

## **FRUIT SCIENCE (FRT) (8+6= 14)**

### **FRT 1.1: Fundamentals of Horticulture**

**3 (2+1)**

#### **Theory:**

Economic importance and classification of horticultural crops and their culture and nutritive value, area and production, exports and imports, fruit and vegetable zones of India and of different states, nursery management practices, soil and climate, vegetable gardens, nutrition and kitchen garden and other types of garden, principles, planning and layout, management of orchards, planting systems and planting densities. Production and practices for fruit, vegetable and floriculture crops, nursery techniques and their management. Principles and methods of pruning and training of fruit crops, types and use of growth regulators in horticulture, water management, weed management, fertility management in horticultural crops, cropping systems, intercropping, multi-tier cropping, mulching, bearing habits, factors influencing the fruitfulness and unfruitfulness. Rejuvenation of old orchards, top working, frame working, principles of organic farming.

**Practical:** Features of orchard, planning and layout of orchard, tools and implements, layout of nutrition garden, preparation of nursery beds for sowing of vegetable seeds, digging of pits for fruit plants, planting systems, training and pruning of orchard trees, preparation of fertilizer mixtures and field application, preparation and application of growth regulators, layout of different irrigation systems, identification and management of nutritional disorder in fruits and vegetables, assessment of bearing habits, maturity standards, harvesting, grading, packaging and storage.

#### **References :**

1. Principles of Horticulture (2005) by U. Kumar, Surendra Prasad, Agro-bios, Jodhpur.
2. Principles of Fruit Culture (2002) by Chundawat, B.S. and Sen, N. L., Agrotech Publishing Academy, Udaipur
3. Basic Horticulture (1997) by Jitendra Singh, Kalyani Publisher, New Delhi.
4. Advances in Horticulture Vol.1 (1993) by Chadha K. L. and Pareek O.P., Malhotra Publishing Houses, New Delhi.

**Theory:**

**Propagation:** Need and potentialities for plant multiplication, sexual and asexual methods of propagation, advantages and disadvantages. Seed dormancy (scarification & stratification) internal and external factors, types of seed germination, methods for breaking seed dormancy, nursery techniques, apomixes – mono-embryony, polyembryony, chimera & bud sport. Propagation Structures: Mist chamber, humidifiers, greenhouses, glasshouses, cold frames, hot beds, poly-houses, nursery tools, containers, media and implements, use of growth regulators in seed and vegetative propagation, methods and techniques of cutting, layering, grafting and budding physiological & bio chemical basis of rooting, factors influencing rooting of cuttings and layering, graft incompatibility. Anatomical studies of bud union, selection and maintenance of mother trees, collection of scion wood stick, scion-stock relationship, and their influences, bud wood certification, techniques of propagation through specialized organs like bulb, rhizome, corm, runners, suckers, etc. Micro-propagation and Micro-grafting, establishment of nursery-site selection, planning and lay out of nursery area, types of nursery, different types of bed, pre-sowing treatments, methods of seed sowing, pricking, watering, weeding, hoeing, fertilization, shading, root culturing technique, lifting windows, grading, packing, storage and transportation. Hardening of plants in nursery, Nursery registration act. Insect/pest/disease control in nursery.

**Practical:**

Media for propagation of plants in nursery beds, pot and mist chamber. Preparation of nursery beds, pre-sowing treatments and sowing of seeds of different size- small, medium and large. Raising of rootstock. Seed treatments for breaking dormancy and inducing vigorous seedling growth. Preparation of plant material for potting and repotting. Hardening plants in the nursery. Practicing different types of cutting, layering, grafting and budding including opacity and grafting, etc. Use of mist chamber in propagation and hardening of plants. Preparation of plant growth regulators for seed germination and vegetative propagation. Visit to a tissue culture laboratory. Digging, labeling and packing of fruit and other plants. Maintenance of nursery records. Use of different types of nursery tools and implements for general nursery and virus tested plant material in the nursery. Cost of establishment of a mist chamber, greenhouse, glasshouse, polyhouse and their maintenance. Top grafting, bridge grafting and nursery management. Nutrient and plant protection applications during nursery.

**References :**

1. Propagation of Horticultural Crops, Vol.I (2005) by Bose T.K. *et al.*, Naya Udyog, Calcutta.
2. Plant Propagation (2002) by Hartman H.T. and Kester D.E., Prentice Hall, New Jersey.
3. Development in Propagation of Horticultural Crops (2005) by Singh A. A., K.V. Prasad, Kumar Pal Singh and D.V.S. Raju, Delhi Agri-Horticultural Society, IARI, New Delhi.
4. Scientific Nursery Management (Fruit & Ornamental Plants) by Reddy Y.T.N., T. Jankiraman and D. Satyanarayan Reddy, the House of Sarpan (Media), Bangalore.
5. Greenhouse Management, Forcing of Flower, Vegetable and Fruits by Taft L.R., Biotech Books, Delhi.

### **FRT.2.3: Growth and Development of Horticultural Crops**

**2 (1+1)**

#### **Theory:**

Growth and development-definitions, components, photosynthetic productivity, leaf area index (LAI) - optimum LAI in horticultural crops, canopy development; different stages of growth, growth curves, growth analysis in horticultural crops. Plant bioregulators- auxin, gibberellin, cytokinin, ethylene inhibitors and retardants, basic functions, biosynthesis, role in crop growth and development, propagation, flowering, fruit setting, fruit thinning, fruit development, fruit drop, and fruit ripening. Flowering-factors affecting flowering, physiology of flowering, photoperiodism-long day, short day and day neutral plants, vernalisation and its application in horticulture, pruning and training physiological basis of training and pruning source and sink relationship, translocation of assimilates. Physiology of seed development and maturation, seed dormancy and bud dormancy, causes and breaking methods in horticultural crops. Physiology of fruit growth and development, fruit setting, factors affecting fruit set and development, physiology of ripening of fruits, climacteric and non-climacteric fruits.

#### **Practical:**

Estimation of photosynthetic potential of horticultural crops, leaf area index, growth analysis parameters including harvest index, bioassay of plant hormones, identification of synthetic plant hormones and growth retardants, preparations of hormonal solution and induction of rooting in cutting, ripening of fruits and control of flower and fruit drop. Important physiological disorders and their remedial measures in fruits and vegetables, rapid tissue test, seed dormancy, seed viability by tetrazolium test, seed germination and breaking seed dormancy with chemicals and growth regulators.

#### **References :**

1. Plant Growth and Development by Leopold A.C.
2. Plant Growth Substances in Agriculture (1972) by Weaver R.J., S. Chand & Co., New Delhi.
3. Principles of Horticulture (2005) by Kumar U. and Prasad S., Agrobios (India), Jodhpur.
4. Principles of Fruit Culture (2002) by Chundawat B.S. and Sen N. L., Agrotech Publishing Co., Udaipur.

### **FRT 3.4: Tropical and Subtropical Fruits**

**3 (2+1)**

#### **Theory:**

Horticultural classification of fruits including genome classification. Horticultural zones of India, detailed study of area, production and export potential, varieties, climate and soil requirements, propagation techniques, planting density and systems, after care, training and pruning. Management of water, nutrient and weeds, special horticultural techniques including plant growth regulators, their solution preparation and use in commercial orchards. Physiological disorders. Post-harvest technology, harvest indices, harvesting methods, grading, packaging and storage of the following crops. Mango, banana, grapes, citrus, papaya, sapota, guava, pineapple, jackfruit, avocado, mangosteen, litchi, carambola, durian and passion fruit. Bearing in mango and citrus, causes and control measures of special production problems, alternate and irregular bearing overcome, control measures. Seediness and kokkan disease in banana, citrus decline and casual factors and their management. Bud forecasting in grapes, sex expression and seed production in papaya, latex extraction and crude papain production, economics of production.

#### **Practical:**

Description and identification of varieties based on flower and fruit morphology in above crops. Training and pruning of grape, mango, guava and citrus. Selection of site and planting system, pre-treatment of banana suckers, de-suckering in banana, sex forms in papaya. Use of plastics in fruit production. Visit to commercial orchards and diagnosis of maladies. Manure and fertilizer application including bio-fertilizer in fruit crops, preparation and application of growth regulators in banana, grapes and mango. Seed production in papaya, latex extraction and preparation of crude papain. Ripening of fruits, grading and packaging, production economics for tropical and sub-tropical fruits.

#### **References :**

1. Fruits : Tropical and Sub-tropical (2002) by Bose T. K., Mitra S.K. and Sadhu M.K., Naya Udyog, Calcutta.
2. Principles of Fruit Culture by Chundawat B.S. and Sen N. L., Agrotech Publishing Academy, Udaipur.
3. Fruit Physiology and Production by Amar Singh, Kalyani Publishers, Calcutta.
4. Text Book on Pomology, Vol.1 to 4 (1996) by T. K. Chattopadhyay, Kalyani Publishers, Calcutta.
5. Advances in Horticulture, Vol.1 to 4 (1993) edited by Chadha K. L. and Pareek O.P., Malhotra Publishing House, New Delhi.
6. Arid Fruit Culture by Chundawat B.S., Oxford and IBH Publishing Co., New Delhi.

## **FRT 4.5: Plantation Crops, Spices and Condiments**

**2 (1+1)**

### **Theory:**

**Plantation crops:** Scope and importance, area and production, uses, industrial importance. Cultivation practices of different plantation crops, Soil and climate, varieties, propagation methods, planting systems, mulching, shade regulation, weed and water management, training and pruning, nutrition, soil management, liming practices, tipping practices, top working, harvesting, post-harvest handling and processing, packaging and marketing, yield and economics of (1) coconut, (2) areca nut, (3) cashew nut, (4) coffee, (5) tea. Information in tabular form of oil palm, cocoa and rubber.

**Spices and Condiments:** Scope and importance, area and production, uses. Classification. Cultivation practices: soil and climate, propagation and methods of planting. Nutritional management, irrigation, weeds control, mulching and cover cropping, shade regulation. Harvesting, post-harvest technology. **Crops** (1) Black pepper (2) Ginger (3) Turmeric (4) Cumin (5) Fenugreek (6) Coriander (7) Fennel.

**Short information on crops (in tabular form):** curry leaf, dill, vanilla, thyme, cardamom, nutmeg, cinnamon and clove.

### **Practical:**

Different parts of palmae crops- coconut, areca nut, oil palm. Description and identification of coconut varieties. Selection of coconut mother palm and seed nut. Propagation, Nursery and planting of coconut and cashew nut. Preparation of seed beds and sowing of seasonal spices and condiments. Identification of plants and available varieties of: Black pepper, clove, cardamom, nutmeg, cumin, fennel, fenugreek, coriander, dill, curry leaf, ginger, turmeric, all spice, etc. Maturity standards, harvesting and post harvest handling. Visit to commercial farms and research centers of plantation and spices crops.

### **References :**

1. Introduction to Spices Plantation, Medicinal and Aromatic Plants (1997) by Kumar, Khadev and Erulappan, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
2. Spices by E.V. Nybe, N. Miniraj and Prof. K. V. Peter (2007), New India Publishing Agency, New Delhi.
3. Minor Spices and Condiments (2002) by J. S. Pruthi, ICAR, New Delhi.
4. Text Book of Vegetable Tuber Crops and Spices (2001) by S. Thamburaj and Narendra Singh, ICAR, New Delhi.

## **FRT 4.6 : Watershed Management and Dry Land Horticulture**

**2 (1+1)**

### **Theory:**

Rainfed horticulture, importance and scope of arid and semi-arid zones of India, Watershed Management, Dry land farming- introduction and definition, Management of land and water-the basic resources, Climate of arid regions and their classification including rainfall pattern, Activities of Research Centers of dry land horticulture Problems of crop production in dry (arid) zones, Existing pattern of land use in dry region in low rainfall area, Drought occurrence, types and management strategies for drought, Soil erosion by wind and water- factors affecting on it, Techniques for soil and soil moisture conservation, Fertilizer application to dry land horticultural crops-organic, inorganic, bio fertilizers, Efficient horticultural crops for dry land and their special features for adaptation-ber, aonla, custard apple, jamun, wood apple, bael, pomegranate, caronda date palm, phalsa, fig, gunda (Cordia) etc. Post harvest handling of arid fruits.

### **Practical:**

Mapping of arid and semi-arid zones of India, Preparation of seed beds, collection of seeds of arid fruits and seed treatments and sowing, Propagation of arid fruit crops like budding in ber, *in-situ* soft wood grafting in mango, custard apple, tamarind, etc. Pruning and training in arid fruit crops, Different structures of water harvesting. Soil and moisture conservation, Maturity indices of Arid fruits, Visit to check dams, reservoirs, River Dam and Watershed Management Project.

### **References :**

1. Arid Fruit Culture by Chundawat B.S., Oxford and IBH Publication Company, New Delhi.
2. Introductory Agro Forestry by Chundawat B. S., Oxford and IBH Publication Company, New Delhi.
3. Principles of Agricultural Engineering Vol.II by A. M. Micheal and T.P. Ojha, Jain Brothers, Ratanada Road, Jodhpur.
4. Watershed Management by Murty J.V.S., New Age International Ltd., New Delhi.
5. Physiological Aspects of Dry Land Farming by U.S. Gupta, Oxford and IBH Publication Company, New Delhi.

## VEGETABLE SCIENCE (VEG) (6+4= 10)

### VEG 1.1: Fundamentals of Vegetable Production

3 (2+1)

#### Theory:

Definition of vegetable; economic, nutritive and aesthetic value of vegetable; area, production and productivity in India, Methods of classification of vegetables and their relative merits and demerits; types of vegetable growing and vegetable forcing structures; effect of temperatures, photo-period, light, relative humidity on vegetable production; organic farming, nutrients essential for plant growth, chemicals and bio-fertilizers and their response; irrigation and water requirements; crop rotation, crop succession, inter-and mixed cropping, weed control, mulching, different pests, diseases and their control measures; role of plant growth substances, vegetable seed production, harvesting storage, grading and marketing of vegetables.

#### Practical:

Raising seedlings on seed bed and pro-tray, Treatment of seed and seed beds, method of sowing, hardening of seedling and transplanting, Characteristics of improved vegetable varieties, use of chemicals, PGRs, weedicide, fertilizer and their application, stage of maturity for harvesting, grading and packaging, Layout of kitchen garden.

#### References :

1. Text book of vegetables, Tuber crops and spices by S. Thamburaj and Narendar Singh
2. Morden Technology of vegetable Production by N.P. Singh, A.K. Bhardwaj, Abnish Kumar and K.M. singh
3. Production Technology of Vegetable Crops By K.G. shanmmugavelu
4. Vegetable crops of India by K.S. Yawalkar
5. Vegetables: Characteristics, production and marketing By L.C. Peirce
6. T.K. Bose.2002.*Vegetable Crops*. Nayaprakash, Kolkata

## VEG 2.2: Tropical and Subtropical Vegetables

3 (2+1)

### Theory:

Area, production, economic importance and export potential of tropical and sub-tropical vegetable crops, Description of varieties and hybrid, climate and soil requirements, seed rate, preparation of field, nursery practices; transplanting of vegetable crops and planting for directly sown/transplanted vegetable crops, spacing, planting systems, water and weed management; nutrient management and deficiencies, use of chemicals and growth regulators, Cropping systems, harvest, yield and seed production, Economic cultivation of tropical and sub-tropical vegetable crops; post-harvest handling and storage, Marketing of tomato, brinjal, chillies, okra, amaranthus, cluster beans, cowpea, Indian bean, snap bean, cucurbits, moringa, curry leaf, portulaca, basella, elephant foot yam, yams and tania.

### Practical:

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

### References :

1. Text book of vegetables, Tuber crops and spices by S. Thamburaj and Narendar Singh
2. Morden Technology of vegetable Production by N.P. Singh, A.K. Bhardwaj, Abnish Kumar and K.M. singh
3. Production Technology of Vegetable Crops By K.G. shanmmugavelu
4. Vegetable crops of India by K.S. Yawalkar
5. Vegetables: Characteristics, production and marketing By L.C. Peirce
6. T.K. Bose.2002.*Vegetable Crops*. Nayaprakash, Kolkata



### **VEG 3.3: Cool Season Vegetable Crops**

**2 (1+1)**

#### **Theory**

Importance of cool season vegetables crops in nutrition and economy, area, production, export potential, varieties, origin, climate and soil, production technologies, cabbage, cauliflower, carrot, radish, spinach, beetroot, onion, garlic, Sprouting, broccoli, brussels' sprouts, leek, potato, sweet potato, pea, asparagus, knol-khol, lettuce, turnip, red cabbage and chinese cabbage.

#### **Practical**

Identification and description of crop and varieties, propagation method, nursery management, preparation of field, sowing/transplanting, identification of physiological and nutritional disorders and their corrections, field visits of commercial farms.

#### **References**

1. Text book of vegetables, Tuber crops and spices by S. Thamburaj and Narendar Singh
2. B.R. Choudhary 2009. *A text book on production technology of vegetables*, Kalyani publishers, Ludhiana.
3. T.K. Bose.2002.*Vegetable Crops*. Nayaprakash, Kolkata
4. P.Hazra 2011. *Modern technology in Vegetable production*. New India publishing Agency. New Delhi
5. T.R. Gopal Krishnan, 2007. *Vegetable Crops*. New India Publishing Agency. New Delhi

### **VEG 5.4: Vegetable Seed Production and Certification**

**2 (1+1)**

#### **Theory:**

General principles of seed production, seed production of different classes of seed, important vegetable crops with special emphasis on land requirements, isolation distance, planting ratio, rouging, time of harvesting, and post harvest management, packing and storage, Planting material, quality attributes and characters of good quality seed, seed testing network in India, seed sampling, germination test and its evaluation, viability test, grow out test, seed health, reporting of seed testing result, Seed certification, objectives and concepts, phases of seed certification, field inspection, general and minimum seed certification standards.

#### **Practical:**

Seed sampling, equipments, procedures, Purity analysis in different crops, Different methods of moisture testing, germination testing, identification of normal and abnormal seedlings, hard seeds, dead seeds in different crops, Seed and seedling vigour test, tetrazolium test, field inspections and rouging in different crops, maintenance of laboratory records and reporting results, visit to seed testing laboratories.

#### **Reference:**

1. Seed Production, Principles and Practices by Miller B., Mc Donald and Awareness.
2. Seed Technology by Agrawal R.L.
3. Principles of Seed Technology by Agrawal P.K.

# **FLORICULTURE AND LANDSCAPE ARCHITECTURE (FLA)**

## **(6+5= 11)**

### **FLA 1.1: Introductory Floriculture**

**2 (1+1)**

#### **Theory:**

Definition, scope and importance of floriculture, Propagation methods in ornamental plants, Potting media and its properties, Classification, growing practices, uses of annuals and herbaceous perennial, shrubs, climbers, trees, bulbous ornamentals, indoor plants, succulents and cacti, Flower arrangement and its importance, drying techniques of flower and its arrangement, Bonsai culture, Art of making bonsai.

#### **Practical:**

Garden tools and implements, Identification of ornamental plants, Propagation and growing of ornamental plants, Potting media, its mixtures and potting and repotting of plants, Management of pot plants, Drying techniques of flower and foliage arrangement, Bonsai practicing and training.

#### **References:**

1. Floriculture in India by Bose T. K. and Mukharjee, Allied Publisher Ltd, New Delhi.
2. Tropical Garden Plants By Willium Warren Thames and Hudson Ltd, 181 A High Holborn, London WC1V7QX
3. An Atlas of Major Flowering Trees in India Second addition. By M. S. Swaminathan, FRS, S.L. Kocchar Published By Rajiv Bery, Macmillan, India Ltd.2/10 Ansari Road, Daryaganj, New Delhi, 110002
4. Tropical Garden Plants in Colour By T. K. Bose B. Chowdhury Published By Horticulture and allied Publishers 27/3 Chakraberia Lane Culcutta 700020, India Ornamental Horticulture in India by Chadha K. L. and B. Chaudhary, ICAR, New Delhi.
5. Development in Propagation of Horticultural Crops by Singh A. P., Prasad K.V., Kanwar Pal Singh and Raju V. S., Delhi Agri-Horticultural Society, IARI, New Delhi.
6. Commercial Flowers by Bose, Yadav, Pal and Das, Naya Prakash, Kolkatta.
7. Scientific Nursery Management (Fruits and Ornamental Plant) by Reddy Y.T.N., Jankiram and Satyanarayan Reddy, The House of Sarpan (Media), Bangalore.

**Theory:**

History, scope of gardening, aesthetic values, Classification and identification of landscape plant materials, Gardens in India, types of gardens, Landscaping, historical background, definition, basic principles and basic components. Principles of gardening, garden components, adornments, lawn making, methods of designing rockery, water garden, etc. Special types of gardens, their walk-paths, bridges, constructed features. Special types of gardens, trees, their design, values in landscaping, propagation, planting shrubs and herbaceous perennials. Importance, design values, propagation, planting, cultural operations, constraints and post-harvest practices of climbers and creepers, palms, ferns, grasses and cacti succulents, Bio-aesthetic planning, definition, need, round country planning, urban planning and planting avenues, schools, villages, beautifying railway stations, dam sites, hydroelectric stations, colonies, river banks, planting material for play grounds. Vertical gardens, roof gardens, Parks and public gardens.

**Practical:**

Identification and description of climbers, creepers, foliage flowering shrubs, trees, palms, ferns, ornamental grasses; cacti succulents, Description and design of garden structures, layout of rockery, water garden, terrace garden, and Japanese gardens, recreational and children's corner. Layout of terrarium, traffic islands, bottle garden, dish garden, Visit to nearby gardens.

**References :**

1. Gardening in India by Bose T.K. and Mukharjee, ICAR, New Delhi.
2. Ornamental Horticulture in India by Chadha K. L. and B. Chaudhary, ICAR, New Delhi.
3. Floriculture and Landscaping by Bose T.K., Maiti T.K., Dhna R.G., and Das P., Naya Prakash, Kolkatta.
4. The Text Book of Bonsai and Flower Arrangement by Alka Singh and Dhaduk B. K., ASPEE College of Horticulture & Forestry, NAU, Navsari.
5. Floriculture in India by Bose T. K. and Mukharjee, Allied Publisher Ltd, New Delhi. Tropical Garden Plants By willium Warren Thames and Hudson Ltd, 181 A High Holborn , London WCIV7QX
6. An Atlas of Major Flowering Trees in India Second addition. By M. S. Swaminathan,FRS, S.L. Kocchar Published By Rajiv Bery, Macmillan, India Ltd.2/10 Ansari Road, Daryaganj, New Delhi, 110002
7. Tropical Garden Plants in Colour By T. K. Bose B. Chowdhury Published By Horticulture and allied Publishers 27/3 Chakraberia Lane Culcutta 700020, India Ornamental Horticulture in India by Chadha K. L. and B. Chaudhary, ICAR, New Delhi.

**Theory:**

Definition, scope and importance of commercial floriculture.

Classification of commercial flowers

1. Annuals
2. Herbaceous perennial
3. Ornamental Bulbs
4. Shrubs and climbers
5. Trees

Cultivation practices and post harvest handling of open field commercial flower crops

- |                |                  |
|----------------|------------------|
| 1. Rose        | 6. Golden rod    |
| 2. Spider Lily | 7. Gladiolus     |
| 3. Jasmine     | 8. Gaillardia    |
| 4. Marigold    | 9. Chrysanthemum |
| 5. Tuberose    | 10. China aster  |

**Practical:**

Identification of commercial flowers with its varieties, Plan layout in the field of different flower crops, Important practices of commercial flowers, Post harvest handling of cut flowers

**References :**

1. Commercial Flowers by Bose, Yadav, Pal and Das, Naya Prakash, Kolkatta.
2. Ornamental Horticulture in India by Chadha K. L., IARI, New Delhi.
3. Introductory Ornamental Horticulture (4<sup>th</sup> Revised Edition 2003) by Arora J.S., Kalyani Publishers, New Delhi.
4. Post Harvest Handling and Storage by Nowak J. and Radniek R.M., London Campan and Hall.

**Theory:**

Origin, Area, Production, Importance and uses. Cultivation: Varieties, climate and soil, Propagation, planting, After care, Manuring and Fertilization, pruning and Training, Harvesting and processing of the following: **Medicinal Plants:** Ashwagandha (*Withania somnifera*), Gugal (*Commiphora wightii*), Safed Musli (*Chlorophytum borivillianum*), Long Piper (*Piper longum*), Kariyatu (*Andrographis paniculata*), Isabgul (*Plantago ovata*), Tulsi (*Ocimum sanctum*), Kunvar Pathu (*Aloe vera*), Satavari (*Asparagus racemosus*), Brahmi (*Centella asiatica*), Jethimadh (*Glycyrrhiza glabra*) and Vidari kand (*Dioscorea bulbifera*).

**Description, properties and use of locally available wild medicinal plants in tabular form:**

Sarpagandha (*Rauwolfia serpentina*), Barmasi (*Catharanthus roseus*), Chanothi (*Abrus precatorius*), Bhoi Ringni (*Solanum xanthocarpum*), Sabjo-damro (*Ocimum sp*), Kuvech (*Mucuna prurita*), Arduci (*Adhatoda vasaca*), Neem (*Azadirachta indica*), Aghedo, Apamarg (*Achyranthus aspera*), Satodi (*Boerhavia diffusa*), Charoli (*Buchnanania lanzan*), Simlo (*Bombax ceiba*), Harde (*Terminalia chebula*), Behda (*Terminalia bellerica*), Kesudo (*Butea monosperma*), Arni (*Cerodendrum phlomoides*), Shankpuspi (*Convolvulus arvensis*), Vaivarno (*Crataeva religiosa*), Dhaturu (*Datura innoxia*), Salparni (*Desmodium gangeticum*), Safed Bhangro (*Eclipta alba*), Mamejvo (*Enicostemma hyssopifolium*), Upalsri (*Hemidesmus indicus*), Akharo (*Astercantha longifolia*), Tetu (*Oroxylum indicum*), Safed Chitrak (*Plumbago zylanica*), Bavchi (*Psorelea corilifolia*) Dodi (*Laptodenia reticulata*) and Betel vine (*Piper betel*). **Aromatic Plants: (Tabular Form)** Citronella *Cymbopogon nardus*, Lemon grass *Cymbopogon citratus*, Palma rosa *Cymbopogon martinii*, Geranium *Pelargonium graveolens*, Vetiver *Vetiveria zizanioides*, Eucalyptus *Eucalyptus globulus*, Mint *Mentha arvensis*, Vanilla *Vanilla spp.*, Rose (*Desi Gulaab- Rosa bourboniana*), (Damask Rose- *Rosa damascene*) Jasmine, Patchauli and Tuberose *Polianthes tuberosa*.

**Practical:**

Identification and botanical description, medicinal properties and uses of different medicinal and Aromatic plant crops, Visit of herbarium, Visit to commercial essential oil extraction plant, Visit to institute and field working on medicinal and aromatic crops.

**References :**

1. Introduction to Spices, Plantation crops, Medicinal and Aromatic plants by N. Kunar JBM and Abdul Khader, P. Rangaswami, I. Irulappan. Published by Oxford & IBH publishing co. pvt. ltd., New Delhi, Kolkata.
2. Medicinal plants by S. G. Joshi, Oxford & IBH publishing co. pvt. ltd. New Delhi, Culcutta, Bombai.
3. Medicinal and Aromatic Crops by Jitendrasingh, Avishkar Publishers, Distributors Jaipur
4. Lexicon of Medicinal Plants in India Vol. by D. N. Guha Bakshi, P. Sensarma, D. C. Pal, Naya Prokash, 206, Bidhan Sarani, Calcutta - 700 006.
5. Identification of Common Indian Medicinal Plants V. N. Naik, Scientific Publisher (India), P.O.Box - 91, Jodhpur (Raj.)

## **FLA 5.5: Protected Cultivation of Horticultural Crops**

**3 (2+1)**

### **Theory:**

Definition and Principles of protected cultivation, Scope and importance of protected cultivation in India, Types of green house and its design, Environmental control: heating and cooling system, Growing media, fertigation and nutrient management. Cultivation practices of important horticultural crops - rose, gerbera, carnation, anthurium, orchids, capsicum, tomato, muskmelon, cucumber and strawberry. Pest and disease management in green house, Harvesting and post harvest handling of poly house produce.

### **Practical:**

Different green house design, Planting design of different crops in poly house, Preparation of different media, formulation and application of different fertilizer mixtures, Irrigation methods and its schedule, Harvesting, grading, packing and storage of cut flowers, Plant protection in green house, Visit to commercial green house units.

### **References :**

1. Hi-tech Floriculture by Reddy, Jankiram, Kulkarni and Misra, Indian Society of Ornamental Horticulture, IARI, New Delhi.
2. Green House Technology and Management by Manohar K.R. and Igathinanthene, B.S. Publishers, Hyderabad.
3. Green House Management, Forcing of Flowers, Vegetables and Fruit by Taft L.R., Biotech Books, Delhi.
4. Green House Management for Flower and Plant Production by Kennard S. Nelson, The Interstate Printers and Publishers, INC, Danville, Illuniois.

## **POST HARVEST TECHNOLOGY (PHT) (4+3= 7)**

### **PHT 2.1: Fundamentals of Post-harvest Technology of Horticultural Crops 2 (1+1)**

#### **Theory :**

Definition, scope and importance of post harvest technology, Chemical composition of fruits, climacteric and non-climacteric fruits. Maturity standards. Physiological and biochemical changes during ripening of fruits and vegetables. Grading and Sorting, methods of storage. Packing and transportation. Pre and post harvest treatments of horticultural crops. Hastening and delaying of ripening process of fruits and vegetables. Norms and certification for processed products.

#### **Practical:**

Judging of maturity standard of various fruits. Estimation of physico-chemical composition of fruits, vegetables and flowers. Pre-cooling chamber, cold storage, collection centre of fruits and vegetables, Grading and packaging of fruits, vegetables and flowers, visit of nearest cold storage, export units, co-operative society and APMC.

#### **References :**

1. Post Harvest Management Marketing and Trade in Horticulture Crops : Volume - II (Proceedings of First Indian Horticulture Congress - 2004 held on 6 - 9 November, 2004. New Delhi)Editor: K. L. Chadha, R. N. Pal, S. K. Singh and K. V. Prasad.  
Publisher: The Horticulture Society of India, New Delhi
2. Post Harvest Management of Horticultural Crops Author: S. Saraswathy, T. L. Preethi, S. Balasubramanyan, J. Suresh, N. Revathy and S. Natarajan. AGROBIOS (India)

**Theory:**

Food and its function, physico-chemical properties of foods, food preparation techniques. Nutrition, relation of nutrition to good health. Energy: definition, determination of energy requirements, food energy and total energy needs of the body. Carbohydrates: functions, source, requirements, digestion, absorption and utilization. Protein: functions, sources, requirements, digestion, absorption, essential and non-essential amino acids, quality of proteins, PER/NPR/NPU, supplementary value of proteins and deficiency. Lipids: functions, sources, requirements, digestion, absorption and utilization, saturated and unsaturated fatty acids, deficiency. Mineral nutrition: macro and micro-minerals, function, utilization, requirements, sources, effects of deficiency. Vitamins (of water soluble and fat-soluble vitamins): functions, sources, effects of deficiency, requirements. Balanced diet: recommended dietary allowances for various age groups, common disorders associated due to malnutrition in population. Food Additives, adulterants and contaminants.

**Practical:**

Acquaintance with equipments used in food technology, 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, protein and fats content of foods. Identification of contaminants in food.

**Reference :**

1. Manual of Analysis of Fruit and Vegetable Products by S. Ranganna, Tata McGraw Hill Publishing Co. Ltd., New Delhi
2. Food Science Chemistry and Experimental Foods by Dr. M. S. Swaminathan, BAPPCO



### **PHT 5.3: Preservation and Value Addition of Horticultural Crops**

**3 (2+1)**

#### **Theory:**

Preservation of fruits and vegetables. Principles of different preservatives. Importance of preservation in national economy. Factors affecting the microbial deterioration of fruits and vegetables. Principles and methods of preservation of fruits and vegetables. Importance and scope of value addition in horticultural crops. Value addition in different fruits, vegetables and flowers. crops.

#### **Practical:**

Study of different types of tools & equipments used in preservation, Canning of fruit and vegetable and their products, Storage of canned product, Study of different types of preservatives, Preparation of juice, squash, cordial and syrups, Preparation of jam and jelly, Preparation of candy, chutney, pickles and ketchup, Study of different methods of drying of vegetables for preservation. Visit to local processing units and packing industries

#### **References :**

1. Commercial Fruits & Vegetables products, By Fruiyes
2. Fruits & vegetables juices processing and anology, By Tresalar and Jeslin
3. Preservation of fruits and vegetables, By Girdharilal Datiya & Tandan

## **NATURAL RESOURCE MANAGEMENT (NRM) (8+7= 15)**

### **NRM 1.1: Introductory Agronomy**

**2 (1+1)**

#### **Theory:**

Agronomy definition scope and its role in crop production, Classification of field crops, Essential plant nutrients, Irrigation and drainage, Cropping systems, Soil and its management, Tillage and its importance, Weeds and their control.

#### **Practical:**

Study of tillage implements, Study of seeding equipments, Different methods of sowing, Study of manures, fertilizer and green manure crops/ seeds (including calculations), Study of inter cultivation implements and practice, Practice of methods of fertilizer application.

#### **References :**

1. Principles of Agronomy by T. Yellamanda Reddy and G. H. Sankara Reddi, Kalyani Publishers, Ludhiana.
2. Principles of Agronomy by Reddy S.R., Administration Office, 4863/2B, Bharat Ram Road, 24, Daryganj, New Delhi.

**Theory:**

Composition of earth crust, soil as a natural body – major components, Eluviations and alleviations formation of various soils, Physical parameters; texture – definition, methods of textural analysis, stocks law, assumption, limitations, textural classes, use of textural triangle; absolute specific gravity/particle density, definition, apparent specific gravity/bulk density – factors influencing, field bulk density. Relation between BD (bulk density), PD – practical problems, Pore space – definition, factors affecting capillary and non-capillary porosity, soil colour – definition, its significance, colour variable, value hue and chroma. Munsell colour chart, factors influencing, parent material, soil moisture, organic matter, soil structure, definition, classification, clay prism like structure, factors influencing genesis of soil structure, Soil air, air capacity, composition, factors influencing, amount of air space, soil air renewal, soil temperature, sources and distribution of heat, factors influencing, measurement, chemical properties, soil colloids, soil water, forms, hygroscopic, capillary and gravitational, soil moisture constants, hygroscopic coefficient, wilting point, field capacity, maximum water holding capacity, energy concepts, PF scale, measurement, classification, Management of Soil Crusting, Soil Compaction and Soil Compression. Soil Biology benefits and harmful effects.

**Practical:**

Collection and preparation of soil samples, estimation of moisture, EC, pH and bulk density. Description of soil profile in the field. Determination of Soil colour using Munsell Chart, Estimation of water holding capacity, Estimation of Infiltration rate using double ring infiltrometer method, Determination of pore space of soil, Determination of field capacity and permanent wilting point of soil

**References :**

1. Brady Nyle C and Ray R Well, 2014. *Nature and properties of soils*. Pearson Education Inc., New Delhi.
2. Indian Society of Soil Science, 2002. *Fundamentals of Soil Science*. IARI, New Delhi.
3. Dilip Kumar Das, 2015. *Introductory Soil Science*. Kalyani Publishers, Ludhiana.
4. Brady, N.C., 1995. *The Nature and properties of Soils*. Macmillan Publishing Co, New York.
5. Ghildyal, B.P. and Tripathi, R.P., 1987. *Soil Physics*. Acad. Press. New York.
6. Das, D .K., 2011. *Introductory Soil Science* (3<sup>rd</sup> Edition), Kalyani publisher, Ludhiana (India).
7. Gupta, P.K. 2009. *Soil, Plant, Water and Fertilizer Analysis* (2<sup>nd</sup> Edition), AGROBIOS, Jodhpur (India).
8. Jackson, M. L., 2012. *Soil Chemical Analysis: Advanced Course*, Scientific Publisher.

**NRM 2.3: Manures and Fertilizers****2 (1+1)****Theory:**

**Manure:** Definition and properties – classification, Bulky organic manures (FYM, Bio-compost, vermicompost) - Preparation - nature - preserving nutrients - availability of nutrients - residual effect. Concentrated manures (Oil cakes, bone meal), Green manures - different green manure crops - suitability to soils - characters - decomposability - C:N ratio - nutrient availability - advantages and disadvantages, Bio-gas plants - utilization of biogas slurry as manure, **Fertilizers :** Classification - N, P and K fertilizers, soluble and liquid fertilizers - composition - Properties - suitability to soils and crops, Need for secondary and micro nutrient fertilizers, Bio-fertilizers - Azolla, Blue Green Algae, Rhizobium, Azatobacter, Phosphobacterium, Methods of application of fertilizers to crops - Factors affecting efficient use of fertilizers

**Practical:**

Identification of different manures and fertilizers, Study of different green manure crops - growing a typical green manure crop in a field and observing its growth characters, incorporations. Study of plants/ trees used for green leaf manuring, Preparation of Farm Yard Manure, Compost making with farm wastes including vermicompost, Visit to Municipal Compost Yard, Calculation of quantities of N, P and K fertilizers, Preparation of micro-nutrient solutions for foliar application.

**References:**

1. Manures and Fertilizers 2007 by A.K. Kolay.

**NRM 3.4: Water Management in Horticultural Crops****2(1+1)****Theory :**

Importance of water, water resources in India, Area of different crops under irrigation, function of water for plant growth, effect of moisture stress on crop growth, Available and unavailable soil moisture – distribution of soil moisture – water budgeting – rooting characteristics – moisture extraction pattern, Water requirement of horticultural crops –lysimeter studies – Plant water potential 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 drip irrigation, their suitability, merits and limitations, fertigation, economic use of irrigation water, Water management problem, soils quality of irrigation water, irrigation management practices for different soils and crops. Layout of different irrigation systems, drip, sprinkler, Layout of underground pipeline system

**Practical:**

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

**References :**

1. Principles of Agricultural Engineering Vol.II by A.M. Micheal and T.P. Ojha, Jain Brothers, Jodhpur
2. Irrigation Theory and Practices by A.M. Micheal, Vikas Publishing House Pvt. Ltd., New Delhi.

## **NRM 4.5: 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, Role of microorganisms in organic matter-decomposition – humus formation, Importance of C:N ratio and pH in plant nutrition, Integrated plant nutrient management, Soil fertility evaluation methods, critical limits of plant nutrient elements and hunger signs, NPK fertilizers: composition and application methodology, luxury consumption, nutrient interactions, deficiency symptoms, toxicity symptoms and remedies, visual diagnosis.

### **Practical:**

Analysis of soil for organic matter, available N,P,K and Micronutrients and interpretations. Gypsum requirement of alkali soils. Lime requirement of acid soils.

### **References :**

1. Nutrient Management in Horticultural Crops (1988) by Bose T. K., Mitra S.K. and Sandhu M.K., Naya Udyog, Calcutta.
2. Nutrient Management in Fruit Crops by Chundawat B.S. (1997), Agrotech Publishing Academy, Udaipur.

## **NRM 4.6: Agro-meteorology and Climate Change**

2 (1+1)

### **Theory**

Agricultural Meteorology- Introduction, definition of meteorology, scope and practical utility of Agricultural meteorology. Composition and structure of atmosphere and definition of weather and climate, aspects involved in weather and climate, atmospheric temperature, soil temperature, solar radiation, atmospheric pressure, atmospheric humidity, evaporation and transpiration, monsoons, rainfall, clouds, drought.. Climate change-causes. Global warming causes and remote sensing. Effect of climate change on horticulture Past and future changes in greenhouse gases within the atmosphere. Sources and sinks for greenhouse gases. Plants sense and respond to changes in CO<sub>2</sub> concentration.. plant development affected by growth in elevated CO<sub>2</sub>. Methodology for studying effect of CO<sub>2</sub>. Increased temperature and plants in tropical/sub-tropical climates- effect on growing season, timing of flowering, duration of fruit development and impacts on crop yields and potential species ranges, interaction of temperature with other abiotic/biotic stress. Mitigation strategies and prospects for genetic manipulation of crops to maximize production in the future atmosphere. Heat unit concept; Air circulation: Primary, Secondary and Tertiary. Air masses and fronts. Stability and instability of atmosphere, Adiabatic process. Agro-climatic zones of India and Gujarat.

### **Practical**

Measurement of temperature; Measurement of rainfall; 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., Lay out of an agromet observatory and types , Measurement vapour pressure ;Analysis of weather parameter.

### **Suggested Reading**

1. K. Srivastava and P. K. Tyagi, 2011. *Practical Agricultural Meteorology*. New Delhi Publishing Agency, New Delhi.
2. D.Lenka, 2006. *Climate, Weather and Crops in India*. Kalyani Publishers, New Delhi.
3. G. S. L. H. V. Prasad Rao, 2008. *Agricultural Meteorology*. Prentice Hall of India Pvt. Ltd., New Delhi.
4. H.S.Mavi and Graeme J. Tupper, 2005. *Agrometeorology – Principles and applications of climate studies in agriculture*. International Book Publishing Co., Lucknow.
5. H.S.Mavi, 1994. *Introduction to Agrometeorology*. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
6. H.V.Nanjappa and B.K.Ramachandrappa, 2007. *Manual on Practical Agricultural Meteorology*. Agrobios India. Jodhpur.
7. S.R.Reddy, 1999. *Principles of Agronomy*. Kalyani Publishers, New Delhi.
8. T.Yellamanda Reddy and G.H.Sankara Reddi, 2010. *Principles of Agronomy*. Kalyani Publishers, New Delhi.
9. Pattersen,S.1958. *Introduction to Meteorology*. Mc. GrawHillBook Co.Inc.,New York .
10. Tailor,J.T.1967. *Agricultural Climatology*. Pergman Press Ltd.,Headington Hill Hall, Oxford, England
11. Trewarthe,T.G.1968. *An Introduction to Climate*. Mc Graw HillBook Co.Inc.,NewYork.
12. Mavi,H.S.1985. *Introduction to Agrometeorology*. Oxford & IBH Publishing Co.,New Delhi.

**Theory:**

Farm power and mechanization, Engine terminology and related numerical, Tractors-type of tractors and their components and power transmission system, Economics of tractor operation, Energy sources- introduction, classification, energy from biomass– Types of biogas plants- constructional details, biogas production and its utilization. Wind energy –types of wind mills and use of wind mills, Liquid bio fuels, bio diesel and ethanol from agricultural produce and its production & uses, Introduction and principles of survey, measurement of distance, correction of error in length and area due to incorrect chain, Cross staff survey, compass and plane table survey, Levelling by collimation and rise and fall method, Mechanics of soil erosion, type of erosion, practices to control soil erosion, Soil conservation structure

**Practical:**

Study of engine construction, components and their functions, Study of engine systems, Study of mechanical power transmission, Experience learning of field operation of tractor and tractor drawn implements, Constructional details of KVIC & Janatha type biogas plants, Constructional details of Dheen Bandu type biogas plants, Field visit to biogas plants, Briquette preparation from biomass, Field visit to wind mills, Visit to Bio-diesel processing plant, Chain and cross staff survey, Compass and plane table survey, Levelling, Study of different soil conservation structures

**References :**

1. Energy Technology: Non-conventional, Renewable and Conventional, by S.S.Rao
2. Biogas Systems (Principles & Applications), by K.M.Mittal
3. Hand book of biogas Technology, by N.S. Grewal, S. Ahluwalia, S.Singh and G. Sing
4. Renewable Energy, by P.D.Dunn. IC Engen by S.S. Thethi.
5. Farm Power Machinery & Surveying by Irshad Ali.
6. Farm Machines & Equipments by C.P. Nakra: Dhanpat Rai Sons
7. Farm Tractors Maintenance & Repairs by S.C. Jain & C.R. Rai.
8. Manual of Soil & Water Conservation Practice by Gurmail Singh; Oxford & IBH Publication Co.

## PLANT PROTECTION (PPT) (3+3= 6)

### PPT 1.1: Introductory Entomology

2(1+1)

#### Theory:

Introduction to phylum arthropoda, Importance of Insecta, Insect dominance, Definition, division and scope of entomology, Comparative account of external morphology-types of mouth parts, antennae, legs, wings and genitalia, Types of larvae and pupa, Classification of insects up to orders and families of economic importance and their distinguished characters, Beneficial insects (predators, parasites and parasitoids), Productive insects (lac insect, silk worms and honey bees), Methods of insect control, Classification of insecticides, Concept of integrated pest management, economic threshold levels.

#### Practical:

Methods of collection and preservation of insects including immature stages, Study of external morphology of grass hopper, Identification of important insects, General body organization of insects, Dissection of mouth parts of cockroach. Study of different formulation of insecticides and plant protection equipments, study of different bio-control agents and mass production technology of *Trichogramma*, study of various microbial control agents their products and mass production technique of NPVs, study of traps used in insect control.

#### References :

1. Agricultural Pests of India and South East Asia by A.S. Atwal, Kalyani Publishers, Ludhiana.
2. Elements of Economic Entomology by David and Kumaraswamy, Allied Publishers, Chennai.
3. A General Text Book of Entomology by A.D. Imms. Bhargav & Co. Mumbai.

### PPT 2.2: Fundamentals of Plant Pathology

2(1+1)

#### Theory:

Introduction, Classification of plant diseases, symptoms, signs, and related terminology, Parasitic causes of plant diseases (fungi, bacteria, viruses, phytoplasma, protozoa, algae & nematodes), their characteristics and classification, Non-parasitic causes of plant diseases, Infection process, survival and dispersal of plant pathogens, Principles and methods of plant disease management, Integrated plant disease management, Classification of disease controlling chemicals (copper and sulphur based fungicides, systemic fungicides, bio-control agents, nematicides and bactericides)

#### Practical:

Familiarity with general plant pathological laboratory and field equipments, Study of disease symptoms and signs, Isolation of plant pathogens, preparation of temporary and permanent nematode mounts and Koch's postulates, Preparation of fungicides solutions, paste and their applications, Collection of disease specimens.

#### References :

1. Plant Pathology by Agrios G.N. (Fifth Edition), A.P., New York.
2. Plant Disease Management by R.S. Singh, Oxford & IBH, New Delhi.



## **PPT 4.3 Pest and Disease Management of Horticultural Crops**

**2 (1+1)**

### **Theory**

**Pest:** Marks of identification, biology, nature of damage, and management strategies of pest of vegetable crops viz., tomato, brinjal, okra, chilli, cabbage, cauliflower, onion, garlic, potato, turmeric, cucurbitaceous vegetables, tuber crops; fruits crop viz., mango, sapota, citrus, banana, pomegranate, custard apple, aonla, ber and guava; flower crops viz., rose, marigold, chrysanthemum, spider lily, tuberose.

**Disease:** Symptoms, mode of spread and survival, favourable weather conditions and managements of vegetable crops viz., tomato, brinjal, okra, chilli, cabbage, cauliflower, onion, garlic, potato, turmeric, cucurbitaceous vegetables, tuber crops; fruits crop viz., mango, sapota, citrus, banana, pomegranate, custard apple, aonla, ber and guava; flower crops viz., rose, marigold, chrysanthemum, spider lily, tuberose

### **Practical**

Identification of different disease and pest of horticultural crops, Collection and preservation of disease/pest specimens, Study the nature of damage/symptoms of pest/disease of solanaceous crops; malvaceous vegetables; cruciferous crops; cucurbitaceous crops; onion and garlic; turmeric, mango and sapota; guava, pomegranate and custard apple, citrus, ber and aonla, banana and flower crops.

### **Reference book:**

1. Disease of horticultural crops & their management by *AgriMoon Team*
2. Diseases of horticultural crops and their management by Jagtap G.P., Dhutraaj, D.N and Dey U.
3. Insects pests of vegetable crops by Chandel R.S., Mehta P.K., Sharma P.C. and Pathania M.
4. Pests of Ornamental Plants by Sathe, T. V. , 2012, Jain book Agency, Delhi.
5. Insect Pest and Disease Management by Prasad, D., 2008, Jain book Agency, Delhi.
6. Diseases of Vegetable Crops and Their Integrated Managment: A Colour Handbook by Mishra, R.K., Singh, A.K. and Sharma A.K., 2013, New India Publishing Agency, New Delhi.

## **BASIC SCIENCE (BSC) (8+7= 15)**

### **BSC 1.1: Introductory Botany**

**2(1+1)**

Introduction to Botany and general classification of plants. Parts of a typical flowering plant. Morphology of root, stem, leaf and flower. Structure and types of plant tissues. Internal structure of Dicot and Monocot Stems, Roots and a typical Leaf. Significance of life cycle with special reference to alternation of generations in Chlamydomonas, Rhizopus, Funaria, Adiantum, Pinus and a flowering plant. Importance of plants in relation to environments.

#### **Practical:**

Morphological studies of roots, stems, leaves and flowers. Studies of permanent slides of histology and anatomy. Morphological studies of gametophytes and sporophytes of the plants pertaining to the life cycle. General survey of the local vegetation. A field trip during the semester.

#### **Reference**

A Class-book of Botany by A. C. Dutta by Oxford University Press, 2000 - Science  
<http://gujarat-education.gov.in/TextBook/textbook/index.htm>  
[www.textbooksonline.tn.nic.in](http://www.textbooksonline.tn.nic.in)

### **BSC 3.2: Introductory Microbiology**

2(1+ 1)

#### **Theory :**

History and Scope of Microbiology, The discovery of micro-organism, spontaneous generation theory, germ theory of diseases, microbial effect on organic and inorganic matter, Development of microbiology in India and composition of microbial world, Microscopy and Specimen Preparation, The bright field microscope, fixation, dyes and simple staining, differential staining, Difference between prokaryotic and eucaryotic cells, Procaryotic cell structure and functions, Types of culture media and pre-culture techniques, Microbial growth in models of bacterial, yeast and mycelial growth curve, Measurement of bacterial growth, General properties of viruses and brief description of bacteriophages, General principle of bacterial genetics, DNA as genetic material, Antibiosis, symbiosis, intramicrobial and extra-microbial association

#### **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, turbidometric estimation of microbial growth

#### **Reference**

Microbiology by Michel J. Pelczar, JR. E.C.S. Chan, Noel R. Krieg.

### **BSC 3.3 Principles of Plant Breeding**

2 (1+1)

#### **Theory**

Plant breeding as a dynamic science, genetic basis of Plant Breeding – classical, centre of origin, quantitative and molecular, Plant Breeding in India – limitations, major achievements, goal setting for future. Sexual reproduction (cross and self-pollination), asexual reproduction, pollination control mechanism (incompatibility and sterility and implications of reproductive systems on population structure). Genetic components of polygenic variation and breeding strategies, selection as a basis of crop breeding and marker assisted selection, Hybridization and selection – goals of hybridization, selection of plants; population developed by hybridization – simple crosses, bulk crosses and complex crosses, General and special breeding techniques, Heterosis – concepts, estimation and its genetic basis, Breeding for resistance of biotic and abiotic stresses, Polyploidy breeding, Mutation breeding

#### **Practical**

Breeding objectives and techniques in important horticultural crops. Floral biology – its measurement, emasculation, crossing and selfing techniques in major crops. Determination of 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 in self and cross pollinated crops. Demonstration of hybrid variation and production techniques, Emasculation, pollination techniques in important horticultural crops.

#### **Suggested Reading:**

1. R.W. Allard. *Principles of plant breeding*. John Wiley & Sons, New York.
2. V.L. Chopra. *Plant breeding: Theory and Practice*. Oxford & IBH Publishing CO. Pvt. Ltd., New Delhi.
3. Phundan Singh. *Essentials of plant breeding*. Kalyani Publishers
4. J.R. Sharma. *Principles and practices of plant breeding*. Tata McGraw Publishing Company Ltd., New Delhi
5. R.C. Chaudhary. *Plant Breeding* Hays and Garber. *Breeding crop plants*. Mc Graw Hill Publications, New York
6. G K Kallo. *Breeding of vegetables*. Panima publishers, New Delhi
7. W.R. Fehr. *Principles of cultivar development: theory and technique (Vol. 1)*. Macmillan Publishing Company, New York.
8. D.S. Falconer. *Introduction to quantitative genetics*. Longman Scientific & Technical, Longman Group, UK, Ltd., England.
9. K. Mather and J.L Jinks. *Introduction to Biometrical genetics*. Chapman and Hall, London

**Theory:**

Historical background of genetics, theories and hypothesis. Physical basis of heredity, cell reproduction, 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, Chromosome theory of inheritance, gene interaction, Modification of monohybrid and dihybrid ratios, Genetic code, chemical basis of heredity, structure of DNA and its replication, Evidence to prove DNA and RNA – as genetic material, Mutations and their classification, Chromosomal aberrations, changes in chromosome structure and number.

**Practical**

Study of fixatives and stains, Squash and smear techniques, Demonstrations of permanent slides and cell division, illustration in plant cells, pollen fertility and viability, determination of gametes, test cross ratios using chi-square test, gene interactions, estimation of linkages using three point test cross from F data and construction of linkage maps. Genetic variation in pea, mitosis and meiosis

**Suggested Reading:**

1. Benjamin Lewin. *Genes (II edn)*. John Wiley & Sons, New York.
2. Farook & Khan. *Genetics & Cytogenetics (I Ed.)*. Premier Publishing House, Hyderabad.
3. Gardner E J, Simmons M J & Snustard D P. *Principles of Genetics (VIII Edn)*. John Wiley & Sons, New York.
4. George Acquaah. *Principles of Plant Genetics and Breeding*. Blackwell
5. Gupta, P.K. 1985. *Cytology, genetics and cytogenetics*. Rastogi Publication, India.
6. Joseph Jahier & INRA working group. *Techniques of Plant Cytogenetics (1986)*. Oxford & IBH Publishing Co Pvt.Ltd., New Delhi
7. Khanna VK. *Genetics–Numerical Problems*. Kalyani Publishers, New Delhi.
8. Loewy & Siekevitz. *Cell Structure & Function (II Ed.)*. Oxford & IBH Publishing Co. Pvt. Ltd, New Delhi.
9. Norman, V. Rothwell. *Understanding Genetics (IV Ed.)*. Oxford University Press, Oxford.
10. Shukla. *Cell Biology (2001)*. Dominant publishers, New Delhi
11. Singh B D. *Fundamentals of Genetics*. Kalyani Publishers, New Delhi
12. Sinnut, Dunn & Dobzhansky. *Principles of Genetics XIX reprint*. Tata McGraw-Hill Publishing Co. Ltd., New Delhi.
13. Srivastava & Tyagi. *Selected Problems in Genetics (Vol.1-3)*. Anmol Publications Pvt. Ltd., New Delhi
14. Stent & Calendar. *Molecular Genetics (II Ed.)*. CBS Publishers, New Delhi
15. Swanson & Webster. *The Cell (V edn)*. Prentice Hall of India Pvt. Ltd, New Delhi
16. William D. Stansfield. *Theory and Problems of Genetics (3<sup>rd</sup> Ed)*. Schaum's Outline series -McGraw-Hill Inc.

## **BSC 4.5: Introductory Crop Physiology**

**2 (1+1)**

Water relations in plants: role of water in plant metabolism, osmosis, imbibition, diffusion, water potential and its components, measurement of water potential in plants, absorption of water, mechanisms of absorption, ascent of sap. Stomata, structure, distribution, classification, mechanisms of opening and closing of stomata, osmotic pressure, guttation, transpiration, methods and mechanism, factors affecting transpiration. Different types of stresses: water, heat and cold tolerance, mechanism of tolerance. Plant nutrition: essentiality, mechanism of absorption, role in plant metabolism, Photosynthesis, importance of photosynthesis, Structure and function of chloroplast, dark and light reactions, , CO<sub>2</sub> fixation, biological nitrogen fixation, C<sub>3</sub>, C<sub>4</sub> and CAM, advantages of C<sub>4</sub> pathway, photorespiration and its implications. Factors affecting the photosynthesis. Respiration, glycolysis, TCA cycle and Electron transport chain, ATP synthesis and factors affecting the respiration.

### **Practical:**

Measurement of water potential by different methods, Osmosis – demonstration, Plasmolysis – demonstration, Root pressure – demonstration, Transpiration rate, Studying the structure of stomata, studying the opening and closing of stomata, Demonstration of importance of light in photosynthesis, Estimation of plant pigments, Studying the activity of catalase, Detection of phenols in plants, Studying the plant movements.

### **Reference**

A Textbook Of Plant Physiology, Biochemistry And Biotechnology By S.Verma , Mohit Verma  
Publisher S. Chand Limited, 2000

## **BSC 5.6 Environmental Science**

**2(1+1)**

### **Theory :**

Environment: introduction, definition and importance. Components of environment - interactions with organisms. Global and Indian environment - past and present status. Environmental pollution and pollutants. Air, water, food, soil, noise pollution - sources, causes and types. Smog, acid rain, global warming, ozone hole, eutrophication, sewage and hazardous waste management. Impact of different pollutions on humans, organisms and environment. Introduction to biological magnification of toxins. Deforestation - forms and causes, relation to environment. Prevention and control of pollution - technological and sociological measures and solutions - Indian and global efforts. India, international and voluntary agencies for environmental conservation - mandates and activities. International conferences, conventions and summits - major achievements. Environmental policy and legislation in India. Introduction to environmental impact assessment. Causes of environmental degradation - socio-economic factors. Human population growth and lifestyle.

### **Practical:**

Visit to local areas - river/forest/ grassland/catchment etc. to document components of ecosystem. Study of common plants, insects, birds and animals. Visit to industries to study pollution abatement techniques.

**Reference :** Ecology and Environment by P D Sharma

## **BSC 5.7: Elementary Plant Biochemistry**

**2 (1+1)**

### **Theory:**

Carbohydrates: Occurrence classification and structure, isomerism, optical activity, reducing property, reaction with acids and alkalis, ozone formation. Lipids: Classification, important fatty acids and triglycerides, essential fatty acids. Physical and chemical control of oils, their rancidity, phospholipids, types and importance. Plant pigments – structure and function of chlorophyll and carotenoids, Proteins: Classification, function and solubility, amino acids – classification and structure, essential amino acids, properties of amino acids, color reactions, amphoteric nature and isomerism; structure of proteins –primary, secondary tertiary and quaternary properties, 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.

### **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 Lowrys method; Fatty acids: Estimation of free fatty acids; Determination of iodine number of vegetable oils; Vitamins: Estimation of Ascorbic acid; Techniques, Extraction of oil from oil seeds.

### **Suggested Reading:**

1. Lehninger, Nelson, D. L. and Michael, M. C. 2004. *Principles of Biochemistry*. Freeman Publishers
2. Narayanan L M. Biochemistry. Saras Publications
3. Bose. Developments in Physiology Biochemistry & Molecular Biology of Plants Vol.-1. New India Publications.
4. Voet, D and Voet J. G. 2004. Biochemistry 4<sup>th</sup> Edn. Wiley & sons Publishers. USA.
5. Sadashiv, S and Manickam, A. 1996. Biochemical methods for Agricultural sciences. New age International publishers, New Delhi.
6. Voet, D. and Voet, J.G. 2004. (3<sup>rd</sup> edit). Biochemistry. John Wiley & sons Incl.USA.
7. Rameshwar, A. 2006. (3<sup>rd</sup> edit). Practical Biochemistry. Kalyani Publishers, NewDelhi.
8. Buchanan, B. B., Gruissem, W. and Jones, R. L. 2002. Biochemistry and molecular biology of plants. 2<sup>nd</sup> edition. Blackwell publications, UK.

## Social Science (SSC) (7+6= 13)

### SSC 1.1: Communication Skills and Personality Development

2(1+1)

#### Theory:

*Structural Grammar:* Introduction to Word Classes, Structure of the Verb in English, Uses of Tenses, Study of Voice, Use of Conjunctions and Prepositions, Sentence Structures and Patterns in English, Articles, Concord, Vocabulary and Composition, Use of Dictionaries-Thesauri and Theory of Translation.

*Spoken English:* Conversations of Different Situations in Everyday Life, the Concept of Stress, Stress Shift in Words and Sentences, Words with Silent Letters and Their Pronunciations, Concepts of Debate, Group Discussion, Elocution and Extempore. Organizing seminars and conferences.

#### Practical:

Structural Grammar: Exercises on Theoretical Topics, Common Mistakes in English, Diary Writing, Translation of General and Scientific Passages, Vocabulary Building, Comprehension Writing, Essay Writing, Paragraph Writing, Précis Writing, Letter Writing and Report Writing.

Spoken English: Short Talks, Dialogues, Conversations related to Everyday Situations, Preparation for Debate- Group Discussion, Elocution and Extempore Speeches, Reading Newspapers- Books and magazines.

#### References :

1. High School English Grammar and Composition ( In Gujarati )by P.C Wren (Author), H. Martin (Author), N.D.V. Prasada Rao (Editor)
2. Telephoning in English B.Jean Naterop and Rod Revell 1997 Cambridge University
3. English conversation practice, Grant Taylor, 1975, Tata Mc Grow Hill Publishing
4. Spoken English, V.Sashikumar & P.V.Dhamija, 1997, Tata Mc Grow Hill Publishing
5. Developing Communication Skills, Krishna Mohan and Meera and Meera Banerjee
6. 1001 ways to improve your conversation and speeches, Herbert V Prochnow, Jaico
7. Text for comprehension Current English for Colleges By N.Krishnaswamy & T. Sriraman Macmillan
8. English – Second language (Std.11)



## **SSC 2.2: Information and Communication Technology**

**2(1+1)**

### **Theory**

IT and its importance. IT tools, IT-enabled services and their impact on society; computer fundamentals; hardware and software; input and output devices; word and character representation; features of machine language, assembly language, high-level language and their advantages and disadvantages; principles of programming- algorithms and flowcharts; Operating systems (OS) - definition, basic concepts, introduction to WINDOWS and LINUX Operating Systems; Local area network (LAN), Wide area network (WAN), Internet and World Wide Web, HTML and IP; Introduction to MS Office - Word, Excel, Power Point. Teleconferencing; ICT in Extension education, ICT use in rural India.

### **Practical**

Exercises on binary number system, algorithm and flow chart; MS Word; MS Excel; MS Power Point; Internet applications: Web Browsing, Creation and operation of Email account; Analysis of horticulture data using MS Excel. Demonstration of video conferencing / teleconferencing system.

### **Suggested Readings**

1. Gurvinder Singh, Rachhpal Singh & Saluja KK. 2003. *Fundamentals of Computer Programming and Information Technology*. Kalyani Publishers.
2. Harshawardhan P. Bal. 2003. *Perl Programming for Bioinformatics*. Tata McGraw-Hill Education.
3. Kumar A 2015. *Computer Basics with Office Automation*. IK International Publishing House Pvt Ltd.
4. Rajaraman V & Adabala N. 2015. *Fundamentals of Computers*. PHI.

### SSC 3.3: Introductory Extension Education

2(1+1)

#### Theory:

Definition, need and principles of Extension Education. -Latest trends in Agriculture. Extension Teaching methods and classification according to use and form (only).-Detail studies of different teaching methods-Poster, leaflet, flash card. Method demonstration, result demonstration and field trip. Communication-Meaning and importance of communication-Elements of communication-Communication skills, verbal, writing, correspondence skill. Concept of KVK, ATMA, Kisan call centre and ATIC.

#### Practical:

Identification of Audio-visual aids and its classification, Preparation of Flash cards, Leaflets, folders etc, Use of OHP and P. A. System, Organization of method demonstration, Power point presentation, Preparation of interview schedules to collect profile of the farmers, Visit of Extension centres-KVK or SSK or IC Centres or EEI or NGO's or, exhibition or Farmer's fair and result demonstration or front line demonstration, Study of gram, taluka and district panchayat

#### References :

1. Dimension of Agril. Extension- by Chauhan,N. B., Patel B. S and Patel, R. C.
2. Education and Communication for Development. by Dhama, O. P. and Bhatnagar, P. (1987). Oxford and IBH publishing Co., New Delhi.
3. Extension Education in Community Development. by Directorate of Extension Education (1964). Director of Extension, Ministry of Agri., Government of India.
4. Hand Book of Extension Education by Rathore, O. S., Dhakar, S.D., Chauhan, M.S. and Ojha, S.N.(2001). Agrotech Publishing Academy, Udaipur.
5. Extension, Communication and Management by Ray, G. L. (1991).. Naya Prakash,206,Bidhan Sarani,Calcutta-6.
6. Extension Education by Reddy, A. A. (2001).. Shree Lakshmi Press, Bapatla (AP).
7. Text Book on Agricultural Communication process and Methods by Sandhu, A. S. (1993). Oxford and IBH Publishing Co. Pvt. Ltd.

### SSC 3.4: Social and Farm Forestry

2(1+1)

#### **Theory:**

Forest influences on climate, soil, conditions, floods, erosion, human health and recreation. Social Forestry - concept, need, objectives and scope of social forestry. Different tree species suitable for fuel, fodder, timber and their cultivation : Subabul, Sesbania, Eucalyptus, casuariana, neem, babul, teak, Sisso, Bamboo, Tamarind, Soapnut, Sandalwood. **Farm Forestry** - Definition, scope and objectives. Need for shelter belts and wind breaks, Design criteria, characteristics of tree species for Farm Forestry. Types of Farm Forestry - Commercial and non-commercial Farm forestry, Scope and limitations - role of multipurpose trees in farm forestry. **Agro-forestry** - Definition, need and scope - objectives and benefits of agro-forestry - classification of agro-forestry systems, choice of tree species suitable for agro-forestry. **Forest Products** - Major and minor Forest products.

#### **Practical:**

Identification of tree species suitable for timber, fuel wood and fodder, Identification of tree species suitable for waste lands and road side plantations, Identification of seeds of important tree species, Collection, extraction and storage of tree seeds. Application of pre-sowing seed treatments to problematic tree seeds, Preparation of nursery beds and sowing, Field planting techniques, Tree height measurement with instruments, Calculations of Volumes of wood, Identification of important minor forest products, Visit to Forest Nursery/ Forest Departments/ Forest Research Centre/Agro-forestry Systems.

#### **References :**

1. Social Forestry and Agroforestry text, Author : Divya M. P. 2008, Publisher : International books & periodicals supply service.
2. Book of Agro-forestry, Author : Gautam and Chundawat, Publisher : International books & periodicals supply service.
3. Social Forestry and Rural Development, Author : Khosla P.K., Publisher : International books & periodicals supply service.
4. An Introduction to Agro-forestry, Author : PKR Nair, Publisher : Khanna Bandhu, 7, Tilak Road, Dehradun - 248 001.

**Theory**

Introduction to statistics, limitations of statistics. Basic concepts: Variable statistics, types and 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 of location, mean, mode, median, weighted mean, geometric mean, harmonic mean, for raw and grouped data. Dispersion: Range, standard deviation, variance, standard error of mean, coefficient of variation for raw and grouped data. Probability: Basic concept, additive and multiplicative laws. Theoretical distributions, normal distributions, sampling, basic concepts, sampling vs. complete enumeration parameter and statistic, sampling methods, simple random sampling and stratified random sampling. Tests of Significance: Basic concepts, tests for equality of means, and independent and paired t-tests, chi-square test for application of attributes and test for goodness of 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 regression coefficient. Experimental designs: Basic concepts, completely randomized design, randomized block design, Computer application in applied statistics

**Practical**

Construction of frequency distribution table and its graphical representation, histogram, frequency polygon, frequency curve, bar chart, simple, multiple, component and percentage bar charts, pie chart, mean, mode and median for row and grouped data, Measure of dispersion, coefficient of variation, “t” test for independent, will equal and unequal variants, paired “t” test, chi-square test for contingency tables and theoretical ratios, correlation and linear regression. Studies on computer application in applied statistics.

**Suggested Reading:**

1. Gupta, S. C. and Kapoor, V. K. 2014. Fundamentals of Mathematical Statistics. Sultan chand and sons. New Delhi NageswaraRao,G.2007.*Statisticsfor AgriculturalSciences*. BSPublications,Hyderabad.
2. Rangaswamy,R.1995.*ATextBookofAgriculturalStatistics*.NewAgeInternationalPublishing Limited, Hyderabad.
3. Gupta, V.,2002. *ComdexComputer Kit*. DreamTechPress,NewDelhi.
4. Parmar,A.Mathur,N.DeepthiP.U.andPrasanna, V. B., 2000.*Workingwith WINDOWS A HandsonTutorials*. Tata McGrawHill Publishing Co., NewDelhi.
5. Bandari, V. B., 2012. *Fundamentals of Information Technology*. Pearson Education,New Delhi.
6. Fundamentals of Computers. 2011. Pearson Education-ITL ESL, New Delhi

**Theory:**

Nature and scope of economics, definition and concepts, divisions of economics, economic systems, 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 of equi-marginal utility, indifference curve and its properties, consumer equilibrium. Theory of demand, demand schedule and curve, market demand, Law of supply – supply schedule and curve elasticities, Price, income and cross elasticities, Engels law of family expenditure – consumers surplus. Theory of firm, factors of production – land and its characteristics, labour and division of labour, theories of population. Capital and its characteristics – classification and capital formation, cost concepts, Market equilibrium, Marketing- definition – Marketing Process – Need for marketing – Role of marketing — Marketing functions – Classification of markets – Identification of various marketing channels – Price spread – Marketing Efficiency –Integration –Constraints in marketing of horticultural/agricultural produce, Market intelligence

**Practical**

Demand and supply analysis, Farm cost concept and calculation, Identification of marketing channel– Calculation of Price Spread – Identification of Market Structure – Visit to different Markets, Exercise on market integration and marketing efficiency.

**Suggested Reading**

1. Dewett, K.K. and Chand, A.1979. *Modern Economic Theory*. S.Chand and Co., New Delhi
2. Dewett, K.K. and Varma, J.D. 1986. *Elementary Economics*. S.Chand and Co., New Delhi.
3. Gupta RD & Lekhi RK. 1982. *Elementary Economic Theory*. Kalyani Publishers.
4. SS Acharya and N L Agarwal. 2005. *Agricultural Marketing in India*. Oxford and IBH Publishing Co. Pvt. Ltd
5. Subba Reddy, S., Raghu ram, P., Neelakanta Sastry T.V., Bhavani Devi. I., 2010, *Agricultural Economics*, Oxford & IBH Publishing Co. Private Limited, New Delhi
6. C.N. Sontakki. *Marketing Management*. Kalyani Publishers, New Delhi.