ESTABLISHED BY AN ACT OF PARLIAMENT IN 2009

तमिलनाडु केन्द्रीय विश्वविद्यालय | CUTN | தமிழ்நாடு மத்தியப் பல்கலைக்கழகம்

CENTRAL UNIVERSITY OF TAMIL NADU

Ph.D HORTICULTURE (2020-21)

CURRICULUM BOOk

Department of Horticulture

School of Life Sciences

Central University of Tamil Nadu

November 2020

Ph.D Horticulture

CURRICULUM DEVELOPMENT COMMITTEE

Prof. S. MANIVANNAN
Head,DepartmentofHorticulture
CentralUniversityofTamilNadu
Thiruvarur

Dr. A. RAMESH KUMAR
Associate Professor,Departmentof Horticulture
CentralUniversityofTamilNadu
Thiruvarur

Dr. K. RAMA KRISHNA
Assistant Professor,Departmentof Horticulture
CentralUniversityofTamilNadu
Thiruvarur

Dr. S. SENTHILKUMAR
Assistant Professor,Departmentof Horticulture
CentralUniversityofTamilNadu
Thiruvarur

Dr. S. SRIVIGNESH
Assistant Professor,Departmentof Horticulture
CentralUniversityofTamilNadu
Thiruvarur

Dr. MOUMITA MALAKAR
Assistant Professor,Departmentof Horticulture
CentralUniversityofTamilNadu
Thiruvarur

तमिलनाडुकेन्द्रीयविश्वविद्यालय
(संसदद्वारापारितअधिनियम 2009केअंतर्गतस्थापित)
CENTRAL UNIVERSITY OF TAMIL NADU
(Established by an Act of Parliament, 2009)
नीलक्कुडीपरिसर/Neelakudi Campus, कंगलान्चेरी/Kangalancherry,
तिरुवारूर/Thiruvarur- 610 005, Tamilnadu
www.cutn.ac.in

School of Life Sciences

Department of Horticulture

Ph.D syllabus 2020-21

A. Vision

Vision Statement of the Department

Develop world class horticulture hub which can cater to the needs of all stake holders for the ultimate wellbeing of the society, through academic excellence, Innovative research and need based extension.

B. Mission

Mission Statements of the Department

M1	Converging conventional knowledge and frontier research towards enhancing sustainability, food and nutritional security in accordance with regional, national and global priorities.
M2	Conservation, evaluation and development of plant genetic resources for climate resilience and environmental security.
M3	Devising sustainable solutions for major pre and post-production problems and constraints in horticultural crops through innovative approaches.
M4	Appraisal and enhancement of market value through forward and back-end linkages for economic security.
M5	Reaching out to the community through humanity-driven technology.

C. Program Specific Outcomes (PSO)

After five years of successful completion of the program, the students will be able to

PSO1	Handle problems and issues arising in the field of horticulture through research, knowledge and skills acquired.
PSO2	Able to design and conduct independent research in the horticulture and allied sectors and contribute back to the society through academician.
PSO3	Lead research and development team in strategic and frontier areas of horticulture.
PSO4	Interlink the concepts of horticulture with the multi-disciplinary science arena for innovative outcomes.
PSO5	Advise and advocate policies related to livelihood security through horticultural research.

D. PEO to Mission Statement Mapping

	PSO1	PSO2	PSO3	PSO4	PSO5
M1	3	1	2	3	2
M2	3	3	3	3	3
M3	3	3	3	3	1
M4	3	3	1	2	3
M5	2	3	2	2	3

E. Graduate Attributes of PhD (Horticulture) Program

1. **Disciplinary Knowledge:** Understand the diverse aspects of biotechnology and apply tools and techniques for the industrial advancement, progress and innovation.
2. **Communication Skills:** Develop verbal and written communication skills to convey the mechanistic concepts with clarity.
3. **Critical Thinking:** Capacity to generate hypothesis, design and conduct of experiments, mining, analysis and interpretation of data, and reporting the findings.
4. **Problem-Solving:** Design and execute processes to find solutions for biological problems to meet the needs of the global society.
5. **Cooperation:** Ability to work independently, yet cooperate and function effectively as a member (team player) or leader of a team.
6. **ICT Skills (Modern Tools usage):** Apply biological concepts and appropriate tools (technique) to solve complex biological problems.
7. **Ethics:** Demonstrate and endorse the universal standards of ethics and responsibilities.
8. **Self-Directed Learning:** Establish autonomy and self-regulation in teaching, learning and professional development.
9. **Reasoning:** Develop the ability to critically and systematically analyze scientific data to be able to draw unbiased conclusions for fulfilling the objectives.
10. **Creativity:** Develop the ability to harness out-of-the-box (divergent and convergent) thinking, and by innovative means overcome technical challenges in biotechnology.
11. **Societal and Environmental Concern:** Appreciate and contribute to improvement of the quality of environment and sustainability of life.
12. **Harnessing Longevity of Learning:** Understand the importance of continuous learning and practices it through life.

F. Program Outcomes(PO)

On the successful completion of the program, the student will be able to

PO1	Serve as an academician to disseminate knowledge to the needy audience in the field of horticulture.
PO2	Fit into any research and development endeavor in the field of horticulture and allied sectors.
PO3	Guide student and farming community in the standalone and participatory research to bring meaningful outcomes.
PO4	Able to pursue post- doctoral research in any international arena.
PO5	Emerge as a genuine research manager adhering tolegal and moral ethics.

G. PO to PEO Mapping

	PO1	PO2	PO3	PO4	PO5
PSO1	3	3	3	3	3
PSO2	2	3	3	3	3
PSO3	2	3	3	3	3
PSO4	3	3	3	3	2
PSO5	3	3	2	1	3

Ph.D Horticulture (Fruit Science) ProgrammeCourse Structure (24 + 7 = 31 Credits)

Sem	Major Course(MC)	Supporting course (SC)	Research & Seminar (RS)	Non credit Compulsory (NC)	Minor course (Mi)	Credit
I	HOR711 (3+1) HOR712(3+ 0)	HOR714 (4+0)	HOR715(0+1)	Nil	HOR71 3(3+1)	16
II	HFS721 (3+1) HFS722 (3+1)	HOR724 (1+1)	HOR725 (0+1)	HFS811 (0)	HOR72 3 (4+0)	15
Total credit	15	6	2	0	8	31

Minimum credit requirement - 31

Ph.D Horticulture (Vegetable Science) ProgrammeCourse Structure (24 + 7= 31 Credits)

Sem	Major Course(MC)	Supporting course (SC)	Research & Seminar (RS)	Non credit Compulsory (NC)	Minor course (Mi)	Credit
I	HOR711 (3+1) HOR712(3+ 0)	HOR714 (4+0)	HOR715(0+1)	Nil	HOR713(3+1)	16
II	HVS721 (3+1) HVS722 (3+1)	HOR724 (1+1)	HOR725 (0+1)	HVS811(0)	HOR723 (4+0)	15
Total credit	15	6	2	0	8	31

Minimum credit requirement - 31

Ph.D Horticulture (Floriculture and Landscaping) ProgrammeCourse Structure (24+ 7= 31 Credits)

Sem	Major Course(MC)	Supporting course (SC)	Research & Seminar (RS)	Non credit Compulsory (NC)	Minor course (Mi)	Credit
I	HOR711 (3+1) HOR712(3+0)	HOR714 (4+0)	HOR715(0+ 1)	Nil	HOR71 3(3+1)	16
II	HFL721 (3+1) HFL722 (3+1)	HOR724 (1+1)	HOR725 (0+1)	HFL811 (0)	HOR72 3 (4+0)	15
Total credit	15	6	2	0	8	31

Available credit -PhD 31

तमिलनाडुकेन्द्रीयविश्वविद्यालय
(संसदद्वारापारितअधिनियम 2009केअंतर्गतस्थापित)
CENTRAL UNIVERSITY OF TAMIL NADU
(Established by an Act of Parliament, 2009)
नीलक्कुडीपरिसर/Neelakudi Campus, कंगलान्चेरी/Kangalancherry,
तिरुवारूर/Thiruvarur- 610 005, Tamilnadu
www.cutn.ac.in

School of Life Science

Department of Horticulture
Regulation – 2022

Choice Based Credit System Curriculum and syllabi
Ph.D Horticulture Programme
Course Structure (31 Credits)

SEMESTER I

S.No.	Code	Course Title	Category	Periods / Week			Total Contact Periods	Credits
				L	T	P		
Theory								
1	**HOR711**	Advances in Growth Regulation of Horticultural Crops	MC	3	0	1	4	4
2	**HOR712**	National Problems in Horticultural Crops	MC	3	0	0	3	3
3	**HOR713**	Genomics and Bioinformatics in Horticulture	Mi	3	0	1	4	4
4	**HOR714**	Research Methodology	SC	4	0	0	4	4
5	**HOR715**	Doctoral Seminar 1	RS	0	0	1	1	1
			Total	**13**	**0**	**3**	**16**	**16**

Types of Courses	Short Form
Major Course	MC
Supporting course	SC
Research & Seminar	RS
Minor Core Course	Mi
Non Credit compulsory	NC

Fruit Science

SEMESTER II

S.No.	Code	Course Title	Category	Periods / Week			Total Contact Periods	Credits
				L	T	P		
Theory								
1	**HFS721**	Advances in Production Technology of Fruit Crops	MC	3	0	1	4	4
2	**HFS722**	Advances in Breeding of Fruit Crops	MC	3	0	1	4	4
3	**HOR723**	Advances in Plant Molecular Biology	Mi	4	0	0	4	4
4	**HOR724**	Research and Publication Ethics	SC	1	0	1	2	2
5	**HOR725**	Doctoral Seminar 2	RS	0	0	1	1	1
6	**HFS811**	Non credit course	NC	0	0	0	0	0
			Total	**11**	**0**	**4**	**15**	**15**

VEGETABLE SCIENCE

SEMESTER II

S.No.	Code	Course Title	Category	Periods / Week			Total Contact Periods	Credits
				L	T	P		
Theory								
1	**HVS721**	Advances in Production Technology of Vegetable Crops	MC	3	0	1	4	4
2	**HVS722**	Advances in Breeding of Vegetable Crops	MC	3	0	1	4	4
3	**HOR723**	Advances in Plant Molecular Biology	Mi	4	0	0	4	4
4	**HOR724**	Research and Publication Ethics	SC	1	0	1	2	2
5	**HOR725**	Doctoral Seminar 2	RS	0	0	1	1	1
6	**HFS811**	Non credit course	NC	0	0	0	0	0
			Total	**11**	**0**	**4**	**15**	**15**

FLORICULTURE AND LANDSCAPING

SEMESTER II

S.No.	Code	Course Title	Category	Periods / Week			Total Contact Periods	Credits
				L	T	P		
Theory								
1	**HFL721**	Advances in Production Technology of Flower Crops	MC	3	0	1	4	4
2	**HFL722**	Advances in Breeding of Flower Crops	MC	3	0	1	4	4
3	**HOR723**	Advances in Plant Molecular Biology	Mi	4	0	0	4	4
4	**HOR724**	Research and Publication Ethics	SC	1	0	1	2	2
5	**HOR725**	Doctoral Seminar 2	RS	0	0	1	1	1
6	**HFS811**	Non credit course	NC	0	0	0	0	0
			Total	**11**	**0**	**4**	**15**	**15**

Total Credit for Ph.D Horticulture Degree – 31 (*Requirement – 12*)

SEMESTER – I					
Course Code	**Course Name**	**L**	**T**	**P**	**Credits**
HOR711	**Advances In Growth Regulation of Horticultural Crops**	3	-	1	4

a. Course Outcome (CO)

On the successful completion of the course, the student will be able to

	Course Outcome	**Level**
CO1	The scholars are able to understand the principles in growth regulation, bio-synthesis and biological functions of growth regulators	Understand
CO2	The scholars able to apply the theoretical knowledge in practice in respect of bio-assay of hormones, quantification of photosynthetic efficiency etc.	Apply
CO3	The students are capable of handling of advanced instruments and able deal with trouble shoot of instruments pertaining to growth regulation of crops.	Analyze
CO4	The scholars learn the advanced concepts and apply them in filed level for crop regulation and architecture management.	Apply

b. Syllabus

Units	**Content**
LI	Ecophysiological influences on growth and development of horticultural crops, flowering, fruit set - Crop load and assimilate partitioning (source-sink) and distribution, Root and canopy regulation, study of plant growth regulators in fruits / vegetables / flowers / Spices- structure, biosynthesis, metabolic and morphogenetic effects of different plant growth promoters and growth retardants.
LII	Absorption, translocation and degradation of phytohormones, pathways and molecular insights - internal and external factors influencing hormonal synthesis, biochemical action, growth promotion and inhibition, Canopy management in horticultural crops, Growth regulation aspects of propagation, embryogenesis, seed and bud dormancy, fruit bud initiation, regulation of flowering, off season production.
LIII	Non model crop findings- Florigen, Self pruning (SP), self-flower truss (SFT) in plant regulation and architect maintenance, Flower drop and thinning, fruit set and development, fruit drop, parthenocarpy, fruit maturity, ripening and storage, Recent trends in molecular approaches in crop growth regulation.
PIV	Root- shoot studies, quantifying the physiological and biochemical effects of physical and chemical growth regulation, bioassay and isolation through chromatographic analysis for auxins, gibberellins, experiments on growth regulation during propagation, dormancy, flowering, fruit set and fruit development stages; Quantification of photosynthetic efficiency in horticultural crops; ROS quantification assay during fruit set and fruit drop; Ethylene and respiration quantification during ripening and storage.
	References: 1. Buchanan B, Gruiessam W & Jones R. 2002. Biochemistry & Molecular Biology of Plants. John Wiley & Sons 2. Epstein E. 1972. Mineral Nutrition of Plants: Principles and

	Perspectives.Wiley. 3. Fosket DE. 1994. Plant Growth and Development: A Molecular Approach.Academic Press. 4. Leoplod AC & Kriedermann PE. 1985. Plant Growth and Development. 3rdEd. McGraw-Hill. 5. Radha T & Mathew L. 2007. Fruit Crops. New India Publ. Agency. 6. Roberts J, Downs S & Parker P. 2002. Plant Growth Development. In: Plants (I. Ridge, Ed.), pp. 221-274, Oxford University Press. 7. Salisbury FB & Ross CW. 1992. Plant Physiology. 4th Ed. Wadsworth PublA

c. Mapping of Program Outcomes with Course Outcomes

	PO1	PO2	PO3	PO4	PO5
CO1	**3**	**3**	**3**	**3**	**3**
CO2	**3**	**3**	**3**	**3**	**2**
CO3	**3**	**3**	**3**	**3**	**2**
CO4	**3**	**3**	**3**	**3**	**3**

(If the correlation between mission statement and program specific outcome is high 3 is assigned, for moderate 2, for low 1, and for 0 are assigned)

d. Evaluation Scheme

	CO1	CO2	CO3	CO4	Total
Internal	10	10	10	10	40
External	15	15	15	15	60
Total	**25**	**25**	**25**	**25**	**100**

SEMESTER – I					
Course Code	**Course Name**	**L**	**T**	**P**	**Credits**
HOR712	National Problems in Horticultural Crops	3	-	0	3

a. Course Outcome (CO)

On the successful completion of the course, the student will be able to

	Course Outcome	**Level**
CO1	Acquire knowledge of some of the important problems confronting to fruits and their solutions.	Understand
CO2	Acquire knowledge of some of the important problems confronting to vegetables and their solutions.	Understand
CO3	Acquire knowledge of some of the important problems confronting to fruits and their solutions	Understand

b. Syllabus

Units	**Content**
LI	Fruits: Senile and seedling orchards- Replant problems and top working, in-situ rain water harvesting and enhancing water use efficiency, Nutrient and irrigation scheduling, Fruit crop based cropping systems, pesticide residues and MRLs issues in fresh produce. GAPs in fruit production, HiTech banana & citrus production, Quality grape production in subtropical regions, crop regulation in pomegranate and guava, Quality plant material. Complex problems confronting fruit cultivation and their management: Alternate bearing in mango & apple, mango malformation, panama wilt of banana, citrus decline, guava wilt, coconut wilt, apple scab, chilling and pollination problems in temperate fruits, frost and virus problems in papaya and bacterial oil spot in pomegranate.
LII	Vegetables: Damping off in vegetable nursery and its management, seed dormancy and its management, pollination issues in protected cultivation, fruit cracking and its management in fruit vegetables, drought mitigation under rain feed vegetable farming system, sprouting in potato and onion. Fruit borers in vegetable crops and elite strategies, Diamond black moth in cole crops, thrips in onion, thrips-mite complex in chilli, potato tuber moth, sweet potato weevil, root knot nematode and its management in vegetable crops Dieback and anthracnose in chilli, postharvest diseases management in bulbs-root-tuber vegetables, potato virus, YVMD in okra, onion purple blotch and bulb rot, CMV in cucurbits,
LIII	Spices and Plantation crops: Pepper quick and slow wilt, spike shedding in pepper, kattae disease of cardamom, rhizome wilt and borer in turmeric, ginger, cardamom, rubberization in garlic, top working in nutmeg, coffee rust, tea mosquito bug in tea and cashew, mite complex in tea, root and stem borer in cashew, rhinoceros betel and red palm weevil in coconut, thanjavur wilt and stem bleeding in coconut, yellowing disorder in arecanut, yellowing disorder in jasmine, wilt/nematode complex in medicinal coleus, Climate change and horticulture production.
	Reference: 1. Blumm, A. 1988.Plant Breeding for Stress Environments.CRC Press,

USA.
2. Bose, T.K., Mitra S.K., Farooqi A.A. and Sadhu, M.K. 1999.Tropical Horticulture. Vol. I. NayaProkash, Kolkata.
3. Bose, T.K., Mitra, S.K. and Sanyal, D. (Ed.). 2002. Fruits of India – Tropical and Sub-tropical. 3rd Ed. Vols.I, II.NayaUdyog, Kolkata.
4. Chadha, K.L. and Pareek, O.P. (Eds.). 1996. Advances in Horticulture. Vol. II to IV.Malhotra Publ. House, New Delhi.
5. Chadha, K.L. and Rethinam, P. (Eds.). 1993. Advances in Horticulture. Vol. IX. Plantation Crops and Spices.Part-I.Malhotra Publ. House, New Delhi.
6. Christiansen, M.N. and Lewis, C.F. 1982. Breeding Plants for Less Favourable Environments.Wiley Inter. Science, USA.
7. Hsiao, T.C. 1973. Plant Responses to Water Stress. Ann. Rev. Plant Physiology 24: 519-570.

c. Mapping of Program Outcomes with Course Outcomes

	PO1	PO2	PO3	PO4	PO5
CO1	**3**	**2**	**3**	**2**	**2**
CO2	**3**	**2**	**3**	**2**	**2**
CO3	**3**	**2**	**3**	**2**	**2**

(If the correlation between mission statement and program specific outcome is high 3 is assigned, for moderate 2, for low 1, and for 0 are assigned)

d. Evaluation Scheme

	CO1	CO2	CO3	Total
Internal	15	15	10	40
External	20	20	20	60
Total	**35**	**35**	**30**	**100**

SEMESTER –I					
Course Code	**Course Name**	**L**	**T**	**P**	**Credits**
HOR713	Genomics and Bioinformatics in Horticulture	3	-	1	4

a. Course Outcome (CO)

On the successful completion of the course, the student will be able to

	Course Outcome	Level
CO1	To get introduced to the basic concepts of genomics and Bioinformatics and its significance in biological data analysis. To gain knowledge about various biological databases and search tools that provide information about nucleic acids and protein and learn about the recent advances in genomics, transcriptomics and proteomics	Understand
CO2	Introduction to the basics of sequence alignment and analysis. Overview about pathway and enzyme databases, Sequence submission tools. Explain about primary and secondary structures of proteins and structure prediction methods. Describe about the various techniques, algorithms and tools used for Phylogenetic Analysis. Students will be able to explain principle, algorithm and different methods of sequence alignments as well as execute alignments to address research problems	Analyze
CO3	Explain about the methods to characterise and manage the different types of biological data, NMR crystallography, X ray crystallography and RNA secondary structure motifs. Students will become familiar with a wide variety of bioinformatics tools and softwares and apply these to conduct basic bioinformatics research and thus develop platform for molecular biology experiments	Apply
CO4	Hands on training on database search, Data retrieval, microarray and RNA-Seq data analysis, protein predication software's and molecular modelling and drug discovery software's. Students will be able to describe and use the biological databases, perform structured query and analyze and discuss the results in biologically significant way.	Skill

b. Syllabus

Units	Content
LI	Bioinformatics and computational genomics, database fundamentals - biological databases, horticultural genome and protein databases, RNA-sequencing, Microarrays, functional genomics (over expression platforms and RNAi, Antisense silencing, CRISPR-Cas 9).
LII	Dynamic Programming Sequence Alignment, BLAST search engine, FASTA search engine, Microarray Clustering and Classification, Terminologies and Ontologies - EcoCYC knowledge base of E. Coli metabolism - Description of UMLS Semantic Network. Multiple Sequence Alignment, MSA algorithm descriptions, ClustalW, 1D Motifs, Algorithms and Databases, methods for sequence weighting, BLOCKS database, Making BLOCK motifs, PROSITE database, 3D structure alignment, SCOP, DALI, LOCK, MUSTA algorithm for geometric hashing and multiple alignment. Hidden Markov models, Molecular energetics and dynamics , Protein structure prediction, Genetic

	networks - Modeling and Simulation of Genetic Regulatory Systems- KEGG database of genes and gene pathways/networks, Gene finding algorithms - Genome Annotation Assessment Project for Arabidopsis, Comparative genomics algorithms, Genome Alignment.
LIII	3D structure computations, NMR, Xtallography, NMR Structure Determination, X-ray Crystallography Structure Determination, Distance Geometry Description, RNA secondary structure, Molecular Modeling and Drug discovery programs. Phylogenetic algorithms – Tree base database of phylogenetic information for plants mostly, Tree of Life Page, Samples from the Tree of Life, Ribosomal Database Project, Natural Language Processing, Proteomics, 3D Motifs, Applications and Integration with Horticulture, Final Thoughts.
PIV	Computers, Operating systems and Programming languages, Internet Resources, Horticultural Genome and Protein Databases, BLAST/RNA Structure, Sequence Alignment, Microarray Data Analysis, Ontology, MSA, HMMs, Identification of Functional Sites in Structures, Protein Structure Prediction - Phylogenetics - Gene Finding - Molecular Modeling and Drug Discovery Software – Assignments.
	Reference: 1. Attwood TK & Parry Smith DJ. 2006. *Introduction to Bioinformatics*. Pearson Edu. 2. Baxevanis AD. 2005. *Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins*. 3rd Ed. Wiley. 3. Bourne PE & Weissig H. (Eds.). 2004. *Structural Bioinformatics*. John Wiley & Sons. 4. Durbin R, Eddy SR, Krogh A & Mitchison G. 1999. *Biological Sequence Analysis: Probabilistic Model of Proteins and Nucleic Acids*. Cambridge Univ. Press. 5. Keshavachandran R, Nazeem PA, Girija D, John PS & Peter KV. 2007. *Recent Trends in Biotechnology of Horticultural Crops*. Vols. I, II. New India Publ. Agency. 6. Kohane IS, Kho A & Butte AJ. 2002. *Microarrays for an Integrative Genomics*. M1T Press. 7. Mount DW. 2001. *Bioinformatics: Sequence and Genome Analysis*. Cold Spring Harbour Laboratory Press.

c. Mapping of Program Outcomes with Course Outcomes

	PO1	PO2	PO3	PO4	PO5
CO1	**3**	**3**	**3**	**2**	**2**
CO2	**3**	**3**	**3**	**3**	**3**
CO3	**2**	**3**	**3**	**3**	**3**
CO4	**3**	**3**	**3**	**3**	**2**

d. Evaluation Scheme

	CO1	CO2	CO3	CO4	Total
Internal	10	10	10	10	40
External	20	20	10	10	60
Total	**30**	**30**	**20**	**20**	**100**

SEMESTER –I					
Course Code	**Course Name**	**L**	**T**	**P**	**Credits**
HOR714	**Research Methodology(s)**	4	-	0	4

a. Course Outcome (CO)

On the successful completion of the course, the student will be able to

	Course Outcome	**Level**
CO1	Acquire knowledge of the literature and a ample understanding of methodologies that are directly or indirectly relevant to their own research	Remember
CO2	Create, develop and exchange research knowledge in collaborative manner for the benefit society	Understand
CO3	Ascertain, deduce and link with new idea so as to make a quality publication that is acceptable by a peer review	Apply
CO4	Manage complex ethical concerns and make a vivid verdicts	Analyze

b. Syllabus

Units	**Content**
LI	Introduction to Research Methodology: Meaning and importance of Research - Types of Research - Selection and formulation of Research Problem; Research Design - Need - Features - Inductive, Deductive and Development of models; Developing a Research Plan - Exploration, Description, Diagnosis, Experimentation, Determining Experimental and Sample Designs; Hypothesis - Different Types - Significance - Development of Working Hypothesis, Null hypothesis; Research Methods: Scientific method vs. Arbitrary Method; Logical Scientific Methods: Deductive, Inductive, Deductive-Inductive, pattern of Deductive - Inductive logical process - Different types of inductive logical methods; Critical Literature Review: Primary and Secondary Sources, Web sources
LII	Statistics and Computer applications: Introduction to Statistics – Probability Theories - Conditional Probability, Poisson distribution, Binomial Distribution and Properties of Normal Distributions, Estimates of Means and Proportions; Chi Square Test, Association of Attributes t Test - ANOVA, Standard deviation Coefficient of variations. Correlation and Regression Analysis, Use of excel sheet for research analysis, Data Analysis using statistical packages, SPSS
LIII	Data Collection and Analysis: Sources of Data - Primary, Secondary and Tertiary; Types of Data - Categorical, nominal & Ordinal; Methods of Collecting Data - Observation, field investigations; Direct studies - Reports, Records or Experimental observations; Sampling methods - Data Processing and Analysis strategies - Graphical representation - Descriptive Analysis - Inferential Analysis - Correlation analysis - Least square method - Hypothesis - testing - Generalization and Interpretation – Modeling
LIV	Scientific Writing: Structure and components of Scientific Reports; Types of Report - Technical Reports and Thesis - Significance - Different steps in the preparation - Layout, structure and Language of typical reports - Illustrations and tables - Bibliography, Referencing and foot notes –Importance of Effective Communication; Preparing Research papers for journals, Seminars and Conferences - Design of paper using TEMPLATE; Preparation of Project Proposal - Title, Abstract, Introduction - Rationale, Objectives, Methodology - Time frame and work plan - Budget and Justification - References; Documentation and scientific writing Results and Conclusions, Presenting a paper in scientific seminar, Thesis writing.

	Structure and Components of Research Report, Types of Report: research papers, thesis, Research Project Reports, Pictures and Graphs, citation styles, writing a review of paper, Bibliography; Importance of Impact factor of a journal and citation Index

c. Mapping of Program Outcomes with Course Outcomes

	PO1	PO2	PO3	PO4	PO5
CO1	**3**	**2**	**3**	**3**	**2**
CO2	**3**	**3**	**3**	**3**	**2**
CO3	**3**	**3**	**3**	**3**	**3**
CO4	**2**	**3**	**3**	**3**	**3**

(If the correlation between mission statement and program specific outcome is high 3 is assigned, for moderate 2, for low 1, and for 0 are assigned)

d. Evaluation Scheme

	CO1	CO2	CO3	CO4	Total
Internal	10	10	10	10	40
External	15	15	15	15	60
Total	**25**	**25**	**25**	**25**	**100**

SEMESTER –I					
Course Code	**Course Name**	**L**	**T**	**P**	**Credits**
HOR715	Doctoral Seminar 1	0	-	1	1

a. Course Outcome (CO)

On the successful completion of the course, the student will be able to

	Course Outcome	**Level**
CO1	Analyze the tactics in development of proficiency in presentation of scientific facts	Analyze
CO2	Understand the research values in overcome the constraints in various divisions of horticulture sector	Understand
CO3	Apply the skills in delivery of scientific knowledge in the common forum	Apply
CO4	Reminisce the scientific backgrounds in applied research	Remember

c. Mapping of Program Outcomes with Course Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO1	**3**	**3**	**3**	**3**	**2**
CO2	**3**	**3**	**2**	**3**	**1**
CO3	**2**	**3**	**3**	**3**	**2**
CO4	**3**	**3**	**3**	**3**	**1**

(If the correlation between mission statement and program specific outcome is high 3 is assigned, for moderate 2, for low 1, and for 0 are assigned)

d. Evaluation Scheme

	CO1	**CO2**	**CO3**	**CO4**	**Total**
Internal	10	10	10	10	40
External	20	20	10	10	60
Total	**30**	**30**	**20**	**20**	**100**

SEMESTER –II					
Course Code	**Course Name**	**L**	**T**	**P**	**Credits**
HOR723	Advances in Plant Molecular Biology	4	-	0	4

a. Course Outcome (CO)

On the successful completion of the course, the student will be able to

	Course Outcome	**Level**
CO1	Opportunity for students to understand current barriers to gene discovery and exploitation of crop plants for crop improvement. Recognize impact of biotechnology on socioeconomic aspects of life.	Understand
CO2	Understanding of novel plant genes and regulation of their expression. Students will acquire knowledge to uncover and understand molecular pathways that control plant response to environmental stresses (biotic & abiotic stresses).	Apply
CO3	Students will be able to understand about plant hormones, interactions and transduction pathways to increasing crop productivity qualitatively & quantitively through improvement of hormanal actions	Analyze
CO4	Development of transgenic plants for crop improvement and plant protection. Major focus of the subject is to develop the laboratory skills. Students will be able to understand to exploit natural resources for the engineering and/or development of plants to face and deliver under sub optimal environmental to develop climate resilient crops.	Skill

b. Syllabus

Units	**Content**
LI	Model Systems in Plant Biology (Arabidopsis, Tomato, etc.) Forward and Reverse Genetic Approaches. Gene transformation approaches in horticultural crops. Gene expression - operon model, induction and repression, control of gene expression in prokaryotes and eukaryotes. Chloroplast and Mitochondrial genomes.Organization expression and, interaction of nuclear, mitochondrial and chloroplast genomes. Cytoplasmic male sterility.
LII	Transcriptional and Post-transcriptional Regulation of Gene Expression, Isolation of promoters and other regulatory elements, RNA interference, Transcriptional Gene Silencing, Transcript and Protein Analysis. Small RNA-mediated Gene Regulation – Types of non-coding RNAs: Sequencing, detection and validation, Mechanism of action and biological roles; Artificial microRNA (amiR) and siRNA technology.
LIII	ABCDE model of floral development and meristem specification, Role of hormones (Ethylene, Cytokinin, Auxin and ABA, SA and JA) in plant development and root architecture maintenance. Auxin and ethylene signaling pathways. Role of mutants in understanding hormone action. Regulation of Flowering, Plant photoreceptors and light signal transduction, vernalization, Circadian Rhythms.
LIV	Abiotic Stress Responses: Salt, Cold, Heat and Drought. Calcium Signal Transduction in Plants Calcium as “Hub and Nodal point” in multiple signaling (biotic and abiotic stress); Development of calcium signaling networks with advanced tools and techniques. Hormonal interactions

	networks relating abiotic stress. Biotic Stress Responses. Molecular Biology of Plant-pathogen Interactions, Molecular Biology of Rhizobium and Agrobacterium- Plant interaction. Senescence and its regulation; Hormonal and environmental control of senescence; PCD in the life cycle of plants. Development and Defense gene expression networks.
	Reference: 1. Lewin, B. (2008). Genes IX. Jones and Bartlett Publishers, Inc., USA. 2. Watson, J.W., Baker, T.A., Bell, S.P., Gann, A., Levine, M. and Losick, R. (2004) . Molecular Biology of Gene. Pearson Education, USA. 3. Taiz, L. and Zeiger, E. -Eds. (2006). Plant Physiology. Sinauer Associates Inc. Publishers, USA. 4. Hopkins, W.G. and Huner, N.P.A. (2004). Introduction to Plant Physiology. John Wiley, UK. 5. Kahl, G. and Meksem, K. -Eds. (2008). The Handbook of Plant Functional Genomics. WileyVCH Verlag GmbH & Co., Germany. 6. John M. Walker, Ralph Rapley. (2009). Molecular biology and biotechnology. The Royal Society of Chemistry publ, UK 7. Adrian Slater, Nigel W. Scott, and Mark R. (2008). The Genetic Manipulation of Plants. Oxford University Press 8. Burton E. Tropp, David Freifelder (2007). Molecular biology: genes to proteins. Jones and Bartlett Publishers, Inc; 3rd Revised edition 9. C. Neal Stewart Jr. (2008). Fowler Plant Biotechnology and Genetics: Principles, Techniques and Applications.Wiley publisher.

c. Mapping of Program Outcomes with Course Outcomes

	PO1	PO2	PO3	PO4	PO5
CO1	**3**	**3**	**3**	**2**	**2**
CO2	**3**	**3**	**3**	**3**	**3**
CO3	**3**	**3**	**3**	**2**	**2**
CO4	**3**	**3**	**3**	**3**	**3**

(If the correlation between mission statement and program specific outcome is high 3 is assigned, for moderate 2, for low 1, and for 0 are assigned)

d. Evaluation Scheme

	CO1	CO2	CO3	CO4	Total
Internal	10	10	10	10	40
External	20	20	10	10	60
Total	**30**	**30**	**20**	**20**	**100**

SEMESTER –II					
Course Code	**Course Name**	**L**	**T**	**P**	**Credits**
HOR724	Research and Publication Ethics	1	-	1	2

a. Course Outcome (CO)

On the successful completion of the course, the student will be able to

	Course Outcome	**Level**
CO1	Acquire the knowledge on Philosophy and ethics, Scientific conduct, Publication ethics.	Understand
CO2	Acquire the knowledge on Open access publishing,Publication misconduct, data base and plagiarism	Apply

b. Syllabus

Units	**Content**
LI	Philosophy and ethics: Introduction to philosophy: definition, nature and scope, concept, branches. Ethics: definition, moral philosophy, nature of moral judgements and relations. Scientific conduct: Ethics with respect to science and research, Intellectual honest and research integrity. Scientific misconducts: falsification, fabrication, and plagiarism. Redundant publications: duplicate and overlapping publications, salami slicing. Selective reporting and misrepresentation of data. Publication ethics: Publication ethics: definition, introduction and importance. Best practices/standards setting initiatives and guidelines: COPE, WAME, etc. Conflicts of interest. Publication misconduct: definition, concept, problems that lead to unethical behaviour and vice-verse, types. Violation of publication ethics, authorship and contributor ship.Identification of publication misconduct, complaints and appeals.Predatory publishers and journals.
PI	Open access publishing: Open access publications and initiatives. SHERPA/RoMEO online resourse to check publisher copyright and self-archiving policies.Software tool to identify predatory publications developed by SPPU. Journal finder/ journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer Journal Suggester, etc. Publication misconduct: A. Group Discussions, Subject specific ethical issues, FFP, authorship, Conflicts of interest, Complaints and appeals: examples and fraud from India and abroad. B. Software tools Use of plagiarism software like Turnitin, Urkund and other open source software tools. Databases and research metrics: A. Databases, Indexing databases, Citation databases: Web of Science, Scopus, etc. B. Research Metrics, Impact Factor of journal as per journal citation report, SNIP, SJR, IPP, Cite Score.Metrics: h-index, g index, i10 index, altmetrics.
	Reference: 1. https://www.ugc.ac.in/pdfnews/9836633_Research-and-Publication-Ethics.pdf.

c. Mapping of Program Outcomes with Course Outcomes

	PO1	PO2	PO3	PO4	PO5
CO1	**2**	**3**	**1**	**2**	**0**
CO2	**2**	**3**	**1**	**1**	**1**

(If the correlation between mission statement and program specific outcome is high 3 is assigned, for moderate 2, for low 1, and for 0 are assigned)

d. Evaluation Scheme

	CO1	CO2	Total
Internal	20	20	40
External	30	30	60
Total	**50**	**50**	**100**

SEMESTER –II					
Course Code	**Course Name**	**L**	**T**	**P**	**Credits**
HOR725	Doctoral Seminar 2	0	-	1	1

a. Course Outcome (CO)

On the successful completion of the course, the student will be able to

	Course Outcome	**Level**
CO1	Analyze the tactics in development of proficiency in presentation of scientific facts	Analyze
CO2	Understand the research values in overcome the constraints in various divisions of horticulture sector	Understand
CO3	Apply the skills in delivery of scientific knowledge in the common forum	Apply
CO4	Reminisce the scientific backgrounds in applied research	Remember

c. Mapping of Program Outcomes with Course Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO1	**3**	**3**	**3**	**3**	**2**
CO2	**3**	**3**	**2**	**3**	**2**
CO3	**2**	**3**	**3**	**3**	**1**
CO4	**3**	**3**	**3**	**3**	**1**

(If the correlation between mission statement and program specific outcome is high 3 is assigned, for moderate 2, for low 1, and for 0 are assigned)

d. Evaluation Scheme

	CO1	**CO2**	**CO3**	**CO4**	**Total**
Internal	10	10	10	10	40
External	20	20	10	10	60
Total	**30**	**30**	**20**	**20**	**100**

FRUIT SCIENCE

SEMESTER –II					
Course Code	**Course Name**	**L**	**T**	**P**	**Credits**
HFS721	Advances in Production Technology of Fruit Crops	3	-	1	4

a. Course Outcome (CO)

On the successful completion of the course, the student will be able to

	Course Outcome	**Level**
CO1	Analyse the influence of rootstocks and planting systems in orchards	Analyse
CO2	Understand the essentialities and importance of crop modelling in scientific fruit culture	Understand
CO3	Apply the deliberative ideologies in ensuring nutritional security	Apply
CO4	Reminisce the production problems, recent managerial approaches and export strategies	Remember

b. Syllabus

Units	**Content**
LI	National and International scenario in fruit production, Recent advances in propagation - root stock influence, planting systems, High density planting, crop modeling, Precision farming, decision support systems - aspects of crop regulation- physical and chemical regulation effects on physiology and development, influence of stress factors, strategies to overcome stress effects, integrated and modern approaches in water and nutrient management, Total quality management (TQM) - Current topics, special crop specific problems, recent approaches for their management and production strategies for export of Mango, Banana, Papaya, Grape, Citrus, Guava, Sapota
LII	Pomegranate, Aonla, Pineapple, Avocado, Jack Fruit, Fig
LIII	Apple, Pear, Peach, Plum, Strawberry, Apricot, Cherries, Almond and Walnut
PIV	Survey of existing fruit cropping systems and development of a model cropping system, Estimating nutrient deficiency, Detection and diagnosis of physiological disorders in fruit crops-estimation of water use efficiency, soil test-crop response correlations, practices in plant growth regulation, studying physiological and biochemical responses, quality analysis, Study of export standards for different fruit crops, Visit to modern orchards and export units.
	Reference: 1. Bose T.K, Mitra S.K & Rathore D.S. (Eds.). 1988. *Temperate Fruits – Horticulture*. Allied Publ. 2. Bose T.K, Mitra S.K & Sanyal D. (Eds.). 2001. *Fruits -Tropical and Subtropical*. Naya Udyog. 3. Bose T.K, Mitra S.K, Farooqi A.A & Sadhu M.K. 1999. *Tropical Horticulture.* Vol. I. Naya 4. Chadha, K.L. And Pareek, D.P., 1993, Advances in Horticulture, Vol. II & III, Malhotra Publishing House New Delhi 5. Chattopadhyay, T.K. (ed) (1998) A Textbook on Pomology vol. II & III, Kalyani Publishers, Calcutta. 6. Prakash. Chadha K.L & Pareek O.P. (Eds.).1996. *Advances in Horticulture*. Vols. IIIV. Malhotra Publishing House. Chadha K.L. 2001. *Handbook of Horticulture*. ICAR. 7. Nakasone H.Y & Paull R.E. 1998. *Tropical Fruits*. CABI.

8. Radha T & Mathew L. 2007. *Fruit Crops*. New India Publ. Agency.
9. Singh, Amar, 1980. Fruit Physiology and Production, Kalyani Publishers, New Delhi.

c. Mapping of Program Outcomes with Course Outcomes

	PO1	PO2	PO3	PO4	PO5
CO1	**2**	**3**	**3**	**3**	**2**
CO2	**3**	**3**	**3**	**2**	**2**
CO3	**3**	**2**	**3**	**3**	**2**
CO4	**3**	**3**	**2**	**3**	**2**

(If the correlation between mission statement and program specific outcome is high 3 is assigned, for moderate 2, for low 1, and for 0 are assigned)

d. Evaluation Scheme

	CO1	CO2	CO3	CO4	Total
Internal	10	10	10	10	40
External	25	25	10	0	60
Total	**35**	**35**	**20**	**10**	**100**

SEMESTER –II					
Course Code	**Course Name**	**L**	**T**	**P**	**Credits**
HFS722	Advances in Breeding of Fruit Crops	3	-	1	4

a. Course Outcome (CO)

On the successful completion of the course, the student will be able to

	Course Outcome	**Level**
CO1	Gain knowledge about the advancements in fruit breeding, strength of plant genetic resources of fruit crops	Remember
CO2	Capable of understanding the different breeding strategies adopted for improvement of fruits crops	Understand
CO3	Analyse the mechanisms and genetics of resistance breeding in fruit crops.	Analyze
CO4	Fix the breeding objectives and device the appropriate strategy for a crop which would lead to development of a new variety / hybrid suiting specified conditions.	Apply

b. Syllabus

Units	**Content**
LI	Evolutionary mechanisms, adaptation and domestication, Genetic resources, cytogenetics, cytomorphology, chemotaxonomy, genetics of important traits and their inheritance pattern, variations and natural selection, spontaneous mutations, incompatibility systems in fruits, recent advances in crop improvement efforts- introduction and selection, chimeras, apomixis, clonal selections, intergeneric, interspecific and intervarietal hybridization, mutation and polyploid breeding, resistance breeding to biotic and abiotic stresses, breeding for improving quality, molecular and transgenic approaches in improvement of selected fruit crops of Mango, Banana, Papaya, Grape, Citrus
LII	Guava, Sapota, Pomegranate, Pineapple, Avocado
LIII	Apple, Pear, Plum, Peach, Apricot, Cherries and Strawberry
PIV	Description and cataloguing of germplasm, pollen viability tests, pollen germination-isozyme techniques-survey and clonal selection, observations on pest, disease and stress reactions in inbreds and hybrids, use of mutagenes and colchicine for inducing mutation and ploidy changes, practices in different methods of breeding fruit crops and *in vitro* breeding techniques, DUS guidelines in fruit crops
	Reference: 1. Bose T.K, Mitra S.K & Sanyal D. (Ed.). 2002. *Fruits of India – Tropical and Sub-tropical*. 3rd Ed. Vols. I, II. Naya Udyog. 2. Chadha KL & Pareek O.P. (Eds.). 1996. *Advances in Horticulture*. Vol. I. Malhotra Publ. House. 3. Chadha K.L & Shikhamany S.D. 1999. *The Grape: Improvement, Production and Post-Harvest Management*. Malhotra Publ. House. 4. Gowen S. 1996. *Banana and Plantains*. Chapman & Hall. 5. Janick J & Moore JN. 1996. *Fruit Breeding*. Vols.I-III. John Wiley & Sons. 6. Nijjar G.S. (Ed.). 1977. *Fruit Breeding in India*. Oxford & IBH. 7. Radha T & Mathew L. 2007. *Fruit Crops*. New India Publ. Agency. 8. Singh S, Shivankar V.J, Srivastava A.K & Singh I.P. (Eds.). 2004. *Advances in Citriculture*. Jagmander Book Agency. 9. Stover R.H & Simmonds N.W. 1991. *Bananas*. Longman. Essex, United Kingdom: Longman Scientific and Technical. 468 p.

c. Mapping of Program Outcomes with Course Outcomes

	PO1	PO2	PO3	PO4	PO5
CO1	**3**	**3**	**3**	**3**	**3**
CO2	**3**	**3**	**3**	**3**	**3**
CO3	**3**	**3**	**3**	**3**	**3**
CO4	**3**	**3**	**3**	**2**	**3**

(If the correlation between mission statement and program specific outcome is high 3 is assigned, for moderate 2, for low 1, and for 0 are assigned)

d. Evaluation Scheme

	CO1	CO2	CO3	CO4	Total
Internal	10	10	10	10	40
External	25	25	10	0	60
Total	**35**	**35**	**20**	**10**	**100**

SEMESTER –II					
Course Code	**Course Name**	**L**	**T**	**P**	**Credits**
HFS811	Comprehensive Exam Qualifying Viva (Non-Credit Compulsory)	0	0	0	0

a. Course Outcome (CO)

On the successful completion of the course, the student will be able to

	Course Outcome	**Level**
CO1	Remember the horticultural technological concepts of major areas	Analyze
CO2	Understand the values of overall production constraints and their remedial measures for fruit crops	Understand
CO3	Apply the combined knowledge acquainted through overall coursework in fruit science	Apply
CO4	Analyse the individuals combined knowledge in subject stream	Remember

b. Mapping of Program Outcomes with Course Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO1	**3**	**3**	**2**	**3**	**2**
CO2	**2**	**3**	**3**	**2**	**2**
CO3	**3**	**2**	**3**	**3**	**1**
CO4	**3**	**3**	**3**	**2**	**2**

(If the correlation between mission statement and program specific outcome is high 3 is assigned, for moderate 2, for low 1, and for 0 are assigned)

c. Evaluation Scheme

	CO1 to CO4	**Total**
Internal	0	0
External	0	0
Total	**0**	**As satisfactory**

VEGETABLE SCIENCE

SEMESTER –II					
Course Code	**Course Name**	**L**	**T**	**P**	**Credits**
HVS721	Advances in Production Technology of Vegetable Crops	3	-	1	4

a. Course Outcome (CO)

On the successful completion of the course, the student will be able to

	Course Outcome	**Level**
CO1	Acquires knowledge on the recent advances and developments taking place in the production and management of vegetables.	Understand
CO2	Hands-on experience in the production and management of vegetables with respective to recent advances	Skill

b. Syllabus

Units	**Content**	**Hrs.**
LI	Present status and prospects of vegetable cultivation; nutritional and medicinal values; climate and soil as critical factors in vegetable production; choice of varieties; nursery management; modern concepts in water and weed management; physiological basis of growth, yield and quality as influenced by chemicals and growth regulators; role of organic manures, inorganic fertilizers, micronutrients and biofertilizers; response of genotypes to low and high nutrient management, nutritional deficiencies, disorders and correction methods; different cropping systems; mulching; containerized culture for year round vegetable production; low cost polyhouse; net house production; crop modeling, organic gardening; vegetable production for pigments, export and processing of Tomato, Brinjal, Chilli, Sweet Pepper, Potato, Cucurbits, Cabbage, Cauliflower and Knol-Khol	
LII	Bhendi, Peas, Beans, Amaranthus, Drumstick, Carrot, Radish, Beet Root and Onion	
LIII	Tapioca, Elephant Foot Yam, Sweet Potato and Taro	
PIV	Seed hardening treatments; practices in indeterminate and determinate vegetable growing and organic gardening; pro-trays and ball culture; diagnosis of nutritional and physiological disorders; analysis of physiological factors like anatomy; photosynthesis; light intensity in different cropping situation; assessing nutrient status, use of plant growth regulators; practices in herbicide application; estimating water requirements in relation to crop growth stages, maturity indices; dryland techniques for rainfed vegetable production; production constraints; analysis of different cropping system in various situation like cold and hot set; vegetable waste recycling management; quality analysis; marketing survey of the above crops; visit to vegetable market and packing houses.	
	Reference: 1. Bose T.K & Som N.G. 1986. *Vegetable Crops of India*. Naya Prakash. 2. Bose T.K, Kabir J, Maity T.K, Parthasarathy V.A & Som M.G. 2003. *Vegetable Crops*. Vols. I-III. Naya Udyog. Brewster J.L. 1994. *Onions and other Vegetable Alliums*. CABI. FFTC. *Improved Vegetable Production in Asia*. Book Series No. 36. 3. Ghosh S.P, Ramanujam T, Jos J.S, Moorthy S.N & Nair R.G. 1988.	

Tuber Crops. Oxford & IBH. Gopalakrishnan T.R. 2007. *Vegetable Crops*. New India Publishing Agency.
4. Kallo G & Singh K. (Ed.). 2001. *Emerging Scenario in Vegetable Research and Development*. Research Periodicals & Book Publ. House.
5. Kurup G.T, Palanisami M.S, Potty V.P, Padmaja G, Kabeerathuma S & Pallai SV. 1996. *Tropical Tuber Crops, Problems, Prospects and Future Strategies*. Oxford & IBH.
6. Sin M.T & Onwueme I.C. 1978. *The Tropical Tuber Crops*. John Wiley & Sons.
7. Singh N.P, Bhardwaj A.K, Kumar A & Singh K.M. 2004. *Modern Technology on Vegetable Production*. International Book Distr. Co.
8. Singh P.K, Dasgupta S.K & Tripathi S.K. 2006. *Hybrid Vegetable Development*. International Book Distr. Co.
9. Vilas. M., Salokhe and Ajay K.Sharma. 2006. Green house-Technology and applications. M/s. Geeta Somani Agrotech publishing Academey, Udaipur.

c. Mapping of Program Outcomes with Course Outcomes

	PO1	PO2	PO3	PO4	PO5
CO1	**3**	**3**	**3**	**2**	**3**
CO2	**3**	**3**	**3**	**3**	**3**

(If the correlation between mission statement and program specific outcome is high 3 is assigned, for moderate 2, for low 1, and for 0 are assigned)

d. Evaluation Scheme

	CO1	CO2	Total
Internal	20	20	40
External	30	30	60
Total	**50**	**50**	**100**

SEMESTER –II					
Course Code	**Course Name**	**L**	**T**	**P**	**Credits**
HVS722	Advances in Breeding of Vegetable Crops(m)	3	-	1	4

a. Course Outcome (CO)

On the successful completion of the course, the student will be able to

	Course Outcome	**Level**
CO1	Gain knowledge about the advancements in vegetable breeding, strength of plant genetic resources of vegetable crops	Remember
CO2	Capable of understanding the different breeding strategies adopted for improvement of vegetable crops	Understand
CO3	Analyse the mechanisms and genetics of resistance breeding in vegetable crops.	Analyze
CO4	Fix the breeding objectives and device the appropriate strategy for a crop which would lead to development of a new variety / hybrid suiting specified conditions.	Apply

b. Syllabus

Units	**Content**
LI	Evolution, distribution, cytogenetics, genetic resources, genetic divergence, types of pollination and fertilization mechanisms, sterility and incompatibility, anthesis and pollination, hybridization, intervarietal, interspecific and inter-generic hybridization, heterosis breeding, inheritance pattern of traits, qualitative and quantitative, plant type concept and selection indices, genetics of spontaneous and induced mutations, problems and achievements of mutation breeding, ploidy breeding and its achievements, in vitro breeding; breeding techniques for improving quality and processing characters; breeding for stresses, mechanism and genetics of resistance, breeding for salt, drought; low and high temperature; toxicity and water logging resistance, breeding for pest, disease, nematode and multiple resistance ofTomato, Brinjal, Chilli, Sweet Pepper, Cucurbits, Cabbage and Cauliflower
LII	Carrot, Beetroot, Radish, Potato, Tapioca, Sweet potato and Elephant Foot Yam
LIII	Bhendi, Onion, Moringa, Amaranthus, Peas and Beans
PIV	Designing of breeding experiments, screening techniques for abiotic stresses, screening and rating for pest, disease and nematode resistance, estimation of quality and processing characters, screening forquality improvement, estimation of heterosis and combining ability, induction and identification of mutants and polyploids, distant hybridization and embryo rescue techniques.
	Reference: 1. *Acta Horticulture*. Conference on Recent Advance in Vegetable Crops. Vol. 127. 2. Chadha K.L, Ravindran P.N & Sahijram L. 2000. *Biotechnology in Horticultural and Plantation Crops*. Malhotra Publ. House. 3. Chadha K.L. 2001. *Hand Book of Horticulture*. ICAR. 4. Dhillon B.S, Tyagi R.K, Saxena S & Randhawa G.J. 2005. *Plant Genetic Resources: Horticultural Crops*. Narosa Publ. House.

	5. Janick J.J. 1986. *Horticultural Science*. 4th Ed. WH Freeman & Co. 6. Kaloo G & Singh K. 2001. *Emerging Scenario in Vegetable Research and Development*. Research Periodicals and Book Publ. House. 7. Kaloo G. 1994. *Vegetable Breeding*. Vols. I-III. Vedams eBooks. 8. Peter K.V & Pradeep Kumar T. 2008. *Genetics and Breeding of Vegetables*. (Revised Ed.). ICAR. 9. Ram H.H. 2001. *Vegetable Breeding*. Kalyani.

c. Mapping of Program Outcomes with Course Outcomes

	PO1	PO2	PO3	PO4	PO5
CO1	**3**	**3**	**3**	**3**	**3**
CO2	**3**	**3**	**3**	**3**	**3**
CO3	**3**	**3**	**3**	**3**	**3**
CO4	**3**	**3**	**3**	**2**	**3**

(If the correlation between mission statement and program specific outcome is high 3 is assigned, for moderate 2, for low 1, and for 0 are assigned)

d. Evaluation Scheme

	CO1	CO2	CO3	CO4	Total
Internal	10	10	10	10	40
External	25	25	10	0	60
Total	**35**	**35**	**20**	**10**	**100**

SEMESTER –II					
Course Code	**Course Name**	**L**	**T**	**P**	**Credits**
HVS811	Comprehensive Exam Qualifying Viva (Non-Credit Compulsory)	0	-0	0-	0

a. Course Outcome (CO)

On the successful completion of the course, the student will be able to

	Course Outcome	**Level**
CO1	Remember the horticultural technological concepts of major areas	Analyze
CO2	Understand the values of overall production constraints and their remedial measures for fruit crops	Understand
CO3	Apply the combined knowledge acquainted through overall coursework in fruit science	Apply
CO4	Analyse the individuals combined knowledge in subject stream	Remember

b. Mapping of Program Outcomes with Course Outcomes

	PO1	**PO2**	**PO3**	**PO4**
CO1	**3**	**3**	**2**	**3**
CO2	**2**	**3**	**3**	**2**
CO3	**3**	**2**	**3**	**3**
CO4	**3**	**3**	**3**	**2**

(If the correlation between mission statement and program specific outcome is high 3 is assigned, for moderate 2, for low 1, and for 0 are assigned)

c. Evaluation Scheme

	CO1 to CO4	**Total**
Internal	0	0
External	0	0
Total	**0**	**As satisfactory**

FLORICULTURE AND LANSCAPING

SEMESTER –II					
Course Code	**Course Name**	**L**	**T**	**P**	**Credits**
HFL721	Advances in Production Technology of Flower Crops	3	-	1	4

a. Course Outcome (CO)

On the successful completion of the course, the student will be able to

	Course Outcome	**Level**
CO1	Select crop-specific cutting-edge production technologies	Understand
CO2	Examine the physiological nitty-gritty lie behind before exposing the flower crops into advance production technology.	Analyze
CO3	Be acquainted with the modern high-throughput technologies practically as well as based on empirical knowledge	Skill
CO4	Implement the acquired skills, understanding and analytical ideas together in hi-tech floriculture sectors to boost the production of commercial ornamental flowers.	Apply

b. Syllabus

Units	**Content**
LI	Commercial flower production systems, Floricultural value chains in a global context, the history, economic significance and future needs for floricultural crops; Impact of climate, societal changes and technologic development on future floricultural systems; possibilities and challenges (viz. land use, urbanization, resource utilization, climate change, new floral crops and products, crop rotations and biological diversity, risks of pests and invasive species) for flower production; ethical aspects in relation to floricultural production.
LII	Role of PGR on advanced flower production; Classification of growth regulators.Synthetic and naturally occurring growth substances. Biosynthesis, metabolism, physiological role and mode of action of different growth regulators and their role with respect to dormancy, promotion and retardation of growth, regulation of flowering, senescence and vase life of flowers.
LIII	Applied plant physiology, Microbiology based strategies for sustainable production (social, economic and ecological aspects), Quality aspects, Technical solutions for measuring growth, development and quality, Growth and development prognosis tools, Geographical aspects and site of production of – alstroemeria, ornamental zinger, rose, anthurium, orchids, liliums, heliconia, bird of paradise, Jasmine, marigold, tuberose, crossandra; Knowledge transfer and communication to different target groups.
PIV	Crop based Nutrition and fertigation.Special practices- Pinching, netting, disbudding, defoliation and chemical pruning; Photoperiodic and chemical induction of flowering; Laying out of experiments by using different growth regulators on dormancy, apical dominance, rooting of cuttings, growth, flowering, senescence and abscission.
	Reference: 1. Bose, T.K., Maiti, R.G., Dhua, R.S.& Das, P. 1999. Floriculture and

Landscaping. Naya Prokash.
2. Chadha, K.L.& Choudhury, B. 1992. Ornamental Horticulture in India. ICAR.
3. George, S.& Peter, K.V. 2008. Plants in a Garden. New India Publ. Agency.
4. Randhawa, G.S.& Mukhopadhyay, A. 1986. Floriculture in India. Allied Publ.
5. Barsra, A.S. 2004. Plant Growth Regulators In Agriculture And Horticulture Their Role And Commercial Uses. IBDC Publishers.
6. Dhanmugam, V. 2018. Commercial flower cultivation. Mohit Publications.
7. Kureel, M.K. 2017. Production Technology of Vegetables and Flowers: a Practical Manual. Astral International Publisher.

c. Mapping of Program Outcomes with Course Outcomes

	PO1	PO2	PO3	PO4	PO5
CO1	**3**	**3**	**3**	**3**	**3**
CO2	**3**	**3**	**3**	**3**	**3**
CO3	**3**	**3**	**3**	**3**	**3**
CO4	**3**	**3**	**3**	**3**	**3**

(If the correlation between mission statement and program specific outcome is high 3 is assigned, for moderate 2, for low 1, and for 0 are assigned)

d. Evaluation Scheme

	CO1	CO2	CO3	CO4	Total
Internal	10	10	10	10	40
External	25	25	10	0	60
Total	**35**	**35**	**20**	**10**	**100**

SEMESTER –II					
Course Code	**Course Name**	**L**	**T**	**P**	**Credits**
HFL722	Advances in Breeding of Flower Crops	3	-	1	4

a. Course Outcome (CO)

On the successful completion of the course, the student will be able to

	Course Outcome	**Level**
CO1	Comprehend regarding the modus-operandi of various advanced breeding strategies appropriate for flower improvement.	Understand
CO2	Draw a linkage between the suitability of cutting-edge breeding tools and crops.	Analyze
CO3	Acquire expertise through knowledge and practical experiences to handle different advance biotechnological tools at different arena of flower crop improvements.	Skill
CO4	Implement the acquired breeding skills for augmenting the potential of flower crops both quantitatively and qualitatively.	Apply

b. Syllabus

Units	**Content**
LI	Plant Breeding of pre and post-Mendelian era;Patterns of Evolution in flowering crops;Specific objectives of breeding in flower crops; Diallele selective mating approach, Concept of plant ideotype and its role in floral crop improvement; Transgressive breeding; Special breeding techniques-Mutation breeding; Breeding resistance for abiotic and biotic stresses in flower crops;Flower Cultivar development by maintenance breeding,Participatory Plant Breeding (PPB), Plant breeders rights and regulations for PVP and farmers rights.
LII	Chromosomal theory of inheritance; Hybrid science of flower cytology&genetics; History, concepts, current research, technological development in flower cytogenetics;Function, movement, number&structure of chromosomesof vital commercial ornamental flowers; Methods of chromosome modification in ornamental flower crops improvement.
LIII	Chromosomal and molecular genetics ofornamental plants - Orchids, Anthurium, Aster, Petunia, Liliums, *Heliconia*, Bird of paradise, Hibiscus, *Crossandra* and Bougainvillea; Flowering annuals - zinnia, cosmos, snapdragon, petunia, pansyand Ornamental foliages.
PIV	Floral biology in self and cross pollinated flower species, selfing and crossing techniques; Induction of polyploidy; Study on the mitosis & pollen grain size of few ornamental flower crops.
	Reference: 1. Anderson, N.O.2006. Flower Breeding and Genetics: Issues, Challenges and Opportunities for the 21st Century. Springer, Netherlands. 2. Gardner EJ &Snustad DP. 1991. Principles of Genetics. John Wiley & Sons. 3. Welch, C.W. 2002. Breeding new plants & flowers. The Crowood Press Ltd. 4. Singh, A.K. 2014. Breeding & Biotechnology of flowers, Vol 1. New India Publishing Agency. 5. Roy, D. 2019. Breeding of ornamental crops. Alpha Science International Ltd. 6. Bhattacharjee SK. 2006. Advances in Ornamental Horticulture. Vols. I-VI. Pointer Publ.

	7. Charles B. 1993. Discussions in Cytogenetics.Prentice Hall. 8. Darlington CD & La Cour LF. 1969. The Handling of Chromosomes. Georger Allen & Unwin Ltd. 9. Singh S &Pawar IS. 2006. Genetic Bases and Methods of Plant Breeding. CBS.

c. Mapping of Program Outcomes with Course Outcomes

	PO1	PO2	PO3	PO4	PO5
CO1	**3**	**3**	**2**	**3**	**2**
CO2	**3**	**3**	**3**	**3**	**2**
CO3	**3**	**2**	**3**	**3**	**3**
CO4	**3**	**3**	**3**	**1**	**3**

(If the correlation between mission statement and program specific outcome is high 3 is assigned, for moderate 2, for low 1, and for 0 are assigned)

d. Evaluation Scheme

	CO1	CO2	CO3	CO4	Total
Internal	10	10	10	10	40
External	25	25	10	0	60
Total	**35**	**35**	**20**	**10**	**100**

SEMESTER –II					
Course Code	**Course Name**	**L**	**T**	**P**	**Credits**
HFL811	Comprehensive Exam Qualifying Viva (Non-Credit Compulsory)	0	0	0	0

a. Course Outcome (CO)

On the successful completion of the course, the student will be able to

	Course Outcome	**Level**
CO1	Remember the horticultural technological concepts of major areas	Analyze
CO2	Understand the values of overall production constraints and their remedial measures for fruit crops	Understand
CO3	Apply the combined knowledge acquainted through overall coursework in fruit science	Apply
CO4	Analyse the individuals combined knowledge in subject stream	Remember

b. Mapping of Program Outcomes with Course Outcomes

	PO1	**PO2**	**PO3**	**PO4**
CO1	**3**	**3**	**2**	**3**
CO2	**2**	**3**	**3**	**2**
CO3	**3**	**2**	**3**	**3**
CO4	**3**	**3**	**3**	**2**

(If the correlation between mission statement and program specific outcome is high 3 is assigned, for moderate 2, for low 1, and for 0 are assigned)

c. Evaluation Scheme

	CO1 to CO4	**Total**
Internal	0	0
External	0	0
Total	**0**	**As satisfactory**

End Semester Question Paper pattern

CENTRAL UNIVERSITY OF TAMIL NADU
EXAMINATION FOR THE DEGREE OF
MASTER OF SCIENCE (HORTICULTURE)
ACADEMIC SESSION 2020-21
INTERANAL EXAMINATION

Course code–Course Name
Month Year | TIME: …. HOURS | TOTAL MARKS: 60

INSTRUCTIONS TO CANDIDATES

1. This paper has TWO (2) parts:

   Part A: One best answer (OBA) (5 questions)
   Fill in the blanks (5 questions)
   Or
   Match the following (5 questions)
   Part B: Descriptive (5 questions)
   Essay (4 questions – Either or Type)

   State your matric number clearly on each answer script.

2. The candidates must answer any **FIVE** questions in **Part B descriptive** and FOUR questions in Essay type (Either or Type)

3. Each question in **Part A** carries 1 (ONE) mark and **Part B** carries 2 (TWO) marks for Descriptive type;10 (TEN) marks for Essay type.

4. While answering **Part B** questions, **draw neatly labelled diagrams** wherever appropriate.

5. The scanned copy of the answer script must be mailed as per the instruction to course teacher immediately after the completion of examination

Registration No.: ……..

(This question paper consists of **20 questions**)

QUESTION PAPER

Time: 2.5 hour Maximum Marks: 60

PART – A

OBJECTIVE (10 x 1 = 10 MARKS)

No. of Questions : 10 (Question No.1 to 10)

Nature of Questions

One Best Answer (with four options) (Q.No. 01 to 05) 5 x 1 Marks = 5

1				
	a)	b)	c)	d)
2				
	a)	b)	c)	d)
3				
	a	b	c)	d)
4				
	a)	b)	c	d)
5				
	a)	b)	C	d)

Fill in the blanks (Q.No. 06 to 10) 5 x 1 Marks = 5

6	
7	
8	
9	
10	

Or

Match the following

PART – B

DESCRIPTIVE TYPE(5 x 2 = 10 Marks)

No. of Questions : 6

No. of Questions to be answered : 5

Nature of Questions : Brief answer

11	
12	
13	
14	
15	
16	

ESSAY TYPE (4 x 10 = 40 Marks)

No. of Questions : 2 (Either or type)

Nature of Questions : Detail answer in paragraph / 1 page

17	
	or
18	
	or
19	
	or
20	
	or