books. Chadha KL & Pareek OP. (Eds.). 1996 *Advances in Horticulture*. Vol. IV. Malhotra Publ. House.

Haid NF & Salunkhe SK. 1997. *Post Harvest Physiology and Handling of Fruits and Vegetables*. Grenada Publ. Mitra SK. 1997. *Post Harvest Physiology and Storage of Tropical and Sub-tropical Fruits*. CABI. Ranganna S. 1997. *Hand Book of Analysis and Quality Control for Fruit and Vegetable Products*. Tata McGraw-Hill.

Sudheer KP & Indira V. 2007. *Post Harvest Technology of Horticultural Crops*. New India Publ. Agency.

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

	Course Outcomes (COs)	Mapped Programme Outcomes
CO1	Concepts of principles and practices of post-harvest management of fruit crops	PO2
CO2	Formulate the concept physiology and biochemistry of fruit ripening	PO2
CO3	Examine the knowledge methods of storage and transportation of fruit crops	PO1
CO4	Deduct the principles and methods of preservation and processing of fruit crops	PO2
CO5	Propose the knowledge of dried and dehydrated products of selected fruit crops	PO3

Modes of Evaluation: Quiz/Assignment/ Seminar/Written Examination Examination Scheme:

Components	MSE	Quiz/Assignment/ Seminars etc.	Practical	ESE
Weightage (%)	30	05	15	50

		Employability	Have knowledge	Develop and use the	Assess societal	Recognize the	Develop into	Effectively perform	Incorporate moral
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
FSC 504	BREEDING OF FRUIT CROPS	2	3	3	2	3	2	2	3

1= weakly mapped 2= moderately mapped 3= strongly mapped

FSC 506 CANOPY MANAGEMENT IN FRUIT CROPS 1+2

Objective

To impart knowledge about the principles and practices in canopy management of fruit crops.

Theory

UNIT I: Canopy management - importance and advantages; factors affecting canopy development.

UNIT II: Canopy types and structures with special emphasis on geometry of planting, canopy manipulation for optimum utilization of light. Light interception and distribution in different types of tree canopies.

UNIT III: Spacing and utilization of land area - Canopy classification; Canopy management through rootstock and scion.

UNIT IV: Canopy management through plant growth inhibitors, training and pruning and management practices.

UNIT V: Canopy development and management in relation to growth, flowering, fruiting and fruit quality in temperate fruits, grapes, passion fruits, mango, sapota, guava, citrus and ber.

Practical

1. Study of different types of canopies.
- 2 Training of plants for different canopy types.
3. Canopy development through pruning.
4. Use of plant growth inhibitors in fruit crops.
5. Geometry of planting.
6. Study on effect of different canopy types on production and quality of fruits.

Book & Reference:

Chadha KL & Shikhamany SD. 1999. *The Grape, Improvement, Production and Post Harvest Management*. Malhotra Publ. House.

Pradeepkumar T, Suma B, Jyothibhaskar & Satheesan KN. 2008. *Management of Horticultural Crops*.

New India Publ. Agency

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

	Course Outcomes (COs)	Mapped Outcomes	Programme

CO1	Concepts of principles and practices of canopy management on fruit crops	PO1
CO2	Formulate the concept of maximize light interception to optimize light distribution within canopy	PO3
CO3	Relate to knowledge of spacing and utilization of land area	PO2
CO4	Develop the concept of training and pruning on fruit crops	PO2
CO5	Propose the practices of canopy management on selected fruit crops	PO1

Modes of Evaluation: Quiz/Assignment/ Seminar/Written Examination Examination Scheme:

Components	MSE	Quiz/Assignment/ Seminars etc.	Practical	ESE
Weightage (%)	30	05	15	50

		Employ expertise to	Have knowledge	Develop and use the most	Assess societal,	Recognize the effects of	Develop into tenacious	Effectively perform on a	Incorporate moral
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
FSC 506	CANOPY MANAGEMENT IN FRUIT CROPS	2	3	3	2	2	3	3	2

1= weakly mapped 2= moderately mapped 3= strongly mapped

FSC 507 GROWTH AND DEVELOPMENT OF FRUIT CROPS 2+2

Objective

To develop understanding of growth and development of Fruit crops which have implications in their management.

Theory:

Unit 1: Growth and development– definition, parameters of growth and development, growth dynamics, morphogenesis. Environmental impact on growth and development, effect of light, photosynthesis and photoperiodism vernalisation, effect of temperature, heat units, thermoperiodism.

Unit 2: Plant growth substances involved in growth regulation; history, development and nomenclature, mode of action and their physiological effects of different classes of growth substances – auxins, gibberellins, cytokinins, inhibitors, ethylene, abscisic acid, etc.

Unit 3: Morphogenesis – differential growth, growth correlations, apical dominance and their significance as applicable to fruit crops. Use of tissue culture in the study of Morphogenesis, Physiology of dormancy in buds and seeds, juvenility, abscission and senescence. Use of growth regulators in regulation of these processes.

Unit 4: Physiology of flowering in fruit crops – relationship with photoperiod and temperature (Vernalization); nature of floral stimulus; hormonal control of flowering and sex expression. Physiological factors associated with fruit set and development; hormonal relation. Fruit ripening– physiological mechanism. Chemical regulation of fruit growth and ripening.

Unit 5: Growth and developmental process during stress – manipulation of growth and development, impact of pruning and training, chemical manipulations in horticultural crops,.

Practicals:

1. Understanding dormancy mechanisms in seeds and stratification of seeds
2. Study of growth and development patterns, techniques of growth analysis
3. Evaluation of photosynthetic efficiency under different environments
4. Study of growth regulator functions, hormone assays and understanding ripening phenomenon in fruits
5. Study of impact of training and pruning on growth and development
6. Study of chemical manipulations on growth and development, understanding stress impact on growth and development.
7. Visit to research centers.

Book & Reference:

Buchanan B, Gruissem W & Jones R. 2002. *Biochemistry & Molecular Biology of Plants*. John Wiley & Sons.

Epstein E. 1972. *Mineral Nutrition of Plants: Principles and Perspectives*. Wiley.

Fosket DE. 1994. *Plant Growth and Development: a Molecular Approach*. Academic Press.

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

	Course Outcomes (COs)	Mapped Programme Outcomes
CO1	Compose in depth awareness with the concept of environmental impact on growth and development	PO1
CO2	Develop in depth know how to do plant growth substances involved in growth regulation on physiological effects on fruit crops	PO3
CO3	Assess how to do the analysis of use of tissue culture on fruit crops and concept of dormancy in buds and seeds	PO2
CO4	Compose in depth awareness on physiology of flowering in fruit crops and chemical regulation of fruit growth and ripening	PO1
CO5	Impart knowledge on growth and developmental process during stress	PO2

Modes of Evaluation: Quiz/Assignment/ Seminar/Written Examination Examination Scheme:

Components	MSE	Quiz/Assignment/ Seminars etc.	Practical	ESE
Weightage (%)	30	05	15	50

		Employ expertise	Have knowledge	Develop and use	Assess societal,	Recognize the	Develop into	Effectively	Incorporate moral
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
FSC 507	GROWTH AND DEVELOPMENT OF FRUIT CROPS	3	2	3	2	3	2	3	3

1= weakly mapped 2= moderately mapped 3= strongly mapped

FSC- 508 NUTRITION OF FRUIT CROPS (2 + 2)

Objective

To develop understanding of nutrition on fruit crops which have implications in their management.

Theory:

Unit 1: Importance and history of nutrition of fruit crops. Primary, secondary and micro elements in nutrition. Role of individual elements on growth and fruiting of fruit crops.

Unit 2: Diagnostic methods for determining nutrition requirements – amount of nutrients removed by crop/plant, foliar diagnosis, visual symptoms of deficiencies/disorders, tissue/plant analysis, soil analysis etc.

Unit 3: Evaluation of nutrient status in orchards. DRIS concept of nutrition. Root studies – root distribution as criteria for determining amount and replacement of nutrients. Nutrient requirements of fruit crops.

Unit 4: Methods of nutrients application – soil, foliar etc. Manures and manuring, organic and green manuring and fertilizer application. Need based nutrition, splits and time of application. Soil pH and nutrient availability, soil salinity and other antagonistic factors.

Unit 5: Use of soil amendments, salt tolerant crops etc. Special problems – nutritional disorders and developments done.

Practicals :

1. Study of diagnostic techniques for determining nutrient status of fruit crops
2. Study of root distribution, leaf sampling techniques
3. Study of equipment's used in nutrient analysis
4. Chemical analysis of different nutrients
5. Study of deficiency symptoms
6. Nutrient culture studies and foliar nutrition.
7. Visit to long-term fertilizer experimental plots in research Centre's

Suggested Reference:

Chudawat, B.S. Fruit Nutrition Management of Fruit Crops. Agritech Publishing Company, Udailpur.

Epstein, E. 1972. Mineral Nutrition of Plants–Principles and Perspectives. John Wiley and Sons, London.

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

	Course Outcomes (COs)	Mapped Programme Outcomes
CO1	Concepts of Importance and history of nutrition of fruit crops	PO1
CO2	Description of Diagnostic methods for determining nutrition such as foliage, visual, plant tissue and soil analysis	PO2
CO3	Description of head- Evaluation of nutrient status in orchards. DRIS concept of nutrition.	PO2
CO4	Concept on methods of nutrients application – Soil, Foliar etc.	PO2
CO5	Propose the practices of soil amendments and salt tolerant crops	PO3

Modes of Evaluation: Quiz/Assignment/ Seminar/Written Examination Examination Scheme:

Components	MSE	Quiz/Assignment/ Seminars etc.	Practical	ESE
Weightage (%)	30	05	15	50

		Employ expertise to	Have knowledge	Develop and use the most	Assess societal,	Recognize the effects of	Develop into tenacious	Effectively perform on a	Incorporate moral
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
FSC 508	NUTRITION OF FRUIT CROPS	2	2	3	2	3	2	3	2

1= weakly mapped 2= moderately mapped 3= strongly mapped

Minor Courses

FSC 603 **ADVANCES IN GROWTH REGULATION OF FRUIT CROPS** 2+2

Objective

Appraisal on the advances in growth regulation of fruit crops.

Theory

UNIT I: Eco physiological influences on growth and development of fruit crops flowering, fruit set- Crop load and assimilate partitioning and distribution.

UNIT II: Root and canopy regulation, study of plant growth regulators in fruit culture-structure, biosynthesis, metabolic and morphogenetic effects of different plant growth promoters and growth retardants.

UNIT III: Absorption, translocation and degradation of phytohormones – internal and external factors influencing hormonal synthesis, biochemical action, growth promotion and inhibition, canopy management for fertigated orchards.

UNIT IV: Growth regulation aspects of propagation, embryogenesis, seed and bud dormancy, fruit bud initiation, regulation of flowering, off season production.

UNIT V: Flower drop and thinning, fruit set and development, fruit drop, parthenocarpy, fruit maturity and ripening and storage, molecular approaches in crop growth regulation-current topics.

Practical

1. Root- shoots studies.
2. Quantifying the physiological and biochemical effects of physical and chemical growth regulation.
3. Bioassay and isolation through chromatographic analysis for auxins, gibberellins, experiments on growth regulation during propagation,
4. Dormancy, flowering, fruit set and fruit development stages.

Suggested Readings

Buchanan B, Gruissem W & Jones R. 2002. *Biochemistry & Molecular Biology of Plants*. John Wiley & Sons. Epstein E. 1972.

Mineral Nutrition of Plants: Principles and Perspectives. Wiley. Fosket DE. 1994. *Plant Growth and Development: A Molecular Approach*. Academic Press. Leopold AC & Kriedemann PE. 1985. *Plant Growth and Development*. 3rd Ed. McGraw-Hill. Radha T & Mathew L. 2007. *Fruit Crops*. New India Publ. Agency. Roberts J, Downs S & Parker

P. 2002. Plant Growth Development. In: *Plants* (I. Ridge, Ed.), pp. 221-274, Oxford University Press.

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

	Course Outcomes (COs)	Mapped Programme Outcomes
CO1	Compose in depth awareness with the concept of Eco physiological influences on growth and development of fruit crops	PO1
CO2	Develop in depth know how to do root and canopy regulation and study of plant growth regulators	PO3
CO3	Assess how to do the absorption, translocation and degradation of phytohormones	PO2
CO4	Compose in depth awareness on physiology of flowering in fruit crops and chemical regulation for off season fruit production	PO1
CO5	Impart knowledge on molecular approaches in crop growth regulation	PO2

Modes of Evaluation: Quiz/Assignment/ Seminar/Written Examination Examination Scheme:

Components	MSE	Quiz/Assignment/ Seminars etc.	Practical	ESE
Weightage (%)	30	05	15	50

Course Code	Course Title	Employ expertise	Have knowledge	Develop and use	Assess societal,	Recognize the	Develop into	Effectively perform	Incorporate moral
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
FSC 507	GROWTH AND DEVELOPMENT OF FRUIT CROPS	3	2	3	2	3	2	3	3

1= weakly mapped 2= moderately mapped 3= strongly mapped

FSC 511 Protected Cultivation and Secondary Agriculture 2+2

Objectives

- i. To equip the students with glass house technology and explain them its functional and operational aspects
- ii. To give knowledge about post-harvest technology and its role in value addition of agricultural products
- iii. To make the students aware about principle, working and maintenance of equipments used for safe handling and processing of produce.

Theory

Unit I	Green house technology: Introduction, Types of Green Houses; Plant response to Green house environment, Planning and design of greenhouses, Design criteria of green house for cooling and heating purposes.
Unit II	Green house equipments, materials of construction for traditional and low cost green houses. Irrigation systems used in greenhouses, typical applications, passive solar green house, hot air green house heating systems, green house drying. Cost estimation and economic analysis.
Unit III	Important Engineering properties such as physical, thermal and aero & hydrodynamic properties of cereals, pulses and oilseed, their application in PHT equipment design and operation.
Unit IV	Drying and dehydration; moisture measurement, EMC, drying theory, various drying method, commercial grain dryer (deep bed dryer, flat bed dryer, tray dryer, fluidized bed dryer, recirculatory dryer and solar dryer).
Unit V	Material handling equipment; conveyer and elevators, their principle, working and selection.
Practical	Study of different type of green houses based on shape. Determine the rate of air exchange in an active summer winter cooling system. Determination of drying rate of agricultural products inside green house. Study of green house equipments. Visit to various Post Harvest Laboratories. Determination of Moisture content of various grains by oven drying & infrared moisture methods. Determination of

	engineering properties (shape and size, bulk density and porosity of biomaterials). Determination of Moisture content of various grains by moisture meter. Field visit to seed processing plant.
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Recommended Books

1. Radha Manohar, K and Igathinathane. C. Greenhouse Technology and Management, 2nd Edition, BS Publications.
2. Tiwari, G.N. Greenhouse Technology for Controlled Environment. Narosa Publishing house Pvt.Ltd.
3. Singh Brahma and Balraj Singh., 2014. Advances in Protected Cultivation, New India Publishing Company.
4. Sahay, K.M. and Singh, K.K. 1994. Unit operations of Agricultural Processing. Vikas Publishing house Pvt. Ltd. New Delhi.
5. Chakraverty, A. Post Harvest Technology of cereals, pulses and oilseeds. Oxford & IBH publishing Co. Ltd., New Delhi.
6. Ojha, T.P and Michael, A.M. Principles of Agricultural Engineering, Vol. I, Jain Brothers, Karol Bag, New Delhi.
7. K.Radha Manohar and C. Igathinathane, 2013. Greenhouse Technology and Management BS Publications.

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	Mapped Programme Outcomes
CO1	Explain the role of greenhouse technology in increasing agricultural productivity and quality of the produce	PO1
CO2	Describe proper functioning of glass house and be able to produce his/her own off season produce with better utilization of available resources	PO2
CO3	Apply Important Engineering properties	PO3
CO4	Analyze Drying and dehydration methods	PO2

C05	Explain about Material handling equipment	P02
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Modes of Evaluation: Quiz/Assignment/ Seminar/Written Examination
Examination Scheme:

Components	MSE I/MSE II	Quiz/Assignment/ Seminars etc.	Practical	ESE
Weightage (%)	30	5	15	50

		Apply science by carrying out pertinent research and test projects for the benefit of	Establish sound agricultural practices, assess new approaches, drive innovation, and be able to effectively contribute to the	Determine, put forward, examine, and assess the scientific and technical data	to operate productively by having improved personal and employability skills and being able to communicate clearly about complex	Know the different agricultural techniques that can be used for food security	Become tenacious individuals who practice and employ the knowledge gained to craft expert answers to practical issues in	Apply management and agricultural ideas to one's own work or to the management of	Apply ethical principles and uphold professional ethics and responsibility of the
Course Code	Course Title	P01	P02	P03	P04	P05	P06	P07	P08
FSC 511	Protected Cultivation and Secondary Agriculture	2	2	2	3	3	3	3	2

1= weakly mapped 2= moderately mapped 3= strongly mapped

Objective

1. To sensitize the students on hi-tech production technology of fruits, vegetables and flower crops.
2. To impart knowledge of mechanization, micro propagation and protected cultivation of horticultural crops
3. To develop understanding of application of precision farming in horticultural crops
4. To provide skills in various activities of the protected cultivation of high value vegetables and flowers

Theory

Unit I: Introduction & importance; Nursery management and mechanization; micro propagation of horticultural crops; Modern field preparation and planting methods,

Unit II: Protected cultivation: advantages, controlled conditions, method and techniques,

Unit III: Micro irrigation systems and its components;

Unit IV: EC, pH based fertilizer scheduling,

Unit V: canopy management, high density orcharding,

Unit VI: Components of precision farming: Remote sensing, Geographical Information System (GIS), Differential Geo-positioning System (DGPS), Variable Rate applicator (VRA),

Unit VII: Application of precision farming in horticultural crops (fruits, vegetables and ornamental crops); mechanized harvesting of produce.

Practical:

1. Types of polyhouses and shade net houses
2. Intercultural operations
3. Tools and equipments: Identification and application
4. Micro propagation
5. Nursery-protrays

6. Micro-irrigation
7. EC, pH based fertilizer scheduling
8. Canopy management
9. Visit to hi-tech orchard/nursery.

Books Recommended

1. Prasad, S. And Kumar, U. 2012. Greenhouse Management of Horticultural Crops. 2nd edition, Agribios publishers, New Delhi.
2. Singh, H.P., Singh, G., Samuel, J.C., and Pathak, R.K.. 2003. Precision Farming in Horticulture. NCPAH, MOA, PFDC, CISH, Lucknow
3. Srivasthava, K.K. 2007. Canopy Management of Fruit Crops. International book distributing co., Lucknow
4. Sahu, K.C. 2008. Text Book of Remote Sensing and Geographical Information Systems. Atlantic publishers & Distributors

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	Mapped Programme Outcomes
CO1	produce quality planting material of fruit crops using modern techniques of protected cultivation, glass house technology and micro propagation methods	P02
CO2	acquire skill in nursery production of commercially important ornamentals and horticultural crops	P01
CO3	demonstrate several techniques to propagate and multiply horticultural crops and commercial nurseries to meet the demand of industry.	P01
CO4	Analyze the components of precision farming	P02
CO5	Use and apply precision tools in production of fruits, vegetables and ornamental crops	P03

Modes of Evaluation: Quiz/Assignment/ Seminar/Written Examination Examination Scheme:

Components	MSE I/MSE II	Quiz/Assignment/ Seminars etc.	Practical	ESE
Weightage (%)	30	5	15	50

Course Code	Course Title	P01	P02	P03	P04	P05	P06	P07	P08
FSC 513	Hi-tech. Horticulture	2	2	3	3	2	2	2	3

1= weakly mapped 2= moderately mapped 3= strongly mapped

STAT 512 EXPERIMENTAL DESIGNS 1+2

Objective

This course is meant for students of agricultural and animal sciences other than Statistics. Designing an experiment is an integrated component of research in almost all sciences. The students would be exposed to concepts of Design of Experiments so as to enable them to understand the concepts involved in planning, designing their experiments and analysis of experimental data.

Theory

UNIT I: Need for designing of experiments, characteristics of a good design. Basic principles of designs- randomization, replication and local control.

UNIT II: Uniformity trials, size and shape of plots and blocks; Analysis of variance; completely randomized design, randomized block design and Latin square design.

UNIT III: Factorial experiments, (symmetrical as well as asymmetrical). Orthogonality and partitioning of degrees of freedom, Confounding in symmetrical factorial experiments, Factorial experiments with control treatment.

UNIT IV: Split plot and strip plot designs; Analysis of covariance and missing plot techniques in randomized block and Latin square designs; Transformations, crossover designs, balanced incomplete block design, resolvable designs and their applications ~ Lattice design, alpha design-concepts, randomisation procedure, analysis and interpretation of results. Response surfaces. Experiments with mixtures.

UNIT V: Bioassays- direct and indirect, indirect assays based on quantal dose response, parallel line and slope ratio assays potency estimation.

Practical

1. Uniformity trial data analysis, formation of plots and blocks, Fairfield Smith Law;
2. Analysis of data obtained from CRD, RBD, and LSD;
3. Analysis of factorial experiments without and with confounding;
4. Analysis with missing data; Split plot and strip plot designs; Transformation of data;
5. Analysis of resolvable designs; Fitting of response surfaces.

Book & Reference:

Cochran WG & Cox GM. 1957. Experimental Designs. 2nd Ed. John Wiley. Dean AM & Voss D. 1999. Design and Analysis of Experiments. Springer. Federer WT. 1985. Experimental Designs. MacMillan.

Fisher RA. 1953. Design and Analysis of Experiments. Oliver & Boyd. Nigam AK & Gupta VK. 1979. Handbook on Analysis of Agricultural Experiments. IASRI Publ. Pearce SC. 1983. The Agricultural Field Experiment: A Statistical Examination of Theory and Practice. John Wiley. Design Resources Server: www.iasri.res.in/design.

PGS 501: Library and Information Services 0+2**Objective:**

To equip the library users with skills to trace information from libraries efficiently, to apprise them of information and knowledge resources, to carry out literature survey, to formulate information search strategies, and to use modern tools (Internet, OPAC, search engines etc.) of information search.

Practical:

Introduction to library and its services; Role of libraries in education, research and technology transfer; Classification systems and organization of library; Sources of information- Primary Sources, Secondary Sources and Tertiary Sources; Intricacies of abstracting and indexing services (Science Citation Index, Biological Abstracts, Chemical Abstracts, CABI Abstracts, etc.); Tracing information from reference sources; Literature survey; Citation techniques/Preparation of bibliography; Use of CD-ROM Databases, Online Public Access Catalogue and other computerized library services; Use of Internet including search engines and its resources; ere sources access methods.

Book & Reference:

ICTBasedLibraryandInformationServices by **Akhtar Hussain** ESS ESS Publication

Foundations of Library and Information Science, Third Edition by **Richard Rubin**

Information Literacy Instruction: Theory and Practice, Second Edition (Information Literacy Sourcebooks) by Esther S. Grassian and Joan R. Kaplowitz (Jul 31, 2009)

PGS 502: Technical Writing and Communications Skills 0+2

Objective

To equip the students/scholars with skills to write dissertations, research papers, etc. To equip the students/scholars with skills to communicate and articulate in English (verbal as well as writing).

Practical

Technical Writing Various forms of scientific writings- theses, technical papers, reviews, 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, précis, citations etc.; commonly used abbreviations in the theses and research communications; illustrations, photographs and drawings with suitable captions; pagination, numbering of tables and illustrations; Writing of numbers and dates in scientific write-ups; Editing and proof-reading; Writing of a review article.

Communication Skills:

Grammar (Tenses, parts of speech, clauses, punctuation marks); Error analysis (Common errors); Concord; Collocation; Phonetic symbols and transcription; Accentual pattern: Weak forms in connected speech: Participation in group discussion: Facing an interview; presentation of scientific papers.

Book & Reference:

- ❖ English Dictionary. 1995. Harper Collins. Gordon HM & Walter JA. 1970.
- ❖ Technical Writing. 3rd Ed. Holt, Rinehart & Winston. Hornby AS. 2000. Comp.
- ❖ James HS. 1994. Handbook for Technical Writing. NTC
- ❖ Mohan K. 2005. Speaking English Effectively.
- ❖ High School English Grammar and Composition. S. Chand & Co.

PGS 503 Intellectual Property and Its management in Agriculture 1+0

Objective

The main objective of this course is to equip students and stakeholders with knowledge of intellectual property rights (IPR) related protection systems, their significance and use of IPR as a tool for wealth and value creation in a knowledgebasedeconomy.

Theory

Unit I: 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), benefits of securing IPRs;

Unit II: 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: Protectable subject matters, protection in biotechnology, protection of other biological materials, ownership and period of protection.

Unit IV: National Biodiversity protection initiatives; Convention on Biological Diversity; International Treaty on Plant Genetic Resources for Food and Agriculture.

Unit V: Licensing of technologies, Material transfer agreements, Research collaboration Agreement, License Agreement.

Book & Reference:

Erbisch FH & 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 & Aesthetic Technologies. Ministry of Agriculture, Government of India. 2004.

State of Indian Farmer. Vol. V. *Technology Generation and IPR Issues*. Academic Foundation. Rothschild M & 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. *The Indian Acts - Patents Act, 1970 and amendments; Design*

Act, 2000; Trademarks Act, 1999; The Copyright Act, 1957 and amendments; Layout Design Act, 2000; PPV and FR Act 2001, and Rules 2003; National Biological Diversity Act, 2003.

PGS 504: Basic Concepts in Laboratory Techniques 0+2

Objective:

To acquaint the students about the basics of commonly used techniques in laboratory.

Practical:

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

Book & Reference:

Furr AK. 2000. CRC Hand Book of Laboratory Safety. CRC Press. Gabb MH & Latchem WE.1968. A Handbook of Laboratory Solutions. Chemical Publ. Co.8. FMPE 503: Testing and Evaluation of Tractors and Farm Equipment