

DEPARTMENT OF HORTICULTURE
MSC SYLLABUS

Credit Requirements

Subject	Master's programme
Major	24
Minor	09
Supporting	05
Seminar	01
Research	25
Total Credits	64
Compulsory Non Credit	06

Major subject: The subject in which the students want specialization.

Minor subject: The subject closely related to students major subject.

Supporting subject: The subject not related to the major subject. It could be any subject considered relevant for student's research work.

Non-Credit Compulsory Courses: The courses are relevant supporting major subjects.

CODE	PAPER TITLE	CREDIT
Fruit Science		
HOR-PG-501	TROPICAL AND DRY LAND FRUIT PRODUCTION	2+1
HOR-PG-502	SUBTROPICAL AND TEMPERATE FRUIT PRODUCTION	2+1
HOR-PG-503	BIODIVERSITY AND CONSERVATION OF FRUIT CROPS	2+1
HOR-PG-504	BREEDING OF FRUIT CROPS	2+1
HOR-PG-505	POST HARVEST TECHNOLOGY FOR FRUIT CROPS	2+1
Floriculture & Landscaping		
HOR-PG-511	BREEDING OF FLOWER CROPS AND ORNAMENTAL PLANTS	2+1
HOR-PG-512	PRODUCTION TECHNOLOGY OF CUT FLOWERS	2+1
HOR-PG-513	PRODUCTION TECHNOLOGY OF LOOSE FLOWERS	2+1
HOR-PG-514	LANDSCAPING AND ORNAMENTAL GARDENING	2+1
HOR-PG-515	TURFING AND TURF MANAGEMENT	2+1
Vegetable Science		
HOR-PG-521	PRODUCTION TECHNOLOGY OF COOL SEASON VEGETABLE CROPS	2+1
HOR-PG-522	PRODUCTION TECHNOLOGY OF WARM SEASON VEGETABLE CROPS	2+1
HOR-PG-523	BREEDING OF VEGETABLE CROPS	2+1
HOR-PG-524	SEED PRODUCTION TECHNOLOGY OF VEGETABLE CROPS	2+1
HOR-PG-525	PRODUCTION TECHNOLOGY OF UNDER EXPLOITED VEGETABLE CROPS	2+1

Plantation, Spices, Medicinal & Aromatic Plants		
HOR-PG-531	PRODUCTION OF PLANTATION CROPS	2+1
HOR-PG-532	PRODUCTION TECHNOLOGY OF SPICE CROPS	2+1
HOR-PG-533	PRODUCTION TECHNOLOGY OF MEDICINAL AND AROMATIC CROPS	2+1
HOR-PG-534	BREEDING OF PLANTATION CROPS AND SPICES	2+1
HOR-PG-535	BREEDING OF MEDICINAL AND AROMATIC CROPS	2+1
Common Compulsory major courses for all students		
HOR-PG-551	POST HARVEST TECHNOLOGY FOR HORTICULTURAL CROPS	2+1
HOR-PG-552	GROWTH REGULATION OF HORTICULTURAL CROPS	2+1
HOR-PG-553	PROTECTED CULTIVATION OF HORTICULTURE CROPS	2+1
Compulsory supportive courses for all students		
HOR-PG-506	BIOTECHNOLOGY FOR CROP IMPROVEMENT	2+1
HOR-PG-507	EXPERIMENTAL DESIGNS	2+1
HOR-PG-569	MASTER'S SEMINAR	1+0
HOR-PG-599	MASTER'S RESEARCH	25
Compulsory Non-Credit Courses		
HOR-PG-571	LIBRARY AND INFORMATION SERVICES	0+1
HOR-PG-572	TECHNICAL WRITING AND COMMUNICATIONS SKILLS	0+1
HOR-PG-573 (e course)	INTELLECTUAL PROPERTY AND ITS MANAGEMENT IN AGRICULTURE	1+0
HOR-PG-574	BASIC CONCEPTS IN LABORATORY TECHNIQUES	0+1
HOR-PG-575 (e course)	AGRICULTURAL RESEARCH, RESEARCH ETHICS AND RURAL DEVELOPMENT PROGRAMMES	1+0
HOR-PG-576 (e course)	DISASTER MANAGEMENT	1+0

A student majoring in Horticulture has to select any one specialization i.e. Fruits Science/ Floriculture & Landscaping/ Vegetable Science/ Plantation, Spices, Medicinal & Aromatic Plants and all the courses of concerned specialization is compulsory. He/she can opt for any other specialization courses as minor. All the students should take compulsory supportive courses.

FRUIT SCIENCE

HOR-PG-501: TROPICAL AND DRY LAND FRUIT PRODUCTION

Theory

Commercial varieties of regional, national and international importance, eco physiological requirements, recent trends in propagation, rootstock influence, planting systems, cropping systems, root zone and canopy management, nutrient management, water management, fertigation, role of bio regulators, abiotic factors limiting fruit production, physiology of flowering, pollination fruit set and development, honeybees in cross pollination, physiological disorders- causes and remedies, quality improvement by management practices; maturity indices, harvesting, grading, packing, storage and ripening techniques; industrial and export potential, Agri. Export Zones (AEZ) and industrial supports.

Crops

Unit I: Mango and Banana

Unit II: Citrus and Papaya

Unit III: Guava, Sapota and Jackfruit

Unit IV: Pineapple, Annonas and Avocado

Unit V: Aonla, Pomegranate, Phalsa and Ber, minor fruits of tropics

Practical

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

Suggested Readings

- Bose TK, Mitra SK & Rathore DS. (Eds.). 1988. *Temperate Fruits - Horticulture*. Allied Publ. Bose TK, Mitra SK & Sanyal D. 2001. (Eds.). *Fruits -Tropical and Subtropical*. Naya Udyog.
- Chadha KL & Pareek OP. 1996. (Eds.). *Advances in Horticulture*. Vols. II- IV. Malhotra Publ. House. Nakasone HY & Paul RE. 1998. *Tropical Fruits*. CABI.
- Peter KV. 2008. (Ed.). *Basics of Horticulture*. New India Publ. Agency.
- Pradeepkumar T, Suma B, Jyothibhaskar & Satheesan KN. 2008. *Management of Horticultural Crops*. Parts I, II. New India Publ. Agency.
- Radha T & Mathew L. 2007. *Fruit Crops*. New India Publ. Agency.
- Singh HP, Negi JP & Samuel JC. (Eds.). 2002. *Approaches for Sustainable Development of Horticulture*. National Horticultural Board.
- Singh HP, Singh G, Samuel JC & Pathak RK. (Eds.). 2003. *Precision Farming in Horticulture*. NCPAH, DAC/PFDC, CISH, Lucknow.

HOR-PG-502: SUBTROPICAL AND TEMPERATE FRUIT PRODUCTION

Theory

Commercial varieties of regional, national and international importance, ecophysiological requirements, recent trends in propagation, rootstock influence, planting systems, cropping systems, root zone and canopy management, nutrient management, water management, fertigation, bioregulation, abiotic factors limiting fruit production, physiology of flowering, fruit set and development, abiotic factors limiting production, physiological disorders-causes and remedies, quality improvement by management practices; maturity indices, harvesting, grading, packing, precooling, storage, transportation and ripening techniques; industrial and export potential, Agri Export Zones(AEZ) and industrial support.

Crops

Unit I: Apple, pear, quince, grapes

Unit II: Plums, peach, apricot, cherries, hazlenut

Unit III: Litchi, loquat, persimmon, kiwifruit, strawberry

Unit IV: Nuts- walnut, almond, pistachio, pecan

Unit V: Minor fruits- mangosteen, carambola, bael, wood apple, fig, jamun, rambutan, pomegranate

Practical

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

Suggested Readings

- Bose TK, Mitra SK & Sanyol D. (Ed.). 2002. *Fruits of India – Tropical and Sub-tropical*. 3rd Ed. Vols. I, II. Naya Udyog.
- Chadha KL & Pareek OP. 1996. (Eds.). *Advances in Horticulture*. Vol. I. Malhotra Publ. House.
- Chadha KL & Shikhamany SD. 1999. *The Grape: Improvement, Production and Post-Harvest Management*. Malhotra Publ. House.
- Janick J & Moore JN. 1996. *Fruit Breeding*. Vols.I-III. John Wiley & Sons.
- Nijjar GS. 1977. (Eds.). *Fruit Breeding in India*. Oxford & IBH.
- Radha T & Mathew L. 2007. *Fruit Crops*. New India Publ. Agency.
- Singh S, Shivankar VJ, Srivastava AK & Singh IP. (Eds.). 2004. *Advances in Citriculture*. Jagminder Book Agency.

HOR-PG-503: BIODIVERSITY AND CONSERVATION OF FRUIT CROPS

Theory

Unit I

Biodiversity and conservation; issues and goals, centers of origin of cultivated fruits; primary and secondary centers of genetic diversity.

Unit II

Present status of gene centers; exploration and collection of germplasm; conservation of genetic resources – conservation *in situ* and *ex situ*.

Unit III

Germplasm conservation- problem of recalcitrancy - cold storage of scions, tissue culture, cryopreservation, pollen and seed storage; inventory of germplasm, introduction of germplasm, plant quarantine.

Unit IV

Intellectual property rights, regulatory horticulture. Detection of genetic constitution of germplasm and maintenance of core group.

Unit V

GIS and documentation of local biodiversity, Geographical indication.

Crops

Mango, sapota, citrus, guava, banana, papaya, grapes, jackfruit, custard, apple, ber, aonla, malus, *Prunus* sp, litchi, nuts, coffee, tea, rubber, cashew, coconut, cocoa, palmyrah, arecanut, oil palm and betelvine.

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.

Suggested Readings

Frankel OH & Hawkes JG. 1975. *Crop Genetic Resources for Today and Tomorrow*. Cambridge University Press.

Peter KV & Abraham Z. 2007. *Biodiversity in Horticultural Crops*. Vol. I. Daya Publ. House.

Peter KV. 2008. *Biodiversity of Horticultural Crops*. Vol. II. Daya Publ. House.

HOR-PG-504: 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, achievements and future thrust in the following selected fruit crops.

Crops

Unit I: Mango, banana and pineapple

Unit II: Citrus, grapes, guava and sapota

Unit III: Jackfruit, papaya, custard apple, aonla, avocado and ber

Unit IV: Mangosteen, litchi, jamun, phalsa, mulberry, raspberry, kokam and nuts

Unit V: Apple, pear, plums, peach, apricot, cherries and strawberry

Practical

Characterization of germplasm, blossom biology, study of anthesis, estimating fertility status, practices in hybridization, ploidy breeding, mutation breeding, evaluation of biometrical traits and quality traits, screening for resistance, developing breeding programme for specific traits, visit to research stations working on tropical, subtropical and temperate fruit improvement

Suggested Readings

Bose TK, Mitra SK & Sanyal D. (Eds.). 2002. *Fruits of India – Tropical and Sub-tropical*. 3rd Ed. Vols. I, II. Naya Udyog.

Chadha KL & Pareek OP. 1996. (Eds.). *Advances in Horticulture*. Vol. I. Malhotra Publ. House.

Chadha KL & Shikhamany SD. 1999. *The Grape: Improvement, Production and Post-Harvest Management*. Malhotra Publ. House.

Janick J & Moore JN. 1996. *Fruit Breeding*. Vols. I-III. John Wiley & Sons.

Nijjar GS. 1977. (Eds.). *Fruit Breeding in India*. Oxford & IBH.

Radha T & Mathew L. 2007. *Fruit Crops*. New India Publ. Agency.

Singh S, Shivankar VJ, Srivastava AK & Singh IP. (Eds.). 2004. *Advances in Citriculture*. Jagminder Book Agency.

HOR-PG-505: POST HARVEST TECHNOLOGY FOR FRUIT CROPS

Theory

Unit I

Maturity indices, harvesting practices for specific market requirements, influence of

pre-harvest practices, enzymatic and textural changes, respiration, transpiration.

Unit II

Physiology and biochemistry of fruit ripening, ethylene evolution and ethylene management, factors leading to post-harvest loss, pre-cooling.

Unit III

Treatments prior to shipment, viz., chlorination, waxing, chemicals, biocontrol agents and natural plant products. Methods of storage- ventilated, refrigerated, MAS, CA storage, physical injuries and disorders.

Unit IV

Packing methods and transport, principles and methods of preservation, food processing, canning, fruit juices, beverages, pickles, jam, jellies, candies.

Unit V

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 and study of vase life extension in cut flower using chemicals, estimation of quality characteristics in stored fruits and vegetables, cold chain management - visit to cold storage and CA storage units, visit to fruit and vegetable processing units, project preparation, evaluation of processed horticultural products.

Suggested Readings

- Bhutani RC. 2003. Fruit and Vegetable Preservation. Biotech Books.
- Chadha KL & Pareek OP. (Eds.). 1996 Advances in Horticulture. Vol. IV. Malhotra Publ. House.
- Haid NF & Salunkhe SK. 1997. Post Harvest Physiology and Handling of Fruits and Vegetables. Grenada Publ.
- Mitra SK. 1997. Post Harvest Physiology and Storage of Tropical and Sub-tropical Fruits. CABI.
- Ranganna S. 1997. Hand Book of Analysis and Quality Control for Fruit and Vegetable Products. Tata McGraw-Hill.
- Sudheer KP & Indira V. 2007. Post Harvest Technology of Horticulture. Introduction to the Physiology and Handling of Fruits, Vegetables and Ornamentals. CABI.

FLORICULTURE & LANDSCAPING
HOR-PG-511: BREEDING OF FLOWER CROPS AND ORNAMENTAL
PLANTS

Theory

Unit I

Principles -- Evolution of varieties, origin, distribution, genetic resources, genetic divergence- Patents and Plant Variety Protection in India.

Unit II

Genetic inheritance -- of flower colour, doubleness, flower size, fragrance, post harvest life.

Unit III

Breeding methods suitable for sexually and asexually propagated flower crops and ornamental plants-- introduction, selection, domestication, polyploid and mutation breeding for varietal development, Role of heterosis, Production of hybrids, Male sterility, incompatibility problems, seed production of flower crops.

Unit IV

Breeding constraints and achievements made in commercial flowers - rose, jasmine, chrysanthemum, marigold, tuberose, crossandra, carnation, dahlia, gerbera, gladioli, orchids, anthurium, aster, heliconia, liliiums, nerium.

Unit V

Breeding constraints and achievements made in ornamental plants – petunia, hibiscus, bougainvillea, Flowering annuals (zinnia, cosmos, dianthus, snap dragon, pansy) and ornamental foliage-- Introduction and selection of plants for waterscaping and xeriscaping.

Practical

Description of botanical features-- Cataloguing of cultivars, varieties and species in flowers, floral biology, selfing and crossing, evaluation of hybrid progenies, seed production-Induction of mutants through physical and chemical mutagens, induction of polyploidy, screening of plants for biotic, abiotic stresses and environmental pollution, *in vitro* breeding in flower crops and ornamental plants.

Suggested Readings

- Bhattacharjee SK. 2006. *Advances in Ornamental Horticulture*. Vols. I-VI. Pointer Publ.
- Bose TK & Yadav LP. 1989. *Commercial Flowers*. Naya Prokash.
- Chadha KL & Choudhury B.1992. *Ornamental Horticulture in India*. ICAR.

- Chadha KL. 1995. *Advances in Horticulture*. Vol. XII. Malhotra Publ. House.
- Chaudhary RC. 1993. *Introduction to Plant Breeding*. Oxford & IBH.
- Singh BD. 1990. *Plant Breeding*. Kalyani.

HOR-PG- 512: PRODUCTION TECHNOLOGY OF CUT FLOWERS

Theory

Unit I

Scope of cut flowers in global trade, Global Scenario of cut flower production, Varietal wealth and diversity, area under cut flowers and production problems in India- Patent rights, nursery management, media for nursery, special nursery practices.

Unit II

Growing environment, open cultivation, protected cultivation, soil requirements, artificial growing media, soil decontamination techniques, planting methods, influence of environmental parameters, light, temperature, moisture, humidity and CO₂ on growth and flowering.

Unit III

Flower production – water and nutrient management, fertigation, weed management, rationing, training and pruning, disbudding, special horticultural practices, use of growth regulators, physiological disorders and remedies, IPM and IDM, production for exhibition purposes.

Unit IV

Flower forcing and year round flowering through physiological interventions, chemical regulation, environmental manipulation.

Unit V

Cut flower standards and grades, harvest indices, harvesting techniques, post-harvest handling, Methods of delaying flower opening, Pre-cooling, pulsing, packing, Storage & transportation, marketing, export potential, institutional support, Agri Export Zones.

Crops: Cut rose, cut chrysanthemum, carnation, gerbera, gladioli, tuberose, orchids, anthurium, aster, liliiums, bird of paradise, heliconia, alstroemeria, alpinia, ornamental ginger, bromeliads, dahlia, gypsophilla, limonium, statice, stock, cut foliage and fillers.

Practical

Botanical description of varieties, propagation techniques, mist chamber operation, training and pruning techniques, practices in manuring, drip and

fertigation, foliar nutrition, growth regulator application, pinching, disbudding, staking, harvesting techniques, post-harvest handling, cold chain, project preparation for regionally important cut flowers, visit to commercial cut flower units and case study.

Suggested Readings

- Arora JS. 2006. *Introductory Ornamental horticulture*. Kalyani.
- Bhattacharjee SK. 2006. *Advances in Ornamental Horticulture*. Vols. I-VI. Pointer Publ.
- Bose TK & Yadav LP. 1989. *Commercial Flowers*. Naya Prokash.
- Bose TK, Maiti RG, Dhua RS & Das P. 1999. *Floriculture and Landscaping*. Naya Prokash.
- Chadha KL & Chaudhury B. 1992. *Ornamental Horticulture in India*. ICAR.
- Chadha KL. 1995. *Advances in Horticulture*. Vol. XII. Malhotra Publ. House.
- Lauria A & Ries VH. 2001. *Floriculture – Fundamentals and Practices*. Agrobios.
- Prasad S & Kumar U. 2003. *Commercial Floriculture*. Agrobios.
- Randhawa GS & Mukhopadhyay A. 1986. *Floriculture in India*. Allied Publ.
- Reddy S, Janakiram B, Balaji T, Kulkarni S & Misra RL. 2007. *Hightech Floriculture*. Indian Society of Ornamental Horticulture, New Delhi.

HOR-PG-513: PRODUCTION TECHNOLOGY FOR LOOSE FLOWERS

Theory

Unit I

Scope of loose flower trade, Significance in the domestic market/export, Varietal wealth and diversity, propagation, sexual and asexual propagation methods, propagation in mist chambers, nursery management, pro-tray nursery under shadenets, transplanting techniques.

Unit II

Soil and climate requirements, field preparation, systems of planting, precision farming techniques.

Unit III

Water and nutrient management, weed management, rationing, training and pruning, pinching and disbudding, special horticultural practices, use of growth regulators, physiological disorders and remedies, IPM and IDM.

Unit IV

Flower forcing and year round flowering, production for special occasions

through physiological interventions, chemical regulation.

Unit V

Harvest indices, harvesting techniques, post-harvest handling and grading, pre-cooling, packing and storage, value addition, concrete and essential oil extraction, transportation and marketing, export potential, institutional support, Agri Export Zones.

Crops: Jasmine, scented rose, chrysanthemum, marigold, tuberose, crossandra, nerium, hibiscus, barleria, celosia, gomphrena, non-traditional flowers (Nyctanthes, Tabernaemontana, ixora, lotus, lilies, tecoma, champaka, pandanus).

Practical

Botanical description of species and varieties, propagation techniques, mist chamber operation, training and pruning techniques, practices in manuring, drip and fertigation, foliar nutrition, growth regulator application, pinching, disbudding, staking, harvesting techniques, post-harvest handling, storage and cold chain, project preparation for regionally important commercial loose flowers, visits to fields, essential oil extraction units and markets.

Suggested Readings

- Arora JS. 2006. *Introductory Ornamental Horticulture*. Kalyani.
- Bhattacharjee SK. 2006. *Advances in Ornamental Horticulture*. Vols. I-VI. Pointer Publ.
- Bose TK & Yadav LP. 1989. *Commercial Flowers*. Naya Prokash.
- Bose TK, Maiti RG, Dhua RS & Das P. 1999. *Floriculture and Landscaping*. Naya Prokash.
- Chadha KL & Chaudhury B. 1992. *Ornamental Horticulture in India*. ICAR.
- Chadha KL. 1995. *Advances in Horticulture*. Vol. XII. Malhotra Publ. House.
- Lauria A & Ries VH. 2001. *Floriculture – Fundamentals and Practices*. Agrobios.
- Prasad S & Kumar U. 2003. *Commercial Floriculture*. Agrobios.
- Randhawa GS & Mukhopadhyay A. 1986. *Floriculture in India*. Allied Publ.
- Sheela VL. 2007. *Flowers in Trade*. New India Publ. Agency.
- Valsalakumari PK, Rajeevan PK, Sudhadevi PK & Geetha CK. 2008. *Flowering Trees*. New India Publ. Agency.

HOR-PG-513: LANDSCAPING AND ORNAMENTAL GARDENING

Theory

Unit I

Landscape designs, types of gardens, English, Mughal, Japanese, Persian,

Spanish, Italian, Vanams, Buddha garden; Styles of garden, formal, informal and free style gardens.

Unit II

Urban landscaping, Landscaping for specific situations, institutions, industries, residents, hospitals, roadsides, traffic islands, damsites, IT parks, corporates.

Unit III

Garden plant components, arboretum, shrubbery, fernery, palmatum, arches and pergolas, edges and hedges, climbers and creepers, cacti and succulents, herbs, annuals, flower borders and beds, ground covers, carpet beds, bamboo groves; Production technology for selected ornamental plants.

Unit IV

Lawns, Establishment and maintenance, special types of gardens, vertical garden, roof garden, bog garden, sunken garden, rock garden, clock garden, colour wheels, temple garden, sacred groves.

Unit V

Bio-aesthetic planning, eco-tourism, theme parks, indoor gardening, therapeutic gardening, non-plant components, water scaping, xeriscaping, hardscaping.

Practical

Selection of ornamental plants, practices in preparing designs for home gardens, industrial gardens, institutional gardens, corporates, avenue planting, practices in planning and planting of special types of gardens, burlapping, lawn making, planting herbaceous and shrubbery borders, project preparation on landscaping for different situations, visit to parks and botanical gardens, case study on commercial landscape gardens.

Suggested Readings

- Bose TK, Maiti RG, Dhua RS & Das P. 1999. *Floriculture and Landscaping*. Naya Prokash.
- Lauria A & Victor HR. 2001. *Floriculture – Fundamentals and Practices* Agrobios.
- Nambisan KMP.1992. *Design Elements of Landscape Gardening*. Oxford & IBH.
- Randhawa GS & Mukhopadhyay A. 1986. *Floriculture in India*. Allied Publ.
- Sabina GT & Peter KV. 2008. *Ornamental Plants for Gardens*. New India Publ. Agency.
- Valsalakumari et al. 2008. *Flowering Trees*. New India Publ. Agency.
- Woodrow MG.1999. *Gardening in India*. Biotech Books.

HOR-PG-514: TURFING AND TURF MANAGEMENT

Theory

Unit I

Prospects of landscape industry; History of landscape gardening, site selection, basic requirements, site evaluation, concepts of physical, chemical and biological properties of soil pertaining to turf grass establishment.

Unit II

Turf grasses - Types, species, varieties, hybrids; Selection of grasses for different locations; Grouping according to climatic requirement- Adaptation; Turfing for roof gardens.

Unit III

Preparatory operations; Growing media used for turf grasses - Turf establishment methods, seeding, sprigging / dibbling, plugging, sodding/turfing, turf plastering, hydro-seeding, astro-turfing.

Unit IV

Turf management – Irrigation, nutrition, special practices, aerating, rolling, soil top dressing, use of turf growth regulators (TGRs) and micronutrients, Turf mowing - mowing equipments, techniques to minimize wear and compaction, weed control, biotic and abiotic stress management in turfs.

Unit V

Establishment and maintenance of turfs for playgrounds, viz. golf, football, hockey, cricket, tennis, rugby, etc.

Practical

Identification of turf grasses, Preparatory operations in turf making, Practices in turf establishment, Layout of macro and micro irrigation systems, Water and nutrient management; Special practices – mowing, raking, rolling, soil top dressing, weed management; Biotic and abiotic stress management; Project preparation for turf establishment, visit to IT parks, model cricket and golf grounds, airports, corporates, Govt. organizations; Renovation of lawns; Turf economics.

Suggested Readings

Nick-Christians 2004. *Fundamentals of Turfgrass Management*.
www.amazon.com

VEGETABLE SCIENCE

HOR-PG-521: PRODUCTION TECHNOLOGY OF COOL SEASON VEGETABLE CROPS

Theory

Introduction, botany and taxonomy, climatic and soil requirements, commercial varieties/hybrids, sowing/planting times and methods, seed rate and seed treatment, nutritional and irrigation requirements, intercultural operations, weed control, mulching, physiological disorders, harvesting, post-harvest management, plant protection measures and seed production of:

Unit I

Potato

Unit II

Cole crops: cabbage, cauliflower, knoll kohl, sprouting broccoli, Brussels sprout

Unit III

Root crops: carrot, radish, turnip and beetroot

Unit IV

Bulb crops: onion and garlic

Unit V

Peas and broad bean, green leafy cool season vegetables

Practical

Cultural operations (fertilizer application, sowing, mulching, irrigation, weed control) of winter vegetable crops and their economics; Experiments to demonstrate the role of mineral elements, plant growth substances and herbicides; study of physiological disorders; preparation of cropping scheme for commercial farms; visit to commercial greenhouse/ polyhouse.

Suggested Readings

- Bose TK & Som MG. (Eds.). 1986. *Vegetable Crops in India*. Naya Prokash.
- Bose TK, Som G & Kabir J. (Eds.). 2002. *Vegetable Crops*. Naya Prokash.
- Bose TK, Som MG & Kabir J. (Eds.). 1993. *Vegetable Crops*. Naya Prokash.
- Bose TK, Kabir J, Maity TK, Parthasarathy VA & Som MG. 2003. *Vegetable Crops*. Vols. I-III. Naya Udyog.
- Chadha KL & Kalloo G. (Eds.). 1993-94. *Advances in Horticulture* Vols. V-X. Malhotra Publ. House.
- Chadha KL. (Ed.). 2002. *Hand Book of Horticulture*. ICAR.

- Chauhan DVS. (Ed.). 1986. *Vegetable Production in India*. Ram Prasad & Sons.
- Decoteau DR. 2000. *Vegetable Crops*. Prentice Hall.
- Edmond JB, Musser AM & Andrews FS. 1951. *Fundamentals of Horticulture*. Blakiston Co.
- Fageria MS, Choudhary BR & Dhaka RS. 2000. *Vegetable Crops: Production Technology*. Vol. II. Kalyani.
- Gopalakrishanan TR. 2007. *Vegetable Crops*. New India Publ. Agency.
- Hazra P & Som MG. (Eds.). 1999. *Technology for Vegetable Production and Improvement*. Naya Prokash.
- Rana MK. 2008. *Olericulture in India*. Kalyani Publ.
- Rana MK. 2008. *Scientific Cultivation of Vegetables*. Kalyani Publ.
- Rubatzky VE & Yamaguchi M. (Eds.). 1997. *World Vegetables: Principles, Production and Nutritive Values*. Chapman & Hall.
- Saini GS. 2001. *A Text Book of Oleri and Flori Culture*. Aman Publ. House.
- Salunkhe DK & Kadam SS. (Ed.). 1998. *Hand Book of Vegetable Science and Technology: Production, Composition, Storage and Processing*. Marcel Dekker.
- Shanmugavelu KG. 1989. *Production Technology of Vegetable Crops*. Oxford & IBH.
- Singh DK. 2007. *Modern Vegetable Varieties and Production Technology*. International Book Distributing Co.

HOR-PG-522: PRODUCTION TECHNOLOGY OF WARM SEASON VEGETABLE CROPS

Theory

Introduction, botany and taxonomy, climatic and soil requirements, commercial varieties/hybrids, sowing/planting times and methods, seed rate and seed treatment, nutritional and irrigation requirements, intercultural operations, weed control, mulching, physiological disorders, harvesting, post harvest management, plant protection measures, economics of crop production and seed production of:

Unit I

Tomato, eggplant, hot and sweet peppers

Unit II

Okra, beans, cowpea and clusterbean

Unit III

Cucurbitaceous crops

Unit IV

Tapioca and sweet potato

Unit V

Green leafy warm season vegetables

Practical

Cultural operations (fertilizer application, sowing, mulching, irrigation, weed control) of summer vegetable crops and their economics; study of physiological disorders and deficiency of mineral elements, preparation of cropping schemes for commercial farms; experiments to demonstrate the role of mineral elements, physiological disorders; plant growth substances and herbicides; seed extraction techniques; identification of important pests and diseases and their control; maturity standards; economics of warm season vegetable crops.

Suggested Readings

- Bose TK & Som MG. (Eds.). 1986. *Vegetable Crops in India*. Naya Prokash.
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- Bose TK, Som MG & Kabir J. (Eds.). 2002. *Vegetable Crops*. Naya Prokash.
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- Chadha KL. (Ed.). 2002. *Hand Book of Horticulture*. ICAR.
- Chauhan DVS. (Ed.). 1986. *Vegetable Production in India*. Ram Prasad & Sons.
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- Fageria MS, Choudhary BR & Dhaka RS. 2000. *Vegetable Crops: Production Technology*. Vol. II. Kalyani.
- Gopalakrishanan TR. 2007. *Vegetable Crops*. New India Publ. Agency. Hazra P & Som MG. (Eds.). 1999. *Technology for Vegetable Production and Improvement*. Naya Prokash.
- Kalloo G & Singh K (Ed.). 2000. *Emerging Scenario in Vegetable Research and Development*. Research Periodicals & Book Publ. House.
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- Rana MK. 2008. *Olericulture in India*. Kalyani.
- Rubatzky VE & Yamaguchi M. (Eds.). 1997. *World Vegetables: Principles, Production and Nutritive Values*. Chapman & Hall.
- Saini GS. 2001. *A Text Book of Oleri and Flori Culture*. Aman Publ. House.

- Salunkhe DK & Kadam SS. (Ed.). 1998. *Hand Book of Vegetable Science and Technology: Production, Composition, Storage and Processing*. Marcel Dekker.
- Shanmugavelu KG. 1989. *Production Technology of Vegetable Crops*. Oxford & IBH.
- Singh DK. 2007. *Modern Vegetable Varieties and Production Technology*. International Book Distributing Co.
- Singh NP, Bharadwaj AK, Kumar A & Singh KM. 2004. *Modern Technology on Vegetable Production*. International Book Distributing Co.
- Singh SP. (Ed.). 1989. *Production Technology of Vegetable Crops*. Agril. Comm. Res. Centre.
- Thamburaj S & Singh N. 2004. *Vegetables, Tuber Crops and Spices*. ICAR.
- Thompson HC & Kelly WC. (Eds.). 1978. *Vegetable Crops*. Tata Mc Graw Hill.

HOR-PG-523: BREEDING OF VEGETABLE CROPS

Theory

Origin, botany, taxonomy, cytogenetics, genetics, breeding objectives, breeding methods (introduction, selection, hybridization, mutation), varieties and varietal characterization, resistance breeding for biotic and abiotic stress, quality improvement, molecular marker, genomics, marker assisted breeding and QTLs, biotechnology and their use in breeding in vegetable crops-Issue of patenting, PPVFR act.

Unit I

Potato and tomato

Unit II

Eggplant, hot pepper, sweet pepper and okra

Unit III

Peas and beans, amaranth, chenopods and lettuce

Unit IV

Gourds, melons, pumpkins and squashes

Unit V

Cabbage, cauliflower, carrot, beetroot, radish, sweet potato and tapioca

Practical

Selection of desirable plants from breeding population observations and analysis of various qualitative and quantitative traits in germplasm, hybrids and segregating generations; induction of flowering, palanological studies, selfing and crossing techniques in vegetable crops; hybrid seed production of vegetable

crops in bulk. screening techniques for insect-pests, disease and environmental stress resistance in above mentioned crops, demonstration of sib-mating and mixed population; molecular marker techniques to identify useful traits in the vegetable crops and special breeding techniques. Visit to breeding blocks.

Suggested Readings

- Allard RW. 1999. *Principles of Plant Breeding*. John Wiley & Sons.
- Basset MJ. (Ed.). 1986. *Breeding Vegetable Crops*. AVI Publ.
- Dhillon BS, Tyagi RK, Saxena S. & Randhawa GJ. 2005. *Plant Genetic Resources: Horticultural Crops*. Narosa Publ. House.
- Fageria MS, Arya PS & Choudhary AK. 2000. *Vegetable Crops: Breeding and Seed Production*. Vol. I. Kalyani.
- Gardner EJ. 1975. *Principles of Genetics*. John Wiley & Sons.
- Hayes HK, Immer FR & Smith DC. 1955. *Methods of Plant Breeding*. McGraw-Hill.
- Hayward MD, Bosemark NO & Romagosa I. (Eds.). 1993. *Plant Breeding-Principles and Prospects*. Chapman & Hall.
- Kaloo G. 1998. *Vegetable Breeding*. Vols. I-III (Combined Ed.). Panima Edu. Book Agency.
- Kumar JC & Dhaliwal MS. 1990. *Techniques of Developing Hybrids in Vegetable Crops*. Agro Botanical Publ.
- Paroda RS & Kaloo G. (Eds.). 1995. *Vegetable Research with Special Reference to Hybrid Technology in Asia-Pacific Region*. FAO.
- Peter KV & Pradeepkumar T. 2008. *Genetics and Breeding of Vegetables*. Revised, ICAR.
- Rai N & Rai M. 2006. *Heterosis Breeding in Vegetable Crops*. New India Publ. Agency.
- Ram HH. 1998. *Vegetable Breeding: Principles and Practices*. Kalyani.
- Simmonds NW. 1978. *Principles of Crop Improvement*. Longman.
- Singh BD. 1983. *Plant Breeding*. Kalyani.
- Singh PK, Dasgupta SK & Tripathi SK. 2004. *Hybrid Vegetable Development*. International Book Distributing Co.
- Swarup V. 1976. *Breeding Procedure for Cross-pollinated Vegetable Crops*. ICAR.

HOR-PG-524: SEED PRODUCTION TECHNOLOGY OF VEGETABLE CROPS

Theory

Unit I

Definition of seed and its quality, new seed policies; DUS test, scope of vegetable seed industry in India.

Unit II

Genetical and agronomical principles of seed production; methods of seed

production; use of growth regulators and chemicals in vegetable seed production; floral biology, pollination, breeding behaviour, seed development and maturation; methods of hybrid seed production.

Unit III

Categories of seed; maintenance of nucleus, foundation and certified seed; seed certification, seed standards; seed act and law enforcement, plant quarantine and quality control.

Unit VI

Physiological maturity, seed harvesting, extraction, curing, drying, grading, seed processing, seed coating and pelleting, packaging (containers/packets), storage and cryopreservation of seeds, synthetic seed technology.

Unit V

Agro-techniques for seed production in solanaceous vegetables, cucurbits, leguminous vegetables, cole crops, bulb crops, leafy vegetables, okra, vegetatively propagated vegetables.

Practical

Seed sampling, seed testing (genetic purity, seed viability, seedling vigour, physical purity) and seed health testing; testing, releasing and notification procedures of varieties; floral biology; rouging of off-type; methods of hybrid seed production in important vegetable and spice crops; seed extraction techniques; handling of seed processing and seed testing equipments; seed sampling; testing of vegetable seeds for seed purity, germination, vigour and health; visit to seed processing units, seed testing laboratory and seed production farms.

Suggested Readings

- Agrawal PK & Dadlani M. (Eds.). 1992. *Techniques in Seed Science and Technology*. South Asian Publ.
- Agrawal RL. (Ed.). 1997. *Seed Technology*. Oxford & IBH.
- Bendell PE. (Ed.). 1998. *Seed Science and Technology: Indian Forestry Species*. Allied Publ.
- Fageria MS, Arya PS & Choudhary AK. 2000. *Vegetable Crops: Breeding and Seed Production*. Vol. I. Kalyani.
- George RAT. 1999. *Vegetable Seed Production*. 2nd Ed. CABI.
- Kumar JC & Dhaliwal MS. 1990. *Techniques of Developing Hybrids in Vegetable Crops*. Agro Botanical Publ.
- More TA, Kale PB & Khule BW. 1996. *Vegetable Seed production Technology*. Maharashtra State Seed Corp.
- Rajan S & Baby L Markose. 2007. *Propagation of Horticultural Crops*. New India Publ. Agency.

Singh NP, Singh DK, Singh YK & Kumar V. 2006. *Vegetable Seed Production Technology*. International Book Distributing Co.
Singh SP. 2001. *Seed Production of Commercial Vegetables*. Agrotech Publ. Academy.

HOR-PG-525: PRODUCTION TECHNOLOGY OF UNDEREXPLOITED VEGETABLE CROPS

Theory

Introduction, botany and taxonomy, climatic and soil requirements, commercial Varieties/hybrids, sowing/planting times and methods, seed rate and seed treatment, nutritional and irrigation requirements, intercultural operations, weed control, mulching, physiological disorders, harvesting, post harvest management, plant protection measures and seed production of:

Unit I

Asparagus, artichoke and leek

Unit II

Brussels's sprout, Chinese cabbage, broccoli, kale and artichoke.

Unit III

Amaranth, celery, parsley, parsnip, lettuce, rhubarb, spinach, basella, bathu (chenopods) and chekurmanis.

Unit IV

Elephant foot yam, lima bean, winged bean, vegetable pigeon pea, jack bean and sword bean.

Unit V

Sweet gourd, spine gourd, pointed gourd, Oriental pickling melon and little gourd (kundru).

Practical

Identification of seeds; botanical description of plants; layout and planting; cultural practices; short-term experiments of underexploited vegetables.

Suggested Readings

Bhat KL. 2001. *Minor Vegetables - Untapped Potential*. Kalyani.
Indira P & Peter KV. 1984. *Unexploited Tropical Vegetables*. Kerala Agricultural University, Kerala.
Peter KV. (Ed.). 2007-08. *Underutilized and Underexploited Horticultural Crops*. Vols. I-IV. New India Publ. Agency.
Rubatzky VE & Yamaguchi M. (Eds.). 1997. *World Vegetables: Principles, Production and Nutritive Values*. Chapman & Hall

Srivastava U, Mahajan RK, Gangopadyay KK, Singh M & Dhillon BS.
2001. Minimal Descriptors of Agri-Horticultural Crops. Part-II:
Vegetable Crops. NBPGR, New Delhi.

PLANTATION, SPICES, MEDICINAL & AROMATIC CROPS

HOR-PG-531: PRODUCTION OF PLANTATION CROPS

Theory

Role of plantation crops in national economy, export potential, IPR issues, clean development mechanism, classification and varietal wealth. Plant multiplication including *in vitro* multiplication, systems of cultivation, multitier cropping, photosynthetic efficiencies of crops at different tiers, rainfall, humidity, temperature, light and soil pH on crop growth and productivity, high density planting, nutritional requirements, physiological disorders, role of growth regulators and macro and micro nutrients, water requirements, fertigation, moisture conservation, shade regulation, weed management, training and pruning, crop regulation, maturity indices, harvesting. Cost benefit analysis, organic farming, management of drought, precision farming.

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: Wattle and betel vine

Practical

Description of botanical and varietal features, selection of mother palms and seedlings in coconut and arecanut, soil test crop response studies and manuring practices, pruning and training, maturity standards, harvesting, Project preparation for establishing plantations, Visit to plantations.

Suggested Readings

- Anonymous, 1985. *Rubber and its Cultivation*. The Rubber Board of India.
Chopra VL & Peter KV. 2005. *Handbook of Industrial Crops*. Panima.
Harler CR. 1963. *The Culture and Marketing of Tea*. Oxford Univ. Press.
Kurian A & Peter KV. 2007. *Commercial Crops Technology*. New India Publ. Agency.
Nair MK, Bhaskara Rao EVV, Nambiar KKN & Nambiar MC. 1979. *Cashew*. CPCRI, Kasaragod.
Peter KV. 2002. *Plantation Crops*. National Book Trust.
Pradeep Kumar T, Suma B, Jyothibhaskar & Satheesan KN. 2008. *Management of Horticultural Crops*. Part I, II. New India Publ.

Agency.

Rai PS & Vidyachandram B. 1981. *Review of Work Done on Cashew*.

UAS, Research Series No.6, Bangalore.

Ranganathan V. 1979. *Hand Book of Tea Cultivation*. UPASI, Tea Res. Stn. Cinchona

Srivastava HC, Vatsaya B & Menon KKG. 1986. *Plantation Crops – Opportunities and Constraints*. Oxford & IBH.

Thampan PK. 1981. *Hand Book of Coconut Palm*. Oxford & IBH.

H O R - P G - 532: PRODUCTION TECHNOLOGY OF SPICE CROPS

Theory

Introduction, importance of spice crops-historical accent, present status - national and international, future prospects, botany and taxonomy, climatic and soil requirements, commercial varieties/hybrids, site selection, layout, sowing/planting times and methods, seed rate and seed treatment, nutritional and irrigation requirements, intercropping, mixed cropping, intercultural operations, weed control, mulching, physiological disorders, harvesting, post harvest management, plant protection measures and seed planting material and micro-propagation, precision farming, organic resource management, organic certification, quality control, pharmaceutical significance and protected cultivation of:

Unit I

Black pepper, cardamom

Unit II

Clove, cinnamon and nutmeg, allspice

Unit III

Turmeric, ginger and garlic

Unit IV

Coriander, fenugreek, cumin, fennel, ajowain, dill, celery

Unit V

Tamarind, garcinia and vanilla

Practical

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

Suggested Readings

- Agarwal S, Sastry EVD & Sharma RK. 2001. *Seed Spices: Production, Quality, Export*. Pointer Publ.
- Arya PS. 2003. *Spice Crops of India*. Kalyani.
- Bhattacharjee SK. 2000. *Hand Book of Aromatic Plants*. Pointer Publ.
- Bose TK, Mitra SK, Farooqi SK & Sadhu MK (Eds.). 1999. *Tropical Horticulture*. Vol.I. Naya Prokash.
- Chadha KL & Rethinam P. (Eds.). 1993. *Advances in Horticulture*. Vols. IX-X. *Plantation Crops and Spices*. Malhotra Publ. House.
- Gupta S. (Ed.). *Hand Book of Spices and Packaging with Formulae*. Engineers India Research Institute, New Delhi.
- Kumar NA, Khader P, Rangaswami & Irulappan I. 2000. *Introduction to Spices, Plantation Crops, Medicinal and Aromatic Plants*. Oxford & IBH.
- Nybe EV, Miniraj N & Peter KV. 2007. *Spices*. New India Publ. Agency.
- Parthasarthy VA, Kandiannan V & Srinivasan V. 2008. *Organic Spices*. New India Publ. Agency.
- Peter KV. 2001. *Hand Book of Herbs and Spices*. Vols. I-III. Woodhead Publ. Co. UK and CRC USA
- Pruthi JS. (Ed.). 1998. *Spices and Condiments*. National Book Trust
- Pruthi JS. 2001. *Minor Spices and Condiments- Crop Management and Post Harvest Technology*. ICAR.
- Purseglove JW, Brown EG, Green CL & Robbins SRJ. (Eds.). 1981. *Spices*. Vols. I, II. Longman.
- Shanmugavelu KG, Kumar N & Peter KV. 2002. *Production Technology of Spices and Plantation Crops*. Agrobios.
- Thamburaj S & Singh N. (Eds.). 2004. *Vegetables, Tuber Crops and Spices*. ICAR.
- Tiwari RS & Agarwal A. 2004. *Production Technology of Spices*. International Book Distr. Co.
- Varmudy V. 2001. *Marketing of Spices*. Daya Publ. House.

HOR-PG-533: PRODUCTION TECHNOLOGY FOR MEDICINAL AND AROMATIC CROPS

Theory

Unit I

Herbal industry, WTO scenario, Export and import status, Indian system of medicine, Indigenous Traditional Knowledge, IPR issues, Classification of medicinal crops, Systems of cultivation, Organic production, Role of institutions and NGO's in production, GAP in medicinal crop production.

Unit II

Production technology for Senna, Periwinkle, Coleus, Aswagandha, Glory lily, Sarpagandha, *Dioscorea* sp., *Aloe vera*, *Phyllanthus amarus*, *Andrographis*

paniculata.

Unit III

Production technology for Medicinal solanum, Isabgol, Poppy, Safed musli, *Stevia rebaudiana*, *Mucuna pruriens*, *Ocimum sp.*

Unit IV

Post harvest handling – Drying, Processing, Grading, Packing and Storage, processing and value addition; GMP and Quality standards in herbal products.

Unit V

Influence of biotic and abiotic factors on the production of secondary metabolites, Regulations for herbal raw materials, Phytochemical extraction techniques.

Unit VI

Aromatic industry, WTO scenario, Export and import status, Indian perfumery industry, History, Advancements in perfume industry.

Unit VII

Production technology for palmarosa, lemongrass, citronella, vetiver, geranium, artemisia, mentha, ocimum, eucalyptus, rosemary, thyme, patchouli, lavender, marjoram, oreganum.

Unit VIII

Post-harvest handling, Distillation methods, advanced methods, Solvent extraction process, steam distillation, Perfumes from non-traditional plants, Quality analysis, Value addition, Aroma chemicals, quality standards and regulations.

Unit IX

Institutional support and international promotion of essential oil and perfumery products.

Practical

Botanical description, Propagation techniques, Maturity standards, Digital documentation, Extraction of secondary metabolites, Project preparation for commercially important medicinal crops, Visit to medicinal crop fields, Visit to herbal extraction units.

Extraction of Essential oils, Project preparation for commercially important Aromatic crops, Visit to distillation and value addition units – Visit to CIMAP.

Suggested Readings

Atal CK & Kapur BM. 1982. *Cultivation and Utilization of Aromatic Plants*. RRL, CSIR, Jammu.

- Atal CK & Kapur BM. 1982. *Cultivation and Utilization of Medicinal Plants*. RRL, CSIR, Jammu.
- Farooqi AA & Sriram AH. 2000. *Cultivation Practices for Medicinal and Aromatic Crops*. Orient Longman Publ.
- Farooqi AA, Khan MM & Vasundhara M. 2001. *Production Technology of Medicinal and Aromatic Crops*. Natural Remedies Pvt. Ltd. Hota D. 2007. *Bio Active Medicinal Plants*. Gene Tech Books.
- Jain SK. 2000. *Medicinal Plants*. National Book Trust.
- Khan IA & Khanum A. *Role of Bio Technology in Medicinal and Aromatic Plants*. Vol. IX. Vkaaz Publ.
- Kurian A & Asha Sankar M. 2007. *Medicinal Plants*. Horticulture Science Series, New India Publ. Agency.
- Panda H. 2002. *Medicinal Plants Cultivation and their Uses*. Asia Pacific Business Press.
- Prajapati SS, Paero H, Sharma AK & Kumar T. 2006. *A Hand book of Medicinal Plants*. Agro Bios.
- Ramawat KG & Merillon JM. 2003. *BioTechnology-Secondary Metabolites*. Oxford & IBH.
- Skaria P Baby, Samuel Mathew, Gracy Mathew, Ancy Joseph, Ragina Joseph. 2007. *Aromatic Plants*. New India Publ. Agency.

HOR-PG-534: BREEDING OF PLANTATION CROPS AND SPICES

Theory

Species and cultivars, cytogenetics, survey, collection, conservation and evaluation, blossom biology, breeding objectives, approaches for crop improvement, introduction, selection, hybridization, mutation breeding, polyploid breeding, improvement of quality traits, resistance breeding for biotic and abiotic stresses, molecular aided breeding and biotechnological approaches, marker-assisted selection, bioinformatics, IPR issues, achievements and future thrusts.

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: Black pepper and cardamom

Unit VI: Ginger and turmeric

Unit VII: Fenugreek, coriander, fennel, celery and ajwain

Unit VIII: Nutmeg, cinnamon, clove and allspice

Practical

Characterization and evaluation of germplasm accessions, Blossom biology, studies on pollen behaviour, practices in hybridization, ploidy breeding, mutation breeding, evaluation of biometrical traits and quality traits, screening for biotic and abiotic stresses, haploid culture, protoplast culture and fusion- induction of somaclonal variation and screening the variants. Identification and familiarization of spices; floral biology anthesis; fruit set; selfing and crossing techniques; description of varieties. Salient features of improved varieties and cultivars from public and private sector, bioinformatics, visit to radiotracer laboratory, national institutes for plantation crops and plant genetic resource centers, genetic transformation in plantation crops for resistance to biotic stress/quality improvement etc.

Suggested Readings

- Anonymous 1985. *Rubber and its Cultivation*. The Rubber Board of India.
- Chadha KL & Rethinam P. (Eds.).1993. *Advances in Horticulture*. Vol. IX. *Plantation Crops and Spices*. Part-I. Malhotra Publ. House.
- Chadha KL, Ravindran PN & Sahijram L. 2000. *Biotechnology in Horticultural and Plantation Crops*. Malhotra Publ. House.
- Chadha KL. 1998. *Advances in Horticulture*. Vol. IX. *Plantation and Spices Crops*. Malhotra Publishing House, New Delhi.
- Chopra VL & Peter KV. *Handbook of Industrial Crops*. Haworth Press. Panama International Publishers, New Delhi (Indian Ed.). Damodaran VK, Vilaschandran T & Valsalakumari PK. 1979. *Research on Cashew in India*. KAU, Trichur.
- Ferwerden FP & Wit F. (Ed.). 1969. *Outlines of Perennial Crop Breeding in the Tropics*. H. Veenman & Zonen.
- Harver AE. 1962. *Modern Coffee Production*. Leonard Hoff.
- Raj PS & Vidyachandra B. 1981. *Review of Work Done on Cashew*. UAS Research Series No.6, Bangalore.
- Thampan PK 1981. *Hand Book of Coconut Palm*. Oxford & IBH.

HOR-PG-535: BREEDING OF MEDICINAL AND AROMATIC CROPS

Theory

Unit I

Plant bio-diversity, conservation of germplasm, IPR issues, Major objectives of breeding of Medicinal and Aromatic Crops, Scope for introduction; cytogenetic background of important Medicinal and Aromatic Crops; Scope for improvement of Medicinal and Aromatic Crops through selection, intra and interspecific hybridization, induced autotetraploidy, mutation breeding and biotechnological approaches.

Unit II

Breeding for yield and quality improvement in medicinal plants, Breeding for

high herbage yield, essential oil and quality components, secondary metabolites in medicinal and aromatic crops; Genetics of active principles and assay techniques useful in evaluation of breeder's material. Breeding problems in seed and vegetatively propagated medicinal and aromatic crops.

Unit III

Achievements and prospects in breeding of medicinal crops, viz. *Cassia angustifolia*, *Catharanthus roseus*, *Gloriosa superba*, *Coleus forskohlii*, *Stevia*, *Withania somnifera*, *Papaver somniferum*, *Plantago ovata*, *Dioscorea* sp.

Unit IV

Prospects in breeding of medicinal crops, viz. *Chlorophytum* sp, *Rauvolfia serpentina*, *Aloe vera*, *Ocimum* sp, *Phyllanthus amarus*, *Solanum* sp.

Unit V

Prospects in breeding of aromatic crops viz., Geranium, vetiver, Lemon grass, Palmarosa, citronella, Rosemary, Patchouli, Eucalyptus, Artemisia and Mint.

Practical

Description of Botanical features, Cataloguing of cultivars, varieties and species in medicinal and aromatic crops, Floral Biology, Selfing and crossing, Evaluation of hybrid progenies, Induction of economic mutants, High alkaloid and high essential oil mutants, evolution of mutants through physical and chemical mutagens, Introduction of polyploidy, Screening of plants for biotic and abiotic stress and environmental pollution, *in-vitro* breeding in medicinal and aromatic crops.

Suggested Readings

- Atal CK & Kapur BM. 1982. *Cultivation and Utilization of Medicinal Plants*. RRL, CSIR, Jammu.
- Chadha KL & Gupta R. 1995. *Advances in Horticulture*. Vol. XI. Malhotra Publ. House.
- Farooqi AA, Khan MM & Vasundhara M. 2001. *Production Technology of Medicinal and Aromatic Crops*. Natural Remedies Pvt. Ltd. Jain SK.
- 2000. *Medicinal Plants*. National Book Trust.
- Julia F & Charters MC. 1997. *Major Medicinal Plants – Botany, Cultures and Uses*. Thomas Publ.
- Kurian A & Asha Sankar, M. 2007. *Medicinal Plants*. Horticulture Science Series, New India Publ. Agency.
- Prajapati ND, Paero Hit SS, Sharma AK, Kumar T. 2006. *A Hand book of Medicinal Plants*. Agro Bios (India).
- Skaria P Babu. 2007. *Aromatic Plants*. New India Publ. Agency.
- Thakur RS, Pauri HS & Hussain A. 1989. *Major Medicinal Plants of India*. CSIR.

COMMON COMPULSORY MAJOR COURSES FOR ALL STUDENTS

HOR-PG-541: POST HARVEST TECHNOLOGY FOR HORTICULTURE CROPS

Theory

Unit I

Maturity indices, harvesting practices for specific market requirements, influence of pre-harvest practices, enzymatic and textural changes, respiration, transpiration.

Unit II

Physiology and biochemistry of fruit ripening, ethylene evolution and ethylene management, factors leading to post-harvest loss, pre-cooling.

Unit III

Treatments prior to shipment, viz., chlorination, waxing, chemicals, biocontrol agents and natural plant products. Methods of storage-ventilated, refrigerated, MAS, CA storage, physical injuries and disorders.

Unit IV

Packing methods and transport, principles and methods of preservation, food processing, canning, fruit juices, beverages, pickles, jam, jellies, candies.

Unit V

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 and study of vase life extension in cut flower using chemicals, estimation of quality characteristics in stored fruits and vegetables, cold chain management - visit to cold storage and CA storage units, visit to fruit and vegetable processing units, project preparation, evaluation of processed horticultural products.

Suggested Readings

- Bhutani RC. 2003. *Fruit and Vegetable Preservation*. Biotech Books.
Chadha KL & Pareek OP. (Eds.). 1996 *Advances in Horticulture*. Vol. IV. Malhotra Publ. House.
Haid NF & Salunkhe SK. 1997. *Post Harvest Physiology and Handling of Fruits and Vegetables*. Grenada Publ.

Mitra SK. 1997. *Post Harvest Physiology and Storage Sub-tropical Fruits*. CABI.

Ranganna S. 1997. *Hand Book of Analysis and Quality Control for Fruit and Vegetable Products*. Tata McGraw-Hill.

Sudheer KP & Indira V. 2007. *Post Harvest Technology of Horticultural Crops*. New India Publ. Agency.

Willis R, Mc Glassen WB, Graham D & Joyce D. 1998. *Post Harvest. An Introduction to the Physiology and Handling of Fruits, Vegetables and Ornamentals*. CABI.

HOR-PG-542: GROWTH REGULATION OF HORTICULTURAL CROPS

Theory

Unit I

Growth and development- definition, parameters of growth and development, growth dynamics, morphogenesis.

Unit II

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.

UNIT III

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.

Unit IV

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.

Unit V

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.

Suggested Readings

- Buchanan B, Gruissem W & Jones R. 2002. *Biochemistry & Molecular Biology of Plants*. John Wiley & Sons.
- Epstein E. 1972. *Mineral Nutrition of Plants: Principles and Perspectives*. Wiley.
- Fosket DE. 1994. *Plant Growth and Development: a Molecular Approach*. Academic Press.
- Leopold AC & Kriedemann PE. 1985. *Plant Growth and Development*. 3rd Ed. Mc Graw-Hill.
- Peter KV. 2008. (Ed.) *Basics of Horticulture*. New India Publ. Agency.
- Roberts J, Downs S & Parker P. 2002. Plant Growth Development. In: *Plants* (I. Ridge, Ed.), pp. 221-274, Oxford University Press.
- Salisbury FB & Ross CW. 1992. *Plant Physiology*. 4th Ed. Wadsworth Publ.

HOR-PG-543: PROTECTED CULTIVATION OF HORTICULTURE CROPS

Theory

Unit I

Greenhouse – World scenario, Indian situation: present and future, Different agro-climatic zones in India, Environmental factors and their effects on plant growth.

Unit II

Basics of greenhouse design, different types of structures – glasshouse, shade net, poly tunnels - Design and development of low cost greenhouse structures.

Unit III

Interaction of light, temperature, humidity, CO₂, water on crop regulation - Greenhouse heating, cooling, ventilation and shading.

Unit IV

Types of ventilation- Forced cooling techniques - Glazing materials - Micro irrigation and Fertigation.

Unit V

Automated greenhouses, microcontrollers, waste water recycling, Management of pest and diseases – IPM.

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.

Suggested Readings

- Aldrich RA & Bartok JW. 1994. *Green House Engineering*. NRAES, Riley, Robb Hall, Cornell University, Ithaca, New York.
- Bhattacharjee BS. 1959. *Rose Growing in Tropics*. Thackarspink & Co.
- Laurie A, Kiplingr DD & Nelson KS. 1968. *Commercial Flower Forcing*. McGraw-Hill.
- Mears DR, Kim MK & Roberts WJ. 1971. *Structural Analysis at an Experimental Cable-supported Air Inflated Green Houses*. Trans. ASAE.
- Pant V Nelson. 1991. *Green House Operation and Management*. Bali Publ.
- Pradeep Kumar T, Suma B, Jyothibhaskar & Satheesan KN. 2007. *Management of Horticultural Crops*. Parts I, II. New India Publ. Agency.

COMPULSORY SUPPORTIVE COURSES FOR ALL STUDENTS

HOR-PG-506: BIOTECHNOLOGY FOR CROP IMPROVEMENT

Theory

Unit I

Biotechnology and its relevance in agriculture; Definitions, terminologies and scope in plant breeding.

Unit II

Tissue culture- History, callus, suspension cultures, cloning; Regeneration; Somatic embryogenesis; Anther culture; somatic hybridization techniques; Meristem, ovary and embryo culture; cryopreservation.

Unit III

Techniques of DNA isolation, quantification and analysis; Genotyping; Sequencing techniques; Vectors, vector preparation and cloning, Biochemical and Molecular markers: morphological, biochemical and DNA-based markers (RFLP, RAPD, AFLP, SSR,SNPs, ESTs etc.), mapping populations (F2s, back crosses, RILs, NILs and DH).

Unit IV

Molecular mapping and tagging of agronomically important traits. Statistical tools in marker analysis, Robotics; Marker-assisted selection for qualitative and quantitative traits; QTLs analysis in crop plants, Gene pyramiding.

Unit V

Marker assisted selection and molecular breeding; Genomics and genoinformatics for crop improvement; Integrating functional genomics information on agronomically/economically important traits in plant breeding; Marker-assisted backcross breeding for rapid introgression, Generation of EDVs.

Unit VI

Recombinant DNA technology, transgenes, method of transformation, selectable markers and clean transformation techniques, vector-mediated gene transfer, physical methods of gene transfer. Production of transgenic plants in various horticultural crops and Commercial releases.

Unit VII

Biotechnology applications in male sterility/hybrid breeding, molecular farming.

Unit VIII

MOs and related issues (risk and regulations); GMO; International regulations, biosafety issues of GMOs; Regulatory procedures in major countries including India, ethical, legal and social issues; Intellectual property rights.

Unit IX

Bioinformatics & Bioinformatics tools.

Unit X

Nanotechnology and its applications in crop improvement programmes.

Practical

Requirements for plant tissue culture laboratory-Techniques in plant tissue culture - Media components and media preparation -Aseptic manipulation of various explants ; observations on the contaminants occurring in media – interpretations - Inoculation of explants; Callus induction and plant regeneration - Plant regeneration; Standardizing the protocols for regeneration; Hardening of regenerated plants; Establishing a greenhouse and hardening procedures - Visit to commercial micropropagation unit. Transformation using Agrobacterium strains, GUS assay in transformed cells / tissues. DNA isolation, DNA purity and quantification tests, gel electrophoresis of proteins and isozymes, PCR-based DNA markers, gel scoring and data analysis for tagging and phylogenetic relationship, construction of genetic linkage maps using computer software.

Suggested Readings

Chopra VL & Nasim A. 1990. Genetic Engineering and Biotechnology: Concepts, Methods and Applications. Oxford & IBH.

- Gupta PK. 1997. Elements of Biotechnology. Rastogi Publ.
- Hackett PB, Fuchs JA & Messing JW. 1988. An Introduction to Recombinant DNA Technology - Basic Experiments in Gene Manipulation. 2nd Ed. Benjamin Publ. Co.
- Sambrook J & Russel D. 2001. Molecular Cloning - a Laboratory Manual. 3rd Ed. Cold Spring Harbor Lab. Press.
- Singh BD. 2005. Biotechnology, Expanding Horizons. Kalyani.

HOR-PG-507: EXPERIMENTAL DESIGNS

Theory

Unit I

Need for designing of experiments, characteristics of a good design. Basic principles of designs- randomization, replication and local control.

Unit II

Uniformity trials, size and shape of plots and blocks; Analysis of variance; Completely randomized design, randomized block design and Latin square design.

Unit III

Factorial experiments, (symmetrical as well as asymmetrical). orthogonality and partitioning of degrees of freedom, Confounding in symmetrical factorial experiments, Factorial experiments with control treatment.

Unit IV

Split plot and strip plot designs; Analysis of covariance and missing plot techniques in randomized block and Latin square designs; Transformations, crossover designs, balanced incomplete block design, resolvable designs and their applications ~ Lattice design, alpha design - concepts, randomisation procedure, analysis and interpretation of results. Response surfaces. Experiments with mixtures.

Unit V

Bioassays- direct and indirect, indirect assays based on quantal dose response, parallel line and slope ratio assays potency estimation.

Practical

Uniformity trial data analysis, formation of plots and blocks, Fairfield Smith Law; Analysis of data obtained from CRD, RBD, LSD; Analysis factorial experiments without and with confounding; Analysis with missing data; Split plot and strip plot designs; Transformation of data; Analysis of resolvable designs; Fitting of response surfaces.

Suggested Readings

- Cochran WG & Cox GM. 1957. Experimental Designs. 2nd Ed. John Wiley.
- Dean AM & Voss D. 1999. Design and Analysis of Experiments. Springer.

Federer WT. 1985. Experimental Designs. MacMillan.
Fisher RA. 1953. Design and Analysis of Experiments. Oliver & Boyd.
Nigam AK & Gupta VK. 1979. Handbook on Analysis of Agricultural Experiments. IASRI Publ.
Pearce SC. 1983. The Agricultural Field Experiment: A Statistical Examination of Theory and Practice.

HOR-PG-549: MASTER'S SEMINAR

The students will deliver a one credit compulsory seminar related to his or her major course.

HOR-PG-550: MASTER'S RESEARCH

The MSc students will submit their synopses of the research work to be done in the first semester and it will be evaluated by Departmental Research Committee. They will submit their theses by the end of fourth semester.

NON-CREDIT COMPULSORY COURSES

HOR-PG-571: LIBRARY AND INFORMATION SERVICES

Theory

To equip the library users with skills to trace information from libraries efficiently, to apprise them of information and knowledge resources, to carry out literature survey, to formulate information search strategies, and to use modern tools (Internet, OPAC, search engines etc.) of information search.

Practical

Introduction to library and its services; Role of libraries in education, research and technology transfer; Classification systems and organization of library; Sources of information- Primary Sources, Secondary Sources and Tertiary Sources; Intricacies of abstracting and indexing services (Science Citation Index, Biological Abstracts, Chemical Abstracts, CABI Abstracts, etc.); Tracing information from reference sources; Literature survey; Citation techniques/Preparation of bibliography; Use of CD-ROM Databases, Online Public Access Catalogue and other computerized library services; Use of Internet including search engines and its resources; e-resources access methods.

HOR-PG-572: TECHNICAL WRITING AND COMMUNICATIONS SKILLS

Theory

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

Practical

Technical Writing - Various forms of scientific writings- theses, technical papers, reviews, manuals, etc; Various parts of thesis and research communications (title page, authorship contents page, preface, introduction, review of literature, material and methods, experimental results and discussion); Writing of abstracts, summaries, précis, citations etc.; commonly used abbreviations in the theses and research communications; illustrations, photographs and drawings with suitable captions; pagination, numbering of tables and illustrations; Writing of numbers and dates in scientific write-ups; Editing and proof-reading; Writing of a review article.

Communication Skills - Grammar (Tenses, parts of speech, clauses, punctuation marks); Error analysis (Common errors); Concord; Collocation; Phonetic symbols and transcription; Accentual pattern: Weak forms in connected speech: Participation in group discussion: Facing an interview; presentation of scientific papers.

Suggested Readings

- Chicago Manual of Style*. 14th Ed. 1996. Prentice Hall of India.
Collins' Cobuild English Dictionary. 1995. Harper Collins.
Gordon HM & Walter JA. 1970. *Technical Writing*. 3rd Ed. Holt, Rinehart & Winston.
Hornby AS. 2000. *Comp. Oxford Advanced Learner's Dictionary of Current English*. 6th Ed. Oxford University Press.
James HS. 1994. *Handbook for Technical Writing*. NTC Business Books.
Joseph G. 2000. *MLA Handbook for Writers of Research Papers*. 5th Ed. Affiliated East-West Press.
Mohan K. 2005. *Speaking English Effectively*. MacMillan India.
Richard WS. 1969. *Technical Writing*. Barnes & Noble.
Robert C. (Ed.). 2005. *Spoken English: Flourish Your Language*. Abhishek.
Sethi J & Dhamija PV. 2004. *Course in Phonetics and Spoken English*. 2nd Ed. Prentice Hall of India.
Wren PC & Martin H. 2006. *High School English Grammar and Composition*. S. Chand & Co.

HOR-PG-573: INTELLECTUAL PROPERTY AND ITS MANAGEMENT IN AGRICULTURE (e-Course)

Theory

Historical perspectives and need for the introduction of Intellectual Property Right regime; TRIPs and various provisions in TRIPs Agreement; Intellectual Property and Intellectual Property Rights (IPR), benefits of securing IPRs; Indian Legislations for the protection of various types of Intellectual Properties; Fundamentals of patents, copyrights, geographical indications, designs and layout, trade secrets and traditional knowledge,

trademarks, protection of plant varieties and farmers' rights and biodiversity protection; Protectable subject matters, protection in biotechnology, protection of other biological materials, ownership and period of protection; National Biodiversity protection initiatives; Convention on Biological Diversity; International Treaty on Plant Genetic Resources for Food and Agriculture; Licensing of technologies, Material transfer agreements, Research Collaboration, Agreement, License Agreement

Suggested Readings

- Erbisch FH & Maredia K. 1998. *Intellectual Property Rights in Agricultural Biotechnology*. CABI.
- Ganguli P. 2001. *Intellectual Property Rights: Unleashing Knowledge Economy*. McGraw-Hill.
- Intellectual Property Rights: Key to New Wealth Generation*. 2001. NRDC & Aesthetic Technologies.
- Ministry of Agriculture, Government of India. 2004. *State of Indian Farmer*. Vol. V. *Technology Generation and IPR Issues*. Academic Foundation.
- Rothschild M & Scott N. (Ed.). 2003. *Intellectual Property Rights in Animal Breeding and Genetics*. CABI.
- Saha R. (Ed.). 2006. *Intellectual Property Rights in NAM and Other Developing Countries: A Compendium on Law and Policies*. Daya Publ. House.
- The Indian Acts - Patents Act, 1970 and amendments; Design Act, 2000; Trademarks Act, 1999; The Copyright Act, 1957 and amendments; Layout Design Act, 2000; PPV and FR Act 2001, and Rules 2003; National Biological Diversity Act, 2003.*

HOR-PG-574: BASIC CONCEPTS IN LABORATORY TECHNIQUES

Practical

Safety measures while in Lab; Handling of chemical substances; Use of burettes, pipettes, measuring cylinders, flasks, separatory funnel, condensers, micropipettes and vascupets; washing, drying and sterilization of glassware; Drying of solvents/chemicals. Weighing and preparation of solutions of different strengths and their dilution; Handling techniques of solutions; Preparation of different agro-chemical doses in field and pot applications; Preparation of solutions of acids; Neutralisation of acid and bases; Preparation of buffers of different strengths and pH values. Use and handling of microscope, laminar flow, vacuum pumps, viscometer, thermometer, magnetic stirrer, micro-ovens, incubators, sandbath, waterbath, oilbath; Electric wiring and earthing. Preparation of media and methods of sterilization; Seed viability testing, testing of pollen viability; Tissue culture of crop plants; Description of flowering plants in botanical terms in relation to taxonomy

Suggested Readings

- Furr AK. 2000. *CRC Hand Book of Laboratory Safety*. CRC Press.
Gabb MH & Latchem WE. 1968. *A Handbook of Laboratory Solutions*.
Chemical Publ. Co.

HOR-PG-575: AGRICULTURAL RESEARCH RESEARCH

(e-Course) AND RURAL DEVELOPMENT PROGRAMMES

Theory

Unit I

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

Unit II

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

Unit III

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

Suggested Readings

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

HOR-PG-576: DISASTER MANAGEMENT (e-Course)

Theory

Unit I

Natural Disasters - Meaning and nature of natural disasters, their types and effects. Floods, Drought, Cyclone, Earthquakes, Landslides, Avalanches, Volcanic eruptions, Heat and cold Waves, Climatic Change: Global warming, Sea Level rise, Ozone Depletion

Unit II

Man-made Disasters - Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire. Oil fire, air pollution, water pollution, deforestation, Industrial wastewater pollution, road accidents, rail accidents, air accidents, sea accidents.

Unit III

Disaster Management- Efforts to mitigate natural disasters at national and global levels. International Strategy for Disaster reduction. Concept of disaster management, national disaster management framework; financial arrangements; role of NGOs, Community-based organizations, and media. Central, State, District and local Administration; Armed forces in Disaster response; Disaster response: Police and other organizations.

Suggested Readings

- Gupta HK. 2003. *Disaster Management*. Indian National Science Academy. Orient Blackswan.
- Hodgkinson PE & Stewart M. 1991. *Coping with Catastrophe: A Handbook of Disaster Management*. Routledge.
- Sharma VK. 2001. *Disaster Management*. National Centre for Disaster Management, India.