Course Curriculum of
PG Programme Horticulture

* *Fruit Science*
* *Vegetable Science*
* *Plantation, Spices, Medicinal and Aromatic Crops*
* *Floriculture and Landscape Architecture*

Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya
Gwalior–474002 (M.P.)

HORTICULTURE (FRUIT SCIENCE)

(For CoA, Gwalior, Indore, Sehore)

Ist Semester

S. No.	CODE	COURSE TITLE	CREDITS
Major Courses			
	FSC 501*	Tropical and Dry Land Fruit Production	2+1
	FSC 502*	Sub Tropical and Temperate Fruit Production	2+1
	FSC 503*	Bio-diversity and Conservation of Fruit Crops	2+1
	FSC 505*	Propagation and Nursery Management for Fruit Crops	2+1
Minor Course			
	VSC -501	Production Technology of Cool Season Vegetable Crops	2+1
	VSC- 504	Growth and Development of Vegetable Crops	2+1
Supporting Courses			
	STAT-511	Statistical Methods for Applied Sciences	3+1
Non Credit Courses			
	PGS-501	Library and Information Services	0+1
	PGS-502	Technical Writing and Communication Skills	0+1
	PGS-503	Intellectual Property and its Management in Agriculture	1+0

II[nd] Semester

Major Courses			
	FSC - 504	Canopy Management in Fruit Crops	1+1
	FSC - 506	Breeding of Fruit Crops	2+1
	FSC - 508	Growth and Development of Horticultural Crops	2+1
Minor Courses			
	VSC - 505	Seed Production Technology of Vegetable Crops	2+1
	VSC - 508	Organic Vegetable Production Technology	1+1
Supporting Courses			
	STAT 512	Experimental Designs	2+1
Non Credit Courses			
	PGS- 504	Basic Concepts in Laboratory Techniques	0+1
	PGS -505	Agricultural Research, Research Ethics and Rural Development Programmes	1+0
	PGS -506	Disaster Management	1+0

III[rd] Semester

	FSC -591	Master's Seminar	0+1
	FSC - 599	Master's Research	**0+10**
IV[th] semester			
	FSC 599	Master's Research	**0+10**

HORTICULTURE (FRUIT SCIENCE)

(For CoH, Mandsaur)

Ist Semester

S. No.	CODE	COURSE TITLE	CREDITS
Major Courses			
	FSC 501	Tropical and Dry Land Fruit Production	2+1
	FSC 502	Sub Tropical and Temperate Fruit Production	2+1
	FSC 503	Biodiversity and Conservation of Fruit Crops	2+1
	FSC 505	Propagation and Nursery Management for Fruit Crops	2+1
Minor Course			
	VSC 501	Production Technology of Cool Season Vegetable Crops	2+1
	VSC 504	Growth and Development of Vegetable Crops	2+1
Supporting Courses			
	STAT 511	Statistical Methods for Applied Sciences	3+1
Non Credit Courses			
	PGS-501	Library and Information Services	0+1
	PGS-502	Technical Writing and Communication Skills	0+1
	PGS-503	Intellectual Property and its Management in Agriculture	1+0

IInd Semester

Major Courses			
	FSC 504	Canopy Management in Fruit Crops	1+1
	FSC 506*	Breeding of Fruit Crops	2+1
	FSC 508	Growth and Development of Horticultural Crops	2+1
Minor Courses			
	VSC 505	Seed Production Technology of Vegetable Crops	2+1
	VSC 508	Organic Vegetable Production Technology	1+1
Supporting Courses			
	STAT 512	Experimental Designs	2+1
Non Credit Courses			
	PGS 504	Basic Concepts in Laboratory Techniques	0+1
	PGS 505	Agricultural Research, Research Ethics and Rural Development Programmes	1+0
	PGS 506	Disaster Management	1+0

IIIrd Semester

	FSC 591	Master's Seminar	0+1
	FSC 599	Master's Research	**0+10**
IVth Semester			
	FSC 599	Master's Research	**0+10**

FSC 501 Tropical and Dry Land Fruit Production 2+1

Objective

To impart basic knowledge about the importance and management of tropical and dry land fruits grown in India.

Theory

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

Crops

UNIT I:	Mango and Banana
UNIT II:	Citrus and Papaya
UNIT III:	Guava, Sapota and Jackfruit
UNIT IV:	Pineapple, Annonas and Avocado
UNIT V:	Aonla, Pomegranate, Phalsa and Ber, minor fruits of tropics

Practical

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

Suggested Readings

Bose T.K., Mitra S.K. & Rathore D.S. (Eds.). 1988. Temperate Fruits - Horticulture. Allied Publ.

Bose T.K., Mitra SK & Sanyal D. 2001. (Eds.). Fruits -Tropical and Subtropical. Naya Udyog.

Chadha K.L. & Pareek O.P. 1996. (Eds.). Advances in Horticulture. Vols. III-V. Malhotra Publ. House.

Nakasone, H.Y. & Paul, R.E. 1998. Tropical Fruits. CABI.

Peter, K.V. 2008. (Ed.). Basics of Horticulture. New India Publ. Agency.

Pradeep kumar T., Suma B., Jyothibhaskar & Satheesan K.N. 2008. Management of Horticultural Crops. Parts I, II. New India Publ. Agency.

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

Singh H.P., Negi, J.P. & Samuel J.C. (Eds.). 2002. Approaches for Sustainable Development of Horticulture. National Horticultural Board.

Singh H.P., Singh, G, Samuel, J.C. & Pathak, R.K. (Eds.). 2003. Precision Farming in Horticulture. NCPAH, DAC/PFDC, CISH, Lucknow.

FSC 502 Subtropical and Temperate Fruit Production 2+1

Objective

To impart basic knowledge about the importance and management of subtropical and temperate fruits grown in India.

Theory

Commercial varieties of regional, national and international importance, eco-physiological requirements, recent trends in propagation, rootstock influence, planting systems, cropping systems, root zone and canopy management, nutrient management, water management, fertigation, bioregulation, abiotic factors limiting fruit production, physiology of

flowering, fruit set and development, abiotic factors limiting production, physiological disorders-causes and remedies, quality improvement by management practices; maturity indices, harvesting, grading, packing, precooling, storage, transportation and ripening techniques; industrial and export potential, Agri Export Zones(AEZ) and industrial support.

Crops

UNIT I	:	Apple, pear, quince, grapes
UNIT II	:	Plums, peach, apricot, cherries, hazelnut
UNIT III	:	Litchi, loquat, persimmon, kiwifruit, strawberry
UNIT IV	:	Nuts- walnut, almond, pistachio, pecan
UNIT V	:	Minor fruits- mangosteen, carambola, bael, wood apple, fig, amun, rambutan, pomegranate

Practical

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

Suggested Readings

Bose, T.K., Mitra, S.K. & Sanyol, D. (Ed.). 2002. Fruits of India – Tropical and Sub-tropical. 3rd Ed. Vols. I, II. Naya Udyog.

Chadha, K.L. & Pareek, O.P. 1996. (Eds.). Advances in Horticulture. Vol. I. Malhotra Publ. House.

Chadha, K.L. & Shikhamany, S.D. 1999. The Grape: Improvement, Production and Post-Harvest Management. Malhotra Publ. House.

Janick, J. & Moore, J.N. 1996. Fruit Breeding. Vols.I-III. John Wiley & Sons.

Nijjar, G.S. 1977. (Eds.). Fruit Breeding in India. Oxford & IBH.

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

Singh, S., Shivankar, V.J., Srivastava, A.K. & Singh, I.P. (Eds.). 2004. Advances in Citriculture. Jagmander Book Agency.

FSC 503 Biodiversity and Conservation of Fruit Crops 2+1

Objective

Understanding the principles of biodiversity and strategies in germplasm conservation of fruit crops.

Theory

UNIT I

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

UNIT II

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

UNIT III

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

UNIT IV

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

UNIT V

GIS and documentation of local biodiversity, Geographical indication.

Crops

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

Practical

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

Suggested Readings

Frankel, O.H. & Hawkes, J.G. 1975. Crop Genetic Resources for Today and Tomorrow. Cambridge University Press.

Peter, K.V. & Abraham, Z. 2007. Biodiversity in Horticultural Crops. Vol. I. Daya Publ. House.

Peter, K.V. 2008. Biodiversity of Horticultural Crops. Vol. II. Daya Publ. House.

FSC 504 Canopy Management in Fruit Crops 1+1

Objective

To impart knowledge about the principles and practices in canopy management of fruit crops.

Theory

UNIT I

Canopy management - importance and advantages; factors affecting canopy development.

UNIT II

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.

UNIT III

Spacing and utilization of land area - Canopy classification; Canopy management through rootstock and scion.

UNIT IV

Canopy management through plant growth inhibitors, training and pruning and management practices.

UNIT V

Canopy development and management in relation to growth, flowering, fruiting and fruit quality in temperate fruits, grapes, passion fruits, mango, sapota, guava, citrus and ber.

Practical

Study of different types of canopies, training of plants for different canopy types, 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.

Suggested Readings

Chadha, K.L. & Shikhamany, S.D. 1999. The Grape, Improvement, Production and Post Harvest Management. Malhotra Publ. House.

Pradeep kumar T., Suma, B., Jyothibhaskar & Satheesan, K.N. 2008. Management of Horticultural Crops. New India Publ. Agency.

FSC 505 Propagation and Nursery Management for Fruit Crops 2+1

Objective

Familiarization with principles and practices of propagation and nursery management for fruit crops.

Theory

UNIT I

Introduction, life cycles in plants, cellular basis for propagation, sexual propagation, apomixis, polyembryony, chimeras. Principles factors influencing seed germination of horticultural crops, dormancy, hormonal regulation of germination and seedling growth.

UNIT II

Seed quality, treatment, packing, storage, certification, testing. Asexual propagation – rooting of soft and hard wood cutting under mist by growth regulators. Rooting of cuttings in hotbeds. Physiological, anatomical and biochemical aspects of root induction in cuttings. Layering – principle and methods.

UNIT III

Budding and grafting – selection of elite mother plants, methods. Establishment of bud wood bank, stock, scion and inter stock, relationship – Incompatibility. Rejuvenation through top working – Progeny orchard and scion bank.

UNIT IV

Micro-propagation – principles and concepts, commercial exploitation in horticultural crops. Techniques - *in vitro* clonal propagation, direct organogenesis, embryogenesis, micrografting, meristem culture. Hardening, packing and transport of micro-propagules.

UNIT V

Nursery – types, structures, components, planning and layout. Nursery management practices for healthy propagule production.

Practical

Anatomical studies in rooting of cutting and graft union, construction of propagation structures, study of media and PGR. Hardening – case studies, micropropagation, explant preparation, media preparation,

culturing – *in vitro* clonal propagation, meristem culture, shoot tip culture, axillary bud culture, direct organogenesis, direct and indirect embryogenesis, micro grafting, hardening. Visit to TC labs and nurseries.

Suggested Readings

Hartmann, H.T. & Kester, D.E. 1989. Plant Propagation – Principles and Practices. Prentice Hall of India.

Bose, T.K., Mitra, S.K. & Sadhu, M.K. 1991. Propagation of Tropical and Subtropical Horticultural Crops. Naya Prokash.

Peter, K.V. (Ed.). 2008. Basics of Horticulture. New India Publ. Agency.

Singh, S.P. 1989. Mist Propagation. Metropolitan Book Co.

Rajan, S. & Baby, L.M. 2007. Propagation of Horticultural Crops. New India Publ. Agency.

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

FSC 506 Breeding of Fruit Crops 2+1

Objective

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

Theory

Origin and distribution, taxonomical status - species and cultivars, cytogenetics, genetic resources, blossom biology, breeding systems, breeding objectives, ideotypes, approaches for crop improvement - introduction, selection, hybridization, mutation breeding, polyploidy breeding, rootstock breeding, improvement of quality traits, resistance breeding for biotic and abiotic stresses, biotechnological interventions, achievements and future thrust in the following selected fruit crops.

Crops

UNIT I: Mango, banana and pineapple

UNIT II: Citrus, grapes, guava and sapota

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

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

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

Practical

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

Suggested Readings

Bose, T.K., Mitra, S.K. & Sanyol, D. (Eds.). 2002. Fruits of India – Tropical and Sub-tropical. 3rd Ed. Vols. I, II. Naya Udyog.

Chadha, K.L. & Pareek, O.P. 1996. (Eds.). Advances in Horticulture. Vol. I. Malhotra Publ. House.

Chadha, K.L. & Shikhamany, S.D. 1999. The Grape: Improvement, Production and Post-Harvest Management. Malhotra Publ. House.

Janick, J. & Moore, J.N. 1996. Fruit Breeding. Vols.I-III. John Wiley & Sons.

Nijjar, G.S. 1977. (Eds.). Fruit Breeding in India. Oxford & IBH.

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

Singh, S., Shivankar, V.J., Srivastava, A.K. & Singh, I.P. (Eds.). 2004. Advances in Citriculture. Jagmander Book Agency.

FSC 508 Growth and Development of Horticultural Crops 2+1

Objective

To develop understanding of growth and development of horticultural crops which have implications in their management.

Theory

UNIT I

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

UNIT II

Annual, semi-perennial and perennial horticultural crops, environmental impact on growth and development, effect of light, photosynthesis and photoperiodism vernalisation, effect of temperature, heat units, thermoperiodism.

UNIT III

Assimilate partitioning during growth and development, influence of water and mineral nutrition during growth and development, biosynthesis of auxins, gibberellins, cytokinins, abscissic acid, ethylene, brasssinosteroids, growth inhibitors, morphactins, role of plant growth promoters and inhibitors.

UNIT IV

Developmental physiology and biochemistry during dormancy, bud break, juvenility, vegetative to reproductive interphase, flowering, pollination, fertilization and fruit set, fruit drop, fruit growth, ripening and seed development.

UNIT V

Growth and developmental process during stress - manipulation of growth and development, impact of pruning and training, chemical

manipulations in horticultural crops, molecular and genetic approaches in plant growth development.

Practical

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

Suggested Readings

Buchanan, B., Gruiessam, W. & Jones, R. 2002. Biochemistry & Molecular Biology of Plants. John Wiley & Sons.

Epstein, E. 1972. Mineral Nutrition of Plants: Principles and Perspectives.Wiley.

Fosket D.E. 1994. Plant Growth and Development: a Molecular Approach. Academic Press.

Leoplod, A.C. & Kriedermann, P.E. 1985. Plant Growth and Development. 3rd Ed. Mc Graw-Hill.

Peter, K.V. 2008. (Ed.) Basics of Horticulture. New India Publ. Agency.

Roberts, J., Downs, S. & Parker, P. 2002. Plant Growth Development. In: Plants (I. Ridge, Ed.), pp. 221-274, Oxford University Press.

Salisbury, F.B. & Ross, C.W. 1992. Plant Physiology. 4th Ed. Wadsworth Publ.

Note : For minor courses please refer the concerned department's courses outline .

HORTICULTURE (VEGETABLE SCIENCE)

(For CoA, Gwalior, Indore, Sehore)

Ist Semester

S.No.	Course No.	Title	Credit
Major Courses			
1.	VSC 501	Production Technology of Cool Season Vegetable Crops	2+1
2.	VSC 502	Production Technology of Warm Season Vegetable Crops	2+1
3.	VSC 503	Breeding of Vegetable Crops	2+1
4.	VSC 504	Growth and Development of Vegetable Crops	2+1
Minor Courses			
1.	FSC 501	Tropical and Dry Land Fruit Production	2+1
2.	FSC 505	Propagation and Nursery Management for Fruit Crops	2+1
Supporting Courses			
1.	STAT-511	Statistical Methods for Applied Sciences	3+1
Non Credit Courses			
1.	PGS-501	Library and Information Services	0+1
2.	PGS-502	Technical Writing and Communications Skills	0+1
3.	PGS-503	Intellectual Property and its Management in Agriculture	1+0

IInd Semester

Major Courses			
1	VSC 505	Seed Production Technology of Vegetable Crops	2+1
2	VSC 507	Production Technology of Underexploited Vegetable Crops	2+1
3	VSC 508	Organic Vegetable Production Technology	1+1

Minor Courses			
1.	FSC 504	Canopy Management in Fruit Crops	2+1
2.	FSC 508	Growth and Development of Horticulture Crops	2+1
Supporting Courses			
1.	STAT 512	Experimental design	2+1
***Non Credit* Courses**			
1.	PGS-504	*Basic Concepts in Laboratory Technology*	0+1
2.	PGS-505	*Agricultural* Research*, Research Ethics and Rural Development Programmes*	1+0
3.	PGS-506	*Disaster Management*	1+0

IIIrd Semester

1	VSC 591	Master's Seminar	**0+1**
2.	VSC 599	Master's Research	0+10

IVth Semester

1	VSC 599	Master's Research	**0+10**

HORTICULTURE (VEGETABLE SCIENCE)

(For CoH, Mandsaur)

Ist Semester

S.No.	Course No.	Title	Credit
Major Courses			
1.	VSC 501	Production Technology of Cool Season Vegetable Crops	2+1
2.	VSC 502	Production Technology of Warm Season Vegetable Crops	2+1
3.	VSC 503	Breeding of Vegetable Crops	2+1
4.	VSC 504	Growth and Development of Vegetable Crops	2+1
Minor Courses			
1.	FSC 501	Tropical and Dry Land Fruit Production	2+1
2.	FSC 505	Propagation of Nursery Management for Fruit Crops	2+1
Supporting courses			
1.	STAT-511	Statistical Methods for Applied Sciences	3+1
Non Credit Courses			
1.	PGS-501	Library and Information Services	0+1
2.	PGS-502	Technical Writing and Communications Skills	0+1
3.	PGS-503	Intellectual Property and its Management in Agriculture	1+0

II[rd] Semester

Major Courses			
1	VSC 505	Seed Production Technology of Vegetable Crops	2+1
2	VSC 507	Production Technology of Under Exploited Vegetable Crops	2+1
3	VSC 508	Organic Vegetable Production Technology	1+1

Minor Courses			
1.	FSC 508	Growth and Development of Horticultural Crops	2+1
2.	FSC 504	Canopy Management in Fruit Crops	2+1
Supporting Courses			
1.	STAT 512	Experimental designs	2+1
***Non Credit C*ourses**			
1.	PGS-504	*Basic Concepts in Laboratory Technology*	0+1
2.	PGS-505	*Agricultural* Research*, Research Ethics and Rural Development Programmes*	1+0
3.	PGS-506	*Disaster Management*	1+0

III[rd] Semester

1	VSC 591	Master's Seminar	**0+1**
2.	VSC 599	Master's Research	0+10

IV[th] Semester

1	VSC 599	Master's Research	**0+10**

VSC 501 Production Technology of cool season Vegetable Crops 2+1

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, knol khol, sprouting broccoli and 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. (1986). *Vegetable Crops in India*. Naya Prokash, Calcutta

Bose TK, Som G & Kabir J. (2002). *Vegetable Crops*. Naya Prokash, Kolkata.

Bose TK, Som MG & Kabir J. (1993). *Vegetable Crops*. Naya Prokash, Kolkata.

Bose TK, Kabir J, Maity TK, Parthasarathy VA & Som MG. (2003). *Vegetable Crops*. Vols. I-III. Naya Udyog.

Chadha KL & Kalloo G. (1993-94). *Advances in Horticulture* Vols. V-X. Malhotra Publ. House, New Delhi.

Chadha KL. (2002). *Hand Book of Horticulture*. ICAR, New Delhi.

Chauhan DVS. (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 Publisher, New Delhi.

Gopalakrishanan TR. (2007). *Vegetable Crops*. New India Publ. Agency, New Delhi.

Hazra P & Som MG. (1999). *Technology for Vegetable Production and Improvement*. Naya Prokash, Kolkata.

Rana MK. (2008). *Olericulture in India*. Kalyani Publ., New Delhi.

Rana MK. (2008). *Scientific Cultivation of Vegetables*. Kalyani Publ., New Delhi.

Rubatzky VE & Yamaguchi M. (1997). *World Vegetables: Principles, Production and Nutritive Values*. Chapman & Hall.

Saini GS. (2001). *A Text Book of Oleri and Flori Culture*. Aman Publ. House.

Salunkhe DK & Kadam SS. (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. Lucknow

Singh SP. (1989). *Production Technology of Vegetable Crops*. Agril. Comm. Res. Centre, Karnal

Thamburaj S & Singh N. (2004). *Vegetables, Tuber Crops and Spices*. ICAR, New Delhi.

Thompson HC & Kelly WC. (1978). *Vegetable Crops*. Tata McGraw-Hill.

VSC 502 Production Technology of warm season Vegetable Crops 2+1

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 (French bean, Indian bean and cluster bean), cowpea

UNIT III
Cucurbitaceous crop

UNIT IV
Tapioca, sweet potato and colocasia

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. (1986). *Vegetable Crops in India*. Naya Prokash, Calcutta.

Bose TK, Kabir J, Maity TK, Parthasarathy VA & Som MG. (2003). *Vegetable Crops*. Vols. I-III. Naya Udyog.

Bose TK, Som MG & Kabir J. (2002). *Vegetable Crops*. Naya Prokash, Kolkata.

Brown HD & Hutchison CS. *Vegetable Science*. JB Lippincott Co.

Chadha KL & Kalloo G. (1993-94). *Advances in Horticulture*. Vols.V-X. Malhotra Publ. House, New Delhi.

Chadha KL. (2002). *Hand Book of Horticulture*. ICAR, New Delhi.

Chauhan DVS. (1986). *Vegetable Production in India*. Ram Prasad & Sons.

Decoteau DR. (2000). *Vegetable Crops*. Prentice Hall, New Delhi.

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 publishers, New Delhi.

Gopalakrishanan TR. (2007). *Vegetable Crops*. New India Publ. Agency, New Delhi.

Hazra P & Som MG. (1999). *Technology for Vegetable Production and Improvement*. Naya Prokash, Kolkata

Kalloo G & Singh K. (2000). *Emerging Scenario in Vegetable Research and Development*. Research Periodicals & Book Publishing House, Houston, Texas, USA.

Nayer NM & More TA (1998). *Cucurbits*. Oxford & IBH Publ. Co., New Delhi.

PalaniswamyM.S. & Peter KV. (2007). *Tuber Crops*. New India Publ. Agency, New Delhi.

Rana MK. (2008). *Olericulture in India*. Kalyani Publishers, New Delhi.

Rana MK. (2008). *Scientific Cultivation of Vegetables*. Kalyani Publishers, New Delhi.

Rubatzky VE & Yamaguchi M. (1997). *World Vegetables: Principles, Production and Nutritive Values*. Chapman & Hall.

Saini GS. (2001). *A Text Book of Oleri and Flori Culture*. Aman Publ. House.

Salunkhe DK & Kadam SS. (1998). *Hand Book of Vegetable Science and Technology: Production, Composition, Storage and Processing*. Marcel Dekker Inc., New York.

Shanmugavelu KG. (1989). *Production Technology of Vegetable Crops*. Oxford & IBH Publishing Co., New Delhi.

Singh DK. (2007). *Modern Vegetable Varieties and Production Technology*. International Book Distributing Co., Lucknow

Singh NP, Bharadwaj AK, Kumar A & Singh KM. (2004). *Modern Technology on Vegetable Production*. International Book Distributing Co., Lucknow.

Singh SP. (1989). *Production Technology of Vegetable Crops*. Agril. Comm. Res. Centre, Karnal.

Thamburaj S & Singh N. (2004). *Vegetables, Tuber Crops and Spices*. ICAR, New Delhi.

Thompson HC & Kelly WC. (1978). *Vegetable Crops*. Tata McGraw Hill.

VSC 503 Breeding of Vegetable Crops 2+1

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

Brinjal, 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, Inc., New York.

Basset MJ. (1986). *Breeding Vegetable Crops*. AVI Publ.

Dhillon BS, Tyagi RK, Saxena S. & Randhawa GJ (2005). *Plant Genetic Resources: Horticultural Crops*. Narosa Publishing House, New Delhi.

Fageria MS, Arya PS & Choudhary AK. (2000). *Vegetable Crops: Breeding and Seed Production*. Vol. I. Kalyani publishers, New Delhi.

Gardner EJ. (1975). *Principles of Genetics*. John Wiley & Sons Inc., New York.

Hayes HK, Immer FR & Smith DC. (1955). *Methods of Plant Breeding*. McGraw-Hill Book Co. Inc., New York.

Hayward MD, Bosemark NO & Romagosa I (1993). *Plant Breeding-Principles and Prospects*. Chapman & Hall, New York.

Kalloo G. (1988). *Vegetable Breeding*. Vols. I-III. CRC Press, Inc. BocaRaton, Florida (USA).

Kalloo G. (1998). *Vegetable Breeding*. Vols. I-III (Combined Ed.). Panima Educational Book Agency, New Delhi.

Kumar JC & Dhaliwal MS. (1990). *Techniques of Developing Hybrids in Vegetable Crops*. Agro Botanical Publ.

Paroda RS & Kalloo G. (1995). *Vegetable Research with Special Reference to Hybrid Technology in Asia-Pacific Regio*n. FAO.

Peter KV & Pradeep Kumar T. (2008). *Genetics and Breeding of Vegetables*. Revised, ICAR., New Delhi.

Rai N & Rai M. (2006). *Heterosis Breeding in Vegetable Crops*. New India Publ. Agency, New Delhi.

Ram HH. (1998). *Vegetable Breeding: Principles and Practices*. Kalyani Publishers, New Delhi.

Simmonds NW. (1978). *Principles of Crop Improvement*. Longman, London

Singh BD. (1990). *Plant Breeding*. Kalyani Publishers, New Delhi.

Singh PK, Dasgupta SK & Tripathi SK. (2004). *Hybrid Vegetable Development*. International Book Distributing Co. Lucknow

Swarup V. (1976). *Breeding Procedure for Cross-pollinated Vegetable Crops*. ICAR, New Delhi.

VSC 504 Growth and Development of Vegetable Crops 2+1

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 abscissic 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. (1978). *Crop Physiology*. Oxford & IBH.

Krishnamoorti HN. (1981). *Application Plant Growth Substances and Their Uses in Agriculture*. Tata-McGraw Hill.

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

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

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

VSC 505 Seed Production Technology of Vegetable Crops 2+1

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 behavior, 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. (1992). *Techniques in Seed Science and Technology*. South Asian Publ.

Agrawal RL. (1997). *Seed Technology*. Oxford & IBH.

Bendell PE. (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 Publishers, New Delhi.

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., Lucknow.

Singh SP. (2001). *Seed Production of Commercial Vegetables*. Agrotech Publ. Academy.

VSC 507 Production Technology of Underexploited Vegetable Crops 2+1

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, Jerusalem artichoke, leek and drumstick

UNIT II

Brussels's sprout, Chinese cabbage, broccoli, kale, Globe artichoke, tannia and curry leaf.

UNIT III

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

UNIT IV

Elephant foot yam, dioscorea (greater yam, lesser yam and white yam), yam bean, lima bean, winged bean, vegetable pigeon pea, jack bean and sword bean.

UNIT V

Sweet gourd, spine gourd, pointed gourd, oriental pickling melon, little gourd (kundru), arrowroot and chinese potato.

Practical

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

Suggested Readings

Bhat KL. (2001). *Minor Vegetables - Untapped Potential*. Kalyani Publishers, New Delhi.

Indira P & Peter KV. (1984). *Unexploited Tropical Vegetables*. Kerala Agricultural University, Kerala.

Peter KV. (2007-08). *Underutilized and Underexploited Horticultural Crops*. Vols. I-IV. New India Publ. Agency, New Delhi.

Rubatzky VE & Yamaguchi M. (1997). *World Vegetables: Principles, Production and Nutritive Values*. Chapman & Hall

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

VSC 508 Organic Vegetable Production Technology 1+1

Theor

UNIT I

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, waster 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, Jodhpur.

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

Palaniappan SP & Annadorai K. (2003). *Organic Farming, Theory and Practice*. Scientific Publisher, Jodhpur.

Pradeep Kumar T, Suma B, Jyothibhaskar & Satheesan KN. (2008). *Management of Horticultural Crops*. New India Publ. Agency, New Delhi.

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

Singh HP and Thomas GV (2010). Organic Horticulture- Principles, Practices & Technologies. Westville Publishing House, New Delhi.

Note : For minor courses please refer the concerned department's courses outline.

Horticulture (Plantation, Spices, Medicinal and Aromatic Crops)
(For CoH, Mandsaur)

Ist Semester

S. No.	Course No.	Title	Credit
Major Courses			
1	PSMA 501	Production of Plantation Crops	2+1
2	PSMA 502	Production Technology of Spice Crops	2+1
3	PSMA 503	Production Technology of Medicinal and Aromatic Crops	2+1
4	PSMA 504	Breeding of Plantation Crops and Spices	2+1
Minor Courses			
1	VSC 501	Production Technology of Cool Season Vegetable Crops	2+1
2	VSC 504	Growth and Development of Vegetable Crops	2+1
Supporting Courses			
1	STAT 511	Statistical Method for Applied Science	3+1
Non Credit Courses			
1	PGS 501	Library and Information Services	0+1
2	PGS 502	Technical Writing and Communication Skills	0+1
3	PGS 503 (e-course)	Intellectual Property and its Management in Agriculture	1+0

II semester

Major Courses			
1	PSMA 505	Breeding of Medicinal and Aromatic Crops	2+1
2	PSMA 506	Processing of Plantation Crops, Spices, Medicinal and Aromatic Crops	2+1
3	PSMA 507	Organic Spice and Plantation Crop Production Technology	2+1

Minor Courses			
1	VSC 505	Seed Production Technology of Vegetable Crops	2+1
2	VSC 508	Organic Vegetable Production Technology	1+1
Supporting Courses			
1	STAT 512	Experimental Designs	2+1
Non credit Courses			
1	PGS 504	Basic Concepts in Laboratory Techniques	0+1
2	PGS 505	Agricultural Research, Research Ethics and Rural Development Programmes	1+0
3	PGS 506	Disaster Management	1+0

IIIrd Semester

1	PSMA 591	Master Seminar	0+1
3	PSMA 599	Master Research	0+10

IVth Semester

1	PSMA 599	Master Research	0+10

PSMA 501 Production of Plantation Crops 2+1

Objective

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

Theory

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

Crops

UNIT I: Coffee and tea

UNIT II: Cashew and cocoa

UNIT III: Rubber, palmyrah and oil palm

UNIT IV: Coconut and arecanut

UNIT V: Wattle and betel vine

Practical

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

Suggested Readings

Anonymous, 1985. *Rubber and its Cultivation*. The Rubber Board of India.

Chopra VL & Peter KV. 2005. *Handbook of Industrial Crops*. Panima.

Harler CR. 1963. *The Culture and Marketing of Tea*. Oxford Univ. Press.

Kurian A & Peter KV. 2007. *Commercial Crops Technology*. New India Publ. Agency.

Nair MK, Bhaskara Rao EVV, Nambiar KKN & Nambiar MC. 1979. *Cashew*. CPCRI, Kasaragod.

Peter KV. 2002. *Plantation Crops*. National Book Trust.

Pradeep Kumar T, Suma B, Jyothibhaskar & Satheesan KN. 2008. *Management of Horticultural Crops*. Part I, II. New India Publ. Agency.

Rai PS & Vidyachandram B. 1981. *Review of Work Done on Cashew*. UAS, Research Series No.6, Bangalore.

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

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

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

PSMA 502 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 I

Black pepper, cardamom

UNIT II

Clove, cinnamon and nutmeg, allspice

UNIT III

Turmeric, ginger and garlic

UNIT IV

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

UNIT V

Tamarind, garcinia and vanilla

Practical

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

Suggested Readings

Agarwal S, Sastry EVD & Sharma RK. 2001. *Seed Spices: Production, Quality, Export*. Pointer Publ.

Arya PS. 2003. *Spice Crops of India*. Kalyani.

Bhattacharjee SK. 2000. *Hand Book of Aromatic Plants*. Pointer Publ.

Bose TK, Mitra SK, Farooqi SK & Sadhu MK (Eds.). 1999. *Tropical Horticulture*. Vol.I. Naya Prokash.

Chadha KL & Rethinam P. (Eds.). 1993. *Advances in Horticulture*. Vols. IX-X. *Plantation Crops and Spices*. Malhotra Publ. House.

Gupta S. (Ed.). *Hand Book of Spices and Packaging with Formulae*. Engineers India Research Institute, New Delhi.

Kumar NA, Khader P, Rangaswami & Irulappan I. 2000. *Introduction to Spices, Plantation Crops, Medicinal and Aromatic Plants*. Oxford & IBH.

Nybe EV, Miniraj N & Peter KV. 2007. *Spices*. New India Publ. Agency.

Parthasarthy VA, Kandiannan V & Srinivasan V. 2008. *Organic Spices*. New India Publ. Agency.

Peter KV. 2001. *Hand Book of Herbs and Spices*. Vols. I-III. Woodhead Publ. Co. UK and CRC USA

Pruthi JS. (Ed.). 1998. *Spices and Condiments*. National Book Trust

Pruthi JS. 2001. *Minor Spices and Condiments- Crop Management and Post Harvest Technology*. ICAR.

Purseglove JW, Brown EG, Green CL & Robbins SRJ. (Eds.). 1981. *Spices*. Vols. I, II. Longman.

Shanmugavelu KG, Kumar N & Peter KV. 2002. *Production Technology of Spices and Plantation Crops*. Agrobios.

Thamburaj S & Singh N. (Eds.). 2004. *Vegetables, Tuber Crops and Spices*. ICAR.

Tiwari RS & Agarwal A. 2004. *Production Technology of Spices*. International Book Distr. Co.

Varmudy V. 2001. *Marketing of Spices*. Daya Publ. House.

PSMA 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, vettiver, geranium, artemisia, mentha, ocimum, eucalyptus, rosemary, thyme, patchouli, lavender, marjoram, oreganum.

UNIT VIII

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

UNIT IX

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

Practical

Botanical description, Propagation techniques, Maturity standards, Digital documentation, Extraction of secondary metabolites, Project preparation for commercially important medicinal crops, Visit to medicinal crop fields, Visit to herbal extraction units. Extraction of Essential oils, Project preparation for commercially important Aromatic crops, Visit to distillation and value addition units – Visit to CIMAP.

Suggested Readings

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

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

Farooqi AA & Sriram AH. 2000. *Cultivation Practices for Medicinal and Aromatic Crops*. Orient Longman Publ.

Farooqi AA, Khan MM & Vasundhara M. 2001. *Production Technology of Medicinal and Aromatic Crops*. Natural Remedies Pvt. Ltd.

Hota D. 2007. *Bio Active Medicinal Plants*. Gene Tech Books.

Jain SK. 2000. *Medicinal Plants*. National Book Trust.

Khan IA & Khanum A. *Role of Bio Technology in Medicinal and Aromatic Plants*. Vol. IX. Vkaaz Publ.

Kurian A & Asha Sankar M. 2007. *Medicinal Plants.* Horticulture Science Series, New India Publ. Agency.

Panda H. 2002. *Medicinal Plants Cultivation and their Uses*. Asia Pacific Business Press.

Prajapati SS, Paero H, Sharma AK & Kumar T. 2006. *A Hand book of Medicinal Plants*. Agro Bios.

Ramawat KG & Merillon JM. 2003. *BioTechnology-Secondary Metabolites*. Oxford & IBH.

Skaria P Baby, Samuel Mathew, Gracy Mathew, Ancy Joseph, Ragina Joseph. 2007. *Aomatic Plants*. New India Publ. Agency.

PSMA 504 Breeding of Plantation Crops and Spices 2+1

Objective

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

Theory

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

Crops

UNIT I: Coffee and tea

UNIT II: Cashew and cocoa

UNIT III: Rubber, palmyrah and oil palm

UNIT IV: Coconut and arecanut

UNIT V: Black pepper and cardamom

UNIT VI: Ginger and turmeric

UNIT VII: Fenugreek, coriander, fennel, celery and ajwoain

UNIT VIII: Nutmeg, cinnamon, clove and allspice

Practical

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

Suggested Readings

Anonymous 1985. *Rubber and its Cultivation*. The Rubber Board of India.

Chadha KL & Rethinam P. (Eds.). 1993. *Advances in Horticulture*. Vol. IX. *Plantation Crops and Spices*. Part-I. Malhotra Publ. House.

Chadha KL, Ravindran PN & Sahijram L. 2000. *Biotechnology in Horticultural and Plantation Crops.* Malhotra Publ. House.

Chadha KL. 1998. *Advances in Horticulture*. Vol. IX. *Plantation and Spices Crops*. Malhotra Publishing House, New Delhi.

Chopra VL & Peter KV. *Handbook of Industrial Crops*. Haworth Press. Panama International Publishers, New Delhi (Indian Ed.).

Damodaran VK, Vilaschandran T & Valsalakumari PK. 1979. *Research on Cashew in India*. KAU, Trichur.

Ferwerden FP & Wit F. (Ed.). 1969. *Outlines of Perennial Crop Breeding in the Tropics*. H. Veenman & Zonen.

Harver AE. 1962. *Modern Coffee Production*. Leonard Hoff.

Raj PS & Vidyachandra B. 1981. *Review of Work Done on Cashew*. UAS Research Series No.6, Bangalore.

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

PSMA 505 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, vettiver, 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.

PSMA 506 Processing of Plantation Crops, Spices Medicinal and Aromatic Crops 2+1

Objective

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

Theory

UNIT I

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

UNIT II

Processing of produce from plantation crops, *viz*. coconut, arecanut, cashewnut, oil palm, palmyrah, date palm, cocoa, tea, coffee, rubber etc.

UNIT III

Processing of medicinal plants– dioscorea, gloriosa, stevia, coleus, ashwagandha, tulsi, isabgol, safed musli, senna, aloe, catharanthus, etc. Different methods of drying and storage. Microbial contamination of stored product. Influence of temperature and time combination on active principles.

UNIT IV

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

PSMA 507 Organic Spice and Plantation Crop Production Technology 2+1

Objective

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

Theory

UNIT I

Importance, principles, perspective, concept and component of organic production of spice and plantation crops.

UNIT II

Organic production of spice crops and plantation crops, *viz.* pepper, cardamom, turmeric, ginger, cumin, vanilla, coconut, coffea, cocoa, tea, arecanut.

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, Panchagavvya, 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, waster 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.

Note : For minor courses please refer the concerned department's courses outline .

Horticulture (Floriculture and Landscape Architecture)

(For CoH, Mandsaur)

Ist Semester

CODE	COURSE TITLE	CREDITS
Major courses		
FLA 501	Breeding of flower crops and ornamental plants	2+1
FLA 502	Production technology of cut flowers	2+1
FLA 503	Production technology of loose flowers	2+1
FLA 504	Landscaping and ornamental gardening	2+1
Minor courses		
FSC 501	Tropical and Dryland Fruit Production	2+1
FSC 505	Propagation and Nursery Management for Fruit Crops	2+1
Supporting Courses		
STAT- 511	Statistical methods for applied sciences	3+1
Non Credit Courses		
PGS 501	Library and Information Services	0+1
PGS 502	Technical Writing and Communication Skills	0+1
PGS 503	Intellectual Property and its Management in Agriculture	1+0

II Semester

Major courses		
FLA505	Protected floriculture	2+1
FLA 506	Value addition in flowers	2+1
FLA 507	Turfing and turf management	2+1
Minor courses		
FSC 504	Canopy management in fruit crops	2+1
FSC 508	Growth and development of horticultural crops	2+1
Supporting Courses		
STAT 512	Design of experiments	2+1

Non Credit Courses		
PGS- 504	Basic concepts in laboratory technology	0+1
PGS- 505	Agricultural Research, Research Ethics and Rural Development Programmes	1+0
PGS- 506	Disaster Management	1+0

IIIrd Semester

FLA 591	Master's Seminar	0+1
FLA 599	Master's Research	0+10

IVth Semester

FLA 599	Master's Research	0+10

FLA 501 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, liliums, 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.

FLA 502 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, liliums, 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.

FLA 503 Production Technology for 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, trasportation 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. 53

Bose TK, Maiti RG, Dhua RS & Das P. 1999. *Floriculture and Landscaping.* Naya Prokash.

FLA 504 Land Scaping 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, burlapping, lawn making, planting herbaceous and shrubbery borders, project preparation on landscaping for different situations, visit to parks and botanical gardens, case study on commercial landscape gardens.

Suggested Readings

Bose TK, Maiti RG, Dhua RS & Das P. 1999. *Floriculture and Landscaping.* Naya Prokash.

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

Nambisan KMP. 1992. *Design Elements of Landscape Gardening*. Oxford & IBH.

Randhawa GS & Mukhopadhyay A. 1986. *Floriculture in India*. Allied Publ.

Sabina GT & Peter KV. 2008. *Ornamental Plants for Gardens*. New India Publ. Agency.

Valsalakumari et al. 2008. *Flowering Trees*. New India Publ. Agency.

Woodrow MG.1999. *Gardening in India.* Biotech Books.

FLA 505 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.

FLA 506 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. *Hightech Floriculture.* Indian Society of Ornamental Horticulture, New Delhi.

FLA 507 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

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.

Note : For minor courses please refer the concerned department's courses outline.