

New

M.Sc.(Hort.)(FruitScience)		
Course Code	Course Title	Credit Hours
HOR501*	Tropical Fruit Production	2+1
HOR502	Nutrition of Fruit Crops	2+1
HOR503	Principles and practices of Organic farming	2+1
HOR504	Intellectual property and its management in agriculture	1+0
HOR505	Experimental design	2+1
HOR506*	Sub-Tropical and Temperate Fruit Production	2+1
HOR507	Canopy management in fruit crops	1+1
HOR508	Conservation Agriculture	1+1
HOR509	Basic concepts of in laboratory techniques	1+0
HOR 510	Information technology in Agriculture	1+1
HOR511*	Propagation and Nursery Management of Fruit Crops	2+1
HOR512	Export Oriented Fruit Production	2+1
HOR513	Dry land farming and watershed management	2+1
HOR 514	Technical writing and communication skills	0+1
HOR 515	Agricultural research, research ethics and rural development programmes	0+1
HOR 516*	Breeding of Fruit Crops	2+1
HOR517	Library and information services	0+1
HOR518	Seminar	0+1
HOR519	Thesis Research	0+30

*Compulsory among major courses

M.Sc.(Hort.)(FruitScience)
First Semester



- **Course Title** :TropicalFruitProduction
- **Course Code** :HOR501
- **Credit Hours** :(2+1)
- **Need of the course:**
Tropicalfruitsoccupyadistinctplaceinglobalfruitproduction.Apartfromecologicalspecificities,tropicalfruitsenjoyfavouramongmassesbeingdeliciousandnutritious.As such, the course has been designed to provide update knowledge on variousproductiontechnologiesoftropicalfruitsonustainablebasis.
- **Objectiveofthecourse**
Toimpartcomprehensiveknowledgetothestudentsonculturalandmanagementpracticesforgrowingtropicalfruits.
Thecourseisorganizedasfollows:

No. Blocks	Units
• Introduction	I ImportanceandBackground
• Agro-Techniques	I Propagation,PlantingandOrchardFloor Management
• CropManagement	I Flowering,Fruit-SetandHarvesting

- **Theory**

- **Block1: Introduction**

- **Unit1:Importance and Background:** Importance, origin and distribution, majorspecies,rootstocksandcommercialvarietiesofregional,nationalandinternationalimportance,eco-physiologicalrequirements.

- **Block2: Agro-techniques**

- **Unit 1:Propagation,PlantingandOrchardFloor Management:** Asexual andsexual methods of propagation, planting systems and planting densities,trainingandpruningmethods,rejuvenation,intercropping,nutrientmanagement, water management, fertigation, use of bio-fertilizers, roleofbio-regulators,abioticfactorslimitingfruitproduction.

- **Block3: CropManagement**

- **Unit 1:Flowering, Fruit-Set and Harvesting:** Physiology of flowering, pollinationmanagement, fruit set and development, physiological disorders – causesand remedies, crop regulation, quality improvement by managementpractices; maturity indices, harvesting, grading, packing, storage andripeningtechniques;insectanddiseasemanagement.

Mango,Banana,Guava,Pineapple,Papaya,Avocado,Jackfruit,Annonas,Aonla,Ber,etc.

- **Practicals**

- Distinguishedfeaturesoftropicalfruitspecies,cultivarsandrootstocks(2);
 - Demonstrationofplantingsystems,trainingandpruning(3);
 - Hands-onpracticesonpollinationandcropregulation(2);
 - Leafsamplingandnutrientanalysis(3);
 - Physiologicaldisorders-maladydiagnosis(1);
 - Physico-chemicalanalysisoffruitqualityattributes(3);
 - Field/Exposurevisittotropicalorchards(1);
 - Projectpreparationforestablishingcommercialorchards(1).

- **TeachingMethods/Activities**

- Classroom Lectures
- Laboratory/Field Practicals
- Student Seminars/Presentations
- Field Tours/Demonstrations
- Assignments
- **Learning outcome**
The students are expected to equip themselves with know-how on agro-techniques for establishment and management of an orchard leading to optimum and quality fruit production of tropical fruits.
- **Suggested Reading**
Bartholomew DP, Paull RE and Rohrbach KG. 2002. *The Pineapple: Botany, Production, and Uses*. CAB International.
Bose TK, Mitra SK and Sanyal D. 2002. *Fruitsof India – Tropical and Sub-Tropical*. 3rd Edn. Naya Udyog, Kolkata.
Dhillon WS. 2013. *Fruit Production in India*. Narendra Publ. House, New Delhi.
Iyer CPA and Kurian RM. 2006. *High Density Planting in Tropical Fruits: Principles and Practices*. IBDC Publishers, New Delhi.
Litz RE. 2009. *The Mango: Botany, Production and Uses*. CAB International. Madhawa Rao VN. 2013. *Banana*. ICAR, New Delhi.
Midmore D. 2015. *Principles of Tropical Horticulture*. CAB International. Mitra SK and Sanyal D. 2013. *Guava*. ICAR, New Delhi.
Morton JF. 2013. *Fruits of Warm Climates*. Echo Point Book Media, USA.
Nakasome HY and Paull RE. 1998. *Tropical Fruits*. CAB International. Paull RE and Duan Q. 2011. *Tropical Fruits (Vol. 1)*. CAB International.
Rani S, Sharma A and Wali VK. 2018. *Guava (Psidium guajava L.)*. Astral, New Delhi.
Robinson JC and Saúco VG. 2010. *Bananas and Plantains*. CAB International.
Sandhu S and Gill BS. 2013. *Physiological Disorders of Fruit Crops*. NIPA, New Delhi.
Schaffer B, Wolstenholme B and Whaley AW. 2013. *The Avocado: Botany, Production and Uses*. CAB International.
Sharma KK and Singh NP. 2011. *Soil and Orchard Management*. Daya Publishing House, New Delhi.
Valavi SG, Peter KV and Thottappilly G. 2011. *The Jackfruit*. Stadium Press, USA.

- **Course Title** : Nutrition of Fruit Crops
- **Course Code** : HORS02
- **Credit Hours** : (2+1)

- **Need of the course?**

Nutrients play a significant role in almost every growth and development process determining vigour, yield and quality of fruits. Henceforth, a course is designed to have an in depth study of various nutrients, their uptake and use efficiency in realizing sustainable fruit production

- **Objective of the course**

To acquaint with principles and practices involved in nutrition of fruit crops. The course is organized as follows:-

No. Blocks	Units
• Introduction	General Concepts and Principles
• Requirements and Applications	Diagnostics, Estimation and Application
• Newer Approaches	Integrated Nutrient Management (INM)

- **Theory**

Block1: Introduction

Unit1: General Concepts and Principles: Importance and history of nutrition in fruit crops, essential plant nutrients, factors affecting plant nutrition; nutrient uptake and their removal from soil.

Block2: Requirements and Applications

Unit1: Diagnostics, Estimation and Application: Nutrient requirements, root distribution in fruit crops, soil and foliar application of nutrients in major fruit crops, fertilizer use efficiency. Methods and

nd techniques for evaluating the requirement of macro- and micro-elements, Diagnostic and interpretation techniques including DRIS. Role of different macro- and micro-nutrients, their deficiency and toxicity disorders, corrective measures to overcome deficiency and toxicity disorders.

Block3: Newer Approaches

Unit 1: Integrated Nutrient Management (INM): Fertigation in fruit crops, bio-fertilizers and their use in INM systems.

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

- **Teaching Methods/Activities**

- Classroom Lectures
- Laboratory/Field Practicals
- Student Seminars/Presentations
- Field Tours/Demonstrations
- Assignments

- **Learning outcome**

- After successful completion of the course, the students would be expected to
- Know the importance and various types of nutrients and their uptake mechanisms
 - Analyse soil and plant status with respect to various nutrients
 - Make use of corrective measures to overcome deficiency or toxicity

- **Suggested Reading**

Atkinson D, Jackson JE and Sharples RO. 1980. *Mineral Nutrition of Fruit Trees*. Butterworth -Heinemann.

Bould C, Hewitt E and Needham P. 1983. *Diagnosis of Mineral Disorders in Plants Vol. 1 Principles*. Her Majesty's Stationery Office, London.

Cooke GW. 1972. *Fertilizers for maximizing yield*. Grenada Publishing Ltd, London.

Epstein E. 1972. *Mineral Nutrition of Plants: Principles and Perspectives*. Wiley Eastern Ltd, Kanwar JS. 1976. *Soil Fertility - Theory and Practice*. ICAR, New Delhi.

Marchner Horst. 1995. *Mineral Nutrition of Higher Plants*, 2nd Ed. Marschner, Academic Press Inc. San Diego, CA.

Mengel K and Kirkby EA. 1987. *Principles of Plant Nutrition*. 4th Ed. International Potash Institute, Worblaufen-Bern, Switzerland.

Prakash M. 2013. *Nutritional Disorders in Fruit Crops: Diagnosis and Management*. NIPA, New Delhi.

Tandon HLS. 1992. *Management of Nutrient Interactions in Agriculture*. Fertilizer Development and Consultation Organization, New Delhi.

Westerman RL. 1990. *Soil Testing and Plant Analysis*, 3rd Ed. Soil Science Society of America, Inc., Madison, WI.

Yawalkar KS, Agarwal J and Bokde S. 1972. *Manures and Fertilizers*. 3rd Ed. Agri Horticultural Publishing House, Nagpur.

- **Course Title** : Principles and Practices of Organic Farming
- **Course Code** : HOR503
- **Credit Hours** : 2+1
- **Objective of the course**
To study the principles and practices of organic farming for sustainable crop production.
- **Theory**
Unit I

Organic farming - concept and definition, its relevance to India and global agriculture and future prospects; principles of organic agriculture; organic and farming standards; organic farming and sustainable agriculture; selection and conversion of land, soil and water management - land use, conservation tillage, shelter zones, hedges, pasture management, agro-forestry.

Unit II

Organic farming and water use efficiency; soil fertility, nutrient recycling, organic residues, organic manures, composting, soil biota and decomposition of organic residues, earthworms and vermicompost, green manures, bio-fertilizers and biogastechnology.

Unit III

Farming systems, selection of crops and crop rotations, multiple and relay cropping systems, intercropping in relation to maintenance of soil productivity.

Unit IV

Control of weeds, diseases and insect pest management, biological agents and pheromones, bio-pesticides.

Unit V

Socio-economic impacts; marketing and export potential; inspection, certification, labeling and accreditation procedures; organic farming and national economy.

• Practical

- Method of making compost by aerobic method
- Method of making compost by anaerobic method
- Method of making vermicompost
- Identification and nursery raising of important agro-forestry trees and shrubs for shelter belts
- Efficient use of biofertilizers, technique of treating legume seeds with *Rhizobium* cultures, use of *Azotobacter*, *Azospirillum*, and PSB cultures in field
- Visit to biogas plant
- Visit to an organic farm
- Quality standards, inspection, certification and labeling and accreditation procedures for farm products from organic farms

• Teaching methods/activities

Classroom teaching with AV aids, group discussion, assignment, exposure visit

• Learning outcome

Basic knowledge on organic farming for sustainable agriculture and development

• Suggested Reading

- Ananthakrishnan TN. (Ed.) 1992. *Emerging Trends in Biological Control of Phytophagous Insects*. Oxford & IBH.
- Gaur AC. 1982. *A Manual of Rural Composting*, FAO/UNDP Regional Project Document, FAO.
- Joshi M. 2016. *New Vistas of Organic Farming*. Scientific Publishers
- Lampin N. 1990. *Organic Farming*. Press Books, Ipswich, UK.
- Palaniappan SP and Anandurai K. 1999. *Organic Farming - Theory and Practice*. Scientific Publ.
- Rao BV Venkata. 1995. *Small Farmer Focused Integrated Rural Development: Socio-economic Environment and Legal Perspective*: Publ. 3, Parisaraprajna Parishatana, Bangalore.
- Reddy MV. (Ed.) 1995. *Soil Organisms and Litter Decomposition in the Tropics*. Oxford & IBH.
- Sharma A. 2002. *Hand Book of Organic Farming*. Agrobios.
- Singh SP. (Ed.) 1994. *Technology for Production of Natural Enemies*. PDBC, Bangalore.
- Subba Rao NS. 2002. *Soil Microbiology*. Oxford & IBH.
- Trivedi RN. 1993. *A Text Book of Environmental Sciences*. Anmol Publ.
- Veeresh GK, Shivashankar Kand Suiglachar MA. 1997. *Organic Farming and Sustainable Agriculture*. Association for Promotion of Organic Farming, Bangalore.
- WHO. 1990. *Public Health Impact of Pesticides Used in Agriculture*. WHO.
- Woolmer P and Swift MJ. 1994. *The Biological Management of Tropical Soil Fertility*. TSBF & Wiley.

Course Title : Intellectual property and management In agriculture

Course Code : HOR504

CreditHours :1+0

Objective of Course

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 knowledge-based economy.

Theory

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; 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; Protectable subject matters, protection in biotechnology, protection of other biological materials, ownership and period of protection; National

Biodiversity protection initiatives; Convention on Biological Diversity; International Treaty on Plant Genetic Resources for Food and Agriculture; Licensing of technologies, Material transfer agreements, Research collaboration Agreement, License Agreement.

Suggested Readings

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

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 FRA Act 2001, and Rules 2003; The Biological Diversity Act, 2002.

I. Course Title : Experimental Designs

II. Course Code : HOR505

III. Credit Hours : 2+1

IV. Need of the course

This course is meant for students of agricultural and animal sciences other than Agricultural 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.

V. 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. Concept of confounding.

Unit IV

Split plot and strip plot designs, analysis of covariance and missing plot techniques in randomized block and Latin square designs; Transformations, Balanced Incomplete Block Design, resolvable designs and their applications, Lattice design, alpha design - concepts, randomization procedure, analysis and interpretation of

results. Response surfaces. Combined analysis.

VI. Practical

- Uniformity trial data analysis, formation of plots and blocks, Fairfield Smith Law, Analysis of data obtained from CRD, RBD, LSD, Analysis of factorial experiments,
- Analysis with missing data,
- Split plot and strip plot designs.

VII. Suggested Reading

- Cochran WG and Cox GM. 1957. *Experimental Designs*. 2nd Ed. John Wiley.
- Dean AM and Voss D. 1999. *Design and Analysis of Experiments*. Springer.
- Montgomery DC. 2012. *Design and Analysis of Experiments*, 8th Ed. John Wiley.
- Federer WT. 1985. *Experimental Designs*. MacMillan.
- Fisher RA. 1953. *Design and Analysis of Experiments*. Oliver & Boyd.
- Nigam AK and 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.

SECOND SEMESTER

- **Course Title** : Subtropical and Temperate Fruit Production
- **Course Code** : HOR506
- **Credit Hours** : (2+1)

- **Need of the course:**

Agro-climatic diversity in India facilitates growing a wide range of fruits extending from tropical to subtropical to temperate fruits and nuts. To highlight their ecological specificities, seasonal variations and pertinent cultural practices, a course is designed exclusively for subtropical and temperate fruits.

- **Objective of the course**

To impart comprehensive knowledge to the students on cultural and management practices for growing subtropical and temperate fruits.

The course is organised as follows:

No. Blocks

Units

- Introduction
- Agro-Techniques

Importance and Background

Propagation, Planting and Orchard Floor Management

- Crop Management

Flowering, Fruit-Set and Harvesting

- **Theory**

Block1: Introduction

Unit I: Importance and Background: Origin, distribution and importance, major species, rootstocks and commercial varieties of regional, national and international importance, eco-physiological requirements.

Block2: Agro-Techniques

Unit I: Propagation, Planting and Orchard Floor Management: Propagation, planting systems and densities, training and pruning, rejuvenation and replanting, intercropping, nutrient management, water management, fertigation, use of bio-fertilizers, role of bio-regulators, abiotic factors limiting fruit production.

Block3: Crop Management

Unit1: Flowering, Fruit-Set and Harvesting: Physiology of flowering, pollination management, fruit set and development, physiological disorders - causes and remedies, crop regulation, quality improvement by management practices; maturity indices, harvesting, grading, packing, storage and ripening techniques; insect and disease management.

Crops

Citrus, Grapes, Litchi, Pomegranate, Apple, Pear, Peach, Plum, Apricot, Cherries, Berries, Persimmon, Kiwifruit, Nuts-Walnut, Almond, Pecan, etc.

Practicals

- Distinguished features of fruit species, cultivars and rootstocks (2);
- Demonstration of planting systems, training and pruning (3);
- Hands-on practices on pollination and crop regulation (2);
- Leaf sampling and nutrient analysis (3);

- Physiological disorders - malady diagnosis (1);
- Physico-chemical analysis of fruit quality attributes (3);
- Field/Exposure visits to subtropical and temperate orchards (1);
- Project preparation for establishing commercial orchards (1).

Teaching Methods/Activities

- Classroom Lectures
- Laboratory/Field Practicals
- Student Seminars/Presentations
- Field Tours/Demonstrations
- Assignments

Learning outcome

After successful completion of the course, the student are expected to equip themselves with principles and practices of producing subtropical (citrus, grapes, litchi, pomegranate, etc.) and temperate fruits (apple, pear, peach, plum, apricot, cherries, berries, kiwifruit, etc.) and nuts (almond, walnut, pecan, etc.)

Suggested Reading

- Chadha KL and Awasthi RP. 2005. *The Apple*. Malhotra Publishing House, New Delhi.
- Chadha TR. 2011. *A Text Book of Temperate Fruits*. ICAR, New Delhi.
- Childers NF, Morris JR and Sibbett GS. 1995. *Modern Fruit Science: Orchard and Small Fruit Culture*. Horticultural Publications, USA.
- Creasy G and Creasy L. 2018. *Grapes*. CAB International. Davies FS and Albrig o LG. 1994. *Citrus*. CAB International.
- Dhillon WS. 2013. *Fruit Production in India*. Narendra Publishing House, New Delhi.
- Jackson D, Thiele G, Looney N and Morley-Bunker M. 2011. *Temperate and Subtropical Fruit Production*. CAB International.
- Ladanyia M. 2010. *Citrus Fruit: Biology, Technology and Evaluation*. Academic Press.
- Layne DR and Bassi D. 2008. *The Peach: Botany, Production and Uses*. CABI.
- Menzel C and Waite GK. 2005. *Litchi and Longan: Botany, Production and Uses*. CAB International.
- Pandey R and Pandey SN. 1996. *The Grape in India*. ICAR, New Delhi.
- Rajput CBS, and Haribabu RS. 2006. *Citriculture*, Kalyani Publishers, New Delhi.
- Sandhu S and Gill BS. 2013. *Physiological Disorders of Fruit Crops*. NIPA, New Delhi.
- Sharma RM, Pandey SN and Pandey V. 2015. *The Pear - Production, Post-harvest Management and Protection*. IBDC Publisher, New Delhi.
- Sharma RR and Krishna H. 2018. *Textbook of Temperate Fruits*. CBS Publishers and Distributors Pvt. Ltd., New Delhi.
- Singh S, Shivshankar VJ, Srivastava AK and Singh IP. 2004. *Advances in Citriculture*. NIPA, New Delhi.
- Tromp J, Webster AS and Wertheim SJ. 2005. *Fundamentals of Temperate Zone Tree Fruit Production*. Backhuys Publishers, Liden, The Netherlands.
- Webster A and Looney N. *Cherries: Crop Physiology, Production and Uses*. CABI.

- **Course Title** : **Canopy Management of Fruit Crops**
- **Course Code** : **HOR 507**
- **Credit Hours** : **(1+1)**

- **Need of the course:**

Plant architecture plays an important role in enhancing photosynthetic efficiency and resultant quantity and quality of the fruit produce. Manipulation of plant growth and development can be done by employing different training and pruning procedures besides through the use of growth regulators, specific rootstocks, etc. Hence this course is developed to address the aforesaid issues.

- **Objective of the course**

To impart knowledge on principles and practices in management of canopy architecture for quality fruit production.

The course organisation is as follows:

No. Blocks	Units
• Canopy Architecture	Introduction, types and Classification
• Canopy Management	Physical Manipulation and Growth regulation

- **Theory**

Block 1: Canopy Architecture

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

Block 2: Canopy Management

Unit I: Physical Manipulation and Growth Regulation: Canopy management through rootstock and scion. Canopy management through plant growth regulators, training and pruning and management practices. Canopy development and management in relation to growth, flowering, fruiting and fruit quality.

- **Practicals**

- Study of different types of canopies (2);
- Training of plants for different canopy types (2);
- Canopy development through pruning (2);
- Understanding bearing behaviour and canopy management in different fruits (2);
- Use of plant growth regulators (2);
- Geometry of planting (1);
- Development of effective canopy with support system (2);
- Study on effect of different canopy types on production and quality of fruits (2).

- **Teaching Methods/Activities**

- Classroom Lectures
- Laboratory/Field Practicals
- Student Seminars/Presentations

- Field Tours/Demonstrations



- Assignments
- **Learning outcome**
After successful completion of the course, the students are expected to learn
 - The basic principles of canopy management to modify plant architecture
 - The skills on training and pruning of fruit crops, and growth regulation
- **Suggested Reading**
Bakshi J.C, Uppal D.K and Khajuria H.N. 1988. *The Pruning of Fruit Trees and Vines*. Kalyani Publishers, New Delhi.
Chadha K.L and Shikhamany S.D. 1999. *The Grape, Improvement, Production and Post Harvest Management*. Malhotra Publishing House, Delhi.
Iyer C.P.A and Kurian R.M. 2006. *High Density Planting in Tropical Fruits: Principles and Practices*. IBDC Publishers, New Delhi.
Pradeep Kumar T. 2008. *Management of Horticultural Crops*. NIPA, New Delhi.
Singh G. 2010. *Practical Manual on Canopy Management in Fruit Crops*. Dept. of Agriculture and Cooperation, Ministry of Agriculture (GoI), New Delhi.
Srivastava K.K. 2012. *Canopy Management in Fruits*. ICAR, New Delhi

- **Course Title** : Conservation Agriculture
- **Course Code** : HOR508
- **Credit Hours** : 1+1

- **Need of the course**
To impart knowledge of conservation of agriculture for economic development.

- **Theory**

Unit I

Conventional and conservation agriculture systems, sustainability concerns, conservation agriculture: Historical background and present concept, global experiences, present status in India.

Unit II

Nutrient management in CA, water management, weed management, energy use, insect-pest and disease management, farm machinery, crop residue management, cover crop management.

Unit III

Climate change mitigation and CA, C-sequestration, soil health management, soil microbes and CA.

CA in agroforestry systems, rainfed/dryland regions

Unit IV

Economic considerations in CA, adoption and constraints, CA: The future of agriculture

- **Practicals**
 - Study of long-term experiments on CA,
 - Evaluation of soil health parameters,
 - Estimation of C-sequestration,
 - Machinery calibration for sowing different crops, weed seed bank estimation under CA, energy requirements, economic analysis of CA.
- **Teaching methods/activities**
Classroom teaching with AV aids, group discussion, oral presentation by students.
- **Learning outcome**
Experience on the knowledge of various types of conservation of agriculture.
- **Suggested Reading**
 - Arakeri H.R and Roy D. 1984. *Principles of Soil Conservation and Water Management*. Oxford & IBH.

- Bisht JK, Meena VS, Mishra PK and Pattanayak A. 2016. Conservation Agriculture-An approach to combat climate change in Indian Himalaya. Publisher: Springer Nature. Doi:10/1007/978-981-10-2558-7.
 - Dhruvanarayana VV. 1993. *Soil and Water Conservation Research in India*. ICAR.
 - FAO. 2004. *Soil and Water Conservation in Semi-Arid Areas*. Soils Bull., Paper 57.
 - Gracia-Torres L, Benites J, Martinez-Vilela A and Holgado-Cabera A. 2003. Conservation Agriculture-Environment Farmer experiences, innovations Socio-economic policy.
 - Muhammad F and Kamdambot HMS. 2014. Conservation Agriculture. Publisher: Springer Cham Heidelberg, New York Dordrecht London. Doi: 10.1007/978-3-319-11620-4.
- Yellamanda Roddy T and Sankara Reddy GH. 1992. *Principles of Agronomy*. Kalyani

- **Course Title** : Basic concepts in laboratory techniques
- **Course Code** : HOR509
- **Credit Hours** : 0+1

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 vacuumpets;
- 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 agro-chemical doses in field and pot applications;
- Preparation of solutions of acids;
- Neutralisation 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.

Suggested Readings

- Furr AK. 2000. *CRCHandBookofLaboratorySafety*. CRC Press.
- Gabb MH and Latchem WE. 1968. *A Handbook of Laboratory Solutions*. Chemical Publ. Co.

I. Course Title : Information Technology in Agriculture

II. Course Code : HOR510

III. Credit Hours : 1+1

IV. Need of the course

This is a course on Introduction to Networking and Internet Applications that aims at exposing the students to understand analogy of computer, basic knowledge of MS Office. Also to understand Internet and WWW, use of IT application and different IT tools in Agriculture

V. Theory

Unit I

Introduction to Computers, Anatomy of computer, Operating Systems, definition and types, Applications of MS Office for document creation & Editing, Data presentation, interpretation and graph creation, statistical analysis, mathematical expressions,

Unit II

Database, concepts and types, uses of DBMS in Agriculture, World Wide Web
Statistical Sciences: Computer Application

765

(WWW): Concepts and components, Introduction to computer programming languages, concepts and standard input/output operations. e-Agriculture, concepts and applications,

Unit III

Use of ICT in Agriculture, Computer Models for understanding plant processes. IT application for computation of water and nutrient requirement of crops, Computercontrolled devices (automated systems) for Agri-input management, Smartphone Apps in Agriculture for farm advises, market price, postharvest management etc.,

Unit IV

Geospatial technology for generating valuable agri-information. Decision support systems, concepts, components and applications in Agriculture, Agriculture Expert System, Soil Information Systems etc. for supporting Farm decisions, Preparation of contingent crop-planning using IT tools.

VI. Suggested Reading

- Vanitha G. 2011. *Agro-informatics*
- <http://www.agrimoon.com>
- <http://www.agriinfo.in>
- <http://www.cagri.org>
- <http://www.agriglance.com>
- <http://agritech.tnau.ac.in>

THIRD SEMESTER

- **Course Title** : Propagation and Nursery Management in Fruit Crops
- **Course Code** : HOR511
- **Credit Hours** : (2+1)
- **Need of the course:**
Availability of sufficient and healthy planting material is pivotal for expanding fruit culture. This necessitates requisite skill and efficient multiplication protocols for raising plants and their in-house management prior to distribution or field transfer, hence the course is developed.
- **Objective of the course**
To understand the principles and methods of propagation and nursery management in fruit crops.
The course is organised as follows:

No. Blocks

Units

- Introduction

I General Concepts and Phenomena

- Propagation
 - I Conventional Asexual Propagation
 - II Micro propagation
- Nursery
 - I Management Practices and Regulation
- **Theory**
 - Block1: Introduction**
 - Unit1:** General Concepts and Phenomena: Introduction, understanding cellular basis for propagation, sexual and asexual propagation, apomixis, polyembryony, chimeras. Factors influencing seed germination of fruit crops, dormancy, hormonal regulation of seed germination and seedling growth. Seed quality, treatment, packing, storage, certification and testing.
 - Block2: Propagation**
 - Unit I:** Conventional Asexual Propagation: Cutting– methods, rooting of soft and hard wood cuttings under mist and hot beds. Use of PGR in propagation, Physiological, anatomical and biochemical aspects of root induction in cuttings. Layering– principle and methods. Budding and grafting– principles and methods, establishment and management of bud wood bank. Stock, scion and interstock relationship –grafting compatibility, physiology of rootstock and top working.
 - Unit II:** Micropropagation: Micro-propagation – principles and concepts, commercial exploitation in horticultural crops. Techniques –*in-vitro* clonal propagation, direct organogenesis, embryogenesis, micrografting, meristem culture, genetic fidelity testing. Hardening, packaging and transport of micro-propagules.
 - Block3: Nursery**
 - Unit I:** Management Practices and Regulation: Nursery–types, structures, components, planning and layout. Nursery management practices for healthy propagule production. Nursery Act, nursery accreditation, import and export of seeds and planting material and quarantine.
- **Practical**
 - Hands on practices on rooting of dormant and summer cuttings(3);
 - Anatomical studies in rooting of cutting and graft union(1);
 - Hands on practices on various methods of budding and grafting(4);
 - Propagation by layering and stooling(2);
 - Micropropagation-explant preparation, media preparation, culturing– meristem tip culture, axillary bud culture, micro-grafting, hardening(4);
 - Visit to commercial tissue culture laboratories and accredited nurseries(2).
- **Teaching Methods/Activities**
 - Classroom Lectures
 - Laboratory/Field Practicals
 - Student Seminars/Presentations
 - Field Tours/Demonstrations
 - Assignments
- **Learning outcome**

The student would be expected to equip to acquire skills and knowledge on principles and practices of macro and micro propagation and the handling of propagated material in nursery.
- **Suggested Reading**

Bose TK, Mitra SK and Sadhu MK. 1991. *Propagation of Tropical and Subtropical Horticultural Crops*. Naya Prokash, Kolkatta.

Davies FT, Geneve RL and Wilson SB. 2018. *Hartmann and Kester's Plant Propagation-Principles and Practices*. Pearson, USA/Prentice Hall of India, New Delhi.

Gill SS, Bal JS and Sandhu AS. 2016. *Raising Fruit Nursery*. Kalyani Publishers, New Delhi. Jain S and Ishil K. 2003. *Micropropagation of Woody Trees and Fruits*. Springer.

Jain Sand Hoggmann H. 2007. *Protocols for Micropropagation of Woody Trees and Fruits*. Springer.

Joshi P. 2015. *Nursery Management of Fruit Crops in India*. NIPA, New Delhi.

Love et al. 2017. *Tropical Fruit Tree Propagation Guide*. UH-CTAHRF_N_49. College of Tropical Agriculture and Human Resources University of Hawaii at Manoa, USA.

Peter KV, eds. 2008. *Basics of Horticulture*. New India Publishing Agency, New Delhi. Rajan Sand Baby LM. 2007. *Propagation of Horticultural Crops*. NIPA, New Delhi.

Sharma RR. 2014. *Propagation of Horticultural Crops*. Kalyani Publishers, New Delhi. Sharma RR and Srivastava M. 2004. *Propagation and Nursery Management*. Intl. Book Publishing Co., Lucknow.

Singh SP. 1989. *Mist Propagation*. Metropolitan Book Co.

Singh RS. 2014. *Propagation of Horticultural Plants: Arid and Semi-Arid Regions*. NIPA, New Delhi.

Tyagi S. 2019. *Hi-Tech Horticulture. Voll: Crop Improvement, Nursery and Rootstock Management*. NIPA, New Delhi.

• **Course Title** : **Export Oriented Fruit Production**

• **Course Code** : **HOR512**

• **Credit Hours** : **(2+1)**

• **Need of the course:**

India is a top ranking country in production of fruit crops especially with respect mangoes, bananas, and grapes. WTO regime opens new vistas for exploring export opportunities of different fruit commodities. Already, India export mangoes, litchi, grapes, walnuts, apples, etc. and there lies a huge potential in this sector. As such a course has been developed to highlight government policies, standards, infrastructural development and export potential vis-à-vis international scenario.

V. Objective of the course

To acquaint with the national and international standards and export potential of fruit crops

The course is organised as under:-

No. Blocks	Units
• Introduction	Statistics and World Trade
• Regulations	Policies, Norms and Standards
• Quality Assurance	Infrastructure and Plant Material

• **Theory**

Block 1: Introduction

Unit I: Statistics and World Trade: National and international fruit export and import scenario and trends; Statistics and India's position and potentiality in world trade; export promotion zones in India. Government Policies.

Block 2: Regulations

Unit I: Policies, Norms and Standards: Scope, produce specifications, quality and safety standards for export of fruits, viz., mango, banana, grape, litchi, pomegranate, walnut, apple and other important fruits. Processed and value-added products, postharvest management for export including packaging and cool chain; HACCP, Codex alimentarius, ISO certification; WTO and its implications, sanitary and phytosanitary measures.

Block 3: Quality Assurance

Unit I: Infrastructure and Plant Material: Quality fruit production under protected environment; different types of structures-

Automated greenhouses, glasshouse, shadenet, polytunnels–Design and development of low cost greenhouse structures. Seed and planting material; meeting export standards, implications of plant variety protection–patent regimes.

- **Practicals**

- Export promotion zones and export scenario of fresh fruits and their products (1);
- Practical exercises on quality standards of fruits for export purpose (2);
- Quality standards of planting material and seeds (2);
- Hi-tech nursery in fruits (1);
- Practical on ISO specifications and HACCP for export of fruits (3);
- Sanitary and phyto-sanitary measures during export of horticultural produce (2);
- Postharvest management chain of horticultural produce for exports (2);
- Visit to export oriented units/agencies like APEDA, NHB, etc.

- **Teaching Methods/Activities**

- Classroom Lectures
- Laboratory/Field Practicals
- Student Seminars/Presentations
- Field Tours/Demonstrations

Consequent upon successful completion of the course, the students are expected to have learnt about

- National and international trade scenario of fruit crops
- Set norms and standards for export of fruit crops
- Requisite infrastructure and growing practices meeting export standards

X. Suggested Reading

Chadha K.L. 1995. *Advances in Horticulture*. Vol. XII. Malhotra Publ. House, New Delhi.

Chetan G.F. 2015. *Export Prospects of Fruits and Vegetables from India: A study of Export market in EU. A project report*. Anand Agricultural University, Anand, Gujarat.

Dattatreya I.M. 1997. *Export potential of Fruits, Vegetables and Flowers from India*. NABARD, Mumbai.

Islam, C. N. 1990. *Horticultural Export of Developing Countries: Past Preferences, Future Prospects and Policies*. International Institute of Food Policy Research, USA.

e-Resources

- <http://apeda.gov.in> <http://nhb.gov.in> <http://indiastat.com> Assignments



- **Course Title** :Dryland Farming and Watershed Management
- **Course Code.** :HOR513
- **Credit Hours** :2+1
- **Objective of the course**
To teach the basic concepts and practices of dryland farming and soil moisture conservation.
- **Theory Unit I**
Unit I
Definition, concept and characteristics of dryland farming; dryland versus rainfed farming; significance and dimensions of dryland farming in Indian agriculture.
- **Unit II**
Unit II
Soil and climatic parameters with special emphasis on rainfall characteristics; constraints limiting crop production in dryland areas; types of drought, characterization of environment for water availability; crop planning for erratic and aberrant weather conditions.
- **Unit III**
Unit III
Stress physiology and resistance to drought, adaptation of crop plants to drought,

drought management strategies; preparation of appropriate crop plans for dryland areas; mid-contingent plan for aberrant weather conditions.
- **Unit IV**
Unit IV
Tillage, tillage, frequency and depth of cultivation, compaction in soil tillage; concept of conservation tillage; tillage in relation to weed control and moisture conservation; techniques and practices of soil moisture conservation (use of mulches, kinds, effectiveness and economics); anti-transpirants; soil and crop management techniques, seeding and efficient fertilizer use.
- **Unit V**
Unit V
Concept of watershed resource management, problems, approach and components.
- **Practical**
 - Method of Seed Priming
 - Determination of moisture content of germination of important dryland crops
 - Determination of Relative Water Content and Saturation Deficit of Leaf
 - Moisture stress effects and recovery behaviour of important crops
 - Estimation of Potential ET by Thornthwaite method
 - Estimation of Reference ET by Penman Monteith Method
 - Classification of climate by Thornthwaite method (based on moisture index, humidity index and aridity index)
 - Classification of climate by Koppen Method
 - Estimation of water balance by Thornthwaite method
 - Estimation of water balance by FAO method
 - Assessment of drought
 - Estimation of length of growing period
 - Estimation of probability of rain and crop planning for different drought conditions
 - Spray of anti-transpirants and their effect on crops
 - Water use efficiency
 - Visit to dryland research stations and watershed projects
- **Teaching methods/activities**
Classroom teaching with AV aids, group discussion, assignment.

- **Learning outcome**

Basic knowledge on dryland farming and soil moisture conservation.

- **Suggested Reading**

- Reddy TY. 2018. *Dryland Agriculture Principles and Practices*. Kalyani publishers
- Das NR. 2007. *Tillage and Crop Production*. Scientific Publ.
- Dhopte AM. 2002. *Agrotechnology for Dryland Farming*. Scientific Publ.
- Dhruv Narayan VV. 2002. *Soil and Water Conservation Research in India*. ICAR.
- Gupta US. (Ed.). 1995. *Production and Improvement of Crops for Drylands*. Oxford & IBH.
- Katyaj JC and Farrington J. 1995. *Research for Rainfed Farming*. CRIDA.
- Rao SC and Ryan J. 2007. *Challenges and Strategies of Dryland Agriculture*. Scientific Publ.
- Singh P and Maliwal PL. 2005. *Technologies for Food Security and Sustainable Agriculture*. Agrotech Publ. Company.
- Singh RP. 1988. *Improved Agronomic Practices for Dryland Crops*. CRIDA.
- Singh RP. 2005. *Sustainable Development of Dryland Agriculture in India*. Scientific Publ.
- Singh SD. 1998. *Arid Land Irrigation and Ecological Management*. Scientific Publ.
- Venkateshwarlu J. 2004. *Rainfed Agriculture in India. Research and Development Scenario*. ICAR.

Course Title : Technical writing and communications skills
Course Code : HOR514
Credit Hours : 0+1

Objective

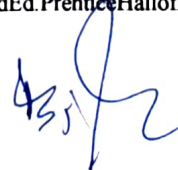
To equip the students/ scholars with skills to write dissertations, research papers, etc. To equip the students/ scholars with skills to communicate and articulate in English (verbal as well as writing).

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 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, Phonetics symbols and transcription;
- Accentual pattern: Weak forms in connected speech;
- Participating in group discussion;
- Facing an interview;
- Presentation of scientific papers.

Suggested Readings

- Barnes and Noble. Robert C. (Ed.). 2005. *Spoken English: Flourish Your Language*.
- *Chicago Manual of Style*. 14th Ed. 1996. Prentice Hall of India.
- *Collins' Cobuild English Dictionary*. 1995.
- Harper Collins. Gordon HM and Walter JA. 1970. *Technical Writing*. 3rd Ed.
- Holt, Rinehart and Winston. Hornby AS. 2000. *Comp. Oxford Advanced Learner's Dictionary of Current English*. 6th Ed. Oxford University Press.
- James HS. 1994. *Handbook for Technical Writing*. NTC Business Books.
- Joseph G. 2000. *MLA Handbook for Writers of Research Papers*. 5th Ed. Affiliated East-West Press.
- Mohan K. 2005. *Speaking English Effectively*. MacMillan India.
- Richard WS. 1969. *Technical Writing*.
- Sethi J and Dhamija PV. 2004. *Course in Phonetics and Spoken English*. 2nd Ed. Prentice Hall of India.



- Wren PC and Martin H. 2006. *High School English Grammar and Composition*. S. Chand & Co.

Course Title : Agricultural research, research ethics and rural development programmes
Course Code : HOR515
Credit Hours : 1+0

Objective

To enlighten the students about the organization and functioning of agricultural research systems at national and international levels, research ethics, and rural development programmes and policies of Government.

Theory

UNIT I History of agriculture in brief; Global agricultural research system: need, scope, opportunities; Role in promoting food security, reducing poverty and protecting the environment; National Agricultural Research Systems (NARS) and Regional Agricultural Research Institutions; Consultative Group on International Agricultural Research (CGIAR); International Agricultural Research Centres (IARC), partnership with NARS, role as a partner in the global agricultural research system, strengthening capacities at national and regional levels; International fellowships for scientific mobility.

UNIT II Research ethics: research integrity, research safety in laboratories, welfare of animals used in research, computer ethics, standards and problems in research ethics.

UNIT III Concept and connotations of rural development, rural development policies and strategies. Rural development programmes: Community Development Programme, Intensive Agricultural District Programme, Special group – Area Specific Programme, Integrated Rural Development Programme (IRDP) Panchayati Raj Institutions, Co-operatives, Voluntary Agencies/Non-Governmental Organisations. Critical evaluation of rural development policies and programmes. Constraints in implementation of rural policies and programmes.

Suggested Readings

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

FOURTH SEMESTER

- **Course Title** : Breeding of Fruit Crops
- **Course Code** : HOR516

- **Credit Hours** : (2+1)

- **Need of the course:**

Development of genetically improved varieties and rootstock is a continuous process which is realized through selection and breeding approaches. This is necessary to enhance the productivity and meet ever-changing climatic conditions and market/consumer preferences. As such, a course is formulated to generate know-how on genetic and breeding aspects of fruit crops.

- **Objective of the course**

To impart comprehensive knowledge on principles and practices of fruit breeding.

No. Blocks	Units
• Introduction	Importance, Taxonomy and Genetic Resources
• Reproductive Biology	Blossom Biology and Breeding Systems
• Breeding approaches	Conventional and Non-Conventional Breeding

- **Theory**

Block1: Introduction

Unit I: Importance, Taxonomy and Genetic Resources: Introduction and importance, origin and distribution, taxonomical status – species and cultivars, cytogenetics, genetic resources.

Block2: Reproductive Biology

Unit I: Blossom Biology and Breeding Systems: Blossom biology, breeding systems – spontaneous mutations, polyploidy, incompatibility, sterility, parthenocarpy, apomixis, breeding objectives, ideotypes.

Block3: Breeding Approaches

Unit I: Conventional and Non-Conventional Breeding: Approaches for crop improvement – direct introduction, selection, hybridization, mutation breeding, polyploid breeding, rootstock breeding, improvement of quality traits, resistance breeding for biotic and abiotic stresses, biotechnological interventions, achievements and future thrusts.

Crops

Mango, Banana, Pineapple, Citrus, Grapes, Litchi, Guava, Pomegranate, Papaya, Apple, Pear, Plum, Peach, Apricot, Cherries, Strawberry, Kiwifruit, Nuts

- **Practicals**

- Exercises on bearing habit, floral biology (2);
- Pollen viability and fertility studies (1);
- Hands-on practices in hybridization (3);
- Raising and handling of hybrid progenies (2);
- Induction of mutations and polyploidy (2);
- Evaluation of biometrical traits and quality traits (2);
- Screening for resistance against biotic stresses (2);
- Developing breeding programmes for specific traits (2);
- Visits to research stations working on fruit breeding (1).

- **Teaching Methods/Activities**

- Classroom Lectures
- Laboratory/Field Practicals
- Student Seminars/Presentations
- Field Tours/Demonstrations
- Assignments

- **Learning outcome**

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

- Have an understanding on importance and peculiarities of fruit breeding
- Have an updated knowledge on reproductive biology, genetics and inherent breeding systems.
- Have detailed knowledge of various methods/approaches of breeding fruit crops

• **Suggested Reading**

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

- I. **Course Title** : Library and information services
 II. **Course Code** : HOR 517
 III. **Credit Hours** : (0+1)

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; e-resources access methods.

Seminar 0+1

Thesis Research 30

1 st Semester						Evaluation Marks
Code No.	Course Title	Credit Hours	Mid Term	End Term	Practical	Total
HOR501	Systemics Of Ornamental Plants	2+1	25	50	25	100
HOR502	Ornamental Gardening and Landscaping	2+1	25	50	25	100
HOR503	Principles and practices of organic farming	2+1	25	50	25	100
HOR504	Intellectual property and its management in agriculture	1+0	25	50	25	100
HOR505	Experimental designs	2+1	25	50	25	100
Total Credits		13	-			

2 nd Semester						Evaluation Marks
Code No.	Course Title	Credit Hours	Mid Term	End Term	Practical	Total
						

HOR506	Breeding Of Ornamental Plants	2+1	25	50	25	100
HOR507	Protected Cultivation Of Flower Crops	2+1	25	50	25	100
HOR508	Conservation agriculture	1+1	25	50	25	100
HOR509	Information technology in agriculture	1+1	25	50	25	100
HOR510	Basic concepts in laboratory techniques	0+1	25	50	25	100
Total Credits		11				-

3 rd Semester						Evaluation Marks
Code No.	Course Title	Credit Hours	Mid Term	End Term	Practical	Total
HOR511	Commercial Production Of Cut Flowers	2+1	25	50	25	100
HOR512	Seed Production In Flower Crops	1+1	25	50	25	100
HOR513	Dry land farming and water shed management	2+1	25	50	25	100
HOR514	Technical writing and communication skills	0+1	25	50	25	100
HOR515	Agricultural research, Research ethics and rural development programs	1+0	25	50	25	100
Total Credits		11				-

4 th Semester						Evaluation Marks
Code No.	Course Title	Credit Hours	Mid Term	End Term	Practical	Total
HOR516	Commercial Production Of Loose Flowers	2+1	25	50	25	100
HOR517	Library and information services	1+0	25	50	25	100
HOR518	Seminar	1				
HOR519	Thesis research	30				
Total Credits		35				-
Total Semester Credit Hours		70				

(Floriculture and Landscaping)

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

Contrary to belief, floriculture encompasses a large number of subsectors that include loose flowers, cut flowers, cut foliage, specialty flowers, cut greens and fillers, pot plants, bedding plants, landscaping and interior landscaping, vertical gardening, dry flowers, lawns, arboriculture, essential oils, nutraceutical pigments, dyes, value addition, etc., Keeping in pace with the latest developments in these sectors, there is a need to update the knowledge among the

students. An effort is therefore made to encompass the advances made in thesectorbyrevisingthepost-graduatecurriculum.

New courses like Systematics of ornamental plants; Indoor plants and Interioscaping,Nursery Management of ornamental plants; Turf grass management; Seed production inflower crops; Crop regulation in ornamental crops; Speciality flowers, fillers and cut greens;Vertical gardening; Modern approaches in breeding of floricultural crops; Current trendsinproductionoffloriculturalcrops;Recentdevelopmentsinprotectedcultivationoffloricultur al cropsareintroducedinthewnewsyllabuswhileretainingsomeoftheoldcourses.

Keeping in view of the National Initiatives and priorities like Skill India and emphasis on StartUps to encourage students to become job creators rather than job seekers, newcoursesareaddedindifferentavenuesoffloriculturelikeIndoorplantsandInterioscaping,Nurse ry management, Turfgrass management, Vertical gardening. These courses will helpand encourage students to develop their skills and would pave way for different StartUpsintheseareas.

Newcourseslikeseedproductioninflowercrops,Cropregulationinornamentalcrops,Specialtyf lowers,fillersandcutgreensareintroducedinlinewithrequirementoimproveprofitability of farmers/ growers. Seed production in flowers which is a high value, lowvolume segment was focused upon which will boost our exports and help in improvingprofitability and improving farmers income. Crop regulation is an important aspect andneedofthehourtoavoidmarketglut,improveprofitabilityandincomeofgrowers.

Rapidchangesanddevelopmenthaveoccurredinglobalarenaparticularlyinthefieldofbiochemi stry,molecularbiologyandbiotechnology.Manyadvances tookplaceinthearea of application of biotechnology approaches in flower crops. A segment on genome editing systems/toolslikeCRISPR-CASisintroducedintothesyllabuskeepinginviewoftherecentdevelopments.Severalnewdevelopme ntsintheareaofprotectedcultivationlikeautomation,sensors,lighting,AI,robotics,retractablegree nhouses,IPR,flowerlabels,etc.aregivendueemphasisinthewnewsyllabus.

Flowers are highly perishable and fluctuation of prices is very high and marketing is a very crucial step where growers and entrepreneurs face problems. Topics on marketing,AgriexportZones,valuechainandcoldchainmanagementandcropinsuranceweregiveni mportance.GovernmentofIndiahasintroducedanumberofschemesandmechanismstosupport the farming community. To make the students aware about the recent steps takenby Government, topic on Institutional support is introduced. Farming community is rapidlydiversifyingintoareaslikeFPO'sandcontractfarmingandtheseareasareintroduced.

Course Title with Credit Load

M.Sc.(Hort.)in Floriculture and Landscaping

Course Code	Course Title	Credit Hours
HOR501*	Systematics of Ornamental Plants	2+1
HOR502*	Ornamental Gardening and Landscaping	2+1
HOR503	Principles and practices of organic farming	2+1
HOR504	Intellectual property and its management in agriculture	1+0
HOR505	Experimental designs	2+1