जननायक चन्द्रशेखर विश्वविद्यालय, बलिया-277001 (उ.प्र.)

Jananayak Chandrashekhar University, Ballia-277001 (U. P.)

FACULTY OF AGRICULTURE

Course structure and Syllabus

M.Sc. (Agriculture)

Horticulture

UNDER SEMESTERSYSTEM AS PER ICAR RECOMMENDATE SYLLABUS

ACADEMIC SESSION -2020-21

M.Sc.(Ag)-Horticulture

FACULTY OF AGRICULRE

SEMESTER SYSTEM

M.Sc. (AGRICULTURE)- HORTICULTURE
FACULTY OF AGRICULTURE
SEMESTER SYSTEM

M.Sc. (Agriculture) – HORTICULTURE programme is envisaged in four divisions viz,Fruit Science, Vegetable Science, Floriculture and Land Scape Architecture and PlantationCrops, Spices, Medicinal and Aromatic crops. However, relevant courses are includedunder each of the four divisions:-

Fruit Science-Thrust on advances in management of fruit crops, Biotechnology, biodiversity conservation, organic production and GAP in fruit, cultivation are included

Vegetable Science- Vegetables form a major component of Indian dietary. They play a major role in nutritional security and save considerable expenses on medicine.Thrust on crop improvement and management of vegetable crops grown in India, Precision farming, biotechnology, organic production and GAP in vegetable, cultivation are included.

Floriculture and Land Scape Architecture- Floriculture is the aesthetic branch of horticulture which deals with the cultivation ofboth traditional and commercial flower crops, either in open field or under protectedconditions and growing of ornamentals including potted plants and their marketing.Floriculture is an emerging Industry.Thrust on high tech. floriculture, protected cultivation and advances in managementof major flower crops grown in India

Plantation Crops, Spices,Medicinal and Aromatic Crops

Plantation, spices, medicinal and aromatic crops occupy a major chunk of cultivable area in south and north east states. These are major export earning crops. They play amajor role in nutritional security and save considerable expenses on medicine.

- Thrust on advances in management and crop improvement of plantation crops, spices, medicinal and aromatic crops.
- Biotechnology, biodiversity conservation, organic production and GAP are included.

Faculty should be trained in advance and frontier aspects of biotechnology and postharvest technology, vegetable, Floriculture and Land Scape Architecture and also for Plantation crops.

1.Laboratory facilities should be strengthened for conduct of practical classes especially inbiotechnology, crop improvement and post harvest technology.

2.One time catch up grant should be awarded to each SAU for meeting expenditure forupgrading the course requirements. Faculty training and retraining should be anintegral component. For imparting total quality management, a minimum of twofaculties in each division under an SAU should be given on-job training in reputednational and international institutes.

Expected Output

Revamping of post graduate programme in whole of Horticultural Sciencethroughout the country, Imparting quality education, Development of technical manpower to cater the need of government, corporate,quasi government and research organizations both in India and abroad in horticulture. Exposure to the faculty in the latest technical know-how, Vital step to sustain the Golden Revolution in India.

M.Sc. (Agriculture) – Horticulture

COURSE STRUCTURE – AT A GLANCE

FIRST SEMESTER **M.M.: 400**

PAPER–101 TROPICAL AND DRY LAND FRUIT PRODUCTION MM.:75

PAPER-102 SUB- TROPICAL AND TEMPERATE FRUIT PRODUCTION MM.:75

PAPER–103 PROPAGATION AND NURSERY MANAGEMENT FOR FRUIT CROPS MM.:75

PAPER –104 PRODUCTION TECHNOLOGY OF COOL SEASON VEGETABLE CROPS MM.:75

PRACTICAL OF ALL MM.:100

SECOND SEMESTER **M.M.:400**

PAPER –201 PRODUCTION TECHNOLOGY OF WARM SEASON VEGETABLE CROPS MM.:75

PAPER –202 SEED PRODUCTION TECHNOLOGY OF VEGETABLE CROPS MM.:75

PAPER –203 COMMERCIAL FLORICULTURE MM.:75

PAPER –204 EXPERIMENTAL TECHNIQUES MM.:75

PRACTICAL OF ALL MM.:100

THIRD SEMESTER **M.M.: 400**

PAPER – 301 PROTECTED FLORICULTURE MM.:75

PAPER – 302 LANDSCAPING, GARDENING AND PRODUCTION OF PLANTATION CROPS MM.:75

PAPER – 303 PRODUCTION TECHNOLOGY OF SPICE CROPS MM.:75

PAPER – 304 PRODUCTION TECHNOLOGY FOR MEDICINAL AND AROMATIC CROPS MM.:75

PRACTICAL OF ALL MM.:100

FOURTH SEMESTER **M.M.: 400**

PAPER – 401 ADVANCES IN BREEDING OF HORTICULTURAL CROPS MM.:75

PAPER – 402 POST HARVEST MANAGEMENT AND PROCESSING OF CROPS MM.:75

PAPER – 403 SEMINAR MM.:75

PAPER – 404 THESES WORK FOR RESEARCH MM.:125

VIVA-VOCE OF THESIS WORK FOR RESEARCH MM.:50

PROPOSED REGULATIONS

Semesters/Papers **SEMESTER- I**	Title of the papers	**Theory**		**Practical**	
		Max. Marks	Min. Marks	Max. Marks	Mini. marks
Paper 101	(Theory Paper)	**75**	25	-	
Paper 102	(Theory Paper)	75	25	-	
Paper 103	(Theory Paper)	75	25	-	
Paper 104	(Theory Paper)	75	25	-	
	PRACTICAL FOR ALL			100	33
Total aggregate of First Semester is 36%		**Max. Marks – 400, Min.Marks – 144**			
SEMESTER –II					
Paper 201	(Theory Paper)	75	25	-	
Paper 202	(Theory Paper)	75	25	-	-
Paper 203	(Theory Paper)	75	25	-	-
Paper 204	(Theory Paper)	75	25	-	-
	PRACTICAL FOR ALL	-	-	100	33
Total aggregate of First Semester is 36%		**Max. Marks – 400, Min. Marks – 144**			
SEMESTER –III					
Paper 301	(Theory Paper)	75	25	-	-
Paper 302	(Theory Paper)	75	25	-	-
Paper 303	(Theory Paper)	75	25	-	-
Paper 304	(Theory Paper)	75	25	-	-
	PRACTICAL FOR ALL	-	-	100	33
Total aggregate of First Semester is 36%		**Max. Marks – 400, Min. Marks – 144**			
SEMESTER –IV					
Paper 401	(Theory Paper)	75	25	-	-
Paper 402	(Theory Paper)	75	25		
Paper 403	SEMINAR	-		75	25
Paper 404	THESIS WORK FOR RESEARCH			125	42
	VIVA-VOCE OF THESIS WORK FOR RESEARCH			50	17
Total aggregate of First Semester is 36%		**Max. Marks – 400 ;Min. Marks – 144**			

Consolidate Performa for allotments of all semester are as follows-

First Semester	400	144
Second Semester	400	144
Third Semester	400	144
Fourth Semester	400	144
Grand Total	1600	576

Note-

1. The research work may be initiated in any of II or III semester but the thesis shall be submitted at the end of IV semester.

2. The evaluation of seminar presentation shall be done by the departmental committee which shall be constituted by the Head of Department /Principal of College.
3. Practical examination shall be conducted by external and internal examiner.
4. The thesis evaluation and viva-voce shall be made by the external and internal examiner.
5. The minimum passing marks of every paper shall be33 % in theory and practical separately and total aggregate of the semester shall be 36 % minimum.

M.Sc. (Ag.) – HORTICULTURE (DETAILED SYLLABUS)

FIRST SEMESTER MM.:400

PAPER – 101TROPICAL AND DRY LAND FRUIT PRODUCTION MM.:75

Commercial varieties of regional, national and international importance, eco-physiological,recent trends in propagation, rootstock influence, planting systems, cropping systems, rootzone 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, physiology disordercausesand remedies, quality improvement by management practices; maturity indices,harvesting, grading, packing, storage and ripening techniques; industrial and exportpotential, 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 tropic

Suggested Readings

• Bose TK, Mitra SK & Rathore DS. (Eds.). 1988. *Temperate Fruits -Horticulture.* AlliedPubl.
• Bose TK, Mitra SK & Sanyal D. 2001. (Eds.). *Fruits -Tropical and Subtropical.* NayaUdyog.
• Chadha KL & Pareek OP. 1996 (Eds.). *Advances in Horticulture.* Vols. IIIV MallotraPubl. House.
• Nakasone HY & Paul RE. 1998. *Tropical Fruits.* CABI.
• Peter KV. 2008 (Ed.). *Basis of Horticulture.* New India Publ. Agency.
• Pradeep Kumar T, Suma B, Jyothibhaskar & Satheesan KN. 2008. *Management ofHorticultural Crops.* Parts I, II. New India Publ. Agency.
• Radha T & Mathew L. 2007. *Fruit Crops.* New India Publ. Agency.
• Singh HP, Negi JP & Samuel JC. (Eds.) 2002. *Approaches for Sustainable Developmentof Horticulture.* National Horticulture Board.
• Singh HP, Singh G, Samuel JC & Pathak RK. (Eds.). 2003. *Precision Farming in Horticulture.* NCPAH, DAC/PFDC, CISH, Lucknow. 12

PAPER – 102SUBTROPICAL AND TEMPERATE FRUIT PRODUCTION MM.:75

Commercial varieties of regional, national and international importance, eco-physiologicalrequirements, recent trends in propagation, rootstock in fluency, planting systems,copping systems, root zone and canopy management, nutrient management, watermanagement, fertigation, bioregulation, abiotic factors limiting fruit production, physiologyof flowering, fruit set development, abiotic factors limiting production, physiologicaldisorders-causes and remedies, quality improvement by management practices; maturityindices, harvesting, garding, packing, precooling, storage, transportation and ripeningtechniques; industrial and export potential, Agri Export Zones (AEZ) and industrial support.

Crops

UNIT- I : Apple, pear, quince, grapes, Minor fruits- mangosteen, carambola, bael,

UNIT- II : Plums, peach, apricot, cherries, hazlenut

UNIT- III : Litchi, loquat, persimmon, kiwifruit, strawberry

UNIT- IV : Nuts- walnut, almond, pistachio, pecan,wood apple, fig, jamun, rambutan, pomegranate

Suggested Readings

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

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

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

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

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

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

PAPER – 103PROPAGATION AND NURSERYMANAGEMENT FOR FRUIT CROPS MM.:75

UNIT- I

Introduction, life cycle in plants, cellular basis for propagation, sexual propagation,apomixis, polyembryony, chimeras. Principles factors influencing seed germination ofhorticultural crops, dormancy, hormonal regulation of germination and seeding 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 cuttingin 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 budwood bank, stock, scion and inter stock, relationship - Incompatibility. Rejuvenationthrough 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.Nursery - Types, Structures, Components, Planning and Layout. Nursery managementpractices for healthy propagule production.

Suggested Readings

• Harmann HT & Kester DE. 1989. *Plant Propagation - Principles and Practices.* Prentice Hall of India.
• Bose TK, Mitra SK & Sadhu MK. 1991. *Propagation of Tropical and Subtropical Horticultural Crops.* Naya Prokash.
• Peter KV. (Ed.) 2008. *Basis of Horticulture.* New India Publ. Agency.
• Singh SP. 1989. *Mist Propagation.* Metropolitan Book Co.
• Rajan S & Baby LM. 2007. *Propagation of Horticultural Crops.* New India Publ. Agency.

PAPER–104PRODUCTION TECHNOLOGY OF COOL SEASON VEGETABLE CROPS MM.:75

Introduction, and taxonomy, climatic and soil requirements, commercial varieties/ hybirds,sowing/planting times and methods, seed rate and seed treatment, nutritional andirrigation requirements, intercultural operations, weed control, mulching, physiologicaldisorders, harvesting, post-harvest management, plant protection measures and seedproduction of :

UNIT - I

Potato, green leafy cool season vegetable

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. Peas and broad bean

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.
• 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.
• Rama MK. (2008). Scientific Cultivation of Vegetables. Kalyani Publ., New Delhi.
• Rubatzky VE & Yamaguchi M. (1997). World Vegetables : Principles, Production andNutritive 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
• Thompson HC & Kelly WC. (1978). Vegetable Crops. Tata McGraw-Hill.

PRACTICAL OF ALL **MM.:100**

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, visit to propical, subtropical, humid tropical and temperate orchards, Project preparation for establishing commercial orchards.Anatomical studies in rooting of cutting and graft union, construction of propagationstructures, study of media and PGR. Hardening - case studies, micro propagation, explantpreparation, media preparation, culturing - *in vitro* clonal propagation, meristem culture,shoot tip culture, axillary bud culture, direct organogenesis, direct and indirectembryogenesis, micro grafting, hardening. Visit to TC labs and nurseries.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/poly house

SECOND SEMESTER **MM.:400**

PAPER – 201PRODUCTION TECHNOLOGY OFWARMSEASON VEGETABLE CROPS MM.:75

Introduction, botany and taxonomy, climatic and soil requirements, commercialVarieties/hybirds, sowing/planting times and methods, seed rate and seed treatment,nutritional and irrigation requirements, intercultural operations, weed control, mulching,physiological disorders, harvesting, postharvest 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) and cowpea

UNIT - III

Cucurbitaceous crops,

UNIT - IV

Tapioca, sweet potato and colosia,Green leafy warm season vegetables

Suggested Readings

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

• Brown HD & Hutchison CS. Vegetable Science. JB Lippincott Co.
• 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: ProductionTechnology.* 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.
• Kalloo G & Singh K. (2000) Emerging Scenario in Vegetable Research andDevelopment. Research Periodicals & Book Publishing House, Houston, Taxas, USA.
• Nayer NM & More TA (1998). Cucurbits. Oxford & IBH Publ. Co., New Delhi.
• Rana MK. (2008). Olericulture in India. Kalyani Publ., New Delhi.
• Rubatzky VE & Yamaguchi M. (1997). World Vegetables: Principles, Production andNutritive 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 & IBHPublishing Co., New Delhi.
• Shanmugavelu KG. (1989). Production Technology of Vegetable Crops. Oxford & IBHDistributing Co., Lucknow
• Singh DK. (2007). Modern Vegetable Varieties and Production Technology.International Book Distributing Co. Lucknow
• Singh NP, Bhardwaj AK, Kumar A & Singh KM. (2004). Moder Technology onVegetable 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 Crops and Spices. ICAR.New Delhi.

PAPER – 202SEED PRODUCTION TECHNOLOGY OF VEGETABLE CROPS MM.:75

UNIT - I

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

UNIT – II

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

UNIT - III

Categories of seed; maintenance of nucleus, foundation and certified seed; seedcertification, seed standards; seed act and law enforcement, plant quarantine and qualitycontrol.

UNIT - IV

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

Suggested Readings

- Agrawal PK & Dadlani M. (1992). Techniques in Seed Science and Technology. SouthAsian Publ.
- Agarwal RL. (1997). Seed Technology. Oxford & IBH.
- Benedell PE. (1998). Seed Science and Technology : Indian Forestry Species. AlliedPubl.
- Fageria MS, Arya PS & Choudhary AK. (2000). Vegetable Crops : Breeding and SeedProduction. Vol I. Kalyani Publishers, New Delhi.

PAPER – 203COMMERCIAL FLORICULTURE **MM.:75**

(A) PRODUCTION TECHNOLOGY OF CUT FLOWERS

UNIT - I

Scope of cut flower in global trade, Global Scenario of cut flower production, Varietalwealth and diversity, area under cut flowers and production problems in India – Patentsright, nursery management, media for nursery, special nursery practices.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. Flower forcing and year round flowering through physiological interventions, chemical regulation, environmental manipulation.

UNIT - II

Growing environment, open cultivation, protected cultivation, soil requirements, artificialgrowing media, soil decontamination techniques, planting methods, influence ofenvironmental parameters, light, temperature, moisture, humidity and CO2 on growth andflowering.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, hiliconia, alstromeria, alpinia, ornamental ginger, bromeliads, dahila, gypsohilla, limonium, statice, stock, cut foliages and fillers.

(B) PRODUCTION TECHNOLOGY FOR LOOSE FLOWERS

UNIT – III

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.Soil and climate

requirements, field preparation, systems of planting, precision farming techniques. Water and nutrient management, weed management, rationing, training and pruning, pinching and disbudding, special horticulture practices, use of growth regulators, physiological disorders and remedies, IPM and IDM.

UNIT - IV

Flower forcing and year round flowering, production for special occasions throughphysiological interventions, chemical regulation. 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 flower (Nyctanthes,Tabemacmontana, ixora, lotus. Lilies, Tecoma, Champaka and Pandarus).

Suggested readings

- Arora JS. 2006 Introductory Ornamental Horticulture. Kalyani.
- Bhattacharjee SK. 2006. Advances in Ornamental Horticulture. Vols. I-VI. PointerPubl.
- Bose TK & Yadav LP. 1989. Commercial Flowers. Naya Prokash.
- Bose TK. Maiti RG, Dhua RS & Das P. 1999. Floriculture and Landscaping. NayaProkash.
- Chandha KL & Chaudhary B. 1992. Ornamental Horticulture in India CAR.
- Chandha KL 1995. Advances in Horticulture. Vol. XII Malhotra Publ. House.
- Lauria A & Ries VH. 2001. Floriculture- Fundamentals and Practices. Agarobios.
- 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 loriculture.Indian Society of Ornamental Horticulture, New Delhi.

PAPER – 204 EXPERIMENTAL TECHNIQUES M.M.:75

UNIT I

Descriptive statistics: probability distributions,binomial, probability distributions of functions of random variables.Classification and tabulation of data.Diagrammatic and Graphical representations of research results.Sampling distributions of sample mean and samplevariance from Normal population, aim, method. Normal distribution - marginal and conditional distributions.

UNIT II

Distribution of quadratic forms. Regression and correlationrank correlation, Regression analysis, partial and multiple correlation and regression, linear and nonlinear relationship. Mechanical errors.Principles of experimental design, precision and accuracy, advantage of replication, experimental technique. Analysis of variance, fundamental principles of analysis of variance. Critical difference, limitations of the analysis of variance.

UNIT III

Statistical analysis and advantage and disadvantage of basic design-completely randomized design, randomized block design, Latin square design. Factorial concept: simple effects, main effects and interaction, factorial experiments (without confounding), Yates method. Confounding, principles of confounding in a 2^3 factorial experiments. Split plot design.

UNIT IV

Missing plot technique; Bartlett's techniques for missing plots, cross-overdesign or switch-over trials, Rotational experiments, progeny selection, compact family block design, uniformity trial, sire index, sampling in field experiments.

Suggested Readings

- Chakrabarti MC. 1962. *Mathematics of Design and Analysis of Experiments*.Asia Publ.House.
- Cochran WG & Cox DR. 1957.*Experimental Designs*.2nd Ed. John Wiley.
- Dean AM & Voss D. 1999.*Design and Analysis of Experiments*.Springer.
- Dey A &Mukerjee R. 1999. *Fractional Factorial Plans*. John Wiley.
- DeyA 1986. *Theory of Block Designs*.Wiley Eastern.
- Hall M Jr. 1986. *Combinatorial Theory*.John Wiley.
- John JA &Quenouille MH. 1977. *Experiments: Design and Analysis*. Charles & Griffin.
- Kempthorne, O. 1976. Design and Analysis of Experiments.John Wiley.
- Khuri AI & Cornell JA. 1996. *Response Surface Designs and Analysis*. 2nd Ed. MarcelDekker.
- Montgomery DC. 2005. *Design and Analysis of Experiments*. John Wiley.
- Raghavarao D. 1971.*Construction and Combinatorial Problems in Design ofExperiments*.John Wiley.

PRACTICAL OF ALL **MM.:100**

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.

Seed sampling, seed testing (genetic purity, seed viability, seedling vigour, physical purity) and seed health testing; testing, relesing and notification procedures of varieties; floral biology; rouging of off-type; methods of hybird 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.

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, postharvest handling, cold chain, project preparation for regionally important cut flowers, visit to commercial cut flower units and case study.

Botanical description of species and varieties, propagation techniques, mist chamber

operation, training and pruning techniques, practice 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.

Selection of ornamental plants, practices in preparing designs for home gardens, industrial gardens, industrial 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.

THIRD SEMESTER MM.:400

PAPER – 301PROTECTED FLORICULTURE AND VALUE ADDITION MM.:75

(A) PRODUCTED FLORICULTURE

UNIT - I

Prospects of protected floriculture in India; Types of protected structures - Greenhouses,polyhouses, shade houses, rain shelters etc., Designing and erection of protectedstructures; Low cost/ Medium cost/ High cost structure - economics of cultivation; Locationspecific designs; Structure components; Suitable flower corps for protected cultivation.Environment control - management and manipulation of temperature, light, humidity, airand CO2; Heating and cooling systems, ventilation, naturally ventilated greenhouses, fanand pad cooled greenhouses, light regulation.

UNIT - II

Containers and substrates, soil decontamination, layout of drip and fertigation system,water and nutrient management, weed management, physiological disorders, IPM andIDM.Crop regulation by chemical methods and special horticultural practices (pinching,disbudding, deshooting, deblossoming, etc.); Stacking and netting, Photoperiod regulation.Harvest indices, harvesting techniques, post-harvest handling techniques, Precooling,sorting, grading, packing, storage, quality standards.

(B) VALUE ADDITION

Unit - III

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 product and decorations.

Unit - IV

Dry flowers - Identification and selection of flowers and plant parts; Raw materialprocurement, preservation and storage; Techniques in dry flower making bleaching, drying, embedding, pressing; Accessories; Designing and arrangement - dry flower baskets, bouquets, pot-pourri, wall hangings, button holes, greeting cards, wreaths; packing and storage.Concrete and essential oils: Selection or species and varieties (including non-conventional species), extraction methods, Packing and storage. Significance of nutural pigments, Extraction methods; Applications.

Suggested Readings

- Bhattacharjee SK. 2006. Advances in Ornamental Horticulture Vols. I-VI Pointer Publ.
- Bose TK & Yadav LP. 1989. Commercial Flower. Naya Prokash.
- Bose TK & Maiti RG. Dhua RS & Das P. 1999. Floriculture and Landscaping. NayaProkash.
- Chadha KL 1995 Advances in Horticulture - Vol XII. Malhotra Publ. House
- Laurie 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, Janakiran B. Balaji T, Kulkarni S & Misra RL. 2007. Hightech Floriculture.Indian of ornamental Horticulture, New Delhi.

PAPER – 302 LANDSCAPING, GARDENING ANDPRODUCTION OF PLANTATION CROPS MM.:75

Unit - I

Landscape designs, types of gardens, English, Mughal, Japanese, Persian, Spanish, Italian, Vanarns, Buddha garden; Styles of garden, formal, informal and free style gardens.Urban landscaping, Landscaping for specific situations, institutions, industries, residents, hospitals, roadsides, traffic islands, dam sites, IT parks, corporates.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 - II

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

Unit-III

Role of plantation crops in national economy, export potential, IPR Issues, cleandevelopment mechanism, classification and varietal wealth. Plant density planting, nutritional requirements, physiological disorders, role of growth regulators and macro and micro nutrients, water requirements, fertigation, moisture conservation, shade regulation, training and pruning, crop regulation, maturity indices, harvesting. Cost benefit analysis, organic farming, precision farming.

Unit IV

Crops- Coffee and Tea, Cashew and Cocoa, Rubber, Palmyrah and oil Palm and betal vine Coconut and areacanut and Wattle

Suggested Readings

- Anonymous, 1985 Rubber and its Cultivation. The Rubber Board of India.
- Bose TK, Maiti RG, Dhua RS & Das P. 1999. Floriculture and Landscaping. NayaProkash.

• 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 Pub/. Agency.
• Lauria A & Victor HR. 2001. Floriculture - Fundamentals and Practices Agrobios.
• Management of Horticulture Crops Part I, II, New India Publ. Agency.
• Nair MK, Bhaskara Rao EVV, Nambiar KKN & Nambiar MC 1979 Cashew. CPCRI, Kasaragod.
• Nambisan KMP. 1992. Design Elements of Landscape Gardening Oxford & IBH.
• Opportunities and Constraints, Oxford & IBH.
• Peter KV.2002. Plantation Crops. National Book Trust.
• Pradeep Kumar T, Suma B, Jyothibhaskar & Satheesan KN. 2008
• Rai PS & Vidyachandram B. 1981, Review of work done on cashew UAS, Research Series No. 6 Bangalore.
• Randhawa GS & Mukhopadhyay A. 1986. Floriculture in India. Allied Publ.
• Ranganathan V, 1979 Hand Book of Tea Cultivation , UPASI, Tea Res, Stn, Cinchona Srivastava HC, Vatsaya B & Menon KKG, 1986 Plantation Crops.
• Sabina GT & Peter KV. 2008. Ornamental Plants for Gardens. New India Publ. Agency
• Valsalakumari et al. 2009. Flowering Trees. New India Publ. Agency. Woodrow MG. 1999. Gardening in India. Biotech Books.

PAPER – 303PRODUCTION TECHNOLOGY OF SPICE CROPS MM.:75

Introduction, importance of spice crops-historical accent, present status - national andinternational, future prospects, botany and taxonomy, climatic and soil requirements,commercial varieties/ hybirds, 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 plantingmaterial and micro-propagation, precision farming, organic resource management, organiccertification, quality control, pharmaceutical significance and protected cultivation of :

UNIT I :

Coriander,Black pepper and cardamom

UNIT II :

Clove, Cinnamon, nutmeg, Allspice and Tamarind

UNIT III :

Turmeric, ginger and garlic,garcinia and vanilla

UNIT IV :

Fenugreek, cumin, fennel, ajowain, dill, celery

Suggested Readings

• Agarwal S, Sastry EVD & Sharma RK.2001 Seed Spices: Production, Quality, ExportPointer Publ.
• Arya PS. 2003, Spice Crops of India. Kalyani
• Dhadacharjee SK 2000, Hand Book of Aromatic Plants. Pointer Publ.

• Bose TK, Mitra SK, Farooqi SK & Sadhu MK (Eds.) 1999, Tropical Horticulture, Vol-INaya Prokash
• 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. ANDCRC USA.
• Pruthi JS. (Ed.) 1998. Spices and Condiments. National Book Trust
• Pruthi JS. 2001. Minor Spices and Condiments- Crop Management and Post HarvestTechnology. ICAR
• Purseglove JW, Brown EG, Green CL & Robbins SRJ. (Eds.) 1981. Spices Vols. I, IILongman.
• Thamburaj S & Singh N. (Eds.) 2004. Vegetables. Tuber Crops and Spices. ICAR.
• Tiwari RS & Agarwal A. 2004. Production Technology of Spices. International BookDistr. Co.
• Varmudy V. 2001 Marketing of Spices. Daya Publ. House.

PAPER–304PRODUCTION TECHNOLOGY OFMEDICINAL AND AROMATIC CROPS

MM.:75

UNIT - I

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

UNIT - II

Production technology for Senna, Periwinkle, Coleus, Aswagandha, Glory Lily, Sarpagandha,Dioscorea sp., Aloe vera, Phyllanthus amarus, Andrographis paniculata. Production technology for Medicinal solanum, Isabgol, Poppy, Safed musli, Stevia rebaudiana, Mucuna pruriens, Ocimum sp.

UNIT - III

Post harvest handling - Drying, Processing, Grading, Packing and Storage, processing and value addition, GMP and Quality standards in herbal products.Influence of biotic and abiotic factors on the production of secondary metabolities,Regulations for herbal raw materials, Phytochemical extraction techniques.Aromatic industry, WTO scenario, Export status, Indian perfumery industry, History, Advancements in perfume industry.

UNIT - IV

Production technology for palmarosa, lemongrass, citronella, vettiver, geranium, artemisia,mentha, ocimum, eucalyptus, rosemary, thyme, patchouli, lavender, marjoram, oreganum.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.Institutional support and international promotion of essential oil and perfumery products

Suggested Readings

• Atal CK & Kanpur BM 1982. Cultivation and Utilization of Aromatic Plants. RRL, CSIR,Jammu.
• Atal CK & Kanpur BM. 1982. Cultivation and Utilization of Medicinal Plants RRL, CSIR,Jammu.

• Farooqu AA, Khan MM & Vasundhara M. 2001. Production Technology of Medicinaland 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, NewIndia Publ. Agency.
• Panda H. 2002. Medicinal Plants Cultivation and their Uses. Asia Pacific BusinessPress.
• Prajapati SS, Paero H, Sharma AK & Kumar T. 2006. A Hand book of Medicinal Plants.Agro Bioss.
• Ramawat KG & Merillon JM. 2003 Bio Technology-Secondary Metabolites. Oxford &IBH.
• Skaria P Baby, Samuel Mathew, Gracy Mathew, Ancy Joseph, Ragina Joseph. 2007.Aomatic Plants. New India Publ. Agency

PRACTICAL OF ALL **MM.:100**

Practical

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

Description of botanical and verietal 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.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, post-harvest handling, packing methods, project preparation, visit to commercial greenhouses.Practices in preparation of bouquets, button-holes, flower baskets, corsages, loral wreaths, garlands with fresh flowers; Techniques in flower management; 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.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, shortn term experiments on spice crops.

FOURTH SEMESTER MM.:400

PAPER–401 ADVANCES IN BREEDING OF HORTICULTURAL CROPS MM.:75
(A) PLANTATION CROPS AND SPICES

Evolutionary mechanisms, adaptation and domestication, genetic resources, geneticdivergence, cytogenetics, variations and natural selection, types of pollination andfertilization mechanisms, sterility and incompatibility system, recent advances in cropimprovement efforts, introduction and selection, chimeras, clonal selections, inter-generic,interspecific and inter-varietal hybridization, heterosis breeding, mutation and polyploidybreeding, resistance breeding to biotic and abiotic stresses, breeding for improving quality,genetics of important traits and their inheritance pattern, molecular and transgenicapproaches and other biotechnological tools in improvement of selected spice andplantation crops.

Crops

UNIT I:

Coriander, Cumin, vanilla, fenugreek, fennel, Coffee, tea,Rubber,Turmeric, ginger, garcinia, tamarind, garlic,Cashew and cocoa

UNIT II:

Nutmeg, clove, cinnamon and allspice, palmyrah and oil palm,Pepper, cardamom, Coconut and arecanut

(B) MEDICINAL AND AROMATIC CROPS

UNIT III

Origin and evolution of varieties, distribution- Genetic resources, genetic divergence, Plant introduction, selection and domestication - Inheritance of important characters, Genetic mechanisms associated with alkaloids and secondary metabolites.Methods of breeding suited to seed and vegetative propagated crops. Polyploidy and mutation breeding in the evolution of new varieties, utilization of male sterility. Breeding for resistance to pests, diseases, nematodes in medicinal and aromatic crops.

UNIT IV

Specific breeding objectives in medicinal and aromatic crops, Genetic bio diversity, Breeding problems and improvements in Senna, Periwinkle, Aswagandha, Isabgol, Sarpagandha, Poppy, Glory lily, *Coleus, Mucuna and Ocimum,* Centella, Bacopa, Dioscorea, Solanum, Andrographis, *Aloevera*, Phyllanthus, Eucalyptus, Bael, Cinchona.Specific breeding objectives in medicinal and aromatic crops, Genetic bio diversity,Breeding problems and improvements in Henbane aromatic grasses, Geranium, Patchouli, Artemisia, Rosemary, Thyme, Sage, Marjoram, Fever few.Biotechnological approaches for crop improvement of medicinal and aromatic crops.

Suggested Readings

• Chadha KL. 1998. *Advances in Horticulture*. Vol. IX, X. *Plantation andSpices Crops*.Malhotra Publ. House.

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

• Chadha KL. 2001. *Hand book of Horticulture*. ICAR.• Chopra VL & Peter KV. 2002. *Handbook of Industrial Crops*. Haworth Press, USA &.Panama International Publ. (Indian Ed.).

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

• George CK. (Ed.). 1989. *Proceedings of First National Seminar on SeedSpices*. SpicesBoard, Ministry of Commerce, Govt. of India, Kochi.
• Harver AE. 1962. *Modern Coffee Production*. Leonard Hoff (Book) Ltd.
• Purseglove JW. 1968. *Tropical Crops – Dictyledons*. Longman.
• Purseglove JW, Brown EG, Green CL & Robbins SRJ. 1984. *Spices*. Vols. I, II. Longman.
• Peter KV. 2001-04. *Handbook of Herbs and Spices*. Vols.I-III.Woodhead Publ. Co., UK& CRC, USA.
• Raj PS & Vidyachandra B. 1981. *Review of Work Done on Cashew*. UAS ResearchSeries No.6, Bangalore.
• Ravindran PN. 2001. *Monograph on Black Pepper*. CRC Press.
• Ravindran PN & Madhusoodanan KJ. 2002. *Cardamom, The Genus Elettaria* Series on*Medicinal and Aromatic Plants – Industrial Profiles*. Routledge, UK
• Rosengarten F Jr. 1969. *The Book of Spices*. Wynnewood; Livingston Publ. Co.
• Shanmugavelu KG, Kumar N & Peter KV. 2002. *Production Technology of Spices andPlantation Crops*. Agrobios• Atal C & Kapoor V. 1992. *Cultivation and Utilization of Medicinal and Aromatic Crops*. CSIR.
• 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.
• Handa SS & Kaul MK. 1982. *Cultivation and Utilization of Medicinal Plants*. NISC, CSIR.
• Jain SK. 2000. *Medicinal Plants*. National Book Trust.
• Julia F & Charters MC. 1997. *Major Medicinal Plants – Botany, Cultures and Uses*.Thomas Publ.
• Prajapati ND, Purohit SS, Sharma AK & Kumar T. 2006. *A Hand book of Medicinal Plants*. Agro Bios.
• Thakur RS, Pauri HS & Hussain A. 1989. *Major Medicinal Plants of India*. CSIR.

PAPER–402POST HARVEST MANAGEMENT AND PROCESSING Of CROPS M.M.:75

(A) POST HARVEST MANAGEMENT OF HORTICULTURAL CROPS

Unit I

Importance of post-harvest technology . Maturity indices,harvesting, handling, grading of fruits, vegetable, cut flowers, plantation crops,medicinal and aromatic plants. Pre-harvest factors affecting quality, factorsresponsible for deterioration of horticultural produce, physiological and biochemicalchanges, hardening and delaying ripening process. Post-harvest treatmentsof crops

Unit II

Quality parameters and specification. Structure of fruits,vegetables and cut flowers related to physiological changes after harvest. Methodsof storage for local market and export. Pre-harvest treatment and pre-cooling, prestoragetreatments. Different system of storage, packing methods and types ofpackages, recent advance in packing. Types of containers and cushion materials, vacuum packing, cold storage, poly shrink packaging, grape guard packingtreatments.

(B) PROCESSING OF HORTICULTURAL CROPS

Unit III

Importance and scope of fruit and vegetable preservation industries in India, foodpipe line, losses in post-harvest operations, unit operations in food processing.Principles and guideline for the

location of processing units. Principles and methodsof preservation by heat pasteurization canning, bottling. Methods of preparation ofjuices, sqashes, syrups, cordials and fermented beverages. Jam, jelly and marmalade.

Unit IV

Preservation by sugar and chemicals, candies, crystallized fruits, preserves chemicalpreservatives, preservation with salt and vinegar, pickling, chutneys and sauces,tomato and mushrooms, freezing preservation. Processing of plantation crops,products, spoilage in processed foods, quality control of processed products, Govt.policy on import and export of processed fruits. Food laws.

Practical

Description and cataloguing of germplasm, pollen viability tests, pollen germination, surveyand clonal selection, screening techniques for abiotic stresses, screening and rating for pest,disease and stress resistance in inbreds and hybrids, estimation of quality and processingcharacters for quality improvement, use of mutagenes and colchicine for inducingmutation and ploidy changes, practices in different methods of breeding and *in vitro*breeding techniques.Description of crops and cultivars, Cataloguing of species and cultivars, floral biology, selfing and crossing, evaluation of hybrid progenies, Induction of economic, colour mutants, Increased alkaloid content in medicinal crops, high essential oil content in aromatic plants, Physical and chemical mutagens, Induction of polyploidy, Screening of plants for biotic and abiotic stresses and environmental pollution, *in-vitro* breeding in flower crops, medicinal and aromatic crops.

Equipment used in food processing units. Physico-chemical analysis of fruits andvegetables. Canning of fruits and vegetables, preparation of squash, RTS, cordial,syrup, jam, jelly, marmalade, candies, preserves, chutneys, sauces, pickles (hot andsweet). Dehydration of fruits and vegetables- tomato product dehydration,refrigeration and freezing, cut out analysis of processed foods. Processing ofplantation crops. Visit to processing Units.

Practice in judging the maturity of various horticultural produce, determination ofphysiological loss in weight and quality. Grading of horticulture produce, postharvesttreatment of horticultural crops, physical and chemical methods. Packagingstudies in fruits, vegetables, plantation crops and cut flowers by using differentpackaging materials, methods of storage, post-harvest disorders in horticulturalproduce. Identification of storage pests and diseased in spices. Visit to markets, packaging houses and cold storages units.

PAPER – 403SEMINAR **MM.:75**

Related to all courses from the all four semesters

PAPER – 404 THESIS WORKS FOR RESEARCH **MM.:125**

Research work will conducted related to topic from all courses of the all four semesters-

Micro-propagation of fruit crops,Fruit crop improvement, □Crop selection for biotic and abiotic stresses, □Diagnostic and recommended integrated system in cultivation of fruit crops

□Precision farming in fruit crops, □Protected cultivation of fruit crops ,□Root distribution studies in fruit crops, □Organic fruit cultivation, □Post harvest management of fruit crops, □Value

addition in fruit crops, □Replant problems in perennial fruit crops, □Organic farming in vegetable crops, □Application of molecular markers in genetic improvement of vegetable crops, □Development of transgenic vegetables, □Growing vegetables under protected conditions, □Mulching in vegetable crops, □Micronutrients in vegetable crops, □Screening of vegetable s against abiotic stress, □Hi-tech methods for raising nursery of vegetable crops, □Dry land and coastal farming, □Drip/micro irrigation in vegetable crops, □Fertigation in vegetable crops, □Research on physiological disorders in vegetable crops, □Breeding for quality improvement, □Breeding for insect-pest and disease resistance, □Breeding for extending shelf life of vegetable crops, □Minimal processing of vegetables, □Research on water management in vegetable crops, □Micro-propagation of major flower crops ,□Flower crops improvement, □Crop selection for biotic and abiotic stresses,□Diagnostic and recommended integrated system in floriculture, □Precision farming in floriculture, □Protected cultivation of flower crops, □Post-harvest management of flower crops, □Nutritional and water requirements of flower crops,Micro-propagation of plantation crops and spices Application of genetic engineering in plantation crops, spices, medicinal and aromatic crops, Use of molecular markers in plantation crops, spices, medicinal and aromatic crops, Plantation crops, spices, medicinal and aromatic crop improvement, Crop selection for biotic and abiotic stresses, Precision farming in plantation crops, spices, medicinal and aromatic crops, Root distribution studies in plantation crops, spices, medicinal and aromatic crops Organic production of plantation crops, spices, medicinal and aromatic crops, Post harvest management of plantation crops, spices, medicinal and aromatic crops, Value addition in plantation crops, spices, medicinal and aromatic,

VIVA-VOCE OF THESIS WORK FOR MASTER RESEARCH **MM.:50**

List of Journals and Magazines

1. Acta Horticulture
2. American Journal of Horticultural Sciences
3. Floriculture Today
4. American Potato Growers
5. American Scientist
6. Annals of Agricultural Research
7. Annual Review of Plant Physiology
8. California Agriculture
9. Haryana Journal of Horticultural Sciences
10. HAU Journal of Research
11. Horticulture Research
12. Horticulture Reviews
13. HortScience
14. IIVR Bulletins
15. Indian Horticulture
16. Indian Journal of Agricultural Sciences
17. Indian Journal of Arid Horticulture
18. Indian Journal of Horticulture
19. Indian Journal of Plant Physiology
20. Indian Spice

21. Journal of American Society for Horticultural Sciences
22. Journal of Applied Horticulture
23. Journal of Arecanut and Spice Crop
24. Journal of Food Science and Technology
25. Journal of Horticultural Sciences
26. Journal of Horticultural Sciences & Biotechnology
27. Journal of Japanese Society for Horticulture Science
28. Journal of Landscape architecture
29. Journal of Ornamental Horticulture
30. Journal of Plant Physiology
31. Journal of Plantation Crops
32. Journal of Post-harvest Biology and Technology
33. Journal of Spices and Aromatic Crops
34. Post-harvest Biology and Technology
35. Scientia Horticulturae
36. Seed Research
37. Seed Science
38. South Indian Horticulture
39. Spice India
40. Vegetable Grower
41. Vegetable Science

List of 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 DevelopmentCenter (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 andTechnologyhttp://www.icar.org.in/ciphet.html
Central Plantation Crops Research Institute(CPCRI), Kasaragod, Keralahttp://cpcri.nic.in/
Central Tuber Crops Research Institute (CTCRI),Thiruvananthapuram,
Keralahttp://www.ctcri.org/
Consultative Group on International AgriculturalResearch, CGIARhttp://www.cgiar.org/
Coffee Board, India http://indiacoffee.org/
Department of Agriculture and Co-operation,Indiahttp://agricoop.nic.in/
Department of Bio-technology, India http://dbtindia.nic.in
Department of Scientific and Industrial Research,Indiahttp://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, Keralahttp://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,Australiahttp://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), Indiahttp://nbpgr.delhi.nic.in/
National Horticulture Board (NHB), India http://hortibizindia.nic.in/
National Institute of Agricultural Extension
Management (MANAGE), Indiahttp://www.manage.gov.in/
National Research Centre for Cashew (NRCC), http://kar.nic.in/cashew/India
National Research Centre for Mushroom(NRCM), Indiahttp://www.nrcmushroom.com/
National Research Centre for Oil Palm (NRCOP),Indiahttp://www.ap.nic.in/nrcop
North Carolina State University, Dept. ofHorticulturehttp://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 Agribisness 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_homepage.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 EnvironmentalHorticulturehttp://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

Cadre-wise teaching staff required

Professor	**01**
Associate Professor	**01**
Assistant Professor	**03**
Total	**05**

Administrative Staff requirement

Laboratory Assistant	**01**
Field Assistant	**02**
Attendant/Messenger	**03**
Total	**06**

Manpower Requirement of Dean's Office

Sl. No. Name of the Post No. of Posts

1. Dean 01

A. Establishment

1. P.A./P.S. to Dean 01
2. Asstt. Administrative Officer 01
3. Asstt. Academic Officer 01
4. Assistant Accounts Officer 01
5. Assistants (one for each AAO) 03
6. Steno/Computer Operators 01
7. Driver 01
8. Farm Manager (Asstt. Prof.) 01*
9. Store Keeper 01

B. Central Instrumentation Laboratory

1. Instrumentation Asstt. Engineer 01
2. Instrumentation Technician/Lab Asstt. 01

C. Library Staff

1. Asstt. Librarian(Asstt. Prof. cadre) 01
2. Library Asstt./Clerk 01
3. Shelf Asstt. 01

D. Students Welfare

1. Physical Education (Asstt. Prof.) 01
2. Attendant 01

E. Hostel Staff

1. Warden 01+01
2. Care taker/Asstt. 01+01

F. Estate Branch

1. Junior Engineer 01
2. Security Asstt. 01

Land Required

(A) Land Utilization Pattern (hectares) Plain Hill/Coastal Region

1. Main Building/Hostels/Residential Quarters (Including roads) 6.8 3.2
2. Playground & other amenities 3.2, 2.0
3. Farm Area, including godown/ stores 20.0, 10.8

Note: If land is not in one stretch, it should be at least within a radius of 5 km

(B) Land allocations (hectares)- 6.0 hactare

Infrastructure facilities (Floor space required)

A. Central Facilities

S. No.	Details	No. of Rooms	Dimensions (ft)
1.	Dean Office	1	20x24
2.	P.A. Room	1	10x12
3.	Committee Room with video conferencing facility	1	20x30
4.	Assistant Administrative Officer including staff	1	20x12
5.	Assistant Accounts Officer including staff	1	20x12
6.	Assistant Academic Officer including staff	1	20x12
7.	Exam Cell (300 capacity)	1	20x12
8.	Evaluation Room	1	20x36
9.	Faculty Room (Ladies)	1	10x12
10.	Faculty Room (Gents)	1	20x12
11.	Placement Cell	1	20x12
12.	Smart Lecture Halls 5	40x30	(60 capacity)
13.	Exam Hall Cum Auditorium	1	100x50
14.	Library/Book Bank	1	30x72
15.	Common Utility Room	1	20x36

16. Central Laboratory 1 50x36
17. Hostels including Mess, Gym/Indoor, Reading Room, Warden Room, Store etc.1 (boys) 150, 1 (girls) 150
18. Canteen 1 20x12 (kitchen with store) 20x36 Seating
19. Wash room (with toilet & urinary facilities) 10 20x12 (keeping ladies requirements)
20. Parking space As per requirement
21. Farm stores, threshing yards including implements and tractor sheds One core complex
22. Vehicles Car 1, Jeep/Car staff 2, Bus-1, Pickup van-1, Motor Bikes 2, Minibus (30 capacity)-1
Tractors- 2
23. Drinking water and irrigation facilities As per requirements
24. Vehicles shed 1 10x80

B. Requirements

No. Details No. of Rooms Dimensions(ft)

1. Office of Head 11 24x12 with wash room facility
2. Faculty Rooms 1+1 12 12x10 + 18x12 and 24x10 depending on the strength
3. Clerical/technical staff 12 12x10 to 24x10 depending on the strength
5. Laboratories 12 30x 60 Larger deptt. will have two
6. Field/Lab Stores 5
7. Green house/poly house/Nursery facilities - 0.02 ha

Departmental Requirement of Horticulture

a. Labortory (Post Harvest)

No. Items Nos.

1 Hand Refractometer 05
2 Digital Refractometer 02
3 Oven 01
4 Refrigerator 01
5 Electronic Weighing Balance 02
6 Pan Balance (1 kg & 10 kg. capacity each) 02
7 Deep Freezer 01
8 pH Meter 01
9 Fruit crusher 01
10 Grinding and Mixing Machine 01
11 Distillation Assembly 01

b. Lab oratory

No. Items Nos.

1. Seed Germinator 02
2. Grafting and budding knife 60
3. Secateur 60
4. Saw 05
5. Loppers 05
6. Mist Chamber 01
7. Poly house with drip irrigation system 02
8. Microscope

c. Food Science & Technology

No. Items Nos.

1. Refrigerator 1
2. Muffle furnace 1
3. Weighing balance 2
4. Water bath 2
5. Hot air oven 2

6. Fruit penetrometer 2
7. Pulper 1
8. Juice extractor 1
9. Crown corking machine 1
10. Spectrophotometer 1
12. Microwave oven 1
13. Baking oven 1
14. Sieve shaker 1
15. Poly pouch sealer 1
16. Crusher 1
17. Masala grinder 1
18. Dehydrator 1
19. Cold room 1
20. Vacuum pump

Central Library and Information System

No.	Items	Nos.
1.	Internet Server	01
2.	Intranet Server	01
3.	Computers for Reading Hall	20
4.	Heavy Duty Photocopiers	02
5.	Computerized Issue and Catalogue Systems	02
6.	Wi-Fi facility in college/library/hostels	As per requirement
7.	CCTV monitoring system for library	01
8.	RFID and Access Control System (Optional)	01
9.	Broadband Internet Connectivity with minimum speed of 1Gbps	