COURSE STRUCTURE AND SYLLABI

B.Sc.(Hons) Horticulture

2018-19 Batch

Centurion UNIVERSITY

M.S.SWAMINATHAN SCHOOL OF AGRICULTURE
CENTURION UNIVERSITY OF TECHNOLOGY & MANAGEMENT
Paralakhemundi, Odisha-761211, INDIA,

Web Site: - www.cutm.ac.in

UG degree: B.Sc. (Hons.) Horticulture

Restructuring of UG programmes for increased practical / practice contents (Department Wise Courses)

I Fruit Science (FS)

BHFS1101	Fundamentals of Horticulture	3(2+1)
BHFS1202	Plant Propagation and Nursery Management	2(1+1)
BHFS1203	Tropical and Subtropical Fruits	3(2+1)
BHFS3104	Orchard and Estate Management	2(1+1)
BHFS2205	Plantation Crops	3(2+1)
BHFS2106	Temperate Fruit crops	2(1+1)
BHFS2107	Weed Management in Horticultural Crops	2(1+1)
BHFS1208	Principles of Plant Breeding	3(2+1)
BHFS1109	Principles of Genetics and Cytogenetics	3(2+1)
BHFS2210	Breeding of Fruit and Plantation Crops	3(2+1)
BHFS2211	Dry land Horticulture	2(1+1)
	Total	**28 (17+ 11)**

II Vegetable Science (VS)

BHVS1201	Tropical and Subtropical Vegetable crops	3(2+1)
BHVS2202	Spices and Condiments	3(2+1)
BHVS3103	Breeding of Vegetable Tuber and Spice Crops	3(2+1)
BHVS3204	Seed Production of Vegetable Tuber and Spice Crops	3(2+1)
BHVS2105	Temperate Vegetable crops	2(1+1)
BHVS3106	Potato and Tuber Crops	2(1+1)
BHVS2207	Precision Farming and Protected Cultivation	3(2+1)
	Total	**19 (12+7)**

III Postharvest Technology (PT)

BHPT3201	Postharvest Management of Horticultural Crops	3(2+1)
BHPT3202	Processing of Horticultural Crops	3(1+2)
BHPT2103	Fundamentals of Food Technology	2(1+1)
	Total	8(4+4)

IV Floriculture & Landscape Architecture (FL)

BHFL2201	Ornamental Horticulture	2(1+1)
BHFL3302	Breeding and Seed Production of Flower and Ornamental Crops	3(2+1)
BHFL1103	Principles of Landscape Architecture	2(1+1)
BHFL2104	Commercial Floriculture	3(2+1)
BHFL3105	Medicinal and Aromatic Crops	3(2+1)
	Total	**13 (8+5)**

V Plant Protection (PP)

BHPP2101	Fundamentals of Plant Pathology	3(2+1)
BHPP2102	Diseases of Fruit, Plantation and Medicinal and Aromatic Crops	3(2+1)
BHPP3103	Diseases of Vegetable, Ornamental and Spice Crops	3(2+1)
BHPP2104	Fundamentals of Entomology	3(2+1)
BHPP2105	Nematode Pests of Horticultural Crops and theirManagement	2(1+1)
BHPP2206	Insect Pests of Fruit, Plantation, Medicinal and Aromatic Crops	3(2+1)
BHPP3207	Apiculture, Sericulture and Lac Culture	2(1+1)
BHPP3208	Insect Pests of Vegetable, Ornamental and Spice Crops	3(2+1)
	Total	**22 (14+8)**

VI Natural Resource Management (NR)

BHNR1101	Fundamentals of Soil Science	2(1+1)
BHNR1202	Soil Fertility and Nutrient Management	2(1+1)
BHNR1203	Environmental Studies and Disaster Management	3(2+1)
BHNR2204	Soil, Water and Plant Analysis	2(1+1)
BHNR2205	Farm Power and Machinery	2(1+1)
BHNR1206	Water Management in Horticultural Crops	2(1+1)
BHNR3107	Organic Farming	3(2+1)
BHNR3108	Agro-meteorology and Climate Change	2(1+1)
BHNR3109	Introductory Agro-forestry	2(1+1)
BHNR3110	Introduction to Major Field Crops	2(1+1)
	Total	**22 (12+10)**

VII Basic Sciences (BS)

BHBS1101	Elementary Statistics and Computer Application 3(2+1)	3(2+1)
BHBS1102	Elementary Plant Biochemistry	2(1+1)
BHBS2103	Elementary Plant Biotechnology	2(1+1)
BHBS1104	Introductory Crop Physiology	2(1+1)
BHBS1205	Growth and Development of Horticultural Crops	2(1+1)
BHBS1106	Introductory Microbiology	2(1+1)
	Total	**13 (7+6)**

VIII Social Sciences (SS)

BHSS1101	Economics and Marketing	3(2+1)
BHSS3202	Horti-Business Management	2(2+0)
BHSS3203	Fundamentals of Extension Education	2(1+1)
BHSS3204	Entrepreneurship Development and Business Management#	2(1+1)
BHSS1105	Communication Skills and Personality Development	2(1+1)
BHSS1206	Information and Communication Technology	2(1+1)
BHSS1207	Physical and Health Education (NC)*	1(0+1)
BHSS1108/	NSS/NCC (NC)*	1(0+1)

BHSS1109		
	Total	**15 (8+7)**
	Grand Total (Semester I to VI)	**140 (82+58)**

S. No	**Activity**	**Credits**
1	Experiential learning (Professional Package)	0+20 (EL)
2	RHWE& Placement in Industries	0+20 (RH)
	Total	**0+40**

S. No.	**RHWE Programme schedule**	**Duration**
1	Orientation Programme	2 weeks
2	Village stay at RSK/Hobli level	12 weeks
3	All India Study Tour	3 weeks
4	Placement Programme	4 weeks
5	Report writing & Final Examination	3 weeks
	Total	**24 Weeks**

STUDENT READY:

Professional Packages Hands on Training /Experimental Learning Modules: Final year B.Sc. (Hort.) students can select two modules under STUDENT READY- Experiential Learning programme depending on the facilities available at the college.

1. Commercial Horticulture
2. Protected cultivation of high value Horticulture crops
3. Processing of fruits and vegetables for value addition
4. Floriculture and landscape architecture
5. Bio-inputs: Bio-fertilizers and bio-pesticides
6. Mass multiplication of plant and molecules through tissue culture
7. Mushroom culture
8. Bee keeping

Batch of student can select two modules under STUDENT READY- ExperientialLearning Programme depending on the facilities available at the college.

II. Rural Horticultural Work Experience Programme (0+20)

i. STUDENT READY - Placement in Industries (0+10)

ii. STUDENT READY- Placement in Villages (0+10)

Semester wise courses

Semester – I

S.N.	**Title of the Course**	**Credit Hours**
BHNR1203	Environmental Studies and Disaster Management	3(2+1)
BHNR1101	Fundamental of Soil Science	2(1+1)
BHNR1206	Water Management in Horticultural Crops	2(1+1)

BHBS1102	Elementary Plant Biochemistry	2(1+1)
BHBS1104	Introductory Crop Physiology	2(1+1)
BHFS 1101	Fundamentals of Horticulture	3(2+1)
BHFL1103	Principles of Landscape Architecture	2(1+1)
BHFS1109	Principles of Genetics and Cytogenetics	3(2+1)
BHBS1106	Introductory Microbiology	2(1+1)
BHSS1105	Communication Skills and Personality Development	2(1+1)
BHSS1108/ BHSS1109	National Service Scheme/National Cadet Corp (NC)*	1(0+1)
	Total	**24(13+11)**

Semester – II

S.N.	**Title of the Course**	**Credit Hours**
BHFS1203	Tropical and Subtropical Fruits	3(2+1)
BHVS1201	Tropical and Subtropical Vegetables	3(2+1)
BHFS1208	Principles of Plant Breeding	3(2+1)
BHNR1202	Soil Fertility and Nutrient Management	2(1+1)
BHSS1101	Economics and Marketing	3(2+1)
BHFS1202	Plant Propagation and Nursery Management	2(1+1)
BHBS1101	Elementary Statistics and Computer Application	3(2+1)
BHBS1205	Growth and Development of Horticultural Crops	2(1+1)
BHSS1207	Physical and Health Education (NC)*	1(0+1)
BHSS1206	Information and communication technology* (NC)*	2(1+1)
	Total	**24(14+10)**

Semester – III

S.N.	**Title of the Course**	**Credit Hours**
BHPP2101	Fundamentals of Plant Pathology	3(2+1)
BHPP2104	Fundamentals of Entomology	3(2+1)
BHVS2105	Temperate Vegetable Crops	2(1+1)
BHPP2105	Nematode pests of horticultural crops and their Management	2(1+1)
BHPP2102	Diseases of fruit, Plantation, Medicinal and Aromatic Crops	3(2+1)
BHPT2103	Fundamentals of Food Technology	2(1+1)
BHFS2106.	Temperate Fruit Crops	2(1+1)
BHFS2107	Weed Management in Horticultural Crops	2(1+1)
BHFL2104	Commercial Floriculture	3(2+1)

BHBS2103	Elementary Plant Biotechnology	2(1+1)
	Total	**24(14+10)**

Semester – IV

S.N.	**Title of the Course**	**Credit Hours**
BHNR2204	Soil, Water and Plant Analysis	2(1+1)
BHVS2202	Spices and Condiments	3(2+1)
BHFL2201	Ornamental Horticulture	2(1+1)
BHFS2205	Plantation Crops	3(2+1)
BHFS2210	Breeding of Fruit and Plantation Crops	3(2+1)
BHNR2205	Farm Power and Machinery	2(1+1)
BHPP2206	Insect Pests of Fruit, Plantation, Medicinal & Aromatic Crops	3(2+1)
BHVS2207	Precision Farming and Protected Cultivation	3(2+1)
BHFS2211	Dry land Horticulture	2(1+1)
	Total	**23(14+9)**

Semester – V

S.N.	**Title of the Course**	**Credit Hours**
BHNR3107	Organic Farming	3(2+1)
BHNR3110	Introduction to Major Field Crops	2(1+1)
BHFL3105	Medicinal and Aromatic crops	3(2+1)
BHNR3109	Introductory Agroforestry	2(1+1)
BHVS3103	Breeding of Vegetable, Tuber and Spice Crops	3(2+1)
BHPP3103	Diseases of Vegetables, Ornamentals and Spice Crops	3(2+1)
BHFS3104	Orchard and Estate Management	2(1+1)
BHNR3108	Agro-meteorology and Climate Change	2(1+1)
BHVS3106	Potato and tuber crops	2(1+1)
	Total	**22(13+9)**

Semester – VI

S.N.	**Title of the Course**	**Credit Hours**
BHPP3207	Apiculture, Sericulture and Lac culture	2(1+1)
BHPP3208	Insect Pests of Vegetable, Ornamental and Spice Crops	3(2+1)
BHPT3201	Postharvest Management of Horticultural Crops	3(2+1)
BHVS3204	Seed production of Vegetable, Tuber and Spice Crops	3(2+1)
BHFL3202	Breeding and Seed Production of Flower and Ornamental Plants	3(2+1)
BHPT3202	Processing of Horticultural Crops	3(2+1)

BHSS3202	Horti-Business Management	2(2+0)
BHSS3204	Entrepreneurship Development and Business Management#	2(1+1)
BHSS3203	Fundamentals of Extension Education	2(1+1)
	Total	**23(14+9)**

Semester – VII

Rural Horticultural Work Experience Programme (BHRW)

S.N. Title of the Course Credit Hours

1 STUDENT READY - Placement in Industries 0+10
2 STUDENT READY- Placement in Villages 0+10
Total 20 (0+20)

Semester – VIII
S.N. Title of theCourse Credit Hours

STUDENT READY: Experimental Learning programme 20(0+20) (BHEL)

1	Commercial Horticulture	No change
2	Protective Cultivation of High Value Horticulture Crops	No change
3	Processing of Fruits and Vegetables for Value Addition	No change
4	Floriculture and Landscape Architecture	New Module
5	Bio-inputs: Bio-fertilizers and Bio-pesticides.	New Module
6	Mass Multiplication of Plant and Molecules through Tissue Culture	New Module
7	Mushroom culture	New Module
8	Bee keeping	New Module
	Total	20 (0+20)

The student undergoing ELP may be allowed to register for a maximum two courses in which They have failed but completed requisite percentage of attendance.

SYLLABUS

I. FRUIT SCIENCE (FS)

BHFS1101. Fundamentals of Horticulture 3(2+1)
Theory

Scope and importance, classification of horticultural crops and nutritive value, area andproduction, exports and imports, fruit and vegetable zones of India and of different states,nursery techniques and their management, soil and climate, vegetable gardens, nutrition andkitchen garden and other types of gardens – principles, planning and layout, management oforchards, planting systems and planting densities. Production and practices for fruit,

vegetableand floriculture crops. Principles objectives, types and methods of pruning and training of fruitcrops, types and use of growth regulators in horticulture, water management– irrigation methods,
Merits and demerits, weed management, fertility management in horticultural crops-manures and Fertilizers, different methods of application, cropping systems, intercropping, multi-tier cropping,mulching– objectives, types merits and demerits, Classification of bearing habits of fruit trees, factorsinfluencing the fruitfulness and unfruitfulness. Rejuvenation of old orchards, top working, frameworking, principles of organic farming, market chain management.

Practical

Features of orchard, planning and layout of orchard, tools and implements, identification ofvarious horticultural crops, layout of nutrition garden, preparation of nursery beds for sowingof vegetable seeds, digging of pits for fruit plants, planting systems, training and pruning oforchard trees, preparation of fertilizer mixtures and field application, preparation and applicationof growth regulators, layout of different irrigation systems, identification and management ofnutritional disorder in fruits, assessment of bearing habits, maturity standards, harvesting,grading, packaging and storage.

Suggested Reading:

Prasad and Kumar, 2014. *Principles of Horticulture* 2nd Edn. Agrobios (India).
Neeraj Pratap Singh, 2005. *Basic concepts of Fruit Science* 1st Edn. IBDC Publishers.
Kumar, N., 1990. *Introduction to Horticulture*. Rajyalakshmi publications, Nagarcoil,Tamilnadu
Chadha,K.L.(ICAR),2002,2001. *Handbook of Horticulture*, ICAR, NewDelhi
K.V.Peter, 2009. *Basics Horticulture.* New India Publishing Agency
Jitendra Singh, 2011. *Basic Horticulture*. Kalyani Publications, New Delhi.

BHFS 1202. Plant Propagation and Nursery Management 2(1+1)
Theory
Propagation: Need and potentialities for plant multiplication, sexual and asexual methodsof propagation, advantages and disadvantages. Seed dormancy types of dormancy (scarification& stratification) internal and external factors, nursery techniques nursery management, apomixes– mono-embrony, polyembrony, chimera& bud sport. Propagation Structures: Mist chamber,humidifiers, greenhouses, glasshouses, cold frames, hot beds, poly-houses, phytotrons nursery(tools and implements), use of growth regulators in seed, types and stages of seed germination withexamples and vegetative propagation, methods and techniques of division-stolons, pseudobulbs,offsets, runners, cutting, layering, grafting, formation of graft union, factor affecting, healing of graftageand budding physiological & bio chemical basis of rooting, factors influencing rooting of cuttingsand layering, graft incompatibility. Anatomical studies of bud union, selection and maintenanceof mother trees, collection of scion wood stick, scion-stock relationship, and their influences, budwood certification, techniques of propagation through specialized organs, corm, runners, suckers.
Micrografting, meristem culture, callus culture, anther culture, organogenesis, somaclonal variationhardening of plants in nurseries. Nursery registration act. Insect/pest/disease control in nursery,Cost of establishment of propagation structures.

Practical

Media for propagation of plants in nursery beds, potting and repotting. Preparation of nurserybeds and sowing of seeds. Raising of rootstock. Seed treatments for breaking dormancy andinducing vigorous seedling growth. Preparation of plant material for potting. Hardening plantsin the nursery. Practicing different types of cuttings, layering, graftings and buddings includingopacity and grafting, top grafting and bridge grafting etc. Use of mist chamber in propagation andhardening of plants. Preparation of plant growth regulators for seed germination and vegetativepropagation. Visit to a tissue culture laboratory. Digging, labelling and packing of nursery fruitplants. Maintenance of nursery records. Use of different types of nursery tools and implementsfor general nursery and virus tested plant material in the nursery. Cost of establishment of amist chamber, greenhouse, glasshouse, polyhouse and their maintenance.. Nutrient and plantprotection applications during nursery.

Suggested Reading:

T.K.Bose, S.K.Mitra, M.K.Sadhu, P. Das and D.Sanyal. *Propagation of Tropical &Subtropical Horticultural Crops, Volume 1(3rd Revised edition).* Naya Udyog, 206, Bidhan Sarani, Kolkata 700006.

Sadhu,M.K.1996. *Plant Propagation*. New age International Publishers, New Delhi.

Mukhergee,S.K. and Majumdar,P.K.1973.Propagation of fruit crops. ICAR, New Delhi.

Ganner,R.J. and Choudhri,S.A.1972.*Propagation of Tropical fruit trees*. Oxford and IBNpublishing Co., New Delhi.

Sarma,R.R.2002. *Propagation of Horticultural Crops*.Kalyani Publishers,(Principles andpractices) New Delhi.

Chundawat,B.S. 1990.*Arid fruit culture*. Oxford and IBH, New Delhi.

Chadha,K.L. (ICAR)2002,2001.*Hand book of Horticulture*. ICAR, New Delhi.

BHFS 1203. Tropical and Sub-Tropical Fruits 3(2+1)

Theory

Horticultural classification of fruits including genome classification. Horticultural zonesof India, detailed study of area, production and export potential, varieties, climate and soilrequirements, propagation techniques, planting density and systems, after care, training andpruning. Management of water, nutrient and weeds, special horticultural techniques includingplant growth regulators, their solution preparation and use in commercial orchards. Physiologicaldisorders. Post-harvest technology, harvest indices, harvesting methods, grading, packaging andstorage of the following crops. Mango, , banana, grapes, citrus, papaya, sapota, guava,pomegranate,bael, ber, amla, anona, fig, pineapple, jackfruit, avocado, mangosteen, litchi, carambola, durian,rambutan, bilimbi, loquat, rose apple breadfruit and passion fruit. Bearing in mango and citrus,causes and control measures of special production problems, alternate and irregular bearingovercome, control measures. Seediness and kokkan disease in banana, citrus decline and casualfactors and their management. Bud forecasting in grapes, sex expression and seed production inpapaya, latex extraction and crude papain production, economic of production.

Practical

Description and identification of varieties based on flower and fruit morphology in abovecrops. Training and pruning of grapes, mango, guava and citrus. Selection of site and plantingsystem, pre-treatment of banana suckers, desuckering in banana, sex forms in papaya. Use ofplastics in fruit production. Visit to commercial orchards and diagnosis of maladies. Manureand fertilizer application including bio-fertilizer in fruit crops, preparation and application ofgrowth regulators in banana, grapes and mango. Seed production in papaya, latex extraction andpreparation of crude papain. Ripening of fruits, grading and packaging, production economicsfor tropical and sub-tropical fruits. Mapping of arid and semi-arid zones of India. Botanicaldescription and identification of ber, fig, jamun, pomegranate, carissa, phalsa, wood apple, West
Indian cherry, tamarind, aonla, bael and annona.

Suggested Reading:

H.P.Singh and M.M.Mustafa, 2009. *Banana*-new innovations. Westville PublishingHouse,New Delhi.
Bose, T.K., Mitra, S.K. and Sanyal, D., 2002. *Tropical and Sub-Tropical*-Vol-I. Nayaudyog-Kolkata
Symmonds, 1996. *Banana*. II Edn. Longman, London.
Radha T and Mathew L., 2007. *Fruit crops*. New India Publishing Agency.
W S Dhillon, 2013. *Fruit Productionin India.* Narendra Publishing House,New Delhi
T.K.Chattopadhyay, 1997. *Text book on pomology*. Kalyani Publishers, New Delhi.
K.L.Chadda, 2009. *Advanced in Horticulture*. Malhotra Publishing House, New Delhi.
S.P. Singh, 2004. *Commercial fruits.* Kalyani Publishers, New Delhi.

BHFS 3104. Orchard and Estate Management 2(1+1)

Theory
Orchard & estate management, importance, objectives, merits and demerits, clean cultivation,sod culture, Sod mulch, herbicides and inorganic and organic mulches. Tropical, sub-tropical and temperate horticultural systems, competitive and complimentary effect of root and shoot systems.

Biological efficiency of cropping systems in horticulture, systems of irrigation. Soil management in relation to nutrient and water uptake and their effect on soil environment, moisture, organisms and soil properties. Factors influencing the fruitfulness and unfruitfulness. Rejuvenation of oldorchards, top working, frame working, Integrated nutrient and pest management. Utilization ofresources constraints in existing systems. Crop model and crop regulation in relation to croppingsystems. Climate aberrations and mitigation measures of Horticultural crops.

Practical
Layout of different systems of orchard and estate, soil management, clean, inter, cover andmixed cropping, fillers. Use of mulch materials, organic and inorganic, moisture conservation,weed control. Layout of various irrigation systems.

Suggested Reading:

Kumar, 1990. *Introduction to Horticulture crops*. Rajyalakshmi Publications,Nagercoil, Tamilnadu.
WS. Dhillon and Bhatt. 2011. *Fruit Tree Physiology*. Narendra Publishing House,New Delhi.
B .C. Mazumdar. 2004. *Principles and Methods of Orchard Establishment*. DayaPublishing House, New Delhi.
B .C. Mazumdar. 2004. *Orchard Irrigation and Soil Management Practices* DayaPublishing Agency, New Delhi. Daya Publishing Agency, New Delhi.

5. BHFS2205. Plantation Crops 3(2+1)

Theory

History and development, scope and importance, area and production, export and importpotential, role in national and state economy, uses, industrial importance, by products utilization,oil and climate, varieties, propagation: principles and practices of seed, vegetative and micropropagation,planting systems and method, gap filling, systems of cultivation, mulching, shaderegulation, weed and water management, training, pruning and handling, nutrition, foliarfeeding, role of growth regulators, soil management, liming practices, tipping practices, topworking, physiological disorders, harvesting, post-harvest handling and processing, packagingand marketing, yield and economics of coconut, arecanut, oil palm, palmyrah palm, cacao, cashewnut, coffee, tea, Date palm and rubber.

Practical

Description and identification of coconut varieties, selection of coconut and arecanut motherpalm and seed nut, planting of seed nuts in nursery, layout and planting of coconut, arecanut,oil palm, cashew nut, cacao gardens, manuring, irrigation; mulching, raising masonry nurseryfor palm, nursery management in cacao. Description and identification of species and varietiesin coffee, harvesting, grading, pulping, fermenting, washing, drying and packing of coffee, seedberry collection, seed extraction, treatment and sowing of coffee, epicotyl, softwood, grafting andtop working in cashew, working out the economics and project preparation for coconut, arecanut,oil palm, cashew nut, cacao, etc. Mother plant selection, preparation of cuttings and rooting of teaunder specialized structure, training, centering, pruning, tipping and harvesting of tea.

Suggested Reading:

Kumar, N.J.B. M. Md. Abdul Khaddar, Ranga Swamy, P. and Irrulappan, I. 1997. *Introduction to spices, Plantation crops and Aromatic plants*. Oxford & IBH, New Delhi.
Nair 1979. *Cashew*. CPCRI, Kerala
Ranganadhan, V. 1979. *Hand Book of Tea Cultivation*. UPASI Tea Research Station, Cinchona.

BHFS 2106. Temperate Fruit Crops 2(1+1)

Theory

Classification of temperate fruits, detailed study of areas, production, varieties, climateand soil requirements, propagation, planting density, cropping systems, after care trainingand pruning, self-incompatibility and pollinisers, use of growth regulators, nutrient and weedmanagement, harvesting, post-harvest handling and storage of apple, pear, peach, apricot, plum,cherry,

persimmon, strawberry, kiwi, Queens land nut (Mecademia nut), almond, walnut, pecannut, hazel nut and chest nut. Re-plant problem, rejuvenation and special production problemslike pre-mature leaf fall, physiological disorders, important insect – pests and diseases and theircontrol measures. Special production problems like alternate bearing problem and their remedies.

Practical

Nursery management practices, description and identification of varieties of above crops,manuring and fertilization, planting systems, preparation and use of growth regulators, trainingand pruning in apple, pear, plum, peach and nut crops. Visit to private orchards to diagnosemaladies. Working out economics for apple, pear, plum and peach.

Suggested Reading:

Chattopadhyay T.K.2009.*A text book on Pomology-IV Devoted to Temperate fruits*. KalyaniPublishers.B-1/292,Rajinder Nagar,Ludhiana-141008

Das B.C and Das S.N .*Cultivation of Minor Fruits*. Kalyani Publishers.B-1/292, Rajinder Nagar, Ludhiana-141008.

Pal J.S.2010. *Fruit Growing* .2010. Kalyani Publishers.B-1/292,Rajinder Nagar,Ludhiana-141008.

Mitra S.K, Rathore D.S and Bose T .K. 1992. *Temperate Fruit Crops. Horticulture and Allied* Publishers, Calcutta.

Chattopadhya, T.K. 2000. *A Text Book on Pomology (Temperate Fruits)* Vol. IV KalyaniPublishers, Hyderabad

W S Dhillon. 2013. *Fruit Production In India*. Narendra Publishing House. New Delhi

BHFS 2107. Weed Management in Horticultural Crops 2(1+1)

Theory

Weeds: Introduction, harmful and beneficial effects, classification, propagation anddissemination; Weed biology and ecology, crop weed association, crop weed competition andallelopathy Concepts of weed prevention, control and eradication; Methods of weed control:physical, cultural, chemical and biological methods. Integrated weed management; Herbicides:advantages and limitation of herbicide usage in India, Herbicide classification, formulations,methods of application; Introduction to Adjuvants and their use in herbicides; Introduction toselectivity of herbicides; Compatibility of herbicides with other agro chemicals; Weed managementin major field and horticultural crops, shift of weed flora in cropping systems, aquatic andproblematic weeds and their control.

Practical

Identification of weeds; Survey of weeds in crop fields and other habitats; Preparation ofherbarium of weeds; Calculations on weed control efficiency and weed index; Herbicide labelinformation; Computation of herbicide doses; Study of herbicide application equipment andcalibration; Demonstration of methods of herbicide application; Preparation of list of commonlyavailable herbicides; Study of phytotoxicity symptoms of herbicides in different crops; Biology ofnut sedge, bermuda grass, parthenium and celosia; Economics of weed control practices; Toursand visits of problem areas.

Suggested reading:

Gupta, O.P. 1984. *Scientific Weed Management*. Today and Tomorrow Printers and Publishers, New Delhi.
Gupta, O.P. 2015. *Modern Weed Management*. Agro Bios (India), Jodhpur.
Naidu, V.S.G.R., *Handbook of Weed Identification*. Directorate of Weed Research, Jabalpur.
Rao, V.S. 2000. *Principles of Weed Science*. Oxford & IBH Publishing Co., New Delhi.
Subramanian, S., Mohammed Ali, A. and Jayakumar, R. 1991. *All About Weed Control*. Kalyani Publishers, Ludhiana.
Das, T.K. 2015. Weed science:Basics and applications, Jain Brothers

BHFS 1208 . Principles of Plant Breeding 3(2+1)

Theory

Plant breeding as a dynamic science, genetic basis of Plant Breeding – classical, quantitativeand molecular, Plant Breeding in India – limitations, major achievements, goal setting for future.Sexual reproduction (cross and self-pollination), asexual reproduction, pollination controlmechanism (incompatibility and sterility and implications of reproductive systems on populationstructure). Genetic components of polygenic variation and breeding strategies, selection as a basisof crop breeding and marker assisted selection Hybridization and selection – goals of hybridization,selection of plants; population developed by hybridization – simple crosses, bulk crosses andcomplex crosses. General and special breeding techniques. Heterosis – concepts, estimation andits genetic basis. Calculation of heterosis, heterobeltosis, GCA, SCA, inbreeding depression, heritabilityand genetic advance. Emasculation, pollination techniques in important horticultural crops. Breedingfor resistance of biotic and abiotic stresses. Polyploidy breeding. Mutation breeding.

Practical

Breeding objectives and techniques in important horticultural crops. Floral biology – itsmeasurement, emasculation, crossing and selfing techniques in major crops. Determinationof mode of reproduction in crop plants, handling of breeding material, segregating generations(pedigree, bulk and back cross methods), Field layout, and maintenance of experimental records inself and cross pollinated crops. Demonstration of hybrid variation and production techniques.Hardy Weinberg Law and calculation, male sterility and incompatibility studies in horticultural cropscalculation of inbreeding depression, heterosis, heterobeltioses, GCA, SCA, GA, heritability.

Suggested Reading:

R.W. Allard. Principles of plant breeding. John Wiley & Sons, New York.
V.L. Chopra. Plant breeding: Theory and Practice. Oxford & IBH Publishing CO. Pvt. Ltd., New Delhi.
Phundan Singh. Essentials of plant breeding. Kalyani Publishers
B.D. Singh. Plant breeding : principles and methods. Kalyani Publishers, Ludhiana.
R.C. Chaudhary. Plant Breeding
B D Singh. Fundamental of Plant breeding. Kalyani. India.
Pundan Singh. Essentials of plant breeding. Kalyani. India
G. S. Chahal and S.S. Gosal. 2002. Principles and Procedures of Plant Breeding. Narosa

Publishing House, New Delhi.

BHFS 1109 . Principles of Genetics and Cytogenetics 3(2+1)

Theory

Historical background of genetics, theories and hypothesis. Physical basis of heredity, cellreproduction, mitosis, meiosis and its significance. Gametogenesis and syngamy in plants.Mendelian genetics–Mendel's principles of heredity, deviation from Mendelian inheritance,pleiotropy, threshold characters, co-dominance, penetrance and expressivity. Chromosometheory of inheritance, gene interaction. Modification of monohybrid and dihybrid rations.Multiple alleles, quantitative inheritance linkage and crossing over, sex linked inheritance andcharacters. Cytoplasmic inheritance and maternal effects. Chemical basis of heredity, structure ofDNA and its replication. Evidence to prove DNA and RNA – as genetic material. Mutations andtheir classification. Chromosomal aberrations, changes in chromosome structure and number.

Practical

Study of fixatives and stains. Squash and smear techniques. Demonstrations of permanentslides and cell division, illustration in plant cells, pollen fertility and viability, determination ofgametes, Solving problems of monohybrid, dihybrid, and test cross ratios using chi-square test,gene interactions, estimation of linkages using three point test cross from F2 data and constructionof linkage maps. Genetics variation in pea.

Suggested Reading:

Gardner E J, Simmons M J &Snustard D P. *Principles of Genetics (VIII Edn)*. John Wiley & Sons, New York.
Benjamin Lewin. *Genes (II edn).* John Wiley & Sons, New York.
Phundan Singh. *Elements of Genetics*. Kalyani publishers, New Delhi.
Sinnut, Dunn & Dobzhansky. *Principles of Genetics* XIX reprint. Tata McGraw-Hill Publishing Co. Ltd., New Delhi.
Swanson, Merz & Young. *Cytogenetics* (II ed.). Prentice Hall of India Pvt. Ltd. New Delhi.
Joseph Jahier& INRA working group. *Techniques of Plant Cytogenetics* (1986). Oxford & IBH Publishing Co Pvt.Ltd., New Delhi
Singh B D. *Fundamentals of Genetics*. Kalyani Publishers, New Delhi
Farook& Khan. *Genetics & Cytogenetics* (I Ed.). Premier Publishing House, Hyderabad.
Shukla. *Cell Biology* (2001). Dominant publishers, New Delhi
B.D. Singh. *Fundamental of Genetics*. Kalyani. India
Gupta, P.K. 1985.*Cytology, genetics and cytogenetics*. Rastogi Publication, India.

BHFS 2210. Breeding of Fruit and Plantation Crops 3(2+1)

Theory

Fruit breeding - History, importance in fruit production, distribution, domestication andadaptation of commercially important fruits, variability for economic traits, breeding

strategies,clonal selection, bud mutations, mutagenesis and its application in crop improvement – policymanipulations – *in vitro* breeding tools (important fruit and plantation crops).

Practical

Exercises on floral biology, pollen viability; emasculation and pollination procedures; hybridseed germination; raising and evaluation of segregating populations; use of mutagens to inducemutations and polyploidy in major crops like Mango, Banana, Citrus, Grapes, Guava, Sapota,Papaya, Custard apple, Aonla, Ber, Litchi, Pomegranate, Jamun, Arecanut, Coconut, Pistchonut,Apple, Pear, Plum, Peach, Apricut and Strawberry.

Suggested Reading:

Nijar 1985.Fruit breeding in India,Oxford& IBH Publishing Co. New Delhi

Anil Kumar Shukla 2004. Fruit breeding approaches & Achievements.International Book Distributing Co. New Delhi.

Kumar, N. 1997. Breeding of Horticultural Crops, Principles and Practices. NewIndia Publishing Agency, New Delhi.

Singh, B.D. 1983.Plant Breeding Principles and methods. Kalyani Publishers,New Delhi.

BHFS 2211. Dryland Horticulture 2(1+1)

Theory

Definition, importance and limitation of dry land horticulture, present status and futurescope. Constraints encounter in dry lands. Agro-climatic features in rain shadow areas, scarsewater resources, high temperature, soil erosion, run-off losses etc.Techniques and management of dry land horticulture. watershed development, soil andwater conservation methods-terraces, contour bunds,etc. Methods of control and impoundingof run-off water-farm ponds, trenches, macro catch pits,etc.,*in-situ* water harvesting methods,micro catchment, different types of tree basins etc. Methods of reducing evapotranspiration, useof shelter belts, mulches, antitranspirants, growth regulators, etc. water use efficiency-need based,economic and conjunctive use of water, micro systems of irrigation etc.Selection of plants having drought resistance. Special techniques, planting and after care-useof seedling races, root stocks, *in-situ* grafting, deep pitting/planting, canopy management etc.Characters and special adaptation of crops: ber, aonla, annona, jamun, wood apple, bael,pomegranate, carissa, date palm, phalsa, fig, west Indian cherry and tamarind.

Practical

Study of rainfall patterns. Contour bunding/trenching, micro catchments, soil erosion andits control. Study of evapotranspiration, mulches and micro irrigation systems. Specialtechniques of planting and aftercare in dry lands. Study of morphological and anatomicalfeatures of drought tolerant fruit crops.

Suggested reading:

Chundawat, B.S. 1990. *Arid Fruit Culture*. Oxford and IBH, New Delhi.

P.L. Taroj, B.B. Vashishtha, D.G.Dhandar. 2004. *Advances in Arid Horticulture*. Internal Book Distributing Co., Lucknow.

T. Pradeep Kumar, B. Suma, Jyothi Bhaskar and K.N.Sathesan. 2008. *Management ofHorticultural Crops*. New India Publishing Agency.

II.VEGETABLE SCIENCE

BHVS1201. Tropical and Sub-tropical Vegetable Crops 3(2+1)

Theory

Area, production, economic importance and export potential of tropical and sub-tropicalvegetable crops. Description of varieties and hybrid, climate and soil requirements, seed rate,preparation of field, nursery practices; transplanting of vegetable crops and planting for directlysown/transplanted vegetable crops. Spacing, planting systems, water and weed management;nutrient management and deficiencies, use of chemicals and growth regulators. Croppingsystems, harvest, yield, post-harvest handling, economics and marketing of tropical and subtropicalvegetable crops such as tomato, brinjal, chillies, capsicum, okra, amaranthus, cluster beans,cowpea, lab-lab, snap bean, cucurbits, moringa, curry leaf, portulaca, basella, sorrel and roselle.

Practical

Identification and description of tropical and sub-tropical vegetable crops; nursery practicesand transplanting, preparation of field and sowing/planting for direct sown and planted vegetablecrops. Herbicide use in vegetable culture; top dressing of fertilizers and intercultural; use ofgrowth regulators; identification of nutrient deficiencies. Physiological disorder. Harvest indicesand maturity standards, post-harvest handling and storage, marketing, seed extraction (cost ofcultivation for tropical and sub-tropical vegetable crops), project preparation for commercialcultivation.

Suggested Reading:

S. Thamburaj, 2014. *Text book of vegetable, tuber crops and Spices*. ICAR, New Delhi
B.R.Choudhary, 2009.*AText book on production technology of vegetables*. Kalyani Publishers. Ludhiana.
T.K.Bose, 2002.*Vegetable Crops*. Nayaprakash. Kolkata
P.Hazra, 2011. *Modern Technology in Vegetable Production*. New India Publishing Agency. New Delhi.
T.R.Gopal Krishnan, 2007. *Vegetable Crops*. New India Publishing Agency. New Delhi.
M.S.Dhaliwal, 2008. *Handbook of Vegetable Crops*. Kalyani Publishers. Ludhiana
M.K.Rana, 2008.*Olericulture in India*. Kalyani Publishers. Ludhiana
P.Hazra, 2006.*Vegetable science*. Kalyani Publishers. Ludhiana
K.L.Chadha, 1993. *Advances in Horticulture*. Malhotra publishing house. New Delhi
Choudhury, B. (ICAR). 1990. Vegetables. 8th edition, National Book Trust, New Delhi.
Singh, D.K., 2007. *Modern Vegetable varieties and production*. IBN publishers, Technology International Book Distributing Co, Lucknow.

BHVS 2202. Spices and Condiments 3(2+1)

Theory

History, scope and importance, Present status, area and production, uses, export potentialand role in national economy. Classification, soil and climate, propagation-seed, vegetative andmicropropagation systems and methods of planting. Nutritional management, irrigation practices,
weed control, mulching and cover cropping. Training and pruning practices, role of growthregulators, shade crops and shade regulation. Harvesting, post-harvest technology, packaging,storage, value added products, methods of extraction of essential oil and oleoresins. Economics ofcultivation, role of Spice Board and Pepper. Export Promotion Council, institutions and researchcenters in R&D. Crops: Cardamom, pepper, betel vine ginger, turmeric, clove, nutmeg, cinnamon,all spice, curry leaf, coriander, fenugreek, fennel, cumin, dill, celery, bishops weed, saffron, vanilla,thyme and rosemary.

Practical
Identification of varieties: propagation, seed treatment – sowing; layout, planting; hoeing andearthing up; manuring and use of weedicides, training and pruning; fixing maturity standards,harvesting, curing, processing, grading and extraction of essential oils and oleoresins. Visit tocommercial plantations.

Suggested Reading:
Shanmugavelu, K.G. Kumar, N and Peter, K.V., 2005. *Production technology of spices andplantation crops*. . Agrosis, Jodhpur
Kumar, N. J.B. M. Md. Abdul khaddar, Ranga Swamy, P. and Irulappan, I., 1997. *Introductionto Spices, Plantation Crops, and aromatic crops*. Oxford & IBH, New Delhi.
Pruthi, J.S., 1980. *Spices and Condiments*. Academic Press, New York.
Pruthi, J.S., 1993. *Major Spices of India- Crop Management Postharvest Technology*. ICAR, New Delhi.
Pruthi, J.S., 2001. *Minor Spices and Condiments-Crop ManagementPost Harvest Technology*. ICAR, New Delhi.

BHVS 3103. Breeding of Vegetable, Tuber and Spice Crops 3(2+1)

Theory
Breeding objectives and important concepts of breeding self-pollinated, cross pollinated andvegetatively propagated crops. Plant genetic resources, their conservation and utilization in cropimprovement. Breeding for insect resistance, breeding for disease resistance, breeding for abiotic
resistance, male sterility and incompatibility and their utilization in development of hybrids.Origin, distribution of species, wild relatives and forms of vegetable crops Tomato, Brinjal, Bhendi,Capsicum, Chilli, Cucurbits, Cabbage, Cauliflower, Tuber crops, Potato, Carrot, Radish, Spicecrops (Ginger, Turmeric).Breeding procedures for development of hybrids/varieties in variouscrops. Genetic basis of adoptability and stability.

Practical
Floral biology and pollination mechanism in self and cross pollinated vegetables, tuber cropsand spices. Working out phenotypic and genotypic heritability, genetic advance. GCA, SCA,combining ability, heterosis, heterobeltosis, standard heterosis, GxE interactions (stability

analysis)Preparation and uses of chemical and physical mutagens. Polyploidy breeding and chromosomalstudies. Techniques of F1 hybrid seed production. Maintenance of breeding records.

Suggested Reading:

Hari Har Ram, 2013.*Vegetable Breeding: Principle and Practices***.** Kalyani Publishers. Ludhiana.
Vishnu Swaroop, 2014. *Vegetable Science &Technology in India*. Kalyani Publishers. Ludhiana
.Kallo.G, 1998. *Vegetable Breeding (Vol.I to IV).* CRC Press. Florida. 1988.
H.P. Singh, 2009.*Vegetable Varieties of India*. Studium Press (India) Pvt Ltd. New Delhi.
M.S. Dhaliwal. 2012**.** *Techniques of Developing Hybrids in Vegetable Crops***.** Agrobios. Jodhpur.
M.S.Dhaliwal, 2009. *Vegetable Seed Production & Hybrid Technology*. Kalyani Publishers.Ludhiana.
Fageria, M.S., 2011. *Vegetable Crops- Breeding and Seed Production*. Kalyani Publishers,Ludhiana.

BHVS 3204. Seed Production of Vegetable, Tuber and Spice Crops 3(2+1)

Theory

Introduction and history of seed industry in India. Definition of seed, classes-types of seed.Differences between grain and seed. Importance and scope of vegetable seed production in India.

Principles of vegetable seed production. Role of temperature, humidity and light in vegetableseed production, land requirements, climate, season, planting time, nursery management, seedrate, rouging, seed extraction and storage of cole crops, root vegetables, solanaceous vegetables,cucurbits, okra, leafy vegetables, bulb crops, leguminous vegetables and exotic vegetables. Seedgermination and purity analysis. Field and seed standards. Seed drying and extraction. Seedlegislation.

Practical

Study of seed structure, colour size, shape and texture. Field inspection of seed crops. Practicesin rouging. Harvesting and seed extraction. Germination and purity analysis. Methods of seedproduction, Seed certification in cole crops, root vegetables, bulb crops, solanaceous vegetables,cucurbits, okra, leafy vegetables, leguminous vegetables and exotic vegetables. Seed processingmachines. Visit to seed production units.

Suggested Reading:

N.P. Nema, 1988.Principles of seed certification and Testing. Allied Publications.
P. Hazra and M.G. Som, 2009. Vegetable seed production and Hybrid Technology. Kalyani Publishers, Ludhiana.
Agrawal R. L. 1999. Seed Technology. Oxford and IBH Publicity Company, New Delhi.
Arya, Prem Singh. 2003. Vegetable seed Production Principles. Kalyani Publishers,Ludhiana.
Fageria, M. S. 2011. Vegetable Crops- Breeding and Seed Production. Kalyani Publishers, Ludhiana.

Singh, S.P. 2001. Seed Production in Commercial Vegetables. Agrotech Publishing Academy, Udaipur.
Vanangamudi, K.2010. Vegetable Hybrid Seed Production and Management. Agrobios,Jodhpur.
Singh, Prabhakar.2015.Seed Production Technology of vegetable. Daya Publishing House,New Delhi.
Prem Singh Arya, 2003. Vegetable breeding, production and seed production. Kalyanipublishers, New Delhi.
Nemgal Singh, P.K. Singh, Y.K. Singh and Virendra kumar, 2006. *Vegetable Seed ProductionTechnology*. International book distributing co., Lucknow.

BHVS210 5. Temperate Vegetable Crops 2(1+1)

Theory

Importance of cool season vegetable crops in nutrition and national economy. Area,production, export potential, description of varieties and hybrids, origin, climate and soil,production technologies, post-harvest technology and Marketing of cabbage, cauliflower, knolkhol,sprouting broccoli, Brussels' sprout, lettuce, palak, Chinese cabbage, spinach, garlic, onion,leek, radish, carrot, turnip, beet root, peas, broad beans, rhubarb, asparagus, globe artichoke,Vegetable kale.

Practical

Identification and description of varieties/hybrids; propagation methods, nurserymanagement; preparation of field, sowing/transplanting; identification of physiological andnutritional disorders and their corrections; post-harvest handling; cost of cultivation and fieldvisits to commercial farms.

Suggested Reading:

S. Thamburaj. 2014. *Text book of vegetable, tuber crops and Spices*. ICAR, New Delhi.
B.R.Choudhary 2009.*AText book on production technology of vegetables*. Kalyani Publishers. Ludhiana.
T.K.Bose. 2002.*Vegetable Crops*. Nayaprakash. Kolkata
P.Hazra. 2011. *Modern Technology in Vegetable Production*. New India Publishing Agency. New Delhi.
T.R.Gopal Krishnan, 2007. *Vegetable Crops*. New India Publishing Agency. New Delhi.
M.S.Dhaliwal, 2008.*Handbook of Vegetable Crops*. Kalyani Publishers. Ludhiana
Singh, Umashankar, 2008. Indian Vegetables. Anmol Publications. Pvt.Ltd .New Delhi.
M.K.Rana, 2008.*Olericulture in India*. Kalyani Publishers. Ludhiana
P.Hazra. 2006.*Vegetable science*. Kalyani Publishers .Ludhiana
Pratibha Sharma, 2007.*Vegetables : Disease Diagnosis and Biomanagement*. Avishkar Publishers. Jaipur
Nath Prem. 1994.*Vegetables for the Tropical Regions*. ICAR New Delhi
Bose, T.K. 2003. Vegetable Crops. Naya udyog publishers, Kolkata. 2002. Naya Prakash,Calcutta
Prem Singh Arya, 1999. Vegetable Seed Production Principles. Kalyani Publishers, New Delhi.
Choudhery, B., 1990. Vegetables. 8th edition. National Book Trust, New Delhi.

BHVS 3106. Potato and Tuber Crops 2(1+1)

Theory

Origin, area, production, economic importance and export potential of potato and tropical,sub-tropical and temperate tuber crops; description of varieties and hybrids. Climate and soilrequirement, season; seed rate; preparation of field; planting practices; spacing; water, nutrientand weed management; nutrient deficiencies. Use of chemicals and growth regulators; croppingsystems. Harvesting practices, yield; economic of cultivation. Post- harvest handling and storage,

field and seed standards, marketing. Crops to be covered – potato, sweet potato, arrow root,cassava, colocasia, xanthosoma, amorphophallus, dioscorea, Jerusalem artichoke, horse radishand other under exploited tuber crops.

Practical

Identification and description of potato and tropical, sub-tropical and temperate tuber crops;planting systems and practices; field preparation and sowing/planting. Top dressing of fertilizersand interculture and use of herbicides and growth regulators; identification of nutrient deficiencies,physiological disorders; harvest indices and maturity standards, post-harvest handling and storage,marketing. Seed collection, working out cost of cultivation, project preparation of commercialcultivation.

Suggested Reading:

S. Thamburaj. 2014. *Text book of vegetable, tuber crops and Spices*. ICAR, New Delhi.
B.R.Choudhary. 2009.*AText book on production technology of vegetables*. Kalyani Publishers. Ludhiana.
T.K.Bose. 2002.*Vegetable Crops*. Nayaprakash. Kolkata

P.Hazra. 2011. *Modern Technology in Vegetable Production*. New India Publishing Agency. New Delhi.
T.R.Gopal Krishnan, 2007. *Vegetable Crops*. New India Publishing Agency. New Delhi.
P.Hazra. 2006.*Vegetable science*. Kalyani Publishers .Ludhiana
Nath Prem. 1994.*Vegetables for the Tropical Regions*. ICAR New Delhi
K.L.Chadha. 1993.*Advances in Horticulture*. Malhotra publishing house. New Delhi
Shanmugavelu, K.G. 1989. Production technology of vegetable crops. Oxford and IBH Publishing Co. Pvt. Ltd, New Delhi.
Bose, T.K. 2003. Vegetable Crops. Naya udyog publishers, Kolkata. 2002. Naya Prakash,Calcutta.
Vincent Lebot, 2008.*Tropical roots and tuber crops*. CAVI.
J.E. Bradashaw, 2010. Root and tuber crops. Springer Publications.

BHVS 2207. Precision Farming & Protected Cultivation 3 (2+1)

Theory

Precision farming – laser leveling, mechanized direct seed sowing; seedling and saplingtransplanting, mapping of soils and plant attributes, site specific input application, weedmanagement, insect pests and disease management, yield mapping in horticultural

crops.Green house technology, Introduction, Types of Green Houses; Plant response to Greenhouseenvironment, Planning and design of greenhouses, Design criteria of greenhouse for cooling andheating purposes. Green house equipment, materials of construction for traditional and low costgreen houses. Irrigation systems used in greenhouses, Typical applications, passive solar greenhouse, hot air greenhouse heating systems, green house drying. Cost estimation and economicanalysis. Choice of crops for cultivation under greenhouses, problems / constraints of greenhouse
cultivation and future strategies. Growing media, soil culture, type of soil required, drainage,flooding and leaching, soil pasteurization in peat moss and mixtures, rock wool and other inertmedia, nutrient film technique (NFT) / hydroponics.

Practical
Study of different types of greenhouses based on shape, construction and cladding materials;Calculation of air rate exchange in an active summer winter cooling system; Calculation of rateof air exchange in an active winter cooling system; Estimation of drying rate of agriculturalproducts inside green house; Testing of soil and water to study its suitability for growing cropsin greenhouses; The study of fertigation requirements for greenhouses crops and estimation ofE.C. in the fertigation solution; The study of various growing media used in raising of greenhousecrops and their preparation and pasteurization / sterilization; Visit to commercial green houses;Economics of protected cultivation.

Suggested Reading:
Balraj Singh. 2006. *Protected cultivation of vegetable crops*. Kalyani Publishers, Ludhiana.
Brahma Singh, 2014.*Advances in Protected Cultivation*. New India Publishing Agency. New Delhi.
Reddy P. Parvatha, 2003. *Protected Cultivation*. Springer Publications. USA.
Reddy, P. Parvatha. 2011. *Sustainable crop protection under Protected Cultivation*. Springer Publications. USA.
Jitendra Singh, 2015.*Precision Farming in Horticulture*. New India Publishing Agency. New Delhi.
Prasad S. 2005. *Greenhouse Management for Horticultural Crops*. Agrobios. Jodhpur.
Jitendra Singh, S.K. Jain, L.K. Dashora, B.S. Cundawat.2013. *Precision forming in Horticulture*. New India Publishing Agency, New Delhi.
T. Pradeep Kumar, B. Suma, Jyothi Bhaskar and K.N.Satheson. 2008. *Management of Horticultural crops*. New India Publishing Agency, New Delhi.
Pant V Nelson. 1991.*Green House Operation and Management*. Bali Publ

III. POST HARVEST TECHNOLOGY

BHPT 3201. Postharvest Management of Horticultural Crops 3(2+1)

Theory
Importance of Postharvest Technology in horticultural crops. Maturity indices, harvesting,handling, grading of fruits, vegetables, cut flowers, plantation crops, spices, medicinal andaromatic plants. Pre-harvest factors affecting quality, factors responsible for deterioration ofhorticultural produce, physiological and bio-chemical changes, hardening and delaying

ripeningprocess. Postharvest treatments of horticultural crops. Quality parameters and specifications.Structure of fruits, vegetables and cut flowers related to physiological changes after harvest.Methods of storage for local market and export. Pre-harvest treatment and pre-cooling, prestoragetreatments. Different systems of storage, packaging methods and types of packages, recentadvances in packaging. Types of containers and cushioning materials, vacuum packaging, coldstorage, poly shrink packaging, grape guard packing treatments. Modes of transport.

Practical

Practice in judging the maturity of various horticultural produce, determination ofphysiological loss in weight and quality. Grading of horticultural produce, post-harvest treatmentof horticultural crops, physical and chemical methods. Packaging studies in fruits, vegetables,plantation crops, spices and cut flowers by using different packaging materials, methods of storage,post-harvest disorders in horticultural produce. Identification of storage pests and diseases inspices. Visit to markets, packing houses and cold storage units.

Suggested Reading:

Verma, L. R. and Joshi, V. K. 2000. Post Harvest Technology of Fruits and Vegetables. Vol. I & I. Indus Publishing Co., New Delhi

Stanley, J. K. 1998. Post Harvest Physiology of Perishable Plant Products. CBS, New Delhi.

Neetu Sharma and Mashkoor Alam, M. 1998. Post Harvest Diseases of Horticultural

Chadha, K. L. and Kalloo, G.1993. Advances in Horticulture. Vol. 4 to 10. MPH, New Delhi.

Mitra, S. K. 1997. Post Harvest Physiology and Storage of Tropical and Sub-tropical Fruits. CAB International.

Pruthi, J. S. 2001. Minor Spices and Condiments – Crop Managements and Post Harvest Technology. ICAR, New Delhi.

Saraswathy, S. *et. al*. 2008. Post harvest Management of Horticultural Crops. Agribios (India).81-7754-322-9.

BHPT 3202. Processing of Horticultural Crops 3(1+2)

Theory

Importance and scope of fruit and vegetable preservation industry in India, food pipe line,losses in post-harvest operations, unit operations in food processing. Principles and guidelines forthe location of processing units. Principles and methods of preservation by heat - pasteurization,canning, bottling. Methods of preparation of juices, squashes, syrups, cordials and fermentedbeverages. Jam, jelly and marmalade. Preservation by sugar and chemicals, candies, crystallizedfruits, preserves chemical preservatives, preservation with salt and vinegar, pickling, chutneys andsauces, tomato and mushrooms, freezing preservation. Processing of plantation crops, products,spoilage in processed foods, quality control of processed products, Govt. policy on import andexport of processed fruits. Food laws.

Practical

Equipments used in food processing units. Physico-chemical analysis of fruits and vegetables.Canning of fruits and vegetables, preparation of squash, RTS, cordial, syrup, jam, jelly, marmalade,candies, preserves, chutneys, sauces, pickles (hot and sweet). Dehydration of

fruits and vegetables– tomato product dehydration, refrigeration and freezing, cut out analysis of processed foods.Processing of plantation crops. Visit to processing units.

Suggested Reading:

Verma, L. R.and Joshi, V. K. 2000. Post Harvest Technology of Fruits and Vegetables. Vol. I & II. Indus Publishing Co., New Delhi.

Y Y Srivastava, R. P. & Sanjeev Kumar. 2002. Fruits and vegetable Preservation – Principles and Practice. International Book Distributing Co., Lucknow.

Srivastava,R. P.andSanjeevK.1998. Fruitandvegetablepreservation principlespractice. InternatinalBookDistributingCo.,Lucknow.

Girdharilal, Siddappa, G. S. and Tandon, G. L.1998. Preservation of fruits and vegetables. ICAR, New Delhi.

Dauthy and Mircea, E.1995. Fruit and vegetables processing. International Book DistributionCo, Lucknow.

BHPT 2103. Fundamentals of Food Technology 2(1+1)

Theory

Food and its function, physico-chemical properties of foods, food preparation techniques,nutrition, relation of nutrition of good health. Characteristics of well and malnourishedpopulation. Energy, definition, determination of energy requirements, food energy, total energyneeds of the body. Mineral nutrition: macro and micro-minerals (Ca, Fe and P), function,utilization, requirements, sources, effects of deficiency. Vitamins: functions, sources, effects ofdeficiency, requirements of water soluble and fat-soluble vitamins. Balanced diet: recommendeddietary allowances for various age groups, assessment of nutritional status of the population.

Practical

Methods of measuring food ingredients, effect of cooking on volume and weight, determination of percentage of edible portion. Browning reactions of fruits and vegetables. Microscopic examination of starches, estimation of energy, value proteins and fats of foods. Planning diet for various age groups.

Suggested Reading:

George F Stewart and Maynard A Amerine. Introduction to food science and technology. Academic press.

Gould W A. Fundamentals of food processing and technology

Manoranjan, K. and Sangita, S. 1996. Food Preservation and Processing. Kalyani Publishers 978-81-272-4262-6.

Shankunthala, M. 1972. Foods-Facts, Principles & Procedure. The Eastern Press, Bengaluru.

Passmore, R. and Eastwood, M. A. 1986. Human Nutrition & Dietetics. ELBS0443039194.

Devendra, K. B. and Priyanka, T. 2006. An Introduction to Food Science and technology andQuality Management. Kalyani Publishers 81-272-2521-5.

Monoranjam, K. and Sangita, S. 2008. Food Preservation and Processing. Kalyani Publishers 978-81-272-4262-6.

Gopalan, G., Ramasastri, B.V. and Balasubramnian, S. C. 1989. Nutritive valve of the Indian

Foods. National Institute of Nutrition, ICMR, Hyderabad.
Swaminathan, M. 1988. Hand book of Food Science & Experimental Foods. Bappco publishers, Bangalore
Manay, S.N, Shadaksharaswamy, M.1998. Food-facts & Principles New Age International Publishers, New Delhi

IV. FLORICULTURE & LANDSCAPE ARCHITECTURE

BHFL2201. Ornamental Horticulture 2(1+1)

Theory

History, definitions, scope of ornamental horticulture, aesthetic values, Floriculture industry,Importance, area and production, industrial importance of ornamental plants and flowers.Importance, classification, design values and general cultivation aspects for ornamental plants *viz*.Annuals, bienniales herbaceous perennials, grasses and bulbous ornamentals. shrubs, climbers,trees, indoor plants, palms and cycads, ferns and sellagenellas, cacti and succulents, Importance,design and establishment of garden features/components viz. hedge, edge, borders, flower beds,bridges, paths, drives, fences, garden walls, gates, carpet bed, arbour, Patio, decking, retainingwalls, shade garden, sunken garden, roof garden, terrace garden, pebble garden, rockery, pools,waterfalls, fountains, bog garden, avenue planting and children garden. Lawn types, establishmentand maintenance. Importance of Garden adornments viz. floral clock, bird bath, statutes,sculptures, lanterns, water basins, garden benches etc.. Importance of flower arrangement,Ikebana, techniques, types, suitable flowers and cut foliage, uses of vertical garden, bottle garden,terrariums, art of making bonsai, culture of bonsai and maintenance.

Practical

Identification and description of annuals, biennials, herbaceous perennials, climbers, shrubs,trees, indoor plants, ferns and sellagenellas, Palms and cycads and Cacti and succulents. Planningand designing and establishment of garden features viz. lawn, hedge and edge, rockery, watergarden, carpet bedding, shade garden, roof garden, Study and creation of terrariums, verticalgarden, study and practice of different types of flower arrangements, preparation of floral bouquets,preparation of floral rangoli, veni etc., Study of Bonsai techniques, Bonsai practicing and training.Visit to nurseries and floriculture units.

Suggested Reading:

Bose, Chowdhury and Sharma.1991.Tropical Garden Plants in colour .Horticulture and allied publishers, 3D Madhab Chatterjee street Kolkata.
K.V.Peter.2009.Ornamental plants. New India publishing agency, Pitampura, New Delhi.
Arora, J.S. 2006. Introductory Ornamental Horticulture. Kalyani Publishers, Ludhiana
Randhawa, G.S. Amitabha Mukhopadhyay, 2004. Floriculture in India. Allied Publishers Pvt. Ltd., New Delhi.
Bose, T.K. Mukherjee, D. 2004. Gardening in India. Oxford & IBH Publishers.
Chadha, K.L. and Chaudhary, B. 1986. Ornamental Horticulture in India. Publication andInformationdivision. ICAR,NewDelhi.

BHFL3302. Breeding and Seed Production of Flower and Ornamental Crops 3(2+1)

Theory

History of improvements of ornamental plants, Centre of origin of flower crops andornamental crops, objectives and techniques in ornamental plant breeding. Introduction, selection,hybridization, mutation and biotechnological technique for improvement of ornamental andflower crops *viz*., Rose, Jasmine, Chrysanthemum, Tuberose, Gerbera, Gladiolus, dahlia Heliconia,Lilium, Gaillardia, Petunia, *Hibiscus*, Bouganvillea, Zinnia, Cosmos, Dianthus, Snapdragon,Pansy, crossandra, marigold, , geranium, antirrhinium, china aster, orchids, anthurium, carnation,hibiscus etc. Breeding for disease resistance. Development of promising cultivars of importantornamentals and flower crops. Role of heterosis and its exploitation, production of F1 hybrids andutilization of male sterility, production of open pollinated seed. Harvesting processing and storageof seeds, seed certification.

Practical

Study of floral biology and pollination in important species and cultivars. Techniques ofinducing polyploidy and mutation. Production of pure and hybrid seeds. Harvesting, conditioning and testing of seeds. Practice in seed production methods.

Suggested Reading:

B.P. Pal. *The Rose in India*.1966.Directorate of Knowledge management in Agriculture, Indian council of Agriculture Research-New Delhi.

T.K. Bose, L.P. Yadav, P. Patil, P. Das and V.A. Partha Sarthy. 2003. *Commercial flowers.* ParthaSankar Basu, Nayaudyog, 206, Bidhan Sarani, Kolkata-700006.

S.K. Bhattacharjee and L.C. De. 2003. *Advanced Commercial Floriculture*. Aavishkar Publishers,Distributors, Jaipur (Rajasthan) India.

Singh,B.D. 1983. Breeding Principles and Methods. Kalyani Publishers, New Delhi.

BHFL 1103. Principles of Landscape Architecture 2(1 +1)

Theory

Historical Importance of Indian gardens, Gardens of ancient world, Definitions, Famousgardens of India and abroad, formal, informal, free style and wild gardens, basic themes ofgardens viz. circular, rectangular and diagonal themes, Steps in preparation of garden design.Use of Auto CAD and Arch CAD in designing gardens. Factors affecting landscape design viz.intial approach, view, human choice, simplicity, topography etc., Principles of Landscape gardensviz. Axis, rhythm, balance, time and light, space, texture, form, mass effect, focal point, mobility,emphasis, unity and harmony etc.. Elements of landscape gardens viz. tangible and intangibleelements. Bio-aesthetic planning, definition, objectives, Planning and designing of home gardens,colonies, country planning, urban landscape, Development of institutional gardens, planning andplanting of avenues, beautifying schools, railway lines, railway stations, factories, bus stands, airports corporate buildings, dams, hydro electric stations, river banks, play grounds, Gardens forplaces of religious importance viz. temples, churches, mosques, tombs etc, Importance, featuresand establishment of English garden , Japanese gardens , Mughal, gardens, French and Persiangarden, Italian gardens, Hindu gardens and Buddhist gardens, Xeriscaping, definition, principlesand practice.

Practical

Study of garden equipments. Study of Graphic language, Use of drawing equipments, graphicsymbols and notations in landscaping designing, Study and designing of different styles of gardens,Study and designing of gardens based on different themes, Designing gardens using Auto-cad/archi-cad, Designing gardens for home, traffic islands, schools and colleges, public buildings,factories, railway stations, air ports, temples, churches, play grounds, corporate buildings/ malls.Designing and planting of avenues for state and National highways, Design and establishment ofJapanese, English and Mughal gardens. Visit to public, institutional and botanical gardens.

Suggested Reading:

A.K. Tiwari and R. Kumar. 2012. *Fundamentals of ornamental horticulture and landscape gardening*. New India.

L.C. De. *Nursery and landscaping*.2013. Pointer publishers, Jaipur India.

Bose, T.K. Malti, R.G. Dhua, R.S. & Das, P. 2004. Nayaprakash, Calcutta. Floriculture and Landscaping

Arora, J.S. 2006. Kalyani publishers, Ludhiana. Introductory Ornamental Horticulture. Kalyani publishers, Ludhiana.

Randhawa, G.S. and Amitabha Mukhopadhyay 2004. Floriculture in India. Allied Publishers Pvt. Ltd., New Delhi.

BHFL2104. Commercial Floriculture 3(2+1)

Theroy

Scope and importance of commercial floriculture in India, production techniques ofcommercial flower crops like rose, marigold, chrysanthemum, orchid, carnation, gladiolus,jasmine, crossandra, anthurium, dahlia, tuberose, bird of paradise, china aster and gerbera fordomestic and export market, production techniques of flowers and foliage filler materials growingof flowers under protected environments such as glass house, plastic house etc., postharvesttechnology of cut flowers in respect of commercial flower crops, dehydration technique for dryingof flowers, production techniques for bulbous.

Practical

Identification of commercially important floricultural crops. Propagation practices inchrysanthemum, sowing of seeds and raising of seedlings of annuals. Propagation by cutting,layering, budding and grafting. Training and pruning of roses. Use of chemicals and othercompounds for prolonging the vase life of cut flowers. Drying and preservation of flowers. Flowerarrangement practices.

Suggested Reading:

T.K. Bose, L.P. Yadav, P. Patil, P. Das and V.A. Partha Sarthy. 2003.*Commercial flowers.* Partha

Sankar Basu, Nayaudyog,206, Bidhan Sarani, Kolkata-700006

S.K. Bhattacharjee and L.C. De. 2003. *Advanced Commercial Floriculture*. Aavishkar Publishers,Distributors, Jaipur (Rajasthan) India.

Randhawa, G.S. Amitabha Mukhopadhyay, 2004. Floriculture in India. Allied Publishers Pvt.

Ltd:
Arora, J.S. 2006. Introductory Ornamental Horticulture. Kalyani Publishers, Ludhiana - 141 008.
Prof. Bhattacharjee, S.K. Advanced Commercial Floriculture. Aavishkar Publishers Distributors, Jaipur - 320 003

BHFL3105. Medicinal and Aromatic Crops 3(2+1)

Theory

History, scope, opportunities and constraints in the cultivation and maintenance of medicinaland aromatic plants in India. Importance, origin, distribution, area, production, climatic and soilrequirements, propagation and nursery techniques, planting and after care, cultural practices,training and pruning, nutritional and water requirements. Plant protection, harvesting andprocessing of under mentioned important medicinal and aromatic plants. Study of chemicalcomposition of a few important medicinal and aromatic plants, extraction, use and economics ofdrugs and essential oils in medicinal and aromatic plants. Therapeutic and pharmaceutical usesof important species. Storage techniques of essential oils. Medicinal Plants: Withania, periwinkle,Rauvolfia, Dioscorea, Isabgol, opium poppy Ammi majus, Belladonna, Cinchona, Pyrethrum and
other species relevant to local conditions. Aromatic Plants: Citronella grass, khus grass, flag (baje),lavender, geranium, patchouli, bursera, menthe, musk, occimum and other species relevant to thelocal conditions. Marketing.

Practical

Collection of medicinal and aromatic plants from their natural habitat and study theirmorphological description, nursery techniques, harvesting, curing and processing techniques and
extraction of essential oils.

Suggested Reading:

Chadha, K.L. ICAR, 2001. Hand Book of Horticulture. Directorate of Information and Publications of Agriculture, Pusa, New Delhi.
Azhar Ali Farooqui and Sreeramu, B.S. 2001. Cultivation of medicinal and aromatic plants. United Press Limited.
Atal, E.K. and Kapur, B. 1982. Cultivation and Utilization of Medicinal and Aromatic plants. CSIR, New Delhi.
Kumar, N. J.B.M. Md. Abdul Khaddar, Ranga Swamy, P. and Irulappan, I. 1997. Introduction to Spices, Plantation Crops Medicinal and Aromatic Plants.Oxford & IBH, New Delhi.
Jain, S.K. 1968. Medicinal Plants .National Book Trust New Delhi. Oxford & IBH, New Delhi.
Dastur, J.F. 1982. Medicinal plants of India Pakistan Taraprevala soms and co-private Ltd, Bombay.

V. PLANT PROTECTION

BHPP2101. Fundamentals of Plant Pathology 3(2+1)
Theory

Introduction to the science of phytopathology, its objectives, scope and historical background.Classification of plant diseases, symptoms, signs, and related terminology. Parasitic causes ofplant diseases (fungi, bacteria, viruses, phytoplasma, protozoa, algae and flowering parasiticplants), their characteristics and classification. Non-parasitic causes of plant diseases. Infectionprocess. Survival and dispersal of plant pathogens. Plant disease epidemiology, forecasting anddisease assessment. Principles and methods of plant disease management. Integrated plantdisease management. Fungicides classification based on chemical nature, Commonly used fungicides,bactericides and nematicides.

Practical

Familiarity with general plant pathological laboratory and field equipments. Study of diseasesymptoms and signs and host parasite relationship. Identification and isolation of plant pathogens.Koch's postulates. Preparation of fungicidal solutions, slurries, pastes and their applications.

Suggested Readings:

R.S.Singh.*Introduction to principles of plant pathology*

R.S. Mehrohtra, Ashok Agarwal. *Fundamental of Plant Pathology*yy .A text book of fungi bacteria and virus-H.C.DUBE

Singh, R.S. 1982. Plant Pathogens - The Fungi. Oxford and IBH Publishing Co., New Delhi.

Ranga Swamy, G. 1988.*Diseases of Crop Plants in India*. Prentice Hall of India Pvt. Ltd., New Delhi.

Singh, R.S. 1994. *Diseases of Vegetable Crops*. Oxford IBH Publishing Co. Pvt. Ltd., New Delhi

Singh, R.S 1996. *Plant Diseases*. Oxford IBH Publishing Co. Pvt. Ltd., New Delhi

Sohi, H.S. 1992. *Diseases of Ornamental plants in India*. ICAR, New Delhi

Srikant Kulkarni, Yashoda R. Hedge. *Diseases of Plantation crops and their management*-, Agrotech publication Academy

S.L. Godara, BBS Kapoor, B.S. Rathore. *Disease management of spice crops*-, Madhu Publications

N.G. Ravichandra, 2013.Fundamentals of Plant Pathology. PHI Hall of India, NewDelhi

R.S. Mehrohtra, Ashok Agarwal. *Fundamental of Plant Pathology*yy

Mehrotra, R.S. and Aneja, K.R. 1990. . An Introduction to Mycology. New Age International (P) Ltd., New Delhi.

Singh, R.S. 1982. Plant Pathogens - The Fungi. Oxford and IBH Publishing Co., New Delhi.

Dhingra and Sinclair 1993. Basic Plant Pathology Methods. CBS, Publishers & Distributors,New Delhi.

BHPP2102 Diseases of Fruit, Plantation, Medicinal and Aromatic Crops 3(2+1)

Theory

Etiology, symptoms, mode of spread, epidemiology and integrated management of thediseases of fruits, plantation, medicinal and aromatic crops *viz* mango, banana, grape, citrus,guava, sapota, papaya, jack fruit, pineapple, pomegranate, ber, apple, pear, peach, plum, almond,walnut, strawberry, areca nut, coconut, oil palm, coffee, tea, cocoa, cashew, rubber, betel vinesenna,

neem, hemp, belladonna, pyrethrum, camphor, costus, crotalaria, datura, dioscorea, mint,opium, *Solanum khasianum* and Tephrosia. Important post-harvest diseases of fruit, plantationand medicinal and aromatic crops and their management.

Practical
Observations of disease symptoms, identification of casual organisms and host parasiterelationship of important diseases. Examination of scrapings and cultures of important pathogens
of fruits, plantation, medicinal and aromatic crops.

Suggested Reading:
L.R. Verma and R.C. Sharma. *Diseases of horticultural Crops*-, Indus Publishers
Srikant Kulkarni, Yashoda R. Hedge, *Diseases of Plantation crops and their management*-Agrotech publication Academy.
S.L. Godara, BBS Kapoor, B.S. Rathore *Disease management of spice crops*-, Madhu Publications.
R.S.Singh, *Plant diseases* –Oxford and IBH Publishing Co. Pvt. Ltd.
Ranga Swamy, G. 1988.*Diseases of Crop Plants in India*. Prentice Hall of India Pvt. Ltd., New Delhi.
Singh, R.S. 1996.*Plant Diseases*. Oxford IBH Publishing Co. Pvt. Ltd., New Delhi.
Saha, L.R. 2002.*Hand Book of Plant Diseases*. Kalyani Publishers, New Delhi.
L.R. Verma and R.C. Sharma. *Diseases of horticultural Crops*., Indus Publishers,New Delhi.

Yashoda R. Hedge. *Diseases of Plantation crops and their managemen*t .Srikant Kulkarni, Agrotech publication Academy.
S.L. Godara, BBS Kapoor, B.S. Rathore. *Disease management of spice crops*.,Madhu Publications.
Ranga Swamy, G. 1988.*Diseases of crop plants in India*. Prentice Hall of India Pvt. Ltd., New Delhi

BHPP3103 Diseases of Vegetable, Ornamental and Spice Crops 3(2+1)

Theory
Etiology, symptoms, mode of spread, epidemiology and integrated management of diseasesof the following vegetables, ornamental and spice crops: tomato, brinjal, chilli, bhindi, cabbage,cauliflower, radish, knol-khol, pea, beans, beet root, onion, garlic, fenugreek, ginger, potato,turmeric, pepper, cumin, cardamom, nutmeg, coriander, clove, cinnamon, jasmine, rose,crossandra, tuberose, gerebera, anthurium, geranium. Important post-harvest diseases ofvegetables and ornamental crops and their management.

Practical
Observations of symptoms, causal organisms and host parasitic relationship of importantdiseases, examination of cultures of important pathogens of vegetables, ornamental and spicecrops in field as well as in protected cultivation.

Suggested Reading:

Srikant Kulkarni, Yashoda R. Hedge. *Diseases of Plantation crops and their management*-, Agrotech publication Academy
S.L. Godara, BBS Kapoor, B.S. Rathore. *Disease management of spice crops*-, Madhu Publications
L.Darwin Christdhar Henry and H.Lewin Devasahayam *Crop diseases: Identification,Treatment and Management*. An Illustrated Handbook –, New India publishing Agency
Singh, R.S. 1994. *Diseases of Vegetable Crops*. Oxford IBH Publishing Co. Pvt. Ltd., New Delhi
Singh, R.S 1996. *Plant Diseases*. Oxford IBH Publishing Co. Pvt. Ltd., New Delhi
Sohi, H.S. 1992. *Diseases of Ornamental plants in India*. ICAR, New Delhi
Ranga Swamy, G. 1988. *Diseases of Crop Plants in India*.Prentice Hall of India Pvt. Ltd., New Delhi.
Saha, L.R. 2002. *Hand Book of Plant Diseases*. Kalyani Publishers
Arjunan, G. Karthikeyan, G. Dinakaran, D. Raguchander, T. 1999. *Diseases of HorticulturalCrops.* .Dept. of Plant Pathology,Tamilnadu Agricultural University Coimbatore.

BHPP2104 Nematode Pests of Horticultural Crops and their Management 2(1+1)

Theory

History and development of nematology - definition, economic importance. Generalcharacters of plant parasitic nematodes, their morphology, taxonomy, classification, biology,symptomatology and control of important plant parasitic nematodes of fruits – (tropical, subtropicaland temperate) vegetables, tuber, ornamental, spice and plantation crops. Role ofnematodes in plant disease complex. Integrated nematode management.

Practical

Methods of sampling and extraction of nematodes from soil and plant parts, killing, fixingand preparation of temporary and permanent nematode mounts. Nematicides and their use.Collection and preservation of 20 plant species/parts damaged by plant parasitic nematodes.

Suggested Reading:

Upadhyay, K.D and Dwivedi, K. 1997. A text book of plant nematology. Amman Publishing House Aman publishing house, Meerut
Gopal Swaroop and Das Gupta 1986.ICAR, New Delhi. Plant Parasitic Nematodes of India Problems and Progress.
Nair, M.R.G.K. 1975. Insects and Mites of Crops in India. ICAR, New Delhi
Butani, D.K. 1984. Insects and Fruits. Periodical Expert Book Agency, New Delhi

BHPP2105 Fundamentals of Entomology 3(2+1)

Theory

Introduction to phylum arthropoda. Importance of class Insecta. Insect dominance. Historyof entomology in India, Importance of entomology in different fields. Definition, division and scopeof entomology. Comparative account of external morphonology-types of mouth parts, antennae,legs, wings and genetalia. Structure, function of cuticle & moulting and body segmentation, Anatomyof digestive, Circulatory, Sensory, respiratory, glandular, excretory, nervous and reproductive systems.

Types of reproduction. Postembryonic development-eclosion. Matamorphosis. Types of egg larvaeand pupa. Classification of insects upto orders, sub-order and families of economic importanceand their distinguished characters. Plant mites – morphological features, important families withexamples.

Practical

Insect collection and preservation. Identification of important insects. General bodyorganization of insects. Study on morphology of grasshopper or cockroach. Preparation ofpermanent mounts of mouth parts, antennae, legs and wings. Dissection of grasshopper andcaterpillar for study of internal morphology. Observations on metamorphosis of larvae and pupae.Dissection of cockroaches.

Suggested Reading:

Borror, D.J., C.A. Triple Horn and N.F.Johnson. 1987. *An introduction to the study of insects (VI Edition)*. Harcourt Brace College Publishers, New York

Chapman, R.F. 1981. The Insects: Structure and function. Edward Arnold (Publishers) Ltd, London

Gullan, P.J. and Cranston, P.S. 2001. *The insects- An outline of entomology*, II edition, Chapman & Hall, Madras, 491p.

Nayar, K.K., T.N.Ananthakrishnan and B.V. David. 1976. *General and applied entomology*, Tata McGraw Hill Publishing Company Limited, New Delhi, 589p.

Srivastava, P.D. and R.P.Singh. 1997. *An introduction to entomology*, Concept Publishing Company, New Delhi, 269p.

BHPP2206 Insect Pests of Fruit, Plantation, Medicinal and Aromatic Crops 3(2+1)

Theory

General – economic classification of insects; Bio-ecology and insect-pest management withreference to fruit, plantation, medicinal and aromatic crops; pest surveillance. Distribution, hostrange, bio-ecology, injury, integrated management of important insect pests affecting tropical,sub-tropical and temperate fruits, plantation, medicinal and aromatic crops like coconut, arecanut, oil palm, cashew, cacao, tea, coffee, cinchona, rubber, betel vine senna, neem, belladonna,pyrethrum, costus, crotalaria, datura, dioscorea, mint, opium, Solanum khasianum and. Storageinsects – distribution, host range, bio-ecology, injury, integrated management of importantinsect pests attacking stored fruits, plantation, medicinal and aromatic crops and their processedproducts. Insecticide residue problems in fruit, plantation, medicinal and aromatic crops andtheir maximum residue limits (MRLs).

Practical

Study of symptoms of damage, collection, identification, preservation, assessment of damageand population of important insect – pests affecting fruits, plantation, medicinal and aromaticcrops in field and storage.

Suggested Reading:

Reddy, P. P., 2010, Plant Protection in Horticulture Vol. 1, 2 & 3, Scientific Publishers, Jodhpur.
Ranjit, P., 2012, Entomological Techniques in Horticultural Crops, New India Publishing Agency.
Nair M R G K, 1995, Insect and Mites of Crops in India, ICAR, New Delhi.
Ayyar, T.V.R. 1963. Hand book of entomology for south India. Govt. press Madras, 516p.
David B V and Kumarswami, T, 1982. Elements of Economic Entomology. Popular Book Department, Madras, 536p.
David.V.Alford. Pest of fruit crops. A.M.Ranjith. Identification and management of Horticultural pest.
Ramnivas Sharma. Identification and management of horticulture pest.
Fryer. Insect pest of fruit crops

BHPP3207 Apiculture, Sericulture and Lac Culture 2(1+1)

Theory

Introduction to beneficial insects. Importance and History of apiculture. Species of honeybees, Rock bee, Little bee, Indian bee, European bee, Italian bee and Dammar bee, lifecycle andcaste determination. Bee colony maintenance, bee colony activities, starting of new colony,location site, transferring colony, replacement of queen, combining colonies, swarm prevention,colony management in different seasons, Equipment for apiary, types of bee hives and theirdescription. Bee pasturage. Honey extraction, honey composition and value, bee wax and tissues.

Importance, History and development in India, silkworms kinds and their hosts, systematicposition, distribution, lifecycles in brief, Silk glands. Mulberry silkworm-morphological features,
races, rearing house and equipments, disinfection and hygiene. Grainage acid treatment, packingand transportation of eggs, Incubation, black boxing, hatching of eggs. Silkworm rearing youngage /chawki rearing and old age rearing of silkworms. Feeding, spacing, environmental conditionsand sanitation. Cocoon characters colour, shape, hardiness and shell ratio. Defective cocoonsand stifling of cocoons. Uses of silk and by-products. Economics of silk production. Moriculture-Mulberry varieties, package of practices, Pests and diseases and their management.
Lac growingareas in India, Lac insects, biology, behaviour, lac cultivation, food plants, pruning, inoculation,cropping, kinds of lac. Enemies of lac-insects.

Practical

Honey bee colony, different bee hives and apiculture equipment. Summer and Wintermanagement of colony. Honey extraction and bottling. Study of pests and diseases of honeybees.
Establishment of mulberry garden. Preparation of mulberry cuttings, planting methods underirrigated and rainfed conditions. Maintenance of mulberry garden-pruning, fertilization, irrigationand leaf harvest. Mulberry pests and diseases and their management and nutritional disorders.Study of different kinds of silkworms and mulberry silkworm morphology, silk glands. Sericultureequipments for silkworm rearing. Mulberry silkworm rearing room requirements. Rearing ofsilkworms-chalky rearing. Rearing of silkworms late age silkworm rearing and study of mountages.Study of silkworm pests and their management. Study of silkworm diseases and its management.

Lac insects-biology, behaviour, lac cultivation, food plants, pruning, inoculation, cropping, kinds of lac. Enemies of lac insects.

Suggested Reading:

Singh, S., 1975. Bee keeping in India – ICAR, New Delhi., 214p.
Singh, D and Singh, D.P. 2006. A hand book of Beekeeping, Agrobios (India).
YA Shinde and BR Patel. Sericulture in India
Tribhuwan Singh. Principles and Techniques of Silkworm Seed Production, Discovery publishing House Pvt. Ltd
M.L. Narasaiah. Problems and Prospects of Sericulture. discovery publishing House Pvt. Ltd.
Ganga,G. and Sulochana Chetty, J. 1997. An introduction to Sericulture (2nd Edn.). Oxford & IBH publishing Co. Pvt. Ltd., New Delhi.

Krishnaswamy, S. (Ed). 1978. Sericulture Manual - Silkworm Rearing. FAO Agrl. Services bulletin, Rome.
Singh, S. 1975. Bee keeping in India. ICAR, New Delhi.

Glover, P.M. 1937. Lac cultivation in India. Indian Lac Research Institute, Ranchi.

K.P.Srivastava .A Text Book on Applied Entomology Vol. I&II. , Kalyani Publishers, Ludhiyana
B.r. David and V.V.Ramamurthy. Elements of Economic Entomology, 7th Edition. Namrutha Publications, Chennai

BHPP3208 Insect Pests of Vegetable, Ornamental and Spice Crops 3(2+1)

Theory

Economic importance of insects in vegetable, ornamental and spice crops -ecology and pestmanagement with reference to these crops. Pest surveillance in important vegetable, ornamentaland spice crops. Distribution, host range, bio-ecology, injury, integrated management ofimportant insect-pests affecting vegetable, ornamental and spice crops. Important storage insectpestsof vegetable, ornamental and spice crops, their host range, bio-ecology, injury and integratedmanagement. Insect –pests of processed vegetables and ornamental crops, their host range, bioecology,injury and integrated management. Insecticidal residue problems in vegetables andornamental crops, tolerance limits etc.

Practical

Study of symptoms, damage, collection, identification, preservation, assessment of damage/population of important insect-pests affecting vegetable, ornamental and spice crops in field and
during storage.

Suggested reading:

Reddy, P. P., 2010, Plant Protection in Horticulture Vol. 1, 2 & 3, Scientific Publishers, Jodhpur

Ranjit, P., 2012, Entomological Techniques in Horticultural Crops, New India Publishing

Agency.

Nair M R G K, 1995, Insect and Mites of Crops in India, ICAR, New Delhi.

Ayyar, T.V.R. 1963. Hand book of entomology for south India. Govt. press Madras, 516p.

P. Srivastava, Dhamo K. Butani Pest management in vegetables – Part1. Researcho Book Centre, 1998

K.P. Srivastava, Dhamo K. Butani Pest management in vegetables – Part-2. Researcho Book Centre, 1998

Dhalinal,.G.S.and Ramesh Arora Integrated Pest Management Concept and Approaches. Kalyani Publishers, Ludhiana.

VI. NATURAL RESOURCE MANAGEMENT

BHNR1101. Fundamentals of Soil Science 2(1+1)

Theory

Composition of earth's crust, soil as a natural body – major components. Eluviations andalleviations formation of various soils. Physical parameters; texture – definition, methods oftextural analysis, stock's law, assumption, limitations, textural classes, use of textural triangle;absolute specific gravity/particle density, definition, apparent specific gravity/bulk density – factorsinfluencing, field bulk density. Relation between BD (bulk density), AD – practical problems. Porespace – definition, factors affecting capillary and non-capillary porosity, soil colour – definition,its significance, colour variable, value hue and chroma. Munsellcolour chart, factors influencing,parent material, soil moisture, organic matter, soil structure, definition, classification, clay prismlike structure, factors influencing genesis of soil structure, soil consistency, plasticity, Atterberg'sconstants. Soil air, air capacity, composition, factors influencing, amount of air space, soil airrenewal, soil temperature, sources and distribution of heat, factors influencing, measurement,chemical properties, soil colloids, organic, humus, inorganic, secondary silicate, clay, hydrousoxides. Ion exchange, cation-anion importance, soil water, forms, hygroscopic, capillary andgravitational, soil moisture constants, hygroscopic coefficient, wilting point, field capacity,moisture equivalent, maximum water holding capacity, energy concepts, PF scale, measurement,gravimetric – electric and tensiometer methods – pressure plate and pressure membraneapparatus – Neutron probe – soil water movement – classification – aerial photography – satelliteof soil features – their interpretation; soil orders; land capability classification; soil of differenteco-systems and their properties, Rock & Minerals classification, Pedogenic process. Objectivesof soil science research institute in India (NBSS&LUP, ISSS, LTFE& NSSTL). Management ofSoil Crusting, Soil Compaction and Soil Compression. Soil Biology benefits and harmful effects.Methods and objective of soil survey, Remote sensing application in soil and plant Studies, Soildegradation.

Practical

Collection and preparation of soil samples, estimation of moisture, EC, pH and bulk density.Textural analysis of soil by Robinson's pipette method. Description of soil profile in the field.Quantification of minerals and their abundance. Determination of Soil colour using MunsellChart. Estimation of water holding capacity and hydraulic conductivity of soils. Estimationof Infiltration rate using double ring infiltrometer method. Estimation of soil moisture using gypsum block and neutron probe method. Soil compaction measurement with Pentrometer.

Determination of pore space of soil. Determination of filed capacity and permanent wilting point of soil. Determination of soil water potential characteristic curves by tensiometer and pressureplate apparatus. Aggregate size distribution analysis of soil. Air capacity of soil by field method.

Suggested Reading:

Brady Nyle C and Ray R Well, 2014. *Nature and properties of soils*. Pearson Education Inc., New Delhi.

Indian Society of Soil Science, 2002. *Fundamentals of Soil Science*. IARI, New Delhi.

Sehgal J. A., 2005. *Textbook of Pedology Concepts and Applications*. Kalyani Publishers, NewDelhi.

Dilip Kumar Das, 2015. Introductory Soil Science. Kalyani Publishers, Ludhiana.

Biswas, T.D. and Mukharjee, S.K., 2015. *Text Book of Soil science*. Tata Mc Graw Hill Publishing Co. Ltd., New Delhi.

Das, D .K.,2011. *Introductory Soil Science* (3rd Edition), Kalyani publisher, Ludhiana (India).

BHNR1202. Soil Fertility and Nutrient Management 2(1+1)

Theory

Introduction to soil fertility and productivity- factors affecting. Essential plant nutrient elements- functions, deficiency systems, transformations and availability. Acid, calcareous and salt affected soils – characteristics and management. Soil organic matter, Role of microorganismsin organic matter- decomposition – humus formation. Importance of C:N ratio and pH in plantnutrition, soil buffering capacity. Integrated plant nutrient management. Soil fertility evaluationmethods, critical limits of plant nutrient elements and hunger signs. NPK fertilizers: compositionand application methodology, luxury consumption, nutrient interactions, deficiency symptoms,visual diagnosis. Plant nutrient toxicity symptoms and remedies measures. Soil test crop responseand targeted yield concept. Biofertilizer. Nutrient use efficiency and management. Secondaryand micronutrient fertilizer. Fertilizer control order. Manures and fertilizers classification andmanufacturing process. Properties and fate of major and micronutrient in soils. Fertilizer useefficiency and management. Effect of potential toxic elements in soil productivity.

Practical

Analysis of soil for organic matter, available N,P,K and Micronutrients and interpretations.Gypsum requirement of saline and alkali soils. Lime requirement of acid soils. Estimation oforganic carbon content in soil. Determination of Boron and chlorine content in soil. Determinationof Calcium, Magnesium and Sulphur in soil. Sampling of organic manure and

fertilizer forchemical analysis. Physical properties of organic manure and fertilizers. Total nitrogen in ureaand farmyard manure. Estimation of ammonical nitrogen and nitrate nitrogen in ammonicalfertilizer. Estimation of water soluble P2O5, Ca and S in SSP, Lime and Gypsum. Estimation ofPotassium in MOP/SOP and Zinc in zinc sulphate. Visiting of fertilizer testing laboratory.

Suggested Reading:

Yawalkar K S, Agarwal JP and Bokde S, 1992. *Manures and Fertilizers.* Agri. Horticultural Publishing House, Nagpur.

Tandon HLS, 1994. *Fertilizers Guide.* Fertilizers Development Consultation Organization, New Delhi.

Ranjan Kumar Basak, 2000. *Fertilizers A Text book.* Kalyani publishers, New Delhi.

Havlin *et al.* 2014. *Soil Fertility and Fertilizers: An Introduction to Nutrient Management* (8th Edition), PHI Learning Pvt. Ltd., Delhi.

Das, D .K., 2011. Introductory Soil Science (3rd Edition), Kalyani Publisher, Ludhiana (India).
Indian Society of Soil Science, 2002. *Fundamentals of Soil Science*. Indian Society of Soil Science, IARI, New Delhi.

Jaiswal, P.C., 2006. *Soil, Plant and Water Analysis* (2nd Edition), Kalyani Publishers, Ludhiana.

BHNR 1203. Environmental Studies and Disaster Management 3(2+1)

Theory

Multidisciplinary nature of environmental studies Definition, scope and importance.

NaturalResources: Renewable and non-renewable resources. Natural resources and associated problems. a)Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining,dams and their effects on forest and tribal people. b) Water resources: Use and over-utilization ofsurface and ground water, floods, drought, conflicts over water, dams-benefits and problems. c)Mineral resources: Use and exploitation, environmental effects of extracting and using mineralresources, case studies. d) Food resources: World food problems, changes caused by agriculture andovergrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity,case studies. e) Energy resources: Growing energy needs, renewable and non-renewable energysources, use of alternate energy sources. Case studies. f) Land resources: Land as a resource, landdegradation, man induced landslides, soil erosion and desertification. Role of an individual inconservation of natural resources. Equitable use of resources for sustainable lifestyles. Ecosystems,Concept of an ecosystem. Structure and function of an ecosystem. Producers, consumers anddecomposers. Energy flow in the ecosystem. Ecological succession. Food chains, food webs andecological pyramids. Introduction, types, characteristic features, structure and function of thefollowing ecosystem:- a. Forest ecosystem, b. Grassland ecosystem, c. Desert ecosystem d. Aquaticecosystems (ponds, streams, lakes, rivers, oceans, estuaries).

Biodiversity and its conservation:-Introduction, definition, genetic, species & ecosystem diversity and biogeographical classificationof India. Value of biodiversity - consumptive use, productive use, social, ethical, aesthetic andoption values. Biodiversity at global, National and local levels, India as a mega-diversity nation.Hot-spots of biodiversity. Threats to biodiversity - habitat loss, poaching of wildlife, man-wildlifeconflicts. Endangered and endemic species of India. Conservation of biodiversity: In-situ and Exsituconservation of biodiversity.

Environmental Pollution: definition, cause, effects and controlmeasures of - Air, Water, Soil, Marine, Noise and Thermal pollution and Nuclear hazards. SolidWaste Management: causes, effects and control measures of urban and industrial wastes. Role ofan individual in prevention of pollution. Social Issues and the Environment: From Unsustainableto Sustainable development, Urban problems related to energy, Water conservation, rain waterharvesting, watershed management, Environmental ethics: Issues and possible solutions, climatechange, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust dies.
Wasteland reclamation, Consumerism and waste products, Environment Protection Act, Air, Water, Wildlife and Forest Conservation Acts, Issues involved in enforcement of environmental legislation and Public awareness. Human Population and the Environment: population growth, variation among nations, population explosion, Family Welfare Programme. Environment and human health: Human Rights, Value Education, HIV/AIDS. Women and Child Welfare. Role of Information Technology in Environment and human health. Field work: Visit to a local area to document environmental assets river/forest/grassland/hill/mountain, visit to a local polluted site-Urban/Rural/Industrial/Agricultural, study of common plants, insects, birds and study of simple ecosystems-pond, river, hill slopes, etc. Natural Disasters- Meaning and nature of natural disasters,their types and effects. Floods, drought, cyclone, earthquakes, landslides, avalanches, volcaniceruptions, Heat and cold waves, Climatic change: global warming, Sea level rise, ozone depletion.

Man Made Disasters- Nuclear disasters, chemical disasters, biological disasters, building fire,coal fire, forest fire, oil fire, air pollution, water pollution, deforestation, industrial waste waterpollution, road accidents, rail accidents, air accidents, sea accidents. Disaster Management-Effect to migrate natural disaster at national and global levels. International strategy for disasterreduction. Concept of disaster management, national disaster management framework; financialarrangements; role of NGOs, community –based organizations and media. Central, state, districtand local administration; Armed forces in disaster response; Disaster response; Police and otherorganizations.

Practical

Visit to local areas - river/forest/ grassland/catchment etc. to document components ofecosystem. Study of common plants, insects, birds and animals. Visit to industries to studypollution abatement techniques and case studies - solid waste management, Human populationand the Environment.

Suggested Reading:

A. Nandini, N. Suneetha and Sucharitha Tandon. *Environmental Studies*.

Aswathanarayana, U. 1999. *Soil resources and the environment*. Oxford and IBH publishing Co., New Delhi. P. 173-195.

D. D. Misra. *Fundamental Concepts in Environmental Studies*.

Diwan, P. and P. Diwan. 1998. *Environmental Management Law and Administration*. Variety Books International, New Delhi.

Krishnamurthy. *An Advanced Textbook on Biodiversity*.

S. Deshwal A. Deshwal. *A Basic Course in Environmental Science.*
Erach Bharucha 2005.Textbook of environmental studies for under graduate courses.UGC, University press, Hyderabad.
Manohara Chary and Jayaram Reddy 2004.Principles of Environmental studies BB publishers, Hyderabad.
William, P. Cunning Ham and Mary Ann. Inquiry and applications Cunningham 2005. Principles of Environmental science. Tata MCG raw-hill publishing company limited, New Delhi.
Gupta, P.K. 2004 Methods in environmental analysis-water, soil and Air. Agro Bios (India). Jodhpur.
Spencer R. Weart. The discovery of global warming.
Daniel B. Botkin, Edward A. Keller. Environmental Science.
Richard T. Wright and Bernard J. Nebel Environmental science: toward a sustainable agriculture.
Linfield C.Brown. Pollution prevention and control.

BHNR 2204. Soil, Water and Plant Analysis 2(1+1)

Theory

Methods of soil and plant sampling and processing for analysis. Characterization of hydraulicmobility – diffusion and mass flow. Renewal of gases in soil and their abundance. Methods ofestimation of oxygen diffusion rate and redox potential. Use of radio tracer techniques in soilfertility evaluation. Soil micro-organisms and their importance. Saline, alkali, acid, waterloggedand sandy soils, their appraisal and management. Chemical and mineral composition ofhorticultural crops. Leaf analysis standards, index tissue, interpretation of leaf analysis valuesQuality of irrigation water. Radio tracer technology application in plant nutrient studies. Rapidtissue tests for soil and plant. Management of poor quality irrigation water in crop management.Soil and Water pollution.

Practical

Introduction to analytical chemistry, Collection and preparation of soil, water and plantsamples for analysis. Determination of pH, electrical conductivity, sodium adsorption ratioand exchangeable sodium percentage of soils. Estimation of available macro and micronutrientelements in soils and their contents in plants. Irrigation water quality analysis. Determinationof pH and EC in irrigation water samples, Determination of Carbonates and bicarbonates insoil and irrigation water, Determination of Calcium and Magnesium in soil and

irrigation water.Determination of N, P, K, Ca, Mg, Sand micronutrients in plant samples. Determination ofSodium, Potassium, Chlorine and Boron in irrigation water.

Suggested Reading:

H.L.S. Tandon. 2013, *Methods of analysis of soil, plant, water and fertilizers*. FDCO, New Delhi.

Yawalkar,K.S.Agarwal,J.P.andBokde,S.,1977. *ManuresandFertilizers*. Agri-HorticulturalPublishingHouse,Nagpur.

Sehgal J. A., 2005. *Textbook of Pedology Concepts and Applications*. Kalyani Publishers, New Delhi.

C. S. Piper. 2014, *Soil and plant analysis*, Scientific publishers India.

M. V. Durai., 2014, *Hand book of Soil, plant, water, fertilizers and manure analysis*. New India Publishing Agency.

BHNR2205. Farm Power and Machinery 2(1+1)

Theory

Basic concepts of various forms of energy, unit and dimensions of force energy and power,calculations with realistic examples. IC Engines: Basic principles of operation of compression,ignition and spark ignition engines, two stroke and four stroke engines, cooling and lubricationsystem, power transmission system, broad understanding of performance and efficiency, tractors,

power tillers and their types and uses. Electric motors: types, construction and performancecomparison. Tillage: objectives, method of ploughing. Primary tillage implements: constructionand function of indigenous ploughs, improved indigenous ploughs, mould board ploughs, discand rotary ploughs. Secondary tillage implements: construction and function of tillers, harrows,levelers, ridgers and bund formers. Sowing and transplanting equipment: seed drills, potatoplanters, seedling transplanter. Grafting, pruning and training tools and equipment. Inter-cultureequipment: sweep. Junior hoe, weeders, long handle weeders. Crop harvesting equipments: potatodiggers, fruit pluckers, tapioca puller and hoists.

Practical

Calculation on force, power and energy. IC engines – showing the components of dismantledengines and motors. Primary and secondary tillage implements, hitching, adjustments andoperations. Spraying equipment, calibration and operation. Plant protection equipment,calculation of dilution ratio and operation.

Suggested Reading:

T. P. Ojha and A.M.Michael. 2005. *Principles of Agricultural Engineering* (Volume - 1), Jain Brothers

Surendra Singh & Verma. 2009. *Farm Machinery Maintenance & Management*. ICAR Publication.

Jagadishwar Sahay.1992. *Elementsof Agricultural Engineering*. AgroBookAgency,Patna.

Kepner RARoy Bainerand Barger BL.1978. *Principles of Farm Machinery*. CBS Publisherand Distributors, Delhi.

JainS C. 2003. *Farm Machinery-Anapproach.* Standard Publishers and Distributors, New Delhi

Nakra, C.P.1986. *Farm Machinery and Equipment*. Dhanpat Raiand Sons, New Delhi

BHNR1206. Water Management in Horticultural Crops 2(1+1)

Theory

Importance of water, water resources in India. Area of different crops under irrigation, functionof water for plant growth, effect of moisture stress on crop growth. Available and unavailable soilmoisture – distribution of soil moisture – water budgeting – rooting characteristics – moistureextraction pattern. Water requirement of horticultural crops – lysimeter studies – Plant waterpotential climatological approach – use of pan evaporimeter – factor for crop growth stages– critical stages of crop growth for irrigation. Irrigation scheduling – different approaches methods of irrigation – surface and sub-surface pressurized methods viz., sprinkler and dripirrigation, their suitability, merits and limitations, fertigation, economic use of irrigation water.Water management problem, soils quality of irrigation water, irrigation management practicesfor different soils and crops. Layout of different irrigation systems, drip, sprinkler. Layout ofunderground pipeline system.

Practical

Measurements of irrigation water by using water measuring devices, use of common formulain irrigation practices, practicing of land leveling and land shaping implements, layout fordifferent methods of irrigation. Estimation of soil moisture constants and soil moisture by usingdifferent, methods and instruments, scheduling of irrigation, different approaches, practicing useof instruments, estimation of irrigation efficiency and water requirements of horticultural crops,irrigation planning and scheduling, soil moisture conservation practices.

Suggested Reading:

Reddy, S. R. 2016. Irrigation Agronomy. Kalyani publishers

Rao, Y.P. and Bhaskar, S.R. 2008. *Irrigation Technology. Theory and practice*. Agrotech publishing Academy, Udaipur.

Dilip Kumar Mujmdar. 2004. *Irrigation Water Management: Principles and Practices*. Prentice Hall of India Pvt. Ltd.,

S.V. Patil & Rajakumar, G. R., 2016. *Water Management in Agriculture and Horticultural Crops*.Satish serial publishing House, Delhi.

BHNR3107 Organic Farming 3(2+1)

Theory

Introduction, concept, relevance in present context; Organic production requirements;Biological intensive nutrient management-organic manures, vermicomposting, green manuring,recycling of organic residues, biofertilizers; Soil improvement and amendments; Integrateddiseases and pest management – use of biocontrol agents, biopesticides pheromones, trap crops,bird perches; Weed management; Quality considerations, certification, labeling and accreditationprocessors, marketing, exports.

Practical

Raising of vegetable crops organically through nutrient, diseases and pest management;vermicomposting; vegetable and ornamental nursery raising; macro quality analysis, grading,packaging, postharvest management.

Suggested Reading:

Reddy, S. R. 2017. Principles of organic farming. Kalyani publishers.

A.K.Dahama. 2007. *Organic farming for sustainable agriculture*. Agrobios (India), Jodhpur.

Arun. K. Sharma. 2011. *Handbook of Organic farming*. Agrobios (India), Jodhpur.

S.P. Palaniappan and K.Annadurai. 2010. *Organic farming – Theory and Practice*. Scientific Publishers. Jodhpur.

Purshit, S.S. 2006. *Trendsin Organic Farmingin India*. Agros Bios (INDIA), Jodhpur.

BHNR 3108 Agro-meteorology and Climate Change 2(1+1)

Theory

Agricultural Meteorology- Introduction, definition of meteorology, scope and practical utility ofAgricultural meteorology. Composition and structure of atmosphere and definition of weather andclimate, aspects involved in weather and climate, atmospheric temperature, soil temperature, solarradiation, atmospheric pressure, atmospheric humidity, evaporation and transpiration, monsoons,rainfall, clouds, drought, weather disasters and their management atmospheric pollution and role of meteorology. Basics of weather forecasting. Climate change-causes. Global warming-causes andremote sensing. Effect of climate change on horticulture Past and future changes in greenhousegases within the atmosphere. Sources and sinks for greenhouse gases. Atmospheric chemistry.

Plants sense and respond to changes in CO2 concentration. Measurement of short-term effectsand mechanisms underlying the observed responses in C3 and C4 species. plant developmentaffected by growth in elevated CO2. Physiology of rising CO2 on nitrogen use and soil fertility,its implication for production. Methodology for studying effect of CO2. Change in secondarymetabolites and pest disease reaction of plants. The mechanisms of ozone and UV

damage andtolerance in plants. Increased temperature and plants in tropical/sub-tropical climates- effect ongrowing season, timing of flowering, duration of fruit development and impacts on crop yieldsand potential species ranges, interaction of temperature with other abiotic/biotic stress. Mitigationstrategies and prospects for genetic manipulation of crops to maximize production in the futureatmosphere. Modifying Rubisco, acclimation, metabolism of oxidizing radicals, and sink capacityas potential strategies.

Practical

Site selection for Agromet observatory; Measurement of temperature; Measurement ofrainfall; Measurement of evaporation (atmospheric/soil); Measurement of atmospheric pressure;Measurement of sunshine duration and solar radiation; Measurement of wind direction and speed
and relative humidity; Study of weather forecasting and synoptic charts. Visit to Meteorologicalobservatory, Visit to IMD meteorological observatory-Lay out plan of standard meteorologicalobservatory. Recording of air and soil temperature. Measurement of radiation and components,Measurement of rainfall-different types of raingauges, Measurement of wind speed and direction
and atmospheric humidity, Recording of evaporation. Synoptic charts and weather reports,symbols, *etc*.

Suggested Reading:

A. K. Srivastava and P. K. Tyagi, 2011. *Practical Agricultural Meteorology*. New Delhi PublishingAgency, New Delhi.

G. S. L. H. V. Prasad Rao, 2008. *Agricultural Meteorology*. Prentice Hall of India Pvt. Ltd., New Delhi.

H.V.Nanjappa and B.K.Ramachandrappa, 2007. *Manual on Practical Agricultural Meteorology*. Agrobios India. Jodhpur.

S.R.Reddy, 1999. *Principles of Agronomy*. Kalyani Publishers, New Delhi.
T.Yellamanda Reddy and G.H.Sankara Reddi, 2010. *Principles of Agronomy*. Kalyani Publishers,New Delhi.

Mavi,H.S.1985. *IntroductiontoAgrometeorology*. Oxford&IBHPublishingCo.,New Delhi.

BHNR 3109 Introductory Agro-forestry 2(1+1)

Theory

Agroforestry – definition, objectives and potential. Distinction between agroforestry andsocial forestry. Status of Indian forests and role in India farming systems. Agroforestry system, subsystemand practice: agri-silviculture, silvipastoral, horti-silviculture, horti-silvipastoral, shiftingcultivation, taungya, home gardens, alley cropping, intercropping, wind breaks, shelterbelts andenergy plantations. Planning for agroforestry – constraints, diagnosis and design methodology,selection of tree crop species for agro-forestry. Agroforestry projects – national, overseas, MPTS– their management practices, economics of cultivation – nursery and planting

(*Acacia catechu*,*Dalbergiasissoo*, Tectona, Populus, Morus, Grewia, Eucalyptus, Quercus spp. and bamboo,tamarind, neem etc.).

Practical

Identification and seeds and seedlings of multipurpose tree species. Nursery practicesfor poplar, Grewiaoptiva, Morus alba, Acacia catechu, *Dalbergiasissoo*, robinia, leucaenaetc. Visit to agro-forestry fields to study the compatibility of MPTS with agricultural crops:silvipastoral, alley cropping, horti-silviculture, agro-silvipasture, fuel and fodder blocks. Visit tosocial forestry plantations – railway line plantations, canal plantations, roadside plantations,industrial plantations and shelterbelts. Rapid assessment of farmers needs for green manure,fodder, fuel wood in selected villages. Economics and marketing of products raised in agroforestrysystems.

Suggested Readings:

A. K. Patra, 2013. *Agroforestry – Principles and Practices*. New India publishing agency.

A. P. Dwivedi, 1992. *Agroforestry – Principles and Practices*. Oxfird and IBH Publishing company.

Dadhwal et al., 2014. *Practical Manual on Agroforestry.* Jaya publishing house, Delhi.

L.K. Jha, 2015. *Advances in Agroforestry*. APH Publishing corporation, New Delhi.

Linford, Jenny, 2007. *A Concise Guide to Trees*. Parragon books service limited, Parragon.

Negi, S.S., 2007. *Agroforestry Hand book*. International book distributer, New Delhi.

P.S. Pathak and Ram Newaj, 2010. *Agroforestry – Potentials and Opportunities.* Agrobios, Jodhpur

Pankaj Panwar & Sunil Puri, 2007. *Agroforestry: Systems &Practices.* New India publishing agency, New Delhi.

Ramesh Umrani and C.K. Jain, 2010. *Agroforestry – Systems &Practices*. ABD Publishers, New Delhi.

Ramachandran Nair, P.K. 1993. *AnIntroductionto Agroforestry*. First reprint in India–2008. Springer International Edition

Tejawani, K.G. 1994. *Agro forestry in India*. Oxford & IBH, Publishing Co. Pvt. Ltd., New Delhi

Luna, R.K. 1989. *Plantation forestry in India*. International Book Distributors, Dehradun.

Leda Satish. 2006. *Biodiesel and Jatropha Plantations*. AGROBIOS, Jodhpur.

Chaturvedi, A.N. and Khanna, L.S. 1982. *Forest Menstruation*. Reprinted in 2006. International Book Distributors, Dehradun

Negi,S.S.2006. *Forest Tree Seed*. Prashant Gahlotat Valley printers and publishers, Dehradun.

Chundawat and S K Gautam.1996. *A text book of Agroforestry*. Oxford and IBH Publishingcompany Pvt. Ltd.

BHNR3110 Introduction to Major Field Crops 2(1+1)

Theory

Classification and distribution of field crops, definitions and concept of multiple cropping,mixed cropping, intercropping, relay and alley cropping, cultural practices for raising majorcereals, pulses, oil seeds and fodder crops, green manuring, crop rotation.

Practical

Identification of crop plants, seeds and weeds. Preparation of cropping scheme. Applicationof herbicides in field crops.

Suggested Reading:

B. Gurarajan, R.Balasubramanian and V.Swaminathan. Recent Strategies on Crop Production. Kalyani Publishers, New Delhi.

Chidda Singh.1997. Modern techniques of raising field crops. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.

Rajendra Prasad. Textbook of Field Crops Production - Commercial Crops. Volume II ICAR Publication.

Rajendra Prasad. Textbook of Field Crops Production - Foodgrain Crops. Volume I ICAR Publication.

S.R.Reddy. 2009. Agronomy of Field Crops. Kalyani Publishers, New Delhi.

S.S.Singh. 2005. Crop Management. Kalyani Publishers, New Delhi.

Rajendra Prasad 2002. Text Book of Field crops Production,ICAR, New Delhi.

Reddy, S.R. 2004. Agronomy of Field crops, Kalyani Publishers, Ludhiana.

VII. BASIC SCIENCES

BHBS 1101 Elementary Statistics and Computer Application 3(2+1)

Theory

Introduction to statistics, limitations of statistics. Basic concepts: Variable statistics, typesand sources of data, classification and tabulation of data, construction of frequency distribution,tables, graphic representation of data, simple, multiple component and percentage, bar diagram,pie diagram, histogram, frequency polygon and frequency curve average and measures oflocation, mean, mode, median, geometric mean, harmonic mean, percentiles and quadrilles, forraw and grouped data. Dispersion: Range, standard deviation, variance, coefficient of variationfor raw and grouped data. Probability: Basic concept, additive and multiplicative laws. Theoreticaldistributions, binominal, poison and normal distributions, sampling, basic concepts, sampling vs.complete enumeration parameter and statistic, sampling methods, simple random sampling andstratified random sampling. Tests of Significance: Basic concepts, tests for equality of means, andindependent and paired t-tests, chi-square test for application of attributes and test for goodnessof fit of Mendalian ratios. Correlation: Scatter diagram, correlation co-efficient and its properties,regression, fitting of simple linear regression, test of significance of correlation and regressioncoefficient. Experimental designs: Basic concepts, completely randomized design, randomizedblock design, latin square designs, factorial experiments, basic concepts, analysis of factorialexperiments up to 3 factors – split plot design, strip plot design, long term experiments, plotsize, guard rows. Computer application: Introduction to computers

and personal computers, basicconcepts, operating system, DOS and Windows, MS Word-Features of word processing, creatingdocument and tables and printing of document, MS Excel-Concept of electronic spreadsheet,creating, editing and saving of spreadsheet, inbuilt statistical functions and formula bar, MSPower point-preparation, presentation of slides and slide show. Introduction to programminglanguages, BASIC language, concepts, basic and programming techniques, MS Office, Win Word,Excel, Power point, introduction to multi-media and its application. Visual basic-concepts, basicand programming techniques, introduction to internet.

Practical

Construction of frequency distribution table and its graphical representation, histogram,frequency polygon, frequency curve, bar chart, simple, multiple, component and percentage barcharts, pie chart, mean, mode for row and grouped data, percentiles, quadrille, and median forrow and grouped data, coefficient of variation, 't' test for independent, will equal and unequalvariants, paired 't' test, chi-square test for contingency tables and theoretical ratios, correlation andlinear regression. Studies on computer components – Basic language, visual basic, programmingtechniques, MS Office, Excel, power point.

Suggested Reading:

Gupta, S. C. and Kapoor, V. K. 2014. Fundamentals of Mathematical Statistics. Sultan chand and sons. New Delhi

Nageswara Rao, G. 2007.*Statistics for Agricultural Sciences*. B.S. Publications,Hyderabad.
Rangaswamy, R.1995. *A T ext Book of Agricultural Statistics*. New Age International Publishing Limited, Hyderabad.

Gupta, V.,2002. *ComdexComputerKit*. DreamTechPress,NewDelhi.

Parmar, A. Mathur, N. DeeptiP .U. and Prasanna, V. B.,2000.*WorkingwithWINDOWS A HandsonTutorials*. Tata Mc Graw Hill Publishing Co., New Delhi.

Bandari, V. B., 2012. *Fundamentals of Information Technology*. Pearson Education, New Delhi.

Fundamentals of Computers. 2011. Pearson Education-ITL ESL, New Delhi,

BHBS1102 Elementary Plant Biochemistry 2(1+1)

Theory

Carbohydrates: Occurrence, classification and structure, physical and chemical propertiesof carbohydrates, isomerism, optical activity, reducing property, reaction with acids and alkalis,ozone formation. Lipids: Classification, important fatty acids and triglycerides, essential fattyacids. Physical and chemical control of oils, their rancidity, phospholipids, types and importance.

Plant pigments – structure and function of chlorophyll and carotenoids, sterols, basic structure,role of brassino sterols in plants. Proteins: Classification, function and solubility, amino acids –classification and structure, essential amino acids, properties of amino acids, colour

reactions,amphoteric nature and isomerism; structure of proteins –primary, secondary tertiary andquaternary properties and reaction of proteins. Enzymes: Classification and mechanism of action;
factors affecting enzyme action, co-factors and coenzymes. Vitamins and minerals as co-enzymes/co-factors. Carbohydrate metabolism – glycolysis and TCA-cycle; metabolism of lipids, fatty acidoxidation, biosynthesis of fatty acids, electron transport chain, bioenergetics of glucose and fattyacids, structure and function of nucleic acid replication, transcription and translation.

Practical
Preparation of standard solutions and reagents; Carbohydrates: Qualitative reactions;Estimation of starch; Estimation of reducing and non reducing sugars from fruits; Amino acids:Reactions of amino acids; Proteins: Estimation of proteins by Lowry's method; Fatty acids:Estimation of free fatty acids; Determination of iodine number of vegetable oils; Vitamins:Estimation of Ascorbic acid; Techniques: Paper chromatography, Thin layer chromatography;Electrophoresis of pigments extracted from flowers, Extraction of oil from oil seeds; Enzymes:Enzyme assay, Enzyme Immobilization.

Suggested Reading:
Lehninger, Nelson, D. L. and Michael, M. C. 2004. *Principles of Biochemistry.* FreemanPublishers

Bose. Developments in Physiology Biochemistry & Molecular Biology of Plants Vol.-1. New India Publications.

Voet, D and Voet J. G. 2004. Biochemistry 4th Edn. Wiley & sons Publishers. USA.

Sadashiv, S and Manickam, A. 1996. Biochemical methods for Agricultural sciences. New age Interantional publishers, New Delhi.

Rameshwar, A. 2006. (3rd edit). Practical Biochemistry. Kalyani Publishers, NewDelhi.

BHBS 2103 Elementary Plant Biotechnology 2(1+1)

Theory
Concepts of Plant Biotechnology: History of Plant Tissue Culture and Plant GeneticEngineering; Scope and importance in Crop Improvement: Totipotency and Morphogenesis,Nutritional requirements of in-vitro cultures; Techniques of In-vitro cultures, Micropropagation,Anther culture, Pollen culture, Ovule culture, Embryo culture, Test tube fertilization, Endosperm
culture, Factors affecting above in-vitro culture; Applications and Achievements; Somaclonalvariation, Types, Reasons: Somatic embryogenesis and synthetic seed production technology;Protoplast isolation, Culture, Manipulation and Fusion; Products of somatic hybrids and cybrids,
Applications in crop improvement. Genetic engineering; Restriction enzymes; Vectors for genetransfer – Gene cloning – Direct and indirect method of gene transfer – Transgenic plants andtheir applications. Blotting techniques – DNA finger printing – DNA based markers – RFLP,

AFLP,RAPD, SSR and DNA Probes – Mapping QTL – Future prospects. MAS, and its application in cropimprovement. Nanotechnology: Definition and scope, types of nano material and their synthesis,green synthesis. Tools and techniques to characterize the nano particles. Nano-biotechnologicalapplications with examples, Nano toxicology and safety.

Practical

Requirements for Plant Tissue Culture Laboratory; Techniques in Plant Tissue Culture; Mediacomponents and preparations; Sterilization techniques and Inoculation of various explants; Asepticmanipulation of various explants; Callus induction and Plant Regeneration; Micro propagationof important crops; Anther, Embryo and Endosperm culture; Hardening / Acclimatization ofregenerated plants; Somatic embryogenesis and synthetic seed production; Isolation of protoplast;Demonstration of Culturing of protoplast; Demonstration of Isolation of DNA; Demonstration ofGene transfer techniques, direct methods; Demonstration of Gene transfer techniques, indirectmethods; Demonstration of Confirmation of Genetic transformation; Demonstration of gelelectrophoricsistechniques. Green synthesis of nano particles and their size characterization.

Suggested Reading:

Singh, B D, 2004. *Biotechnology Expanding Horizons* 2nd Edn. Kalyani Publishers, New Delhi.

Gupta, P.K., 2015. *Elements of Biotechnology* 2nd Edn. Rastogi and Co., Meerut.

Razdan M K, 2014. *Introduction to plant Tissue Culture* 2nd Edn. Science Publishers, inc. USA.

Thomar, R.S., Parakhia, M.V., Patel, S.V. and Golakia, B.A., 2010. *Molecular markers and PlantBiotechnology*, New Publishers, New Delhi.

Purohit, S.S., 2004. *A Laboratory Manual of Plant Biotechnology* 2nd Edn. Agribios, India.

Chawla H S. 2016. Introduction to Plant biotechnology, Science Publishers

BHBS 1104 Introductory Crop Physiology 2(1+1)

Theory

Water Relations in Plants: Role of water in plant metabolism, osmosis inhibition, diffusion,water potential and its components, measurement of water potential in plants, absorption ofwater, mechanism of absorption and ascent of sap. Stomata: Structure, distribution, classification,mechanism of opening and closing of stomata. Osmotic pressure, guttation, stem bleeding;transpiration methods and mechanism and factors affecting transpiration. Drought: Differenttypes of stresses; water, heat and cold tolerance; mechanism of tolerance. Plant Nutrition:Essentiality, mechanism of absorption and its role in plant metabolism. Biological NitrogenFixation Photosynthesis, structure and function of chloroplast, dark and light reactions, cyclic andnon-cyclic electron transfer, CO2 fixation – C3, C4 and CA metabolism, advantages of C4 pathway.Photorespiration and its implications, factors affecting photosynthesis. Mode of herbicide action,Secondary metabolites and plant defense.

Practical

Measurement of water potential, osmosis, root pressure, structure of the stomata, distribution,opening and closing of the stomata, measurement, transpiration and calculation of transpirational
pull demonstration. Importance of light and chlorophyll in photosynthesis, pigment identification in horticultural crops, measurement of relative water content (RWC), studying plant movements.

Suggested Reading:

Srivastava G.C. Crop Physiology

Pandey S.N. and Sinha B.K. Plant Physiology

Taiz and Zeiger. Plant Physiology

Salisbulry and Ross. Plant Physiology

Delvin, R.M . 1986. Plant Physiology. CBS. Delhi.

Richard, N. Arteca. 2004. Plant Growth Substances. CBS. New Delhi.

Basra, A. S. 2004. Plant Growth Regulators in Agriculture & Horticulture. HAWARTH press.New York.

BHBS 1205 Growth and Development of Horticultural Crops 2(1+1)

Theory

Growth and development-definitions, components, photosynthetic productivity, Canopyphotosynthesis and productivity, leaf area index (LAI) - optimum LAI in horticultural crops,canopy development; different stages of growth, growth curves, Crop development and dynamics(Case studies of annual/perennial horticultural crops), growth analysis in horticultural crops.Plant bio-regulators- auxin, gibberellin, cytokinin, ethylene inhibitors and retardants, basic functions, biosynthesis, role in crop growth and development, propagation, flowering, fruitsetting, fruit thinning, fruit development, fruit drop, and fruit ripening. Flowering-factorsaffecting flowering, physiology of flowering, photoperiodism-long day, short day and day neutralplants, vernalisation and its application in horticulture, pruning and training physiological basisof training and pruning-source and sink relationship, translocation of assimilates. Physiologyof seed development and maturation, seed dormancy and bud dormancy, causes and breakingmethods in horticultural crops. Physiology of fruit growth and development, fruit setting, factorsaffecting fruit set and development, physiology of ripening of fruits-climatic and non-climactericfruits. Physiology of fruits under post-harvest storage.

Practical

Estimation of photosynthetic potential of horticultural crops, leaf area index, growth analysisparameters including harvest index, bioassay of plant hormones, identification of synthetic planthormones and growth retardants, preparations of hormonal solution and induction

of rooting incuttings, ripening of fruits and control of flower and fruit drop. Important physiological disorders
and their remedial measures in fruits and vegetables, seed dormancy, seed germination andbreaking seed dormancy with chemicals and growth regulators.

Suggested Reading:

Salisbulry. 2007. *Plant Physiology.* CBS. New Delhi.

Delvin, R.M . 1986. Plant Physiology. CBS. Delhi.
Richard, N. Arteca. 2004. Plant Growth Substances. CBS. New Delhi.

Jacobs, W. P. 1979. Plant Hormones And Plant Development. Cambridge Univ. London.
Basra, A. S. 2004. Plant Growth Regulators In Agriculture & Horticulture. HAWARTH press. New York.

Lincoln Taiz and Eduards Zeiger (5th Edition). Plant physiology. Sinauer Associates, Inc.
Noggle G.R and Fritz T.G.1944. Introductory Plant Physiology.

Pandey and Sinha 2016. Plant Physiology.

BHBS 1106 Introductory Microbiology 2(1+1)

Theory

History and Scope of Microbiology: The discovery of micro-organism, spontaneousgeneration conflict, germ theory of diseases, microbial effect on organic and inorganic matter.Development of microbiology in India and composition of microbial world. Microscopy andSpecimen Preparation: The bright field microscope, fixation, dyes and simple staining, differentialstaining. Difference between prokaryotic and eukaryotic cells. Prokaryotic cell structure andfunctions. Types of culture media and pre-culture techniques. Microbial growth in models ofbacterial, yeast and mycelia growth curve. Measurement of bacterial growth. General propertiesof viruses and brief description of bacteriophages. DNA as genetic material. Antibiosis, symbiosis,intra-microbial and extra-microbial association. Sterilization methods – Physical and chemical,
Isolation of pure cultures and preservation of cultures, Plant growth promoting microorganisms and mushrooms – Economical importance, Industrially important microorganisms in large scale production and common microbial fermentations. Mushrooms- edible and poisonous types, nutritive values, Culturing and production techniques.

Practical

Examination of natural infusion and living bacteria; examination of stained cells by simple staining and Gram staining. Methods for sterilization and nutrient agar preparation. Broth culture, agar slopes, streak plates and pour plats, turbid metric estimation of microbial growth, mushroom culture- Spawn production, Culture and production techniques, harvesting, packing and storage.

Suggested Reading:

M J Pelczer, 1998. *Microbiology* 5th Edn. Tata Mc. Grow Hill Education Pvt. Ltd.

Stainer, R, 1987. *General Microbiology*. Palgrave Macmillan.

R P Singh, 2007. *General Microbiology*. Kalyani Publishers.

Pelczar, jr. M.J.E.C.S.Chan and Krieg, N.R. 1996. *Microbiology*. Mc Graw Hill Publishers, Newyork.

Prescott, L.M. Harley, J.P. and Klein, D.A (5ed) 2002. *Microbiology*. Mc Graw Hill Publishers, Newyork.

Madigan, M. Martinkoj, M. and Parker (10 ed.) 2003. *Biology of Microorganisms*. Prentice Hall of India Pvt. Ltd., New Delhi.

Jamaluddin, M. Malvidya, N. and Sharma, A. 2006. *General Microbiology*. Scientific Publishers, Washington.

VIII. Social SCIENCES

BHSS1101 Economics and Marketing 3(2+1)

Theory

Nature and scope of economics, definition and concepts, divisions of economics, economicsystems, approaches to the study of economics. Consumption – theory of consumer behaviour,laws of consumption, classification of goods. Wants – their characteristics and classification,utility and its measurement, cardinal and ordinal, law of diminishing marginal utility, law ofequi-marginal utility, indifference curve and its properties, consumer equilibrium. Theory ofdemand, demand schedule and curve, market demand. Price, income and cross elasticities,Engil's law of family expenditure – consumer's surplus. Theory of firm, factors of production –

land and its characteristics, labour and division of labour, theories of population. Capital and itscharacteristics – classification and capital formation. Enterprises – forms of business organization– merits and demerits. Laws or return – law of diminishing marginal return – cost concepts. Lawof supply – supply schedule and curve elasticities. Market equilibrium, distribution – theoriesof rent, wage, interest and profit. Price determination and forecasting under various marketstructures. Marketing- definition – Marketing Process – Need for marketing – Role of marketing— Marketing functions – Classification of markets – Marketing of various channels – Pricespread – Marketing Efficiency – Integration – Constraints in marketing of agricultural produce.Market intelligence – Basic guidelines for preparation of project reports- Bank norms – Insurance– SWOT analysis – Crisis management.

Practical

Techno-economic parameters for preparation of projects. Preparation of Bankable projects for various agricultural products and its value added products. Identification of marketing channel– Calculation of Price Spread – Identification of Market Structure – Visit to different Markets.

Suggested Reading

H L Ahuja. S. Chand and Company Limited. *Advanced Economic Theory*. Micro Economic Analysis.
Dewett, K.K. The Economic Theory

Dewett, K.K. and Chand, A.1979. *Modern Economic Theory*. S.Chand and Co., New Delhi

Dewett, K.K. and Varma, J.D. 1986. Elementary Economics. S.Chand and Co., New Delhi.

Gupta RD & Lekhi RK. 1982. Elementary Economic Theory. Kalyani Publishers.

Jhingan, M.L. 2012. Macro Economic Theory. Vrinda publishers, New Delhi.

SS Acharya and N L Agarwal. 2005. Agricultural Marketing in India. Oxford and IBH Publishing Co. Pvt. Ltd

Subba Reddy, S., Raghu ram, P., Neelakanta Sastry T.V., Bhavani Devi. I., 2010, *Agricultural Economics*, Oxford & IBH Publishing Co. Private Limited, New Delhi

BHSS 3202 Horti-Business Management 2(2+0)

Theory

Farm management - definition, nature, characteristics and scope. Farm managementprinciples and decision making, production function, technical relationships, cost concepts,curves and functions – factors, product, relationship – factors relationship, product relationship,optimum conditions, principles of opportunity cost-equi-marginal returns and comparativeadvantages, time value of money, economic of scale, returns to scale, cost of cultivation andproduction, break even analysis, decision making under risk and uncertainty. Farming systemsand types. Planning – meaning, steps and methods of planning, types of plan, characteristicsof effective plans. Organizations – forms of business organizations, organizational principles,division of labour. Unity of command, scalar pattern, job design, span of control responsibility,power authority and accountability. Direction – guiding, leading, motivating, supervising,coordination – meaning, types and methods of controlling – evaluation, control systems anddevices. Budgeting as a tool for planning and control. Record keeping as a tool of control.Functional areas of management – operations management – physical facilities, implementingthe plan, scheduling the work, controlling production in terms of quantity and quality. Materialsmanagement – types of inventories, inventory costs, managing the inventories, economic orderquantity (EOQ). Personnel management – recruitment, selection and training, job specialization.Marketing management – definitions, planning the marketing programmes, marketing mix andfour P's. Financial management – financial statements and rations, capital budgeting. Projectmanagement – project preparation evaluation measures.

Suggested Reading

S.S. Johl, J.R. Kapur. 2006, *Fundamentals of Farm Business Management*. Kalyani Publishers, New Delhi
Karan Singh and Kahlon A S. *Economics of Farm Management in India*. Theory and Practice. New Delhi. Allied

L.M. Prasad. 2001. *Principles and Practices of Management*, 9th Ed. S. Chand & Sons, New Delhi.

Koontz Harold. *Principles of Managemen*t. Tata McGraw-Hill Education Private Limited, New Delhi.

K.K. Dewett and M.H. Navalur. *Modern Economic Theory*. S. Chand & Sons, New Delhi.

P. Subba Rao. *Human Resource Management*. Himalaya Publications.

Benjamin Mc Donald P 1985. *Investment Projects in Agriculture- Principles and Case studies*. Longman Group Limited. Essex. UK

Pandey U K 1990. *An Introduction to Agricultural Finance* .Kalyani Publishers New Delhi.

BHSS3203 Fundamentals of Extension Education 2(1+1)

Theory

Extension education: meaning, definition, nature, scope, objectives, principles, approachesand history. Horticulture extension: process, principles and selected programmes of leadingnational and international forest institutes. People's participation in Horticulture programmes.Motivation of Farmers, rural youth and voluntary organizations for Horticulture extensionwork Rural Development: meaning, definition, objectives and genesis. Transfer of technologyprogrammes like lab to land programme (LLP) national demonstration (ND), front linedemonstration (FLD) Krishi Vigyan Kendras (KVK), Technology Assessment and RefinementProgramme (TARP) etc. of ICAR. Communication: meaning, definition, elements and selectedmodels. Audio – visual aids: importance, classification and selection. Adoption and diffusionprocess, Teaching and learning-concepts and principles, Teaching steps, Programming planningprocess – meaning, scope, principles and steps. Evaluation: meaning, importance and methods.Scope and importance of Participatory Rural Appraisal (PRA) & Rapid Rural Appraisal (RRA).Management and administration: meaning, definition, principles and functions. Concepts ofhuman resource development (HRD), rural leadership. ICT in Extension education, ICT use inrural India.

Practical

Visits to study structure, functions, linkages and extension programmes of ICFRE institutes/voluntary organizations/Mahila Mandal, Village Panchayat, State Dept. of Horticulture /All IndiaRadio (AIR). Exercises on distortion of message, script writing for farm broadcasts and telecasts,planning, preparation & use of NPVA like poster, chart, flash cards, folders etc. and AVA likeOHP & 35 mm slide projector transparencies. Identification of local leaders to study their rolein extension work. Evaluation of some selected case studies of forestry extension programmes.Preparation of Village Agricultural productions plan.

Suggested Reading:

Adivi Reddy, A., 2001, *Extension Education*, Sree Lakshmi press, Bapatla.

Dahama, O. P. and Bhatnagar, O.P., 1998, *Education and Communication for Development*,

Oxford and IBH publishing Co. Pvt. Ltd., New Delhi.

Muthaiah Manoraharan, P. and Arunachalam, R., *Agricultural Extension*, Himalaya Publishing House (Mumbai).

Sagar Mondal and Ray, G. L., *Text Book On Rural Development, Entrepreneurship And Communication Skills*, Kalyani Publications.

Rathore, O. S. *et al.*, 2012, *Handbook of Extension Education*, Agrotech Publishing Academy, Udaipur.

Ray, G. L., 1991 (1st Edition), *Extension Communication and Management*, Kalyani Publishers, Ludhiana {7th revised edition - 2010}.

Supe, S. V., 2013 (2nd Edition), *A Text Book of Extension Education*, Agrotech Publishing Academy, Udaipur.

Van Den Ban, A. W. and Hawkins, H. S., *Agricultural Extension*, S. K .Jain for CBS Publishers & Distributors, New Delhi.

M. Hilaris. Indian Agriculture and Information: Soundari, New century Publications, 2011and Communication technology (ICT)

BHSS 3204 Entrepreneurship Development and Business Management 2(1+1)

Theory

Entrepreneurship Development: Assessing overall business environment in the Indianeconomy. Overview of Indian social, political and economic systems and their implicationsfor decision making by individual entrepreneurs. Globalization and the emerging business /entrepreneurial environment. Concept of entrepreneurship; entrepreneurial and managerialcharacteristics; managing an enterprise; motivation and entrepreneurship development;importance of planning, monitoring, evaluation and follow up; managing competition;entrepreneurship development programs; SWOT analysis, Generation, incubation andcommercialization of ideas and innovations. Government schemes and incentives for promotionof entrepreneurship. Government policy on Small and Medium Enterprises (SMEs) / SSIs. Exportand Import Policies relevant to horticulture sector. Venture capital. Contract farming and jointventures, public-private partnerships. Supply chain management and total quality management.Overview of horti inputs industry. Characteristics of Indian horticultural processing and exportindustry. Social Responsibility of Business. Communication Skills: meaning and process ofcommunication, verbal and non-verbal communication; listening and note taking, writing skills,oral presentation skills developing organizational and managerial skills, problem solving skills.field diary and lab record; indexing, footnote and bibliographic procedures.

Practical

Listening and note taking, writing skills, oral presentation skills; field diary and lab record;indexing, footnote and bibliographic procedures. Reading and comprehension of general

andtechnical articles, precis writing, summarizing, abstracting; Conducting market survey to thedemand for product, preparing advertisements for popularization of product, news writing,preparing project proposals, individual, group presentation, features of oral presentation,presentation, evaluation of presentation and evaluation of sheet, dyadic communication-faceto face conversation, telephone conversation, rate of speech and clarity of voice, speaking andlistening politeness, telephone etiquettes, organising general and group meeting, salient featuresof participation in seminars and conferences, conducting and participating in mock interviews.

Suggested Reading:

Benjamin MC Donald P. 1985, *Investment Projects in Agriculture- Principles and Case studies*. Longman Group Limited. Essex. UK.

Chole, R. R. *et al*., 2012, *Entrepreneurship Development and Communication skills*, Scientific publishers, Jodhpur.

Gittiner, J P., 1982, *Economic Analysis of Agricultural Projects*, The John Hopkins University Press Baltimore, USA.

Hopkins J A and Baker C B Danville, *Financial Management in Agriculture*, 6th ed Barry P J, IL Interstate Publishers.

Kotler Philip and Armstrong, *Principles of Marketing*. Prentice-Hall.

Pandey U. K., *An Introduction to Agricultural Finance.*

Sagar Mondal and G. L. Ray, *Text Book on Rural Development, Entrepreneurship and Communication Skills*, Kalyani Publications.

Dr.A.K.Singh,2009.Entrepreneurship Development and Management. Lakshmi Publications Ltd.,

BHSS1105 Communication Skills and Personality Development 2(1+1)

Theory

Structural Grammar: Introduction of Word Classes; Structure of Verb in English; Uses ofTenses; Study of Voice; Study of Conjunctions and Prepositions; Sentence Patterns in English.Spoken English: Conversations of different situations in everyday life; the concept of stress; stressshift in words and sentences; silent letters in words and pronunciation of words with silent letters,the basic intonation patterns. Reading and comprehension of general and technical articles, précis writing, summarizing, abstracting; individual and group presentations, impromptu presentation,public speaking; Group discussion. Organizing seminars and conferences.

Practical

Structural Grammar: Exercises in word classes, identification and study of verbs in sentences,application of tenses and voice, exercises in conjunctions and prepositions, other

structuralgrammar exercises, report writing, letter writing (different types of letters). Spoken English:Conversations of everyday life, the concept of stress; stress shift. Silent letters in words, basicintonation patterns, preparing and address.

Suggested Reading:

Balasubramanian T. 1989. *A Text book of Phonetics for Indian Students*. Orient Longman, New Delhi.

Balasubrmanyam M. 1985. *Business Communication*. Vani Educational Books, New Delhi.

Naterop, Jean, B. and Rod Revell. 1997. *Telephoning in English*. Cambridge University Press, Cambridge.

Mohan Krishna and Meera Banerjee. 1990. *Developing Communication Skills*. Macmillan India Ltd. New Delhi.

Narayanaswamy V R. 1979. *Strengthen your writing*. Orient Longman, New Delhi.

Sharma R C and Krishna Mohan. 1978. *Business Correspondence*. Tata Mc Graw Hill publishingCompany, New Delhi.

Carnegie, Dale. 2012. *How to Win Friends and Influence People in the Digital Age*. Simon & Schuster.

Covey Stephen R. 1989. *The Seven Habits of Highly Successful People*. Free Press.

Spitzberg B, Barge K & Morreale, Sherwyn P. 2006. *Human Communication: Motivation, Knowledge & Skills*. Wadsworth.

Verma, KC. 2013. *The Art of Communication.* Kalpaz.

BHSS 1206 Information and Communication Technology 2(1+1)

Theory

IT and its importance. IT tools, IT-enabled services and their impact on society; computerfundamentals; hardware and software; input and output devices; word and character representation;features of machine language, assembly language, high-level language and their advantages anddisadvantages; principles of programming- algorithms and flowcharts; Operating systems (OS)- definition, basic concepts, introduction to WINDOWS and LINUX Operating Systems; Localarea network (LAN), Wide area network(WAN), Internet and World Wide Web, HTML and IP;Introduction to MS Office - Word, Excel, Power Point. Audio visual aids - definition, advantages,classification and choice of A.V aids; cone of experience and criteria for selection and evaluationof AV aids; video conferencing. Communication process, Berlo' s model, feedback and barriers tocommunication.

Practical

Exercises on binary number system, algorithm and flow chart; MS Word; MS Excel; MS PowerPoint; Internet applications: Web Browsing, Creation and operation of Email account; Analysisof fisheries data using MS Excel. Handling of audio visual equipments. Planning, preparation,presentation of posters, charts, overhead transparencies and slides. Organization of an audiovisual programme.

Suggested Readings

Gurvinder Singh, Rachhpal Singh & Saluja KK. 2003. *Fundamentals of Computer Programming and Information Technology.* Kalyani Publishers.

Harshawardhan P. Bal. 2003. *Perl Programming for Bioinformatics*. Tata McGraw-Hill Education.

Kumar A 2015. *Computer Basics with Office Automation*. IK International Publishing House Pvt Ltd.

Rajaraman V & Adabala N. 2015. *Fundamentals of Computers*. PHI.

Sarvanan. 2015. *ICT in Agriculture*. Agriobios

BHSS 1207 Physical and Health Education (NC) 1(0+1)

Practical

Physical Education: Introduction to physical education. Posture, exercise for good posture,physical fitness exercises for agility, strength, coordination, endurance and speed. Rules areregulations of important games, skill development in any one of the games – football, hockey,cricket, volleyball, ball badminton, throw ball, tennikoit. Participation in one of the indoor games
– shuttle badminton, chess and table tennis. Rules and regulations of athletic events, participation in any one of the athletic events – broad jump, high jump, triple jump, javelin throw, discussthrow, shot put, short and long distance running, Safety education, movement education, effectiveway of doing day-today activities. First-aid training, coaching for major games and indoor games.

Asans and indigenous ways for physical fitness and curative exercises. Exercises and games for leisure time, use and experience. Importance of Asanas and Surya namaskar. Free hand exercises and Yoga. Recreation: definition, agencies promoting recreation, camping and recreation. Note: Warming up and conditioning exercises are compulsory before the commencement of each class.

Suggested Reading:

O.P. Aneja. Encyclopaedia of Physical education, sports and exercise science (4 volumes).

Anil Sharma. Encyclopaedia of Health and Physical Education (7 Volumes).

N V Chaudhery, R Jain. Encyclopedia of Yoga Health and Physical Education (7 Volumes).

Pintu Modak, O P Sharma, Deepak Jain. Encyclopaedia of Sports and Games with latest rules and regulations (8 volumes).

Edwin F Bryant. Yoga sutrap of Patanjali.

BHSS 1108 National Service Scheme/National Cadet Corps (NC) 1(0+1)

Practical

NSS: Orientation of students in national problems, study of philosophy of NSS, fundamentalsrights, directive principles of state policy, socio-economic structure of Indian society, population
problems, brief of five year plan. Functional literacy, non-formal education of rural youth,eradication of social evils, awareness programmes, consumer awareness, highlights of consumer
act. Environment enrichment and conservation, health, family welfare and nutrition.

NCC:Introduction to NCC, defense services, system of NCCtraining, foot drill, sizing, forming up inthree ranks, open and close order march, dressing, getting on parade, dismissing and falling out,saluting, marching, arms drill, shoulder arm, order arm, present arm, guard of honour, ceremonialdrill, weapon training – rifle bayonet, light machine gun, sten machine carbine, introduction andcharacteristic stripping, assembling and cleaning, loading, unloading and firing. Field craft, visualtraining, targets, judging distance, fire discipline and fire control orders, battle craft, field signals,description of ground, section formation, section battle drill, scouts and patrols, ambush, fieldengineering, map reading, conventional signs, grid systems, use of service protractor, prismaticcompass and its use, self-defense, general principles, precautions and training, attacks and counterattacks, marching and searching, first aid, hygiene and sanitation, civil defense, leadership andNCC song**.**

IX. STUDENT READY-PROGRAMME (ELP+RHWE) 40(0+40)

Practical

Students will practically gain hands on expertise for a semester in any two options out ofcommercial horticulture, protective cultivation of high value horticulture crops, processing offruits and vegetables for value addition, floriculture and landscape gardening, production ofbioinputs-biofertilizers and biopesticides, mass multiplication of plants and bio-molecules throughtissue culture, mushroom culture and bee keeping. In one semester students will be workingwith horticulture farmers/horticulture based industries in collaboration with developmentaldepartments, extension functionaries, input suppliers, marketing and procurement functionaries,processing industries.

1) EXPERIENTIAL LEARNING PROGRAMME (ELP) 20(0+20)

1. Module-I. Commercial Horticulture: Nursery production of fruit crops: Raising ofrootstocks, grafting and budding of rootstocks, management of grafted plants,

plantcertification, packaging and marketing, quality control. Nursery production of ornamentals:Production of plantlets, production of potted plants, management and maintenance, sale andmarketing. Protected cultivation of vegetables and flowers: Nursery raising/procurementand transplanting, management and maintenance of the crop, postharvest handling, qualitycontrol and marketing.

2. Module-II. Protective cultivation of high value horticulture crops: Visit to commercialpolyhouses, Project preparation and planning. Specialised lectures by commercial exporthouse. Study of designs of green- house structures for cultivation of crops. Land preparationand soil treatment. Planting and production: Visit to export houses; Market intelligence;Marketing of produce; cost analysis; Visit to export houses; Market intelligence; Marketing ofproduce; cost analysis; institutional management. Report writing and viva-voce.

3. Module-III. Processing of fruits and vegetables for value addition: Planning and execution of a market survey, preparation of processing schedule, preparation of project module basedon market information, calculation of capital costs, source of finance, assessment of workingcapital requirements and other financial aspects, identification of sources for procurement ofraw material, production and quality analysis of fruits and vegetables products at commercialscale, packaging, labelling, pricing and marketing of product.

4. Module-IV. Floriculture and landscape gardening: Preparation of project report, soil andwater analysis, preparation of land and layout. Production and Management of commercialflowers. Harvesting and postharvest handling of produce. Marketing of produce, CostAnalysis, Institutional Management, Visit to Flower growing areas and Export House,Attachment with private landscape agencies. Planning and designing, site analysis, selectionand use of plant material for landscaping. Formal and informal garden, features, styles,principles and elements of landscaping. Preparation of landscape plans of home gardens,farm complexes, public parks, institutions, high ways, dams and avenues. Making of lawns,use of software in landscape. Making of bouquets, button hole, wreath, veni and gazaras,car and marriage palaces. Dry flower Technology (identification of suitable species, drying,packaging and forwarding techniques).

5. Module-V. Bio-inputs: Bio-fertilizers and bio-pesticides: Isolation and pure cultureestablishment of fertilisers and bio-pesticides. Culture methods and substrates. Scale ofmethods for bio-fertilizers and bio-pesticides. Substrate preparation and mixing techniques.Quality analysis of bio-fertilizers and bio-pesticides. Testing the final product in small scalelevel. Storage, marketing and cost analysis of bio-fertilizers and pesticides.

6. Module-VI. Mass multiplication of plants and molecules through tissue culture:
Preparation of sock solutions of tissue culture media. Preparation of solid media and liquidmedia. Initiation of in vitro culture and multiplication (preparation of explant, inoculationand culturing) (crop to selected). Sub-culturing, Hardening and establishment, Initiation ofcallus cultures – suspension cultures, Induction of selected biomolecules in callus, Harvestingand extraction of biomolecule, Marketing and cost analysis.

7. Module-VII. Mushroom culture: Construction cultivation room/structure and Disinfection.Compost preparation & pasteurization. Procurement of mother culture and spawnpreparation. Procurement of casing soil and preparation for production. Mushroom seeding,Casing with soil and maintenance, Harvesting, processing, Grading, packing, marketing andCost economics of mushroom culture.

8. Module-VIII. Bee keeping: Procurement and arrangement of bee keeping equipments.Location and collection of potent nectar yielding bee flora seeds from wild. Raising/ enrichingthe high nectar yielding bee flora in the campus. Location and hiving the natural bee colonyfrom the wild. Establishing the apiary with suitable/favourable necessaries. Maintenanceand multiplication of hived colonies. Management of natural enemies and diseases ofbees. Maintenance of bee colonies during dearth and honey flow seasons. Harvesting andProcessing of honey and bee wax. Marketing and cost analysis.

2) RURAL HORTICULTURAL WORK EXPERIENCE PROGRAMME 20(0+20)

1. Placement in Industries (0+10)
2. Placement in Village (0+10)