Department of Plantation, Spices, Medicinal & Aromatic Crop Sciences

Ph.D Programme

Course No.	**Title of the Course**	Credits
1st Semester		
PSMA 701	Advances in Production of Plantation Crops	2+1
PSMA 702	Advances in Production of Spice Crops	2+1
PSMA 703	Advances in Production of Medicinal and aromatic Crops	2+1
2nd Semester		
PSMA 751	Advances in Breeding of Plantation crops and Spices	3+1
PSMA 752	Advances in Breeding of Medicinal and aromatic Plants	2+1
PSMA 799	Seminar I	1+0
3rd Semester		
PSMA 801	Biotechnology in Plantation Crops and Spices	2+1
PSMA 802	Post harvest Processing and Extraction of Spices, Plantation, Medicinal and aromatic Crops	3+1
PSMA 849	Seminar II	1+0
4th Semester		
PSMA 851	Environmental Horticulture	2+1
	5th Semester	
	NIL	
	6th Semester	
PSMA 999	Seminar III	1+0
PSMA 1000	Doctoral Research	0+45

Programme Details

PSMA 701 Advances in Production of Plantation crops (2+1)

Plantation crops – area and production, export potential - varietal wealth and appraisal on the crop improvement in plantation crops. Mass multiplication techniques, high density planting, systems of cultivation, multitier cropping, companion cropping, studies of on canopy and root management, photosynthetic efficiencies of crops at different tiers, biotic and abiotic factors on growth and productivity, nutritional requirements, role of macro and micro nutrients, nutrient deficiency symptoms, growth regulators, water requirement, fertigation, soil and moisture conservation practices, drought management, permanent vegetation management, basin management, training and pruning, maturity indices, harvesting, curing, processing and value addition, grading, packing and storage, role of commodity boards in plantation crop development, production of plantation crops through GAP, GMP and HACCP.

Crops
UNIT I: Coffee and tea
UNIT II: Cashew and cocoa
UNIT III: Rubber, palmyrah and oil palm
UNIT IV: Coconut and arecanut
UNIT V**:** Betelvine
Practical
Description of botanical and varietal features-selection of mother palms and elite clones, clonal fidelity testing, nursery techniques and propagation methods, high density planting, training and pruning practices, fertigation and foliar nutrition, shade regulation, maturity standards, harvesting, curing, processing and grading, project preparation for establishing new plantations, visit to plantation gardens, commodity boards and plantation based industries.

PSMA 702: Advances in Production of Spice Crops (2+1)

Theory
Spices- current status on area and production, state, national and global scenario of spices, global trade, problems encountered in spices productivity, systems of cultivation, varieties, soil and climate, propagation techniques and nursery management, planting systems and methods, cropping pattern, permanent floor management concepts in mulching and weed management, canopy and root studies under different spice-based cropping systems, shade and basin management, INM practices, irrigation and fertigation techniques, chemical regulation of crop productivity, IPM, clean cultivation strategies, harvesting, post-harvest and quality management for value added spices, quality standards, GAP and GMP for spices production, quality control and certification. Protected cultivation of high value spice crops. Value addition and byproduct utilization. Pricision farming and organic farming in spice crops and commodity boards in spices development .
UNIT I: Pepper and cardamom
UNIT II: Nutmeg, clove, cinnamon and allspice
UNIT III: Turmeric, ginger, garcinia, tamarind and garlic
UNIT IV: Coriander, fenugreek, fennel, cumin and vanilla
UNIT V: Paprika and important herbal spices

Practical
Identification of seeds and plants, botanical description of plant , preparation of herbarium, propagation, nursery techniques and propagation methods ,field layout and method of planting, cultural practices, harvesting, drying, storage, packaging and processing, value addition , short term experiments on spice crops.

PSMA 703 Advance in Production of Medicinal and aromatic Crops 2+1

Theory
UNIT I:Genetic biodiversity of medicinal plants, conservation networks, global initiatives on medicinal crops conservation and development, world history on usage of medicinal plants, preference to natural products, advanced research in biomedicines, nutraceuticals and natural drugs, American, European and Asian legislations on plant drugs, intellectual property rights and patents.

UNIT II:Indian traditional wisdom and heritage- Indian herbal wealth, documentations, databases, scientific validation, production problems of medicinal and aromatic plants, export and import status. WTO scenario - Principles and guidelines for GAP, GCP and GMP in medicinal crops.
UNIT III:Climate, soil and substrate culture, improved varieties, organic production, nutrition and irrigation requirements, inter culture, mulching, weed control, maturity indices and harvesting, post harvest handling, drying, processing, grading, packing and storage, quality standards in medicinal plants, biotechnological approaches for advances in phytochemical extraction technologies, separation of bio-molecules, distillation methods, essential oil extraction and value addition in aromatic crops, phytochemicals and drug development.
UNIT IV:Medicinal crops : *Coleus forskohlii,* glory liliy*,* senna, periwinkle*, Stevia rebaudiana,* aswagandha*,* sarpagandha*, aloe vera, Dioscorea* sp*, Phyllanthus amarus, Andrographis paniculata,* medicinal solanum*,* Isabgol*, poppy, Digitalis* sp*, Commiphora* sp*, Ipecac, Henbane, Ocimum* sp*., Centella, Bacopa, Saraca indica* and *bael.*

UNIT V:Aromatic crops: Palmarosa, lemongrass, citronella, vettiver, geranium, artemisia, mentha, ocimum, eucalyptus, rosemary, thyme and patchouli.

Practical
Identification and documentation- propagation in medicinal crops, maturity standards, harvesting and drying techniques, processing and grading, analysis of bio-molecules, extraction of secondary metabolites, identification and characterization of - secondary metabolites, essentialoils, visit to commercial medicinal crops field, visit to GMP, phytochemical extraction and value addition unit.

PSMA 751 Advances in breeding of Plantation Crops and Spices (3+1)

Theory
Evolutionary mechanisms, adaptation and domestication, genetic resources, genetic divergence, cytogenetics, variations and natural selection, types of pollination and fertilization mechanisms, sterility and incompatibility system, recent advances in crop improvement efforts, introduction and selection, chimeras, clonal selections, intergeneric, interspecific and intervarietal hybridization, heterosis breeding, mutation and polyploidy breeding, resistance breeding to biotic and abiotic stresses, breeding for improving quality, genetics of important traits and their inheritance pattern, molecular and transgenic approaches and other biotechnological tools in improvement of selected spices and plantation crops.
Crops
UNIT I: Coffee and tea
UNIT II: Cashew and cocoa
UNIT III: Rubber, palmyrah and oil palm
UNIT IV: Coconut and arecanut
UNIT V: Pepper and cardamom
UNIT VI: Nutmeg, clove, cinnamon and allspice
UNIT VII: Turmeric, ginger, garcinia, tamarind and garlic
UNIT VIII: Coriander, fenugreek, fennel, cumin and vanilla
Practical
Description and cataloguing of germplasm, pollen viability tests, pollen germination, survey and clonal selection, screening techniques for abiotic stresses, screening and rating for pest, disease and

stress resistance in inbreeds and hybrids, estimation of quality and processing characters for quality improvement, use of mutagens and colchicines for inducing mutation and ploidy changes, practices in different methods of breeding and *in vitro* breeding techniques.

PSMA 752 Advances in Breeding of medicinal and Aromatic crops (2+1)

Theory

UNIT I:Origin and evolution of varieties, distribution, genetic resources, genetic divergence, plant introduction, selection and domestication , inheritance of important characters, genetic mechanisms associated with alkaloids and secondary metabolites.

UNIT II:Methods of breeding suited to seed and vegetative propagated crops. Polyploidy and mutation breeding in the evolution of new varieties, exploitation of heterosis, utilization of male sterility. Breeding for resistance to pests, diseases, nematodes in medicinal and aromatic crops.

UNIT III:Specific breeding objectives in medicinal and aromatic crops, genetic bio diversity, breeding problems and improvements in senna, periwinkle, aswagandha, isabgol, sarpagandha, poppy, glory lily, coleus, *Mucuna and ocimum,* centella, bacopa, dioscorea, solanum, andrographis, Aloe vera, phyllanthus, eucalyptus, bael and cinchona.

UNIT IV:Specific breeding objectives in medicinal and aromatic crops, genetic bio diversity, breeding problems and improvements in henbane aromatic grasses, geranium, patchouli, artemisia, rosemary, thyme, sage, marjoram and fever few.

UNIT V:Biotechnological approaches for crop improvement of medicinal and aromatic crops.

Practical

Description of crops and cultivars, cataloguing of species and cultivars, floral biology, selfing and crossing, evaluation of hybrid progenies, induction of economic, colour mutants, increased alkaloid content in medicinal crops, high essential oil content in aromatic plants, physical and chemical mutagens, induction of polyploidy, screening of plants for biotic and abiotic stresses and environmental pollution, *in-vitro* breeding in flower crops, medicinal and aromatic crops.

PSMA 801 Biotechnology in Plantation Crops and Spices (2+1)

Theory

Crops: Coconut, oil palm, coffee, tea, cocoa, pepper, cardamom, turmeric, ginger and vanilla .

UNIT I:*In vitro* culture methods and molecular approaches for crop improvement in plantation crops and spices, production of haploids, disease elimination in horticultural crops, micro grafting , somaclones and identification of somaclonal variants, *in vitro* techniques to overcome fertilization barriers, *in vitro* production of secondary metabolites.

UNIT II:Protoplast culture and fusion, construction, identification and characterization of somatic hybrids and cybrids, wide hybridization, embryo rescue of recalcitrant species, *in vitro* conservation of spices and plantation crops.

UNIT III:*In vitro* mutation for biotic and abiotic stresses, recombinant DNA methodology, gene transfer methods, tools, methods and applications of rDNA technology.

UNIT IV:Quality improvement , improvement for biotic and abiotic stresses and transgenic plants.

UNIT V:Role of molecular markers in characterization of transgenic crops, fingerprinting of cultivars etc., achievements, problems and future thrusts in horticultural biotechnology.

Practical

Establishment of axenic explants, callus initiation and multiplication , production of suspension culture, cell and protoplast culture, fusion, regeneration and identification of somatic hybrids and cybrids, identification of embryonic and non-embryonic calli, development of cell lines, *in vitro* mutant selection for biotic and abiotic stresses, *In vitro* production and characterization of secondary metabolites, isolated microspore culture, isolation and amplification of DNA, gene transfer methods and molecular characterization of transgenic plants.

PSMA 802 Post Harvest Processsing and Extraction of Spices, Plantation, Medicinal and Aromatic crops (3+1)

UNIT I:Post-harvest handling of plant material, preparation of plant material for packaging and extraction. Methods of extraction of secondary metabolites from spices, plantation, medicinal and aromatic crops like coconut, arecanut, betelvine, turmeric, ginger, black pepper, sarpagandha, steroid bearing solanums, ashwagandha, periwinkle, senna and coleus .
UNIT II:Procedures and equipments used for extraction of active principles. Principles and practices of different types of chromatographs - paper, thin layer, column, gas and high performance liquid chromatography and mass spectroscopy. Preservation of plant extracts and their trade mechanisms.
UNIT III:Harvesting, drying, handling and preparation of different aromatic crops - jasmine, tuberose, oil-bearing rose, patchouli, mints and basils for essential oil extraction.
UNIT IV:Principles and practices of different types of extraction - distillation, solvent extraction, supercritical fluid extraction, etc. Fine flavour and perfume extraction. Qualitative determination of essential oils. *In vitro* production of biomass and organic extraction of oils. Quality analysis and characterization through chromatographs.
UNIT V:Commercial uses of essential oils and aromatherapy. Commercial utilization of spent material. Storage of essential oils.

Practical
Identification of different economic parts of medicinal and aromatic crops. Preparation of plant material for extraction. Study of different extraction methods. Study of solvents used in extraction of concrete and absolutes. Extraction of crude drugs and essential oils from different medicinal and aromatic crops respectively. Handling of different chromatographs. Quality analysis of essential oils - both physical and chemical, determination of phenol values, acid values and alcohol values. Sensory evaluation of essential oils. Storage studies in essential oils. Visit to commercial extraction and product development units.

PSMA 851 Environmental Horticulture (2+1)

Theory
UNIT I:Environmental complex, interaction of ecological factors in horticultural crop production, interaction of physiographic factors in horticultural crop production. Geo-chemical and hydrological cycles and their impact on ecosystems.
UNIT II:Global warming- carbon trading role of green house gases, elevated CO_2 and its impact on productivity of horticultural systems. Habitat ecology, changes in habitats and its impact on horticultural production ,habitat analysis, conservation biology, domestication. Forest ecosystem and its evolution to a hort-ecosystem.
UNIT III:Phytogeography. changes in land use pattern and its impact on horticultural crop production. Natural resource management in hortisystems. Subsistence farming systems of the world, threat and challenges.

UNIT IV:Environmental pollution in horti systems, chemicals, fertilizers, etc. Waste management in processing industry, phytoremediation.Alternate farming systems, horticultural therapy Environmental policy and legislation in India, International treatise and Summit, Biodiversity Board, Act, etc.

Practical

Phyto-sociological analysis, assessment of plant associations in natural and domestic systems, productivity assessment of various ecosystems, analysis and assessment of various phytogeographic zones, assessment of land use changes and its impact on horticultural systems, assessment of biodiversity and pesticide residue analysis in horticultural produce.