

M. Sc. (Hort.) in PHT-

1st Semester-

PHT-501: Principles of Post Harvest Technology (2+1)

Theory: Introduction, History and role of post harvest technology; principles and methods of food preservation. Post harvest handling (harvesting, precooling, sorting, grading and packaging) of perishables i.e. fruits, vegetables and flowers. Food storage systems; ripening and senescence of horticultural crops; Post harvest treatment for quality retention of horticultural crops; spoilage of fruits & vegetables, methods to reduce decay. Processing of fruit and vegetables (canning, dehydration, freezing and value added products).

Practical : Acquaintance with basic PHT equipment, Determination of TSS and acidity, Packaging, Visual identification of spoilage, specific gravity, and Texture analysis, On-Farm storage of fruits and vegetables, Respiration, Processing of fruits and vegetables to value added products.

PHT-502: Pre-harvest Physiological Aspects Related to Post Harvest (1+1) Management of Horticultural Produce

Theory : Introduction, Growth and development - definition, parameters of growth and development. Role of environmental factors e.g. light, temperature, humidity etc. and on physiological processes like photosynthesis and photoperiodism, vernalisation, respiration on post harvest life and quality. Physiological changes associated with ripening and seed development and preharvest factors affecting ripening and spoilage. Influence of plant growth regulators as pre harvest application on post harvest storage life and quality. Growth and developmental processes during stress manipulation of developing crop

Practical : Understanding ripening phenomenon in fruits and vegetables, study of impact of physical manipulations on growth and development and post harvest parameters, study of chemical manipulations on growth and development and post harvest parameters, understanding stress impact on growth and development and post harvest parameters.

PHT-503: Harvesting, Handling and Marketing of Fruits and Vegetables (2+1)

Theory : Introduction, Fruits and Vegetables – Introduction, Harvesting-maturity selection and harvest; Harvest operation; Time of harvest and predicting harvest maturity indices; Harvesting methods; Harvesting aids; Field containers, transport from field and temperature protection; product assembly, packing house operation viz., delivery, grading, sizing, pretreatments including chlorination/waxing etc., packaging, packing, unitization, cooling and loading, shipment, storage and ripening techniques; industrial and export potential. Distribution-Marketing channels, wholesaling, retailing, merchandizing and integration.

Fruits : Mango, Banana, Citrus and Papaya, Guava, Sapota and Jackfruit, Pineapple, Annonas, Avocado, Aonla, Pomegranate, Phalsa and Ber, Apple, pear, quince, grapes, plums, peach, apricot, cherries, hazelnut, litchi, loquat, persimmon, kiwifruit and strawberry, Nuts- walnut,

almond, pistachio, pecan, Minor fruits- mangosteen, carambola, bael, wood apple, fig, jamun, rambutan and pomegranate.

Vegetables : Potato, Cole crops : cabbage, cauliflower, knoll kohl, sprouting broccoli, Brussels Sprout, Root crops; carrot, radish, turnip and beetroot, bulb crops: onion and garlic, peas and broad bean, green leafy cool season vegetables. Tomato, eggplant, hot and sweet peppers, okra, beans, cowpea and cluster bean. Cucurbitaceous crops, Tapioca and sweet potato, Green leafy, warm season vegetables.

Practical: Maturity selection and harvest, harvesting practices. Assessment of quality and grading, prepackaging and protective treatments. Identification of packaging materials, containers for packaging.

PHT-504: Post Harvest Technology of Ornamentals (2+1)

Theory : Introduction, Factors regulating post harvest quality of flowers; Post harvest quality requirements. Harvesting and grading standards of important commercial flowers, Methods of pre-cooling, packaging and storage of flowers. Principle involved in the formation of colour pigments in ornamentals. Chemistry and importance of secondary metabolites in rose, jasmine, marigold, tuberose, carnation, orchids, lilliums and bougainvillea. Extraction of biocolours and their value addition, uses in food and textile industries. Biochemistry and post harvest management of cut flowers. Post harvest biotechnology of flowers, ornamental plants, achievements of bio-technology in flower crops. Senescence of ornamentals, changes associated with senescence; Loss reduction methodologies; Floral preservatives and bud opening solution; water relation; Physiological and microbial stem plugging; Techniques of flowers and foliage drying and its preservation.

Practical : Stages of harvesting of flowers and standards. Harvesting, grading, bunching, packaging treatment of flowers, pre-cooling of flowers. Packaging system of different flower. Vase life evaluation of different cut flower and their effect on quality. Drying techniques of foliage and flowers. Extraction, purification and estimation of pigments, essential oil/concrete.

PHT-505: Principles and Methods of Processing (2+1)

Theory : Introduction, Historical development in food processing, type of food and causes for food spoilage. Basic principles of fruits and vegetables processing; Thermal processing, pH classification of foods, heat resistance of micro organism; Heat resistance of enzymes in foods, methods for determination of process time; Spoilage of thermal processed food; Containers - canning, rigid tin plates and cans, aluminum cans, glass containers – types; Flexible packaging materials, Composite can, specification, corrosion of cans, heat penetration into containers. Effects of low temperature on fresh commodities and prepared product. Freezing preservation, freezing points of foods, slow and quick freezing, Cryogenic freezing and frozen food storage. Drying and dehydration, sun drying solar dehydration, mechanical drying types of driers, osmotic dehydration. Food fermentation – Alcoholic, acetic and lactic fermentation. Pickling and curing; Effect of salt on food preservation, types of salt cured products. Traditional and new products; Chemical preservation, SO₂, benzoic acid, sorbic acid, antioxidants and antibiotics, newer preservatives, Preservation by controlling water activity – high sugar products, intermediate moisture food, food concentration. Food irradiation, principles, types and sources of

radiation, dosimetry, mode of action of ionizing radiation; Radiation effect on food constituents and regulation.

Practical : List and cost of equipment, utensils, additives required for small scale processing industry. Determination of syrup and brine strength. Blanching and fumigation of fruits and vegetables. Drying and dehydration of fruits and vegetables.

2nd Semester-

PHT-551: Post Harvest Technology of Fruit and Vegetable Crops- I (2+1)

Theory: Introduction, Maturity indices, harvesting practices for specific market requirements, influence of pre-harvest practices on post harvest quality. Physiology and biochemistry of fruit ripening, enzymatic and textural changes, respiration, and transpiration, ethylene evolution and ethylene management, factors leading to post-harvest loss, pre-cooling. Treatments prior to shipment, viz., chlorination, waxing, chemicals, bio control agents and natural plant products. Storage conditions-temperature, humidity and atmospheric composition; Storage systems-ambient temperature storage, ventilated, refrigerated and freezing, MAS, CA storage, physical injuries and disorders, irradiation of fresh produce. Packing methods and transport. Export requirements, quarantine requirements, quality management insect and pest infestation and control measure. Pesticides and fungicide residues. Principles and methods of preservation, food processing, canning, fruit juices, beverages, pickles, jam, jellies, candies. Dried and dehydrated products, nutritionally enriched products, fermented fruit beverages, packaging technology, processing waste management, food safety standards.

Practical : Analyzing maturity stages of commercially important horticultural crops, improved packing and storage of important horticultural commodities, physiological loss in weight of fruits and vegetables, estimation of transpiration, respiration rate, ethylene release, estimation of quality characteristics in stored fruits and vegetables, cold chain management – visit to cold storage and CA storage and CA storage units, visit to fruit and vegetable processing units, project preparation, evaluation of processed horticultural products.

PHT-552: Fundamentals of Processing of Vegetables (2+1)

Theory : Introduction, History of food preservation. Present status and future prospects of vegetable preservation industry in India. Spoilage of fresh and processed vegetables; biochemical changes and enzymes associated with spoilage; principal spoilage organisms, food poisoning and their control measures. Role of microorganisms in food preservation. Raw materials for processing. Primary and minimal processing; processing equipments; Layout and establishment of processing industry, FPO licence. Importance of hygiene; Plant sanitation. Quality assurance and quality control, TQM, GMP. Food standards – FPO, PFA, etc. Food laws and regulations. Food safety – Hazard analysis and critical control points (HACCP). Labeling and labeling act, nutrition labeling. Major value added products from vegetables. Food additives and containers. Processing and its effects on nutrition. Utilization of byproducts of vegetable processing industry; Management of waste from processing factory. Investment analysis. Principles and methods of sensory evaluation of fresh and processed vegetables.

Practical : Study of machinery and equipments used in processing of horticultural produce; Chemical analysis for nutritive value of fresh and processed vegetables; Study of different types of spoilages in fresh as well as processed vegetables; Classification and identification of spoilage organisms; Laboratory examination of vegetable products; Sensory evaluation of fresh and processed vegetables; Visit to processing units to study the layout, equipments, hygiene, sanitation and residual / waste management.

PHT-553: Post Harvest Physiology and Biochemistry of Fruits and Vegetables (2+1)

Theory: Introduction, Structure and composition of fruits and vegetables. Genetical, environmental, managerial, harvest and postharvest factors affecting physiology and biochemical constituents of fruits and vegetables. Maturity and ripening processes and factors affecting them. Presence of constituents viz, carbohydrates, acid, lipids, amino acid, colouring and flavouring compounds, vitamin, bitter and astringent principles and their changes during development; maturation and ripening of fruits and vegetables; Physiology and Biochemical changes after harvest; Respiration and ripening, Biosynthesis of ethylene and its regulation, Ethylene action and ripening processes. Regulation of ripening and senescence of fruits and vegetables.

Practical: Structural and texture studies. Quality evaluation of different fruits and vegetables. Determination of firmness. TSS, moisture, titratable acid, sugar, protein, starch, fats, chlorophyll, carotene, anthocyanin, phenols and tannins. Measurement of respiration and ethylene evaluation.

PHT-554: Value addition in Flowers (2+1)

Theory : Introduction, Prospects of value addition, National and global scenario, production and exports, Women empowerment through value added products making, supply chain management. Types of value added products, value addition in loose flowers, garlands, veni, floats, floral decorations, value addition in cut flowers, flower arrangement, styles, Ikebana, morebana, free style, bouquets, button- holes, flower baskets, corsages, floral wreaths, garlands, etc.; Selection of containers and accessories for floral products and decorations. Dry flowers- Identification and selection of flowers and plant parts; Raw material procurement, preservation and storage; Techniques in dry plant parts; Raw material procurement, preservation and storage; Techniques in dry flower making – Drying, bleaching, dyeing, embedding, pressing; Accessories; Designing and arrangement – dry flower baskets, bouquets, pot-pourri, wall hangings, button holes, greeting cards, wreaths; Packing and storage. Concrete and essential oils; Selection of species and varieties (including non-conventional species), extraction methods, Packing and storage, Selection of species and varieties, Types of pigments, carotenoids, anthocyanin, chlorophyll, betalains; Significance of natural pigments, Extraction methods; Applications.

Practicals : Practices in preparation of bouquets, button-holes, flower baskets, corsages, floral wreaths, garlands with fresh flowers; Techniques in flower arrangement; Techniques in floral decoration; Identification of plants for dry flower making; Practices in dry flower making; Preparation of dry flower baskets, bouquets, pot-pourri, wall hangings, button holes, greeting cards, wreaths, etc., Visit to dry flower units, concrete and essential oil extraction units.

3rd Semester-

PHT-601: Spoilage of Fruits, Vegetables and Processed Products

(2+1)

Theory : Introduction, Principles and causes of spoilage of fresh and processed products. Role of microorganism – general morphology, cytology and reproduction, Growth of micro organism – factors affecting growth; Food substrate – type of food – pH classification of food, Growth curve methods of measuring microbial growth, Destruction of micro organism.

Physical, chemical and biological factors influencing the destruction of microorganism including the concept of Z, F and D values. Role of enzymes in food spoilage; Spoilage causing agents. Heat resistance microorganism and enzymes. General principles of food preservation. Relation of causal organisms with processing methods. Hurdle technology. Preservatives and their mode of action. Sources and prevention of contamination, food hygiene and sanitation, food poisoning – food borne infection and intoxication, mycotoxin. Food safety – preventive measure – HACCP- Preventive measure for spoilage. Spoilage of canned product, juice, squashes, jellies, pickles, dehydrated and alcoholic product.

Postharvest pathology (biology and control of postharvest diseases of important fruits, vegetable and flowers); insect, pest infestation and control, quarantine requirements, physiological disorder and management.

Practical : Determination of spoilage of different processed product. Media preparation. Method of single plate count (SPC). Isolation procedures. Water analysis for microbial quality. Diagnosis of spoilage.

PHT 602: Post Harvest Technology of Fruit and Vegetable Crops- II

(2+1)

Theory: Introduction, Minimal processing of fruits and vegetables. Thermal processing requirements - canning and bottling operation for commercially important fruits and vegetables, machinery used for the operation. Aseptic packaging. Food concentration, unit operation and equipment. Membrane and freeze concentration. Comparative evaluation of concentration methods. Aroma composition, aroma recovery system, packaging and storage of juice and aroma concentrates. Beverage, RTS, squashes, syrups, sherbet – recipes, preparation, packaging and storage - quality standard and specification. Jam, jellies, marmalades and technology of their production. Theory of jel formation.

Pickles and chutney – type and production. Packaging of pickles and chutneys. Spoilage and quality control. Dehydration, raw material preparation, pre-treatment and process details for commercially important products. Drying system. Fruits juice powder, custard powder - packaging, storage requirement. Tomato products, raw material quality for different type of products, preparation of products-juice, puree, paste, ketchup, soup and sauces

Preserves, raw material preparation, factors affecting sugar impregnation, preparation of commercially important products, packaging and storage. By products from fruits and vegetables processing waste. Citrus peel oil, pectin from pectinaceous material and vinegar. Mushroom

processing, canned, dehydrated and other products, packaging and storage, nutritive value. Food standards, FPO, PFA, Codex, BIS, standard specification.

Practical: Extraction of pectin and its evaluation. Test for pectin and quantification. Preparation of jam and jelly. Preparation and preservation of juice, squash, RTS, nectar and cordial. Preparation of tomato sauce, ketchup and chutney. Preparation and processing of preserve, candied and crystallized fruits and vegetables. Methods of pickling of fruits and vegetables. Visit to a processing factory.

PHT-649: Seminar - I (1+0)

4th Semester-

PHT-651: Export Oriented Horticulture (2+1)

Theory : Introduction, India's position and potentiality I world trade; export promotion zones in India. Scope, produce specifications, quality and safety standards for export of fruits *viz.*, mango, grape, litchi, pomegranate, walnut, cashewnut etc., vegetables *viz.*, onion, chilli, okra, bitter gourd, gherkin etc., flowers *viz.*, rose, carnation, chrysanthemum, gerbera, specialty flowers etc., cut green and foliage plants, Processed and value-added products, post harvest management for export including packaging and cool chain; HACCP, Codex alimentarius, ISO certification; WTO and its implications, sanitary and phyto-sanitary measures. Seed and planting material; hi-tech nurseries.

Practical : Export promotion zones for vegetables and export of fresh vegetables and their products; quality standards of vegetables for export purpose; practical on quality standards of major flower for exports; quality standards of planting material and seeds; Hi-tech nursery in floriculture; quality standards of major fruits for exports; practical on ISO specifications and HACCP for export of fruits; Sanitary and Phytosanitary measures during export of horticultural produce; post harvest management chain of horticultural produce for exports.

PHT-652: Post Harvest Technology of Spices and Plantation Crops (2+1)

Theory : Introduction, Importance of spices and plantation crops in processing industries. Physico-chemical properties of important spices and plantation crops and their products. Use of spices and plantation crops – commercially as well as medicinal. Processing of major spices – chillies, cardamom, ginger, black pepper and turmeric. Minor spices – coriander, clove, nutmeg, and other leaf and seeds spices. Harvesting, handling, processing, grading and packaging of fresh and processed product of cashewnut, arecanut, coconut, betelvine, coffee, tea and cocoa. Chemical composition of different products.

Practical : Harvesting and post harvest treatments. Extraction of oil, oleoresin etc. preparation of some processed product from spices. Visit to spices processing industry.

PHT -699: Seminar - II (1+0)