POST GRADUATE SYLLABUS
(Prepared from ICAR PG Syllabus of Horticulture)

Degree to be awarded

M. Sc. (Hort.) in Pomology and Post Harvest Technology

Department of Pomology and Post Harvest Technology
FACULTY OF HORTICULTURE
UTTAR BANGA KRISHI VISWAVIDYALAYA
PUNDIBARI, COOCH BEHAR
### Departmental PG Courses and Syllabus

#### a) M.Sc. courses

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<th>Sl</th>
<th>Course</th>
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<td>1</td>
<td>PPT501*</td>
<td>Tropical &amp; Subtropical Fruit Production- I</td>
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<td>PPT502*</td>
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<td>PPT 503*</td>
<td>Temperate Fruit Production Technology</td>
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<td>PPT504*</td>
<td>Breeding of Fruit Crops</td>
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<td>Post Harvest Physiology &amp; Handling of Horticultural Crops</td>
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<td>PPT508</td>
<td>Storage Systems and Operations</td>
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#### b) Ph.D. courses

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*Compulsory for Master’s programme; **Compulsory for Doctoral programme, # for B.Sc. (Ag.)
M.SC. SYLLABUS

1. PPT501: Tropical & Subtropical Fruit Production- I

Theory
Commercial varieties of regional, national and international importance, ecophysiological requirements, recent trends in propagation, rootstock influence, planting systems, cropping systems, nutrient management, water management, role of bio-regulators, training and pruning, flowering, pollination, fruit set and development, physiological disorders, causes and remedies, maturity indices, harvesting, grading, packing, storage and ripening; export potential, Agri. Export Zones (AEZ) of following crops: Mango, Banana, Citrus, Papaya, Guava, Pineapple, Litchi and Grape

Practical
Nutrition, weed management and propagation techniques of above mentioned crops. Identification of important cultivars, observations on growth and development, practices in growth regulation, malady diagnosis, analyses of quality attributes, visit to tropical and subtropical orchards, Project preparation for establishing commercial orchards.

2. PPT502: Tropical & Subtropical Fruit Production- II

Theory
Commercial varieties of regional, national and international importance, ecophysiological requirements, recent trends in propagation, rootstock influence, planting systems, cropping systems, nutrient management, water management, role of bio-regulators, training and pruning, flowering, pollination, fruit set and development, physiological disorders, causes and remedies, maturity indices, harvesting, grading, packing, storage and ripening; export potential, Agri. Export Zones (AEZ) of following crops: Sapota, Jackfruit, Rambutan, Avocado, aonla, Pomegranate, Ber, Loquat, Persimmon, Mangosteen, Carambola, bael, fig, jamun.

Practical
Nutrition, weed management and propagation techniques of above mentioned crops. Identification of important cultivars, observations on growth and development, practices in growth regulation, malady diagnosis, analyses of quality attributes, visit to tropical, subtropical orchards, Project preparation for establishing commercial orchards.

3. PPT503: Temperate Fruit Production Technology

Theory
Commercial varieties of regional, national and international importance, ecophysiological requirements, recent trends in propagation, rootstock influence, planting systems, cropping systems, nutrient management, water management, role of bio-regulators, training and pruning, flowering, pollination, fruit set and development, physiological disorders, causes and remedies, maturity indices, harvesting, grading, packing, storage and ripening; export potential, of following crops: Apple, pear, Plums, peach, apricot, kiwifruit, strawberry, cherries, walnut, almond, pistachio, pecan, hazelnut.

Practical
Identification of important cultivars, observations on growth and development, practices in growth regulation, malady diagnosis, analyses of quality attributes, visit to temperate orchards, Project preparation for establishing commercial orchards.

4. PPT504: Breeding of Fruit Crops

Theory
Origin and distribution, taxonomical status- species and cultivars, cytogenetics, genetic resources, blossom biology, breeding systems, breeding objectives, ideotypes, approaches for crop improvement- introduction, selection, hybridization, mutation breeding, polyploid breeding, rootstock breeding, improvement of quality traits, resistance breeding for biotic and abiotic stresses, biotechnological interventions, achievement and future thrust in the following selected fruit crops:
Mango, banana, pineapple, Citrus, grapes, guava, sapota, papaya, custardapple, litchi, apple, pear, and strawberry

**Practical**
Characterization of germplasm, blossom biology, determination of sex ratio, study of floral and leaf characteristics, study of anthesis, practices in hybridization, evaluation of biometrical traits and quality traits, visit to research stations working on tropical, subtropical and temperate fruit improvement

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**5. PPT 505: Post Harvest Physiology & Handling of Horticultural Crops 3(2+1)**

**Theory**
Pre harvest factors affecting post harvest quality and physiology of fruits and vegetables. Structure and composition of fruits and vegetables, physiological implications and structure on water movement, its loss and uptake and exchange of gasses. Maturity & Harvesting Indices, Harvesting injuries, Methods of harvesting, Postharvest changes, Ripening & Senescence, Respiration & Respiratory climacteric Ethylene biosynthesis and its action on ripening. Manipulation and regulation of postharvest physiology, ripening, senescence to extend storage life of fruits and vegetables, Bulk handling methods, Pack house operations – cleaning, trimming, grading, sorting, curing, de-greening, pre-cooling, washing and waxing. Storage: Goals, storage considerations, methods of storage- low cost storage, refrigerated storage, CA and MA storage, Storage disorders.

**Practical**
Judging harvest maturity, Quality evaluation of different harvested fruits and vegetables – determination of firmness, TSS, moisture, acidity, sugars, ascorbic acid, chlorophylls, carotenoids, phenol, tannin, starch, proteins, Grading and sizing, Methods of waxing and its evaluation. Visit to cold storage and CA storage units.

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**6. PPT 506: Principal of Preservation of Horticultural Crops 3(2+1)**

**Theory**

**Practical**
Studies of food additives, colour, flavour, preservatives and antioxidants. Extraction and quantification of pectin. Determination of water activity, Determination of syrup, and brine strength. Drying and dehydration of fruits and vegetables. Demonstration of canning and freezing operation. List & cost of equipments, utensils and other additives required for small scale industry. Visit to fruit and vegetable processing units.

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**7. PPT 507: Propagation, Nursery Management & Biotechnology of Fruit Crops 3(2+1)**

**Theory**
relationship, Incompatibility. Rejuvenation through topworking, Progeny orchard and scion bank. Nursery –
types, structures, components, planning and layout. Nursery management practices for healthy
propagule production. Micro-propagation – principles and concepts, commercial exploitation in fruit crops.
Techniques – in vitro clonal propagation, organogenesis, embryogenesis, micrografting, meristem culture.
Hardening, packing and transport of micro-propagules. Harnessing bio-technology in fruit crops,
influence of plant materials, physical, chemical factors and growth regulators on growth and
development of plant cell, tissue and organ culture. Callus culture – types, cell division, differentiation,
morphogenesis, organogenesis, embryogenesis. Physiology of hardening - hardening and field transfer,
organ culture – meristem, embryo, anther, ovule culture, embryo rescue, somaclonal
variation, protoplast culture and fusion. Omatichybrids and cybrids, wide hybridization, in vitro pollination
and fertilization, cryopreservation, rapid clonal propagation, genetic engineering in fruit crops, use of
molecular markers.

Practical
Different propagation methods for fruit crops. Study of construction of
propagation structures, study of media and PGR. Visit to nurseries. Hardening – case studies,
Micropropagation, explant preparation, media preparation. An exposure visit to low cost, commercial
and homestead tissue culture laboratories, media preparation, Project preparation for establishment of
commercial tissue culture laboratory.

8. PPT 508: Storage systems and operations 3(2+1)
Theory:
Introduction. Principles of storage, Objectives of storage, storage considerations - temperature, relative
humidity and atmospheric composition. Concept of cool chain. Storage systems - low cost storage
techniques; zero energy cool chamber, high cost storage techniques; ambient temperature storage.
Refrigerated storage: design and operation, hypobaric storage, MAP and CAP, storage with irradiation,
concept of multipurpose cold storage. Chilling injuries and other physiological disorder in storage.
Practical: equipments and design of different storage system, Effectiveness of ZECC in extending storage
Calculation related to mass and energy balance. Visit to cold storage.

9. PPT 509: Organic Fruit Production And Gap For Fruit Crops 2(1+1)
Theory
Organic horticulture – definition, principles, methods, merits and demerits. Organic farming systems,
components of organic horticultural systems, different organic inputs, their role in organic
horticulture, role of biofertilizers, biodynamics and the recent developments. Sustainable soil fertility
management, weed management practices in organic farming, biological/natural control of pests and
diseases, organic horticulture inequality improvement. Genesis of GAP –
definition/description, components listed by FAO, framework. Management of site history and soil, crop
and fodder production, IPM, INM, IWM, irrigation water, crop production and protection. Identification
of ways of improving the productivity and profitability, and resource efficiency, harvest and post harvest handling.
Animal production, product certification, animal waste management, animal health and welfare, harvest.
On-farm processing, storage, energy and waste management, human health, wildlife benefits. Institutions involved in GAP certification. Indian agencies, EUREP GAP (European Retail Producers Group – Good Agricultural Practices), EUREP etc.

Practical
Bio-composting, biofertilizers and their application, methods of preparation of compost, vermicompost,
application of neem products, visit to fields cultivated under organic practices
10. PPT510: Orchard Management Including Canopy Management in Fruit Crops

**Theory**
Principles, planning for orchard establishment, Selection of site for orchard, Layout and system of planting in orchard. High density orcharding, Cropping systems followed in orchard: Intercropping, multitier cropping, mulching, sod culture, cover cropping, green manuring. Weed management. Canopy management—importance and advantages; factors affecting canopy development. Canopy types and structures with special emphasis on geometry of planting, canopy manipulation for optimum utilization of light. Light interception and distribution in different types of fruit canopies. Spacing and utilization of land area - Canopy classification; Canopy management through rootstock and scion. Canopy management through plant growth inhibitors, training and pruning and management practices. Canopy development and management in relation to growth, flowering, fruiting and fruit quality in tropical, subtropical and temperate fruit crops.

**Practical**
Lay out of orchard, study of different system of planting, green manuring, cover cropping, intercropping, use of fillers, soil solarization. Study of different types of canopies, training of plants, canopy development through pruning, use of plant growth inhibitors, geometry of planting; study on effect of different canopy types on production and quality of fruits.

11. PPT 511: Protected Cultivation and Climate Management for Fruit Crops

**Theory**
Greenhouse – World scenario, Indian situation: present and future, Different agro-climatic zones in India, Environmental factors and their effects on plant growth. Basics of greenhouse design, different types of structures – glasshouse, shadene, polytunnels, Design and development of low cost greenhouse structures. Interaction of light, temperature, humidity, CO₂, water on crop regulation. Greenhouse heating, cooling, ventilation and shading. Types of ventilation – Forced cooling techniques, Glazing materials, Micro irrigation and Fertigation. Automated greenhouses, microcontrollers, waste water recycling, Management of pest and diseases – IPM. Introduction to climate change. Factors directly connected to climate change, average temperature, change in rainfall amount and patterns, rising atmospheric concentration of CO₂, pollution levels such as tropospheric ozone, change in climatic variability and extreme event like receding of glaciers in Himalayas. Sensors for climate registration and crop monitoring, phytomonitoring and biosensors, plants response to the climate changes, premature bloom, marginally overwintering or inadequate winter chilling hours, insect pests, longer growing seasons and shifts in planting hardiness for perennial fruit crops. Impact of climate changes on invasive insect, disease, weed, pests, horticulture yield, quality and sustainability, Climate management in greenhouse—mulching, use of plastic, windbreak, spectral changes, frost protection. Climate management in greenhouse— heating, vents, CO₂ injection, screens, artificial light.

**Practical**
Designs of greenhouse, low cost poly tunnels, nethouse- Regulation of light, temperature, humidity in greenhouses, media, greenhouse cooling systems, ventilation systems, fertigation systems, special management practices, project preparation for greenhouses, visit to greenhouses.

12. PPT512: Growth and Development of Horticultural Crops

**Theory**
Growth and development – definition, parameters of growth and development, growth dynamics, morphogenesis. Annual, semi-perennial and perennial horticultural crops, environmental impact on growth and development, effect of light, photosynthesis and photoperiodism, vernalisation, effect of temperature, heat units, thermoperiodism. Assimilate partitioning during growth and development, influence of water
and mineral nutrition during growth and development, biosynthesis of auxins, gibberellins, cytokinins, abscissic acid, ethylene, brassinosteroids, growth inhibitors, morphactins, role of plant growth promoters and inhibitors. Developmental physiology and biochemistry during dormancy, bud break, juvenility, vegetative to reproductive interphase, flowering, pollination, fertilization and fruit set, fruit drop, fruit growth, ripening and seed development. Growth and developmental process during stress - manipulation of growth and development, impact of pruning and training, chemical manipulations in horticultural crops, molecular and genetic approaches in plant growth development.

**Practical**
Understanding dormancy mechanisms in seeds, tubers and bulbs and stratification of seeds, tubers and bulbs, visit to arid, subtropical and temperate horticultural zones to identify growth and development patterns, techniques of growth analysis, evaluation of photosynthetic efficiency under different environments, study of growth regulator functions, hormone assays, understanding ripening phenomenon in fruits and vegetables, study of impact of physical manipulations on growth and development, study of chemical manipulations on growth and development, understanding stress impact on growth and development

13. **PPT: 513  Biodiversity and Conservation of Fruit Crops  3(2+1)**

**Theory**
Biodiversity and conservation; issues and goals, centers of origin of cultivated fruits; primary and secondary centers of genetic diversity. Present status of gene centers; exploration and collection of germplasm; conservation of genetic resources – conservation in situ and ex situ. Germplasm conservation - problem of recalcitrance - cold storage of scions, tissue culture, cryopreservation, pollen and seed storage; inventory of germplasm, introduction of germplasm, plant quarantine. Intellectual property rights, regulatory horticulture. Detection of genetic constitution of germplasm and maintenance of core group. GIS and documentation of local biodiversity, Geographical indication of following crops: Mango, sapota, citrus, guava, banana, papaya, grapes, jackfruit, custard apple, ber, aonla, apple, plum, litchi

**Practical**
Documentation of germplasm – maintenance of passport data and other records of accessions; field exploration trips, exercise on ex situ conservation – cold storage, pollen/seed storage, cryopreservation, visits to National Gene Bank and other centers of PGR activities. Detection of genetic constitution of germplasm, core sampling, germplasm characterization using molecular techniques.

14. **PPT: 591  Maters’ Seminar –I  1(1+0)**
Ph.D. SYLLABUS

1. PPT601 Advances in Breeding of Fruit Crops 3(2+1)
   **Theory**
   Evolutionary mechanisms, adaptation and domestication, Genetic resources, cytogenetics, cytomo- 
   lography, 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 
   following fruit crops: Mango, banana, Papaya, grapes, citrus, Guava, sapota, Pineapple, Apple, pear, 
   and strawberry
   **Practical**
   Description and cataloguing of germplasm, pollen viability tests, pollen germination surveys and 
   clonal selection, observations on pest, disease and stress reactions in inbreds and hybrids, use of 
   mutagens and colchicine for inducing mutations and ploidy changes, practices in different methods 
   of breeding fruit crops and in-vitro breeding techniques.

2. PPT602 Advances in Production of Fruit Crops-I 3(2+1)
   **Theory**
   National and International scenario in fruit production, Recent advances in propagation—rootstock 
   influence, planting systems, High density planting, crop modeling, Precision farming, decision support 
   systems—aspect 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) of following crops: 
   Mango, banana, Papaya, grapes, citrus, Guava, sapota and aonla
   **Practical**
   Survey of existing fruit cropping systems and development of a model cropping system, estimating 
   nutrient deficiency—estimation of water use efficiency, soil test—crop response correlations, practices 
   in plant growth regulation, studying physiological and biochemical responses, quality analysis.

3. PPT603 Advances in Production of Fruit Crops-II 3(2+1)
   **Theory**
   National and International scenario in fruit production, Recent advances in propagation—rootstock 
   influence, planting systems, High density planting, crop modeling, Precision farming, decision support 
   systems—aspect 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) of following crops: 
   Pineapple, avocado, jack, Apple, pear, plums, strawberry, peach, apricot, cherries
   **Practical**
   Survey of existing fruit cropping systems and development of a model cropping system, estimating 
   nutrient deficiency—estimation of water use efficiency, soil test—crop response correlations, practices 
   in plant growth regulation, studying physiological and biochemical responses, quality analysis.

4. PPT604 Advances in Growth Regulation of Fruit Crops 3(2+1)
   **Theory**
   Ecophysiological influences on growth and development of fruit crops—flowering, fruit set—Root and 
   canopy regulation, study of plant growth regulators in fruit culture—biosynthesis, metabolic and 
   morphogenetic effects of different plant growth promoters and growth retardants.
Absorption, translocation and degradation of phytohormones—internal and external factors influencing hormonal synthesis, biochemical action, growth promotion and inhibition, growth regulation aspect of propagation, seed and bud dormancy, fruit bud initiation, regulation of flowering, off season production. Flower drop and thinning, fruit set and development, fruit drop, parthenocarpy, fruit maturity and ripening and storage, molecular approaches in crop growth regulation

**Practical**
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.

5. **PPT605: Genomics and Bioinformatics in Horticulture**

**Theory**
Phylogenetic algorithms - Tree based 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.

**Practical**

6. **PPT606: Biotic and Abiotic Stress Management in Horticultural Crops**

**Theory**
Stress–definition, classification, stresses due to water (high and low), temperature (high and low), radiation, wind, soil conditions (salinity, alkalinity, ion toxicity, fertilizer toxicity, etc.), Pollution–increased level of CO₂, industrial wastes, impact of stress in horticultural crop production, stress indices, physiological and biochemical factors associated with stress, horticultural crops suitable for different stress situations. Crop modeling for stress situations, cropping system, assessing the stress through remote sensing, understanding adaptive features of crops for survival under stress, interaction among different stress and their impact on crop growth and productivity, Greenhouse effect and methane emission and its relevance to abiotic stresses, use of anti transpirants and PGRs in stress management, mode of action and practical use, HSP inducers in stress management techniques of soil moisture conservation, mulching, hydrophilic polymers. Rainwater harvesting, increasing water use efficiency, skimming technology, contingency planning to mitigate...
different stress situations, cropping systems, stability and sustainability indices.

**Practical**
Seed treatment/hardening practices, container seedling production, analysis of soil moisture estimates (FC, ASM, PWP), analysis of plant stress factors, RWC, chlorophyll fluorescence, chlorophyll stability index, ABA content, plant waxes, stomatal diffusional resistance, transpiration, photosynthetic rate etc. under varied stress situations, influence of stress on growth and development of seedlings and roots, biological efficiencies, WUE, solar energy conversion and efficiency, crop growth sustainability indices, economics of stress management, visit to orchards and watershed locations.

7. **PPT 607: COMMERCIAL FRUIT NURSERY**

**Theory:** Selection of soil, locality, site for fruit nursery, progeny tree, structures for a nursery. Propagation of different fruit plants, care of young nursery plants, maintenance, lifting and packing operations, preparation of a calendar for nursery operations, Economics for development of a fruit nursery. Nursery registration act.

**Practical:** Planning and lay out of a fruit nursery. Preparation of a nursery bed and planting techniques for different fruit crops. Layout of different propagation structures. Methods of lifting and packing of fruit plants.

8. **PPT 608: Advances in Post Harvest Physiology**

**Theory:** The general biology of plant senescence, control of RNA and enzyme synthesis during fruit ripening, Respiration and energy metabolism in senescence plant tissue, Enzyme activities and post-harvest changes, plant membrane lipids, changes and alteration during ageing and senescence, hormonal regulation of senescence, ageing and ripening. Formation of enzymatic products in the fruits during growth and storage. Stress metabolites in postharvest fruits and vegetables- role of ethylene. Post harvest pathology- etiology of postharvest disease, important postharvest disease, host pathogen interaction in postharvest disease, control of postharvest disease, hormonal and chemical postharvest treatments, which influence the postharvest quality, maturity and storability of fruits.

9. **PPT 609: Advances in Food Preservation**

**Theory:** Principles of Hurdle Technology- thermal and non-thermal methods as hurdles, microbial stability and quality aspect. Minimally Processed foods, Intermediate moisture foods, role of water activity in food preservation, Chemicals and Biochemicals Used in Food Preservation- Natural food preservatives, bacteriocins; Pulsed electric field- microbial inactivation, application, present status and future scope; Fundamentals and Applications of High Pressure Processing to Foods, Advances in Use of High Pressure to Processing and Preservation of Plant Foods, Commercial High-Pressure Equipment; Food Irradiation—An Emerging Technology; Ultraviolet Light and Food Preservation; Microbial Inactivation by Ultrasound; Use of oscillating Magnetic Fields as a Nonthermal Technology; Nonthermal Technologies in Combination with Other Preservation Factors. Preservation by ohmic heating—Advances in Ohmic Heating and Moderate Electric Field (MEF) Processing; Radio-Frequency Heating in Food Processing; Current State of Microwave Applications to Food Processing; Supercritical Fluid Extraction: An Alternative to Isolating bioactive compounds.

10. **PPT: 591**  
    **Doctoral Seminar –I**  
    1(1+0)

11. **PPT: 592**  
    **Doctoral Seminar –II**  
    1(1+0)