

POST GRADUATE SYLLABUS

(Prepared from ICAR PG Syllabus of Horticulture)

Degree to be awarded

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

Department of Pomology and Post Harvest Technology

FACULTY OF HORTICULTURE

UTTAR BANGA KRISHI VISWAVIDYALAYA

PUNDIBARI, COOCH BEHAR

Departmental PG Courses and Syllabus

a) M.Sc. courses

Sl	Course	Course Title	Credit
1	PPT501*	Tropical & Subtropical Fruit Production- I	2+1
2	PPT502*	Tropical & Subtropical Fruit Production- II	2+1
3	PPT 503*	Temperate Fruit Production Technology	2+1
4	PPT504*	Breeding of Fruit Crops	2+1
5	PPT 505*	Post Harvest Physiology & Handling of Horticultural Crops	2+1
6	PPT 506*	Principles of Preservation of Horticultural Crops	2+1
7	PPT507*	Propagation, Nursery Management & Biotechnology of Fruit Crops	2+1
8	PPT508	Storage Systems and Operations	2+0
9	PPT509	Organic Fruit Production and Gap For Fruit Crops	2+0
10	PPT510	Orchard Management Including Canopy Management in Fruit Crops	1+0
11	PPT511	Protected Cultivation and Climate Management for Fruit Crops	2+1
12	PPT512	Growth and Development of Horticultural Crops	2+1
13	PPT 513	Biodiversity and Conservation of Fruit Crops	1+0
14	PPT 591	Master's Seminar	1+0
15	PPT599	Master's Research	20

M.SC. SYLLABUS

1. PPT501: Tropical & Subtropical Fruit Production- I 3 (2+1)

Theory

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

Practical

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

2. PPT502: Tropical & Subtropical Fruit Production- II 2+1

Theory

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

Sapota, Jackfruit, rambutan, Avocado, aonla, Pomegranate, Ber, Loquat, Persimmon, mangosteen, Carambola, bael, fig, jamun,

Practical

Nutrition, weed management and propagation techniques of above mentioned crops. Identification of

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

3. PPT 503: Temperate Fruit Production Technology 3 (2+1)

Theory

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

Practical

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

4. PPT 504: Breeding of Fruit Crops 3(2+1)

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: Mango, banana, pineapple, Citrus, grapes, guava, sapota, papaya, custard apple, litchi, apple, pear, and strawberry

Practical

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

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

Theory

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

Practical

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

6. PPT 506: Principal of Preservation of Horticultural Crops

3(2+1)

Theory

History of food preservation, general principles of preservation; asepsis. Thermal processing, heat resistance of micro-organism & enzymes in food, heat penetration in cans, determination of process time. Low temperature preservation: freezing, methods of freezing, changes during freezing, changes during storage of freezing products. Theory of gel formation, pectin chemistry, sources, problems in jelly making. Drying & Dehydration: blanching, sun drying, mechanical drying, and different types of driers. Food fermentation - alcoholic, acetic, and lactic fermentation, pickling. Preservatives - Class-I & II preservatives, their mode of action, use of antibiotics in food preservation, Preservation by ionizing radiation - principles, sources and types of radiations, their mode of action. Food colour, Food flavour, Food additives.

Practical

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

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

Theory

Introduction, sexual propagation, apomixis, polyembryony, chimeras. Factors influencing seed germination, dormancy. Asexual propagation - different types of cutting. Physiological, anatomical and biochemical aspects of root induction in cuttings. Layering. Budding and grafting - selection of elite mother plants. Establishment of budwood bank, stock, scion and interstock relationship, incompatibility. Rejuvenation through top working, Progeny orchard and scion bank. Nursery - types, structures, components, planning and layout. Nursery management practices for healthy propagule production. Micro-propagation - principles and concepts, commercial exploitation in fruit crops. Techniques - *in vitro* clonal propagation, organogenesis, embryogenesis, micrografting, meristem culture. Hardening, packing and transport of micro-propagules. Harnessing bio-technology in fruit crops, influence of plant materials, physical, chemical factors and growth regulators on growth and development of plant cell, tissue and organ culture. Callus culture - types, cell division, differentiation, morphogenesis, organogenesis, embryogenesis. Physiology of hardening - hardening and field transfer, organ culture - meristem, embryo, anther, ovule culture, embryo rescue, somaclonal variation, protoplast culture and fusion. Omatic hybrids and cybrids, wide hybridization, *in vitro* pollination and fertilization, cryopreservation, rapid clonal propagation, genetic engineering in fruit crops, use of molecular markers.

Practical

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

8. PPT 508 : Storage systems and operations 3(2+1)

Theory:

Introduction. Principles of storage, Objectives of storage, storage considerations- temperature, relative humidity and atmospheric composition. Concept of cool chain. Storage systems- low cost storage techniques; zero energy cool chamber, high cost storage techniques: ambient temperature storage. Refrigerated storage: design and operation, hypobaric storage, MAP and CAP, storage with irradiation, concept of multipurpose cold storage. Chilling injuries and other physiological disorder in storage.

Practical: equipments and design of different storage system, Effectiveness of ZECC in extending storage life, post harvest loss assessment. Demonstration of chilling injury and physiological disorder in storage. Calculation related to mass and energy balance. Visit to cold storage.

9. PPT509: Organic Fruit Production And Gap For Fruit Crops 2(1+1)

Theory

Organic horticulture– definition, principles, methods, merits and demerits. Organic farming systems, components of organic horticultural systems, different organic inputs, their role in organic horticulture, role of biofertilizers, biodynamics and their recent developments. Sustainable soil fertility management, weed management practices in organic farming, biological/natural control of pests and diseases, organic horticulture in quality improvement. Genesis of GAP–

definition/description, components listed by FAO, framework. Management of site history and soil, crop and fodder production, IPM, INM, IWM, irrigation water, crop production and protection. Identification of ways of improving the productivity, profitability, and resource efficiency. Harvest and post-harvest handling.

Animal production, product certification, animal waste management, animal health and welfare, harvest. On farm processing, storage, energy and waste management, human health,

welfare, safety, wildlife benefits. Institutions involved in GAP certification. Indian agencies, EUREPGAP (European Retail Producers Group-Good Agricultural Practices), EUREP etc.

Practical

Bio-composting, biofertilizers and their application, methods of preparation of compost, vermicompost, application of neem products, visit to fields cultivated under organic practices

10. PPT510 Orchard Management Including Canopy Management in Fruit Crops 2(1+1)

Theory

Principles, planning for orchard establishment, Selection of site for orchard, Layout and system of planting in orchard. High density orcharding, Cropping systems followed in orchard: Intercropping, multi-tier cropping, mulching, sod culture, cover cropping, green manuring. Weed management. Canopy management- importance and advantages; factors affecting canopy development. Canopy types and structures with special emphasis on geometry of planting, canopy manipulation for optimum utilization of light. Light interception and distribution in different types of tree canopies. Spacing and utilization of land area - Canopy classification; Canopy management through rootstock and scion.

Canopy management through plant growth inhibitors, training and pruning and management practices. Canopy development and management in relation to growth, flowering, fruiting and fruit quality in tropical, subtropical and temperate fruit crops.

Practical

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

11. PPT 511: Protected Cultivation and Climate Management for Fruit Crops 3(2+1)

Theory

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

Practical

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

12. PPT 512: Growth and Development of Horticultural Crops 3(2+1)

Theory

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

Practical

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

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

Theory

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

Practical

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

14. PPT: 591

Masters' Seminar –I

1(1+0)

POST GRADUATE SYLLABUS

(Prepared from ICAR PG Syllabus of Horticulture)

Degree to be awarded

M. Sc. (Hort.) in Vegetable and Spice Crops

DEPARTMENT OF VEGETABLE AND SPICE CROPS

FACULTY OF HORTICULTURE

UTTAR BANGA KRISHI VISWAVIDYALAYA

PUNDIBARI, COOCH BEHAR

Tentative distribution of courses

M. Sc. Semester –I

VSC 501* PRODUCTION TECHNOLOGY OF COOL SEASON VEGETABLE CROPS 2+1

VSC 504* GROWTH AND DEVELOPMENT OF VEGETABLE CROPS 2+1

VSC 506 SYSTEMATICS OF VEGETABLE CROPS 1+1

VSC 510* PRODUCTION TECHNOLOGY OF SPICE CROPS 2+1

M. Sc. Semester –II

VSC 502* PRODUCTION TECHNOLOGY OF WARM SEASON VEGETABLE CROPS 2+1

VSC 505 SEED PRODUCTION TECHNOLOGY OF VEGETABLE CROPS 2+1

VSC 511* BREEDING OF SPICES 2+1

M. Sc. Semester –III

VSC 503* BREEDING OF VEGETABLE CROPS 2+1

VSC 507 PRODUCTION TECHNOLOGY OF UNDEREXPLOITED VEGETABLE CROPS 1+1

VSC 508 ORGANIC VEGETABLE PRODUCTION TECHNOLOGY 1+1

VSC 513 ORGANIC SPICE PRODUCTION TECHNOLOGY 2+1

M. Sc. Semester –IV

VSC 509 FUNDAMENTALS OF PROCESSING OF VEGETABLES 1+1

VSC 512* PROCESSING OF SPICES 1+1

VSC 591* MASTER'S SEMINAR 1+0

M. Sc. Semester I–IV

VSC 599* MASTER'S RESEARCH 20

Code Numbers

- All courses are divided into two series: 500-series courses pertain to Master's level, and 600-series to Doctoral level. A Ph. D. student must take a minimum of two 600 series courses, but may also take 500-series courses if not studied during Master's programme.
- Credit seminar for Master's level is designated by code no. 591, and the two seminars for Doctoral level are coded as 691 and 692, respectively.
- Similarly, 599 and 699 codes have been given for Master's research and Doctoral research, respectively.

Course Contents

The contents of each course have been organized into:

- Objective – to elucidate the basic purpose.
- Theory units – to facilitate uniform coverage of syllabus for paper setting.
- Suggested Readings – to recommend some standard books as reference material. This does not unequivocally exclude other such reference material that may be recommended according to the advancements and local requirements.

- A list of journals pertaining to the discipline is provided at the end which may be useful as study material for 600-series courses as well as research topics.
- E-Resources - for quick update on specific topics/events pertaining to the subject.
- Broad research topics provided at the end would facilitate the advisors for appropriate research directions to the PG students.

Minimum Credit Requirements

Subject	Master's programme	Doctoral programme
Major	20	15
Minor	09	08
Supporting	05	05
Seminar	01	02
Research	20	45
Total Credits	55	75

Compulsory Non Credit Courses See relevant section

Major subject: The subject (department) in which the students takes admission

Minor subject: The subject closely related to students major subject (e.g., if the majorsubject is Entomology, the appropriate minor subjects should be Plant Pathology & Nematology).

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

Non-Credit Compulsory Courses: Please see the relevant section for details. Sixcourses (PGS 501-PGS 506) are of general nature and are compulsory for Master'sprogramme. Ph. D. students may be exempted from these courses if already studiedduring Master's

COURSES OF VEGETABLE CROPS

Course Structure – at a Glance

CODE COURSE TITLE CREDITS

VSC 501* PRODUCTION TECHNOLOGY OF COOL SEASONVEGETABLE CROPS2+1
 VSC 502* PRODUCTION TECHNOLOGY OF WARM SEASONVEGETABLE CROPS2+1
 VSC 503* BREEDING OF VEGETABLE CROPS 2+1
 VSC 504* GROWTH AND DEVELOPMENT OF VEGETABLE CROPS 2+1
 VSC 505 SEED PRODUCTION TECHNOLOGY OF VEGETABLECROPS2+1
 VSC 506 SYSTEMATICS OF VEGETABLE CROPS 1+1
 VSC 507 PRODUCTION TECHNOLOGY OF UNDEREXPLOITEDVEGETABLE CROPS1+1
 VSC 508 ORGANIC VEGETABLE PRODUCTION TECHNOLOGY 1+1
 VSC 509 FUNDAMENTALS OF PROCESSING OF VEGETABLES 1+1

VSC 591* MASTER'S SEMINAR 1+0

VSC 599* MASTER'S RESEARCH 20

COURSES OF SPICE CROPS

VSC 510* PRODUCTION TECHNOLOGY OF SPICE CROPS 2+1

VSC 511* BREEDING OF SPICES 2+1

VSC 512* PROCESSING OF SPICES 1+1

VSC 513 ORGANIC SPICE PRODUCTION TECHNOLOGY 2+1

* Compulsory for Master's programme; **Compulsory for Doctoral programme

COMPULSORY NON-CREDIT COURSES

(Compulsory for Master's programme in all disciplines; Optional for Ph.D. scholars)

PGS 501 LIBRARY AND INFORMATION SERVICES 0+1

PGS 502 TECHNICAL WRITING AND COMMUNICATIONS SKILLS 0+1

PGS 503(e-Course) INTELLECTUAL PROPERTY AND ITS MANAGEMENT IN AGRICULTURE 1+0

PGS 504 BASIC CONCEPTS IN LABORATORY TECHNIQUES 0+1

PGS 505 (e-Course) AGRICULTURAL RESEARCH, RESEARCH ETHICS AND RURAL DEVELOPMENT PROGRAMMES 1+0

PGS 506 (e-Course) DISASTER MANAGEMENT 1+0

VEGETABLE CROPS

Course Contents

VSC 501 PRODUCTION TECHNOLOGY OF COOL SEASON VEGETABLE CROPS 2+1

Objective

To educate production technology of cool season vegetables.

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.
- Gopalakrishnan 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 Oleric 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 SP. (Ed.). 1989. *Production Technology of Vegetable Crops*. Agril. Comm. Res. Centre.
- Thamburaj S & Singh N. (Eds.). 2004. *Vegetables, Tuber Crops and Spices*. ICAR.
- Thompson HC & Kelly WC. (Eds.). 1978. *Vegetable Crops*. Tata McGraw-Hill.

VSC 502 PRODUCTION TECHNOLOGY OF WARM SEASON 2+1 VEGETABLE CROPS

Objective

To teach production technology of warm season vegetables.

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.
- Bose TK, Kabir J, Maity TK, Parthasarathy VA & Som MG. 2003. *Vegetable Crops*. Vols. I-III. Naya Udyog.
- Bose TK, Som MG & Kabir J. (Eds.). 2002. *Vegetable Crops*. Naya Prokash.
- Brown HD & Hutchison CS. *Vegetable Science*. JB Lippincott Co.
- 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. 1964. *Fundamentals of Horticulture*. Blakiston Co
- Fageria MS, Choudhary BR & Dhaka RS. 2000. *Vegetable Crops: Production Technology*. Vol. II. Kalyani.
- Gopalakrishnan TR. 2007. *Vegetable Crops*. New India Publ. Agency.
- Hazra P & Som MG. (Eds.). 1999. *Technology for Vegetable Production and Improvement*. Naya Prokash.
- Kaloo G & Singh K (Ed.). 2000. *Emerging Scenario in Vegetable Research and Development*. Research Periodicals & Book Publ. House.
- Nayer NM & More TA 1998. *Cucurbits*. Oxford & IBH Publ.
- Palaniswamy & Peter KV. 2007. *Tuber Crops*. New India Publ. Agency.
- Pandey AK & Mudranalay V. (Eds.). *Vegetable Production in India: Important Varieties and Development Techniques*.
- Rana MK. 2008. *Olericulture in India*. Kalyani.
- Rana MK. 2008. *Scientific Cultivation of Vegetables*. Kalyani.
- Rubatzky VE & Yamaguchi M. (Eds.). 1997. *World Vegetables: Principles, Production and Nutritive Values*. Chapman & Hall.
- Saini GS. 2001. *A Text Book of Olericulture and Floriculture*. 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 McGraw Hill.

VSC 503 BREEDING OF VEGETABLE CROPS 2+1

Objective

To educate principles and practices adopted for 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. 1988. *Vegetable Breeding*. Vols. I-III. CRC Press.

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.

VSC 504 GROWTH AND DEVELOPMENT OF VEGETABLE CROPS 2+1

Objective

To teach the physiology of growth and development of vegetable crops.

Theory

UNIT I Cellular structures and their functions; definition of growth and development, growth analysis and its importance in vegetable production.

UNIT II Physiology of dormancy and germination of vegetable seeds, tubers and bulbs; Role of auxins, gibberellins, cytokinins and abscisic acid; Application of synthetic hormones, plant growth retardants and inhibitors for various purposes in vegetable crops; Role and mode of action of morphactins, antitranspirants, anti-auxin, ripening retardant and plant stimulants in vegetable crop production.

UNIT III Role of light, temperature and photoperiod on growth, development of underground parts, flowering and sex expression in vegetable crops; apical dominance.

UNIT IV Physiology of fruit set, fruit development, fruit growth, flower and fruit drop; parthenocarpy in vegetable crops; phototropism, ethylene inhibitors, senescence and abscission; fruit ripening and physiological changes associated with ripening.

UNIT V Plant growth regulators in relation to vegetable production; morphogenesis and tissue culture techniques in vegetable crops.

Practical

Preparation of solutions of plant growth substances and their application; experiments in breaking and induction of dormancy by chemicals; induction of parthenocarpy and fruit ripening; application of plant growth substances for improving flower initiation, changing sex expression in cucurbits and checking flower and fruit drops and improving fruit set in solanaceous vegetables; growth analysis techniques in vegetable crops.

Suggested Readings

Bleasdale JKA. 1984. *Plant Physiology in Relation to Horticulture*. 2nd Ed. MacMillan.

Gupta US. (Ed.). 1978. *Crop Physiology*. Oxford & IBH. Krishnamoorti HN. 1981. *Application Plant Growth Substances and Their Uses in Agriculture*. Tata-McGraw Hill.

Peter KV. (Ed.). 2008. *Basics of Horticulture*. New India Publ. Agency.

Saini RS, Sharma KD, Dhankhar OP & Kaushik RA. (Eds.). 2001. *Laboratory Manual of Analytical Techniques in Horticulture*. Agrobios.

Wien HC. (Ed.). 1997. *The Physiology of Vegetable Crops*. CABI.

VSC 505 SEED PRODUCTION TECHNOLOGY OF VEGETABLE CROPS 2+1

Objective

To educate principles and methods of quality seed and planting material production in 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.

VSC 506 SYSTEMATICS OF VEGETABLE CROPS 1+1

Objective

To teach morphological, cytological and molecular taxonomy of vegetable crops.

Theory

UNIT I Principles of classification; different methods of classification; salient features of international code of nomenclature of vegetable crops.

UNIT II Origin, history, evolution and distribution of vegetable crops, botanical description of families, genera and species covering various tropical, subtropical and temperate vegetables.

UNIT III Cytological level of various vegetable crops; descriptive keys for important vegetables.

UNIT IV Importance of molecular markers in evolution of vegetable crops; molecular markers as an aid in characterization and taxonomy of vegetable crops.

Practical

Identification, description, classification and maintenance of vegetable species and varieties; survey, collection of allied species and genera locally available; preparation of keys to the species and varieties; methods of preparation of herbarium and specimens.

Suggested Readings

- Chopra GL. 1968. *Angiosperms - Systematics and Life Cycle*. S. Nagin
Dutta AC. 1986. *A Class Book of Botany*. Oxford Univ. Press.
Pandey BP. 1999. *Taxonomy of Angiosperm*. S. Chand & Co.
Peter KV & Pradeepkumar T. 2008. *Genetics and Breeding of Vegetables*. (Revised), ICAR.
Soule J. 1985. *Glossary for Horticultural Crops*. John Wiley & Sons.
Srivastava U, Mahajan RK, Gangopadhyay KK, Singh M & Dhillon BS.
2001. *Minimal Descriptors of Agri-Horticultural Crops*. Part-II: *Vegetable Crops*. NBPGR, New Delhi.
Vasistha. 1998. *Taxonomy of Angiosperm*. Kalyani.
Vincent ER & Yamaguchi M. 1997. *World Vegetables*. 2nd Ed. Chapman & Hall.

VSC 507 PRODUCTION TECHNOLOGY OF UNDEREXPLOITED VEGETABLE CROPS

2+1

Objective

To educate production technology of underutilized 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, jackbean 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, Gangopadhyay KK, Singh M & Dhillon BS. 2001. *Minimal Descriptors of Agri-Horticultural Crops*. Part-II: *Vegetable Crops*. NBPGR, New Delhi.

VSC 508 ORGANIC VEGETABLE PRODUCTION TECHNOLOGY 1+1

Objective

To educate principles, concepts and production of organic farming in vegetable crops.

Theory

UNIT II Importance, principles, perspective, concept and component of organic production of vegetable crops.

UNIT II Organic production of vegetables crops, viz., solanaceous crops, cucurbits, cole crops, root and tuber crops.

UNIT III Managing soil fertility, pests and diseases and weed problems in organic farming system; crop rotation in organic horticulture; processing and quality control for organic foods.

UNIT IV Methods for enhancing soil fertility, mulching, raising green manure crops. Indigenous methods of compost, Panchagavya, Biodynamics, preparation etc. Pest and disease management in organic farming; ITK's in organic farming. Role of botanicals and bio-control agents.

UNIT V GAP and GMP- Certification of organic products; organic production and export - opportunity and challenges.

Practical

Method of preparation of compost, vermicomposting, biofertilizers, soil solarization, bio pesticides in horticulture, green manuring, mycorrhizae and organic crop production, water management, organic soil amendment for root disease, weed management in organic horticulture. Visit to organic fields and marketing centers.

Suggested Readings

Dahama AK. 2005. *Organic Farming for Sustainable Agriculture*. 2nd Ed. Agrobios.

Gehlot G. 2005. *Organic Farming; Standards, Accreditation Certification and Inspection*. Agrobios.

Palaniappan SP & Annadorai K. 2003. *Organic Farming, Theory and Practice*. Scientific Publ.

Pradeepkumar T, Suma B, Jyothibhaskar & Satheesan KN. 2008.

Management of Horticultural Crops. New India Publ. Agency.

Shivashankar K. 1997. *Food Security in Harmony with Nature*. 3rd IFOAM ASIA, Scientific Conf. 1-4 December, 1997, UAS, Bangalore.

VSC 509 FUNDAMENTALS OF PROCESSING OF VEGETABLES 2+1

Objective

To educate principles and practices of processing of vegetable crops.

Theory

UNIT I History of food preservation. Present status and future prospects of vegetable preservation industry in India.

UNIT II Spoilage of fresh and processed horticultural produce; biochemical changes and enzymes associated with spoilage of horticultural produce; principal spoilage organisms, food poisoning and their control measures. Role of microorganisms in food preservation.

UNIT III Raw materials for processing. Primary and minimal processing; processing equipments; Layout and establishment of processing industry, FPO licence. Importance of hygiene; Plant sanitation.

UNIT IV Quality assurance and quality control, TQM, GMP. Food standards – FPO, PFA, etc. Food laws and regulations.

UNIT V Food safety – Hazard analysis and critical control points (HACCP). Labeling and labeling act, nutrition labeling.

UNIT VI Major value added products from vegetables. Utilization of by products of vegetable processing industry; Management of waste from processing factory.

UNIT VII 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 horticultural produce; Classification and identification of spoilage organisms; Study of biochemical changes and enzymes associated with spoilage; Laboratory examination of vegetable products; Sensory evaluation of fresh and processed vegetables; Study of food standards – National, international, CODEX Alimentarius; Visit to processing units to study the layout, equipments, hygiene, sanitation and residual / waste management.

Suggested Readings

- Arthey D & Dennis C. 1996. *Vegetable Processing*. Blackie/Springer-Verlag.
- Chadha DS. 2006. *The Prevention of Food Adulteration Act*. Confed. of Indian Industry.
- Desrosier NW. 1977. *Elements and Technology*. AVI Publ. Co.
- FAO. 1997. *Fruit and Vegetable Processing*. FAO.
- FAO. CODEX Alimentarius: Joint FAO/WHO Food Standards Programme. 2nd Ed. Vol. VB. *Tropical Fresh Fruits and Vegetables*. FAO.
- FAO. *Food Quality and Safety Systems – Training Manual on Food Hygiene and HACCP*. FAO.
- Fellow's P. 1988. *Food Processing Technology*. Ellis Horwood International.
- Frazier WC & Westhoff DC. 1995. *Food Microbiology*. 4th Ed. Tata McGraw Hill.
- Giridharilal GS, Siddappa & Tandon GL. 1986. *Preservation of Fruits and Vegetables*. ICAR.
- Gisela J. 1985. *Sensory Evaluation of Food – Theory and Practices*. Ellis Horwood.
- Graham HD. 1980. *Safety of Foods*. AVI Publ. Co.
- Hildegrade H & Lawless HT. 1997. *Sensory Evaluation of Food*. CBS.
- Joslyn M & Heid. *Food Processing Operations*. AVI Publ. Co.
- Mahindru SN. 2004. *Food Safety: Concepts and Reality*. APH Publ. Corp.
- Ranganna S. 1986. *Handbook of Analysis and Quality Control for Fruit and Vegetable Products*. 2nd Ed. Tata-McGraw Hill.
- Shapiro R. 1995. *Nutrition Labeling Handbook*. Marcel Dekker.
- Srivastava RP & Kumar S. 2003. *Fruit and Vegetable Preservation: Principles and Practices*. 3rd Ed. International Book Distrib. Co.
- Tressler & Joslyn MA. 1971. *Fruit and Vegetable Juice Processing Technology*. AVI Publ. Co.
- Verma LR & Joshi VK. 2000. *Post-harvest Technology of Fruits and Vegetables: Handling, Processing, Fermentation and Waste Management*. Indus Publ. Co.

SPICE CROPS

VSC 510* PRODUCTION TECHNOLOGY OF SPICE CROPS 2+1
VSC 511* BREEDING OF SPICES 2+1
VSC 512*PROCESSING OF SPICES 1+1
VSC 513 ORGANIC SPICE PRODUCTION TECHNOLOGY 2+1
VSC607** ADVANCES IN SPICE PRODUCTION 2+1
VSC608 ADVANCES IN BREEDING OF SPICE CROPS 2+1
VSC609BIOTECHNOLOGY IN SPICES 1+1

Course Contents

VSC510 PRODUCTION TECHNOLOGY OF SPICE CROPS 2+1

Objective

To impart basic knowledge about the importance and production technology of spices grown in India.

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 IBlack pepper, cardamom

UNIT IIClove, cinnamon and nutmeg, allspice

UNIT IIITurmeric, ginger and garlic

UNIT IVCoriander, fenugreek, cumin, fennel, ajowain, dill, celery

UNIT VTamarind, 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.

VSC511 BREEDING OF SPICES 2+1

Objective

To impart comprehensive knowledge about the principles and practices of breeding of 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: Black pepper and cardamom

UNIT II: Ginger and turmeric

UNIT III: Fenugreek, coriander, fennel, celery and ajwain

UNIT IV: 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.

VSC512 PROCESSING OF SPICES 2+1

Objective

To facilitate deeper understanding on principles and practices of postharvest technology of spices

Theory

Commercial uses of spices. Processing of major spices- cardamom, black pepper, ginger, turmeric, chilli and paprika, vanilla, cinnamon, clove, nutmeg, allspice, coriander, fenugreek, curry leaf. Extraction of pigments, oleoresin and essential oils.

Practical

Study of processing of different spices.

Extraction of active ingredients from different spices and herbs using TLC, HPLC, GC/MS technology. Identification of different odoriferous factors in essential oil with GLC/GCMS. Physico-chemical and sensory evaluation of oils and oleoresin. Value added products from spices.

Suggested Readings

- Chadha KL et al. (Eds.). 1993-95. *Advances in Horticulture*. Vol. IX. *Plantation Crops and Spices*. Malhotra Publishing House, New Delhi.
- Fellows PJ. 1988. *Food Processing Technology*. Ellis Horwood International. Switzerland.
- Fennema OR. 1985. *Food Chemistry*. Marcel Dekker.
- Kumar N, Abdul Khader ML, Rangaswamy P & Ikrulappan I. 1994. *Spices, Plantation Crops, Medicinal and Aromatic Plants*. Rajalakshmi Publ.
- Mandal RC. 1996. *Coconut Production and Processing Technology*. Agro.Bot.
- Mandal RC. 1997. *Cashew: Production and Processing Technology*. Agro.Bot.
- Masada Y. 1986. *Analysis of Essential Oil by Gas Chromatograph and Mass Spectrometry*. John Wiley & Sons.
- Paine FA. 1987. *Modern Processing, Packaging and Distributions Systems for Food*. AVI Publ.

Peter KV. (Ed.). 2001. *Handbook of Herbs and Spices*. Vols.I-III. Wood Head Publishing Co., UK & CRC, USA.

Sudheer KP & Indira V. 2008. *Post-Harvest Technology of Horticultural Crops*. Horticulture Science Series. New India Publ. Agency.

Thampan PK. 1981. *Handbook of Coconut Palm*. Oxford & IBH.

VSC513 ORGANIC SPICE PRODUCTION TECHNOLOGY 2+1

Objective

To educate principles, concepts and production of organic farming in spice.

Theory

UNIT I Importance, principles, perspective, concept and component of organic production of spices.

UNIT II Organic production of spice crops, viz. pepper, cardamom, turmeric, ginger, cumin, vanilla.

UNIT III Managing soil fertility, pests and diseases and weed problems in organic farming system; crop rotation in organic horticulture; processing and quality control for organic foods.

UNIT IV Methods for enhancing soil fertility, mulching, raising green manure crops. Indigenous methods of compost, Panchagavya, Biodynamics, preparation etc.; Pest and disease management in organic farming; ITK's in organic farming. Role of botanicals and bio-control agents.

UNIT V GAP and GMP- Certification of organic products; organic production and export - opportunity and challenges.

Practical

Method of preparation of compost, vermicomposting, biofertilizers, soil solarization, bio pesticides in horticulture, green manuring, mycorrhizae and organic crop production, waste management, organic soil amendment for root disease, weed management in organic horticulture. Visit to organic fields and marketing centers.

Suggested Readings

Dahama AK. 2005. *Organic Farming for Sustainable Agriculture*. 2nd Ed. Agrobios.

Gehlot G. 2005. *Organic Farming: Standards, Accreditation, Certification and Inspection*. Agrobios.

Palaniappan SP & Annadorai K. 2003. *Organic Farming: Theory and Practice*. Scientific Publ.

Pradeepkumar T, Suma B, Jyothibhaskar & Satheesan KN. 2008. *Management of Horticultural Crops*. New India Publ. Agency.

Shivashankar K. 1997. *Food Security in Harmony with Nature*. 3rd IFOAMASIA, Scientific Conference. 1-4 Dec., 1997, UAS, Bangalore.

COMPULSORY NON-CREDIT COURSES

(Compulsory for Master's programme in all disciplines; Optional for Ph.D. scholars)

CODE COURSE TITLE CREDITS

PGS 501 LIBRARY AND INFORMATION SERVICES 0+1

PGS 502 TECHNICAL WRITING AND COMMUNICATIONS SKILLS 0+1

PGS 503 (e-Course) INTELLECTUAL PROPERTY AND ITS MANAGEMENT IN AGRICULTURE 1+0

PGS 504 BASIC CONCEPTS IN LABORATORY TECHNIQUES 0+1

PGS 505 (e-Course) AGRICULTURAL RESEARCH, RESEARCH ETHICS AND RURAL DEVELOPMENT PROGRAMMES 1+0

PGS 506 (e-Course) DISASTER MANAGEMENT 1+0

Course Contents

PGS 501 LIBRARY AND INFORMATION SERVICES 0+1

Objective

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; eresources access methods.

PGS 502 TECHNICAL WRITING AND COMMUNICATIONS SKILLS 0+1

Objective

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.

PGS 503 (e-Course) INTELLECTUAL PROPERTY AND ITS MANAGEMENT IN AGRICULTURE 1+0

Objective

The main objective of this course is to equip students and stakeholders with knowledge of intellectual property rights (IPR) related protection systems, their significance and use of IPR as a tool for wealth and value creation in a knowledge-based economy.

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.

PGS 504 BASIC CONCEPTS IN LABORATORY TECHNIQUES 0+1

Objective

To acquaint the students about the basics of commonly used techniques in laboratory.

Practical

Safety measures while in Lab; Handling of chemical substances; Use of burettes, pipettes, measuring cylinders, flasks, separatory funnel, condensers, micropipettes and vaccumets; 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.

PGS 505 (e-Course) AGRICULTURAL RESEARCH, RESEARCH ETHICS AND RURAL DEVELOPMENT PROGRAMMES 1+0

Objective

To enlighten the students about the organization and functioning of agricultural research systems at national and international levels, research ethics, and rural development programmes and policies of Government.

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) Panchayati Raj 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.

PGS 506 (e-Course) DISASTER MANAGEMENT 1+0

Objectives

To introduce learners to the key concepts and practices of natural disaster management; to equip them to conduct thorough assessment of hazards, and risks vulnerability; and capacity building.

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.

e - Resources in Horticulture

Australian Society for Horticultural Science <http://www.aushs.org.au/>

Agricultural & Processed Food Products Export Development Authority (APEDA)

<http://www.apeda.com/>

American Society for Horticultural Science <http://www.ashs.org/>

Asian Vegetable Research and Development Center (AVRDC) <http://www.avrdc.org.tw/>

Australian Society for Horticultural Science <http://www.aushs.org.au/>

Central Food Technological Research Institute (CFTRI) <http://www.cftri.com/>

Central Institute of Medicinal & Aromatic Plants (CIMAP) <http://www.cimap.org/>

Central Institute of Post harvest Engineering and Technology <http://www.icar.org.in/ciphnet.html>

Central Plantation Crops Research Institute (CPCRI), Kasaragod, Kerala <http://cpcri.nic.in/>

Central Tuber Crops Research Institute (CTCRI), Thiruvananthapuram, Kerala

<http://www.ctcri.org/>

Consultative Group on International Agricultural Research, CGIAR <http://www.cgiar.org/>

Coffee Board, India <http://indiacoffee.org/>

Department of Agriculture and Co-operation, India <http://agricoop.nic.in/>

Department of Bio-technology, India <http://dbtindia.nic.in>

Department of Scientific and Industrial Research, India <http://dsir.nic.in/>

FAO <http://www.fao.org/>

Global Agribusiness Information Network: <http://www.fintrac.com/gain/>:

Greenhouse Vegetable Information: <http://www.ghvi.co.nz/>

Indian Agricultural Research Institute (IARI) <http://www.iari.res.in/>

Indian Council of Agricultural Research (ICAR) <http://www.icar.org.in>

Indian Institute of Horticultural Research (IIHR) www.iihr.res.in

Indian Institute of Spices Research (IISR), Calicut, Kerala <http://www.iisr.org/>

Indo-American Hybrid Seeds www.indamseeds.com

Institute of Vegetable and Ornamental Crops <http://www.igzev.de/>

Institute for Horticultural Development, Victoria, Australia <http://www.nre.vic.gov.au/agvic/ih/>

Kerala Agricultural University www.kau.edu

Iowa State University Department of Horticulture <http://www.hort.iastate.edu/>

National Bureau of Plant Genetic Resources (NBPGR), India <http://nbpgr.delhi.nic.in/>

National Horticulture Board (NHB), India <http://hortibizindia.nic.in/>
National Institute of Agricultural Extension Management (MANAGE), India
<http://www.manage.gov.in/>
National Research Centre for Cashew (NRCC), <http://kar.nic.in/cashew/India>
National Research Centre for Mushroom (NRCM), India <http://www.nrcmushroom.com/>
National Research Centre for Oil Palm (NRCOP), India <http://www.ap.nic.in/nrcop>
North Carolina State University, Dept. of Horticulture http://www2.ncsu.edu/cals/hort_sci/
Oregon State University, Dept. of Horticulture <http://osu.orst.edu/dept/hort>
Pineapple News <http://agrss.sherman.hawaii.edu/pineapple/pineappl.htm>
Pomology Resources Center <http://www.bsi.fr/pomologie/english> /pomology:
Rubber board, India <http://rubberboard.org.in/>
Spice Paprika web site <http://www.paprika.deltav.hu/>
Spices Board, India <http://www.indianspices.com/>
Sri Lanka Agribusiness on-line <http://www.agro-lanka.org/>
Sustainable Apple Production: <http://orchard.uvm.edu/>
Tea Board, India <http://tea.nic.in/>
The Horticultural Taxonomy Group <http://www.hortax.org.uk/>
The International Society of Citriculture: http://www.lal.ufl.edu/isc_citrus_ho
mepage.htm
The Internet Garden <http://www.internetgarden.co.uk/>
The Rose Resource <http://rose.org/>
The USDA Agricultural Research Service <http://www.ars.usda.gov/>
University of Florida, Dept. of Environmental Horticulture <http://hort.ifas.ufl.edu/>
University of California, Fruit&Nut Research <http://fruitsandnuts.ucdavis.edu/>
US Environmental Protection Agency <http://www.epa.gov/>:
USDA <http://www.usda.gov/>

POST GRADUATE SYLLABUS

(Prepared from ICAR PG Syllabus of Horticulture)

Degree to be awarded

M. SC. (HORT.) IN FLORICULTURE, MEDICINAL AND AROMATIC PLANTS

Department of Floriculture, Medicinal and Aromatic Plants
FACULTY OF HORTICULTURE
UTTAR BANGA KRISHI VISWAVIDYALAYA
PUNDIBARI, COOCH BEHAR

PROPOSED POST- GRADUATE CURRICULA & SYLLABI

MASTER DEGREE PROGRAMME
[M. SC. (HORT.) IN FLORICULTURE, MEDICINAL AND AROMATIC PLANTS]

CODE	COURSE TITLE	CREDITS
FIRST SEMESTER		
FAM-501	PRODUCTION TECHNOLOGY OF CUT FLOWERS	2+1
FAM - 502	BREEDING OF FLOWER CROPS AND ORNAMENTAL PLANTS	2+1
FAM- 503	PRODUCTION TECHNOLOGY OF MEDICINAL AND AROMATIC CROPS	2+1
SECOND SEMESTER		
FAM-551	PRODUCTION TECHNOLOGY OF LOOSE FLOWERS	2+1
FAM-552	LANDSCAPING AND ORNAMENTAL GARDENING	2+1
FAM - 553	BREEDING OF MEDICINAL AND AROMATIC CROPS	2+1
THIRD SEMESTER		
FAM-601	PROTECTED FLORICULTURE	2+1
FAM-602	VALUE ADDITION IN FLOWERS	2+1
FAM- 603	PROCESSING OF MEDICINAL AND AROMATIC CROPS	2+1
FAM-604	TURFING AND TURF MANAGEMENT	2+1
FOURTH SEMESTER		
FAM-651	CAD FOR OUTDOOR AND INDOORSCAPING	2+1
FAM - 652	UNDEREXPLOITED MEDICINAL AND AROMATIC PLANTS	1+1
FAM- 691	MASTER'S SEMINAR	1+0
FAM- 699	MASTER'S RESEARCH	20

COMPULSORY NON-CREDIT COURSES
(Compulsory for Master's programme; Optional for Ph.D. scholars)

CODE	COURSE TITLE	CREDITS
PGS - 501	LIBRARY AND INFORMATION SERVICES	0+1
PGS - 502	TECHNICAL WRITING AND COMMUNICATIONS SKILLS	0+1
PGS - 503 (e-Course)	INTELLECTUAL PROPERTY AND ITS MANAGEMENT IN AGRICULTURE	1+0
PGS - 504	BASIC CONCEPTS IN LABORATORY TECHNIQUES	0+1
PGS - 505 (e-Course)	AGRICULTURAL RESEARCH, RESEARCH ETHICS AND RURAL DEVELOPMENT PROGRAMMES	1+0
PGS - 506 (e-Course)	DISASTER MANAGEMENT	1+0

MINIMUM CREDIT REQUIREMENTS

Subject	Master's programme
Major	20
Minor	09
Supporting	05
Seminar	01
Research	20
Total credits	55
Compulsory non-credit courses	06 (compulsory)

FLORICULTURE, MEDICINAL AND AROMATIC PLANTS COURSE CONTENTS

FAM – 501 : PRODUCTION TECHNOLOGY OF CUT FLOWERS

(2+1)

Objective

To impart basic knowledge about the importance and production technology of cut flowers grown in India.

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, lilliums, bird of paradise, heliconia, alstroemeria, alpinia, ornamental ginger, bromeliads, dahlia, gypsophilla, limonium, statice, stock, cut foliages 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. 52
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.

FAM - 502 : BREEDING OF FLOWER CROPS AND ORNAMENTAL PLANTS (2+1)

Objective

To impart comprehensive knowledge about the principles and practices of 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 foliages– 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.

FAM – 503 : PRODUCTION TECHNOLOGY FOR MEDICINAL AND AROMATIC CROPS (2+1)

Objective

To impart comprehensive knowledge about the production technology of 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*. AgroBios

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.

FAM- 551 : PRODUCTION TECHNOLOGY OF LOOSE FLOWERS (2+1)

Objective

To impart basic knowledge about the importance and management of loose flowers grown in India.

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.

FAM – 552 : LANDSCAPING AND ORNAMENTAL GARDENING (2+1)

Objective

Familiarization with principles and practices of 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, bur lapping, 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.

FAM – 553 : BREEDING OF MEDICINAL AND AROMATIC CROPS (2+1)

Objective

To impart comprehensive knowledge about the principles and practices of breeding of plantation crops and spices.

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.

FAM – 601 : PROTECTED FLORICULTURE

(2 + 1)

Objective

Understanding the principles, theoretical aspects and developing skills in protected cultivation of flower crops.

Theory

UNIT I

Prospects of protected floriculture in India; Types of protected structures – Greenhouses, polyhouses, shade houses, rain shelters etc., Designing and erection of protected structures; Low cost/Medium cost/High cost structures – economics of cultivation; Location specific designs; Structural components; Suitable flower crops for protected cultivation.

UNIT II

Environment control – management and manipulation of temperature, light, humidity, air and CO₂; Heating and cooling systems, ventilation, naturally ventilated greenhouses, fan and pad cooled greenhouses, light regulation.

UNIT III

Containers and substrates, soil decontamination, layout of drip and fertigation system, water and nutrient management, weed management, physiological disorders, IPM and IDM.

UNIT IV

Crop regulation by chemical methods and special horticultural practices (pinching, disbudding, deshooting, deblossoming, etc.); Staking and netting, Photoperiod regulation.

UNIT V

Harvest indices, harvesting techniques, post-harvest handling techniques, Precooling, sorting, grading, packing, storage, quality standards.

Practical

Study of various protected structures, practices in design, layout and erection of different types of structures, practices in preparatory operations, soil decontamination techniques, practices in environmental control systems, practices in drip and fertigation techniques, special horticultural practices, determination of harvest indices and harvesting methods, postharvest handling, packing methods, project preparation, visit to commercial greenhouses.

Suggested Readings

- 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. 1995. *Advances in Horticulture*. Vol. XII. Malhotra Publ. House.
- Lauria A & Victor HR. 2001. *Floriculture – Fundamentals and Practices* Agrobios.
- Nelson PV. 1978. *Green House Operation and Management*. Reston Publ. Co.
- 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.

FAM – 602 : VALUE ADDITION IN FLOWERS

(2+1)

Objective

To develop understanding of the scope and ways of value addition in flowers.

Theory

UNIT I

Prospects of value addition, National and global scenario, production and exports, Women empowerment through value added products making, supply chain management.

UNIT II

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.

UNIT III

Dry flowers– Identification and selection of flowers and 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.

UNIT IV

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.

Practical

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.

Suggested Readings

Bhattacharjee SK. 2006. *Advances in Ornamental Horticulture*. Vols. I-VI. Pointer Publ.

Chadha KL.1995. *Advances in Horticulture*. Vol.XII. Malhotra Publ. House.

Lauria A & Victor HR. 2001. *Floriculture – Fundamentals and Practices* Agrobios.

Prasad S & Kumar U. 2003. *Commercial Floriculture*. Agrobios.

Reddy S, Janakiram B, Balaji T, Kulkarni S & Misra RL. 2007.*HightechFloriculture*. Indian Society of Ornamental Horticulture, New Delhi.

FAM – 603 : PROCESSING OF MEDICINAL AND AROMATIC PLANTS (2+1)

Objective

To facilitate deeper understanding on principles and practices of post harvest technology of medicinal and aromatic crops.

Theory

UNIT I

Processing of medicinal plants– dioscorea, gloriosa, stevia, coleus, ashwagandha, tulsi, isabgol, safed musli, senna, aloe, catharanthus, etc.

UNIT II

Different methods of drying and storage. Microbial contamination of stored product. Influence of temperature and time combination on active principles.

UNIT III

Extraction and analysis of active principles using TLC / HPLC / GC. Distillation, solvent extraction from aromatic plants– davana, mint, rosemary, rose, citronella, lavender, jasmine, etc.

UNIT IV

Study of aroma compounds and value addition. Nano-processing technology in medicinal and aromatic plants.

Practical

Study of processing of different spices and plantation crops. Study of processing of medicinal plants, their drying and storage. Extraction of active ingredients from different spices and herbs using TLC, HPLC, GC/MS technology. Distillation, solvent extraction from aromatic plants – davana, mint, rosemary, citronella, lavender, jasmine, etc. Identification of different odoriferous factors in essential oil with GLC/GCMS. Physico-chemical and sensory evaluation of oils and oleoresin. Value added products from spices and plantation crops.

Suggested Readings

Chadha KL et al. (Eds.). 1993-95. *Advances in Horticulture*. Vol. IX. *Plantation Crops and Spices*. Malhotra Publishing House, New Delhi.

Fellows PJ. 1988. *Food Processing Technology*. Ellis Horwood International. Switzerland.

Fennema OR. 1985. *Food Chemistry*. Marcel Dekker.

Kumar N, Abdul Khader ML, Rangaswamy P & Ikrulappan I. 1994. *Spices, Plantation Crops, Medicinal and Aromatic Plants*. Rajalakshmi Publ.

Mandal RC. 1996. *Coconut Production and Processing Technology*. Agro. Bot.

Mandal RC. 1997. *Cashew: Production and Processing Technology*. Agro. Bot.

Masada Y. 1986. *Analysis of Essential Oil by Gas Chromatograph and Mass Spectrometry*. John Wiley & Sons.

Paine FA. 1987. *Modern Processing, Packaging and Distributions Systems for Food*. AVI Publ.

Peter KV. (Ed.). 2001. *Handbook of Herbs and Spices*. Vols.I-III. Wood Head Publishing Co., UK & CRC, USA.

Sudheer KP & Indira V. 2008. *Post-Harvest Technology of Horticultural Crops*. Horticulture Science Series. New India Publ. Agency.

Thampan PK. 1981. *Handbook of Coconut Palm*. Oxford & IBH.

FAM – 604 : TURFING AND TURF MANAGEMENT

(2+1)

Objective

To develop understanding of the principles and management of turfing.

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

FAM – 651 : CAD FOR OUTDOOR AND INDOORSCAPING

(2+1)

Objective

To impart basic knowledge about the operation of Computer Aided Designing (CAD) in landscape garden designing.

Theory

UNIT I

Exposure to CAD (Computer Aided Designing) – Applications of CAD in landscape garden designing, 2D drawing by AUTOCAD, 3D drawing by ARCHICAD, 3D drawing by 3D MAX software, Creating legends for plant and non-plant components, Basics of Photoshop software in garden designing.

UNIT II

2D drawing methods, AUTOCAD Basics, Coordinate systems in AUTOCAD LT 2007, Point picking methods, Toolbars and Icons, File handling functions, Modifying tools, Modifying comments, Isometric drawings, Drafting objects.

UNIT III

Using patterns in AUTOCAD drawing, Dimension concepts, Hyperlinking, Script making, Using productivity tools, e-transmit file, making sample drawing for outdoor and indoor garden by AUTOCAD 2D Drawing techniques, Drawing web format design, Making layout.

UNIT IV

3D drawing methods, ARCHICAD file system, Tools and Infobox, modification tools, structural elements, GDL objects (Grid Dimensional Linking), Creation of garden components through ARCHICAD.

UNIT V

ARCHICAD organization tools, Dimensioning and detailing of designs, Attribute settings of components, Visualization tools for landscape preview, Data management, plotting and accessories for designing, Inserting picture using photoshop, Making sample drawing for outdoor and indoor gardens.

Practical

Practices in point picking methods, Using tool bars and icons, Using modifying tools and modifying comments, Isometric drawings, Using productivity tools, Drawing designs by AUTOCAD for home garden, institutional garden and special types of garden, Using tools and info-box for 3D drawing, Creation of garden components with ARCHICAD, Organization, dimensioning, detailing and visualization tools with ARCHICAD, Using Photoshop package for 3D picture insertion, Drawing designs with ARCHICAD for home garden, interior garden designing, IT parks, Corporates, Theme parks and Ecotourism spots.

Suggested Readings

Christine Wein-Ping Yu 1987. *Computer-aided Design: Application to Conceptual Thinking in Landscape Architecture*. amazon.com

FAM – 652 : UNDEREXPLOITED MEDICINAL AND AROMATIC CROPS (1+1)

Objective

To facilitate understanding on the importance, conservation and cultivation of medicinal and aromatic crops.

Theory

UNIT I

Introduction, importance, present status and future prospects, origin, distribution, species, varieties, economic parts and their uses in different diseases, Biodiversity and conservation, RET (Rare, Endangered and Threatened) and MPCAs (Medicinal Plants Conservation Areas).

UNIT II

Underutilized species – importance, traditional usage, ISM, TCM, Functional foods.

UNIT III

Production technology of underutilized medicinal crops– *Morinda citrifolia*, *Caesalpinia sappan*, *Caralluma*, *Terminalia chebula*, *Strychnos nuxvomica*, *Solanum trilobatum*, *Physalis*, *Aegle marmelos*, *Alpinia* sp., *Anthocephalus kadamba*, *Costus*.

UNIT IV

Production technology of underutilized aromatic crops– *Curcuma aromatica*, *C. caesia*, *Coleus aromaticus*, *Ocimum kilimanjaricum*, *Bursera*.

UNIT V

National and international conservation network, IPR issues, Promotion of under utilized species, Processing and value addition, Marketing.

Practical

Case studies.

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

Chadha KL Gupta. R. 1995. *Advance in Horticulture*. Vol. XI. *Medicinal & Aromatic Plants*. Malhotra Publ. House.

CSIR. 1971. *The Wealth of India*. Vols. A-Z. CSIR.

- Farooqui AA, Khan MM & Sreeramu BS. 1997. *Cultivation of Medicinal and Aromatic Crops in India*. Naya Prokash.
- Guenther E. 1975. *The Essential Oils*. Robert K. Krieger Publ. Co.
- Jain SK. 1979. *Medicinal Plants*. National Book Trust.
- Kurian A & Asha Sankar M. 2007. *Medicinal Plants*. Horticulture Science Series, New India Publ. Agency.
- Peter KV. (Ed.). 2007-08. *Underexploited and Underutilized Horticultural Crops*. Vols.I-IV. New India Publ. Agency.
- Sivarajan VV & Balachandran I. 1994. *Ayurvedic Drugs and their Plant Sources*. Oxford & IBH.

COMPULSORY NON-CREDIT COURSES

(Compulsory for Master's programme in all disciplines; Optional for Ph.D. scholars)

Course Contents

PGS – 501 : LIBRARY AND INFORMATION SERVICES

(0+1)

Objective

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; eresources access methods.

PGS – 502 : TECHNICAL WRITING AND COMMUNICATIONS SKILLS

(0+1)

Objective

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.

PGS – 503 : INTELLECTUAL PROPERTY AND ITS MANAGEMENT IN (e-Course) AGRICULTURE (1+0)

Objective

The main objective of this course is to equip students and stakeholders with knowledge of intellectual property rights (IPR) related protection systems, their significance and use of IPR as a tool for wealth and value creation in a knowledge-based economy.

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.

PGS – 504 : BASIC CONCEPTS IN LABORATORY TECHNIQUES

(0+1)

Objective

To acquaint the students about the basics of commonly used techniques in laboratory.

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.

**PGS – 505 : AGRICULTURAL RESEARCH, RESEARCH ETHICS AND RURAL
(e-Course) DEVELOPMENT PROGRAMMES**

(1+0)

Objective

To enlighten the students about the organization and functioning of agricultural research systems at national and international levels, research ethics, and rural development programmes and policies of Government.

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) Panchayati Raj 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.

PGS – 506 : DISASTER MANAGEMENT

(1+0)

(e-Course)

Objectives

To introduce learners to the key concepts and practices of natural disaster management; to equip them to conduct thorough assessment of hazards, and risks vulnerability; and capacity building.

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.\

POST GRADUATE SYLLABUS

(Prepared from ICAR PG Syllabus of Horticulture)

Degree to be awarded

M. Sc. (Hort.) in Plantation Crops and Processing

Department Of **Plantation Crops and Processing**
FACULTY OF HORTICULTURE
UTTAR BANGA KRISHI VISWAVIDYALAYA
PUNDIBARI, COOCH BEHAR

PG (M.Sc. (Hort.) and Ph.D.) Courses at a glance:

SL.N O.	Course Code	Course Title	Credit Hours	To be offere d in Sem.
(A) M.Sc.(Hort.)				
1.	PCP- 501*	PRODUCTION TECHNOLOGY OF PLANTATION CROPS-I	3(2+1)	1 st
2.	PCP- 502*	PRODUCTION TECHNOLOGY OF PLANTATION CROPS-II	3(2+1)	2 nd
3.	PCP- 503*	PRODUCTION TECHNOLOGY OF PLANTATION CROPS-III	2(1+1)	1 st
4.	PCP- 504*	BREEDING OF PLANTATION CROPS	3(2+1)	3 rd
5.	PCP- 505*	PROCESSING OF PLANTATION CROPS-I	3(2+1)	1 st
6.	PCP-	PROCESSING OF PLANTATION CROPS-II	3(2+1)	2 nd

	506*			
7.	PCP-507*	ORGANIC PRODUCTION TECHNOLOGY OF PLANTATION CROPS	3(2+1)	4 th
8.	PCP-591*	MASTER'S SEMINER	1(1+0)	3rd
9.	PCP-599	MASTER'S RESEARCH(Non-Credit)	2(0+20)	
Total			21(14+7)	

*Compulsory for M.Sc. (Hort.) Programme

Revised PG Syllabus, 2011

A) For M.Sc.(Hort.)

1) PCP-501 PRODUCTION TECHNOLOGY OF PLANTATION CROPS-I 3(2+1)

Theory:

Introduction-Definition, role of plantation crops in National economy; Area, production, productivity, export and import; Centre of origin, Botanical characteristics, classification and varietal wealth. Soil and climatic factors on crop growth and productivity, their problems; Plant propagation, planting and after care, bringing to bearing; nutritional management-macro and micro nutrients, deficiency symptoms, physiological disorders, role of growth regulator, water requirements, fertigation, water management- drainage and irrigation, shade regulation, weed management, training and pruning, crop regulation, maturity indices, harvesting. Uprooting and replanting; various production problems- weeds, pests and diseases, their management; Multitier cropping, photosynthetic efficiencies of crops at different tiers, cost benefit analysis; Organic farming, management of drought, precision farming.

Crops: Tea, Cocoa, Rubber, Coconut, Betel vine

Practical:

Description of botanical and varietal features, selection of elite/ mother plants and seedlings, soil test crop response studies and manuring practices, pruning and training, maturity standards, harvesting, Project preparation for establishing nursery and plantations, visit to plantation.

2) PCP-502 PRODUCTION TECHNOLOGY OF PLANTATION CROPS-I I 3(2+1)

Theory:

Introduction, importance, 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, nutritional and irrigation requirements, intercropping, mixed cropping, intercultural operation, 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.

Crops: Coffee, cashew nut, Areca nut and Oil palm

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.

3) PCP-503 PRODUCTION TECHNOLOGY OF PLANTATION CROPS-III 3(2+1)

Theory:

Introduction, importance, historical accent, present status- national and international, future prospects, botany and taxonomy, climatic and soil requirements, seed rate and seed treatment, nutritional and irrigation requirements, intercropping, mixed cropping, intercultural operation, 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.

Crops: Cinchona, Chicory and Palmyrah

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.

4) PCP-504 BREEDING OF PLANTATION CROPS

3(2+1)

Theory:

Species and cultivars, cytogenetic, survey, collection, conservation and evaluation, floral biology, breeding objectives, approaches for crop improvement, introduction, selection, hybridization, mutation breeding, polyploidy breeding, improvement of quality traits, resistance breeding for biotic and abiotic stresses, in-vitro multiplication, haploid culture, protoplast culture and fusion induction of somaclonal variation and screening the variants, molecular aided breeding and biotechnological approaches, marker assisted selection, bioinformatics, IPR issues, achievements and future thrusts.

Crops: Tea, coffee, coconut, arecanut, cashew, cocoa, rubber, palmyrah, oil palm, cinchona, chicory.

Practical: Characterization and evaluation of germplasm accessions, blossom biology, studies on pollen behavior, anthesis; fruit set; selfing and crossing techniques; description of varieties salient features of improved varieties and cultivars from public and private sector, practices in hybridization, polyploidy breeding, mutation breeding, evaluation of biometrical traits and quality traits, screening for biotic and abiotic stresses, visit to biotechnological/radio tracer laboratory national institutes for plantation crops and plant genetic resource centres, genetic transformation in plantation crops for resistance to biotic and abiotic stresses/quality improvement.

5) PCP-505 PROCESSING OF PLANTATION CROPS – I

3(2+1)

Theory:

Introduction, principles and practices of post harvest technology of plantation crops, commercial uses of plantation crops. Processing of major produce from plantation crops, processing and value addition, grading, packing and storage.

Crops: Tea, Cocoa, Rubber, Coconut, Betel vine.

Practical: Study of processing of different plantation crops and storage. Value added products from plantation crops.

6) PCP-506 PROCESSING OF PLANTATION CROPS – II

3(2+1)

Theory:

Principles and practices of post harvest technology of plantation crops, commercial uses of plantation crops. Processing of major produce from plantation crops.

Crops: Coffee, cashew nut, Areca nut and Oil palm, cinchona, chicory, palmyrah.

Practical: Study of processing of different plantation crops and storage. Value added products from plantation crops.

7) PCP-507 ORGANIC PRODUCTION TECHNOLOGY OF PLANTATION CROPS 3(2+1)

Theory:

Importance, principles, perspective, concept and component of organic production of plantation crops. Managing soil fertility, pest, diseases and weed problems in organic farming system; crop rotation in organic horticulture, processing and quality control for organic food. Methods for enhancing soil fertility, mulching, raising green manure crops. Indigenous methods of compost, panchagavya, biodynamics, preparation etc; pest disease management in organic farming; ITK's in organic farming. Role of botanicals and biocontrol agents. GAP and GMP- certification of organic products; organic production and export opportunity and challenges.

Practical:

Method of preparation of compost, vermicomposting, bio fertilizers, soil solarization, bio pesticides in horticulture, green manuring, mycorrhizae and organic crop production, waste management, organic soil amendment for root disease, weed management, in organic horticulture. Visit to organic fields and marketing centres.