

SEMESTER-II

HORT 151: 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, 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, 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 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, economic of production.

Practical

Description and identification of varieties based on flower and fruit morphology in above crops. Training and pruning of grapes, mango, guava and citrus. Selection of site and planting system, pre-treatment of banana suckers, desuckering 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. Mapping of arid and semi-arid zones of India. Botanical description 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.
- M.S.Ladaniya, 2013. *Citrus Fruits*. Elsevier, India post ltd.
- Bose, T.K., Mitra, S.K. and Sanyal, D., 2002. *Tropical and Sub-Tropical-Vol-I*. Naya udyog-Kolkata
- Rajput, CBS and Srihari babu, R., 1985. *Citriculture*. Kalyani Publishers, 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.
- Symmonds, 1996. *Banana*. II Edn. Longman, London.
- Radha T and Mathew L., 2007. *Fruit crops*. New India Publishing Agency.
- W S Dhillon, 2013. *Fruit Production in India*. Narendra Publishing House, New Delhi
- T.K.Chattopadhyay, 1997. *Text book on pomology*. Kalyani Publishers, New Delhi.
- R.E.Litz, 2009. *The Mango* 2nd Edn. Cabi Publishing, Willingford, U.K.
- K.L.Chadda, 2009. *Advanced in Horticulture*. Malhotra Publishing House, New Delhi.
- S.P. Singh, 2004. *Commercial fruits*. Kalyani Publishers, New Delhi.
- F.S. Davies and L.G.Albrigo, 2001. *Citrus*, Cab International.

HORT 152: Tropical and Subtropical Vegetable Crops**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, post-harvest handling, economics and marketing of tropical and sub-tropical vegetable 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 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.

Suggested Reading:

- S. Thamburaj, 2014. *Text book of vegetable, tuber crops and Spices*. ICAR, New Delhi
- B.R.Choudhary, 2009. *A Text 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.
- K.V.Kamath, 2007. *Vegetable Crop Production*. Oxford Book Company. Jaipur
- M.S.Dhaliwal, 2008. *Handbook of Vegetable Crops*. Kalyani Publishers. Ludhiana
- Singh, Umashankar, 2008. *Indian Vegetables*. Anmol Publications. Pvt.Ltd .New Delhi.
- K S Yawalkar, 2008. *Vegetable crops in India*. Agri-Horticultural Pub. House. Nagpur. 2004
- 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
- Uma Shankar, 2008. *Vegetable Pest Management Guide for Farmers*. International Book Distribution Co. Publication. Lucknow.
- 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 & IBH Publishing Co. Pvt. Ltd, 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.
- Premnath, Sundari Velayudhan and Singh, D.P., 1987. *Vegetables for the tropical region*. ICAR, New Delhi.

HORT 153: Ornamental Horticulture

3(2 +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, biennales herbaceous perennials, grasses and bulbous ornamentals. shrubs, climbers, trees, indoor plants, palms and cycads, ferns and sellagenellas, cacti and succulents. History of Gardening in India. 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, retaining walls, shade garden, sunken garden, roof garden, terrace garden, pebble garden, rockery, pools, waterfalls, fountains, bog garden, avenue planting and children garden. Lawn types, establishment and maintenance. Importance of Garden adornments viz. floral clock, bird bath, statues, 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. Planning and designing and establishment of garden features viz. lawn, hedge and edge, rockery, water garden, carpet bedding, shade garden, roof garden, Study and creation of terrariums, vertical garden, 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.

Richard Bird. 2002. Flowering trees and shrubs. Printed in Singapore by Star Standard Industries pvt. Ltd.

Bimaldas Chowdhury and Balai Lal Jana.2014.Flowering Garden trees. Pointer publishers, Jaipur. India.

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 and Information division. ICAR, New Delhi.

HORT 154: Plant Propagation and Nursery Management

2 (1+1)

Theory

Propagation: Need and potentialities for plant multiplication, sexual and asexual methods of propagation, advantages and disadvantages. Seed dormancy types of dormancy (scarification & stratification) internal and external factors, nursery techniques nursery management, apomixes – mono-embryony, polyembryony, 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 with examples and vegetative propagation, methods and techniques of division-stolons, pseudobulbs, offsets, runners, cutting, layering, grafting, formation of graft union, factor affecting, healing of graftage and budding physiological & bio chemical basis of rooting, factors influencing rooting of cuttings and layering, graft incompatibility. Micrografting, meristem culture, callus culture, anther culture, organogenesis, somaclonal variation hardening of plants in nurseries. Nursery registration act. Insect/pest/disease control in nursery,

Practical

Media for propagation of plants in nursery beds, potting and repotting. Preparation of nursery beds and sowing of seeds. Raising of rootstock. Seed treatments for breaking dormancy and inducing vigorous seedling growth. Preparation of plant material for potting. Hardening plants in the nursery. Practicing different types of cuttings, layering, graftings and buddings including opacity and grafting, top grafting and bridge 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, labelling and packing of nursery fruit 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.. Nutrient and plant protection applications during nursery.

Suggested Reading:

- Hudson T. Hartmann, Dale E. Kester, Fred T. Davies, Jr. and Robert L. Geneve. *Plant Propagation-Principles and Practices(7th Edition)*. PHI Learning Private Limited, New Delhi-110001
- 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.
- Guy W. Adriance and Feed R. Brison. *Propagation of Horticultural Plants*. Axis Books (India).
- S. Rajan and B. L. Markose (series editor Prof. K.V.Peter). *Propagation of Horticultural Crops-Horticulture Science Series vol.6*. New India Publishing Agency, Pitam Pura, New Delhi-110088.
- Hartman,H.T and Kester,D.E.1976.*Plant Propagation Principles and practices*. Prentice hall of India Pvt.Ltd., Bombay.
- Sadhu,M.K.1996. *Plant Propagation*. New age International Publishers, New Delhi.
- Mukherjee,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 IBN publishing Co., New Delhi.
- Sarma,R.R.2002. *Propagation of Horticultural Crops*.Kalyani Publishers,(Principles and practices) New Delhi.
- Symmonds,1996. *Banana*.II edition Longman, London.
- 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.

HORT 155: Growth and Development of Horticultural Crops

2(1+1)

Theory

Growth and development-definitions, components, photosynthetic productivity, Canopy photosynthesis 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, 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-climatic and non-climacteric fruits. Physiology of fruits under post-harvest storage.

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 cuttings, 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 and breaking seed dormancy with chemicals and growth regulators.

Suggested Reading:

Salisbury. 2007. *Plant Physiology*. CBS. New Delhi.
 Taiz, L. 2010. *Plant Physiology*. SINAUR. USA.
 Zeiger. 2003. *Plant Physiology*. PANIMA. New Delhi.
 Edward E. Durna. 2014. *Principles of Horticultural Physiology*. CABI, UK.
 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. *Plant Physiology*.
 JKA Bleasdale, *Plant Physiology in relation to Horticulture*
 Amarjit Basra, *Plant Growth Regulators in Agriculture and Horticulture: Their role & Commercial Uses*
 C.Rajendran, K.Ramamoorthy and S. Juliet Hepziba, *Nutritional and Physiological Disorders in Crop Plants*

GPB(H) 156: Principles of Plant Breeding**3 (2+1)****Theory**

Plant breeding as a dynamic science, genetic basis of Plant Breeding – classical, 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. Calculation of heterosis, heterobeltosis, GCA, SCA, inbreeding depression, heritability and genetic advance. Emasculation, pollination techniques in important horticultural crops. 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. Hardy Weinberg Law and calculation, male sterility and incompatibility studies in horticultural crops calculation 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
 J.R. Sharma. *Principles and practices of plant breeding*. Tata McGraw Publishing Company Ltd., New Delhi
 B.D. Singh. *Plant breeding : principles and methods*. Kalyani Publishers, Ludhiana.
 R.C. Chaudhary. *Plant Breeding*
 Hays and Garber. *Breeding crop plants*. Mc Graw Hill Publications, New York

- G K Kallo. *Breeding of vegetables*. Panima publishers, New Delhi
- W.R. Fehr. *Principles of cultivar development: theory and technique (Vol. 1)*. Macmillan Publishing Company, New York.
- D.S. Falconer. *Introduction to quantitative genetics*. Longman Scientific & Technical, Longman Group, UK, Ltd., England.
- R.K. Singh and B.D. Chaudhary. *Biometrical methods in quantitative genetic analysis*. Kalyani Publishers, Ludhiana.
- K. Mather and J.L Jinks. *Introduction to Biometrical genetics*. Chapman and Hall, London
- 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.
- Poehlman, J.M. and Borthakar, D. 1995. *Breeding Asian Field Crops*. Oxford& IBH Publishing Co., New Delhi

PPH(H) 157: Fundamental of 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 of water, 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: Different types of stresses; water, heat and cold tolerance; mechanism of tolerance. Plant Nutrition: Essentiality, mechanism of absorption and its role in plant metabolism. Biological Nitrogen Fixation Photosynthesis, structure and function of chloroplast, dark and light reactions, cyclic and non-cyclic electron transfer, CO₂ fixation – C₃, C₄ and C₄ 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:

- Salisbury. 2007. *Plant Physiology*. CBS. New Delhi.
- Taiz, L. 2010. *Plant Physiology*. SINAUR. USA.
- Zeiger. 2003. *Plant Physiology*. PANIMA. New Delhi.
- Edward E. Durna. 2014. *Principles Of Horticultural Physiology*. CABI, UK.
- 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*
- Noggle G.R and Fritz T.G. *Introductory Plant Physiology*
- Pandey and Sinha. *Plant Physiology*
- Salisbury and Ross. *Plant Physiology*
- Carl fedtke. *Biochemistry and Physiology of Herbicide Action*

Aswani pareek, S.K. Sopory, Hans Bohnert Govindjee. Abiotic stress adaptation in plants: Physiological, Molecular and Genomic foundation
 Horst Marschner, Mineral Nutrition of Higher plants

ACSS(H) 158: 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 microorganisms in organic matter- decomposition – humus formation. Importance of C:N ratio and pH in plant nutrition, soil buffering capacity. 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, visual diagnosis. Plant nutrient toxicity symptoms and remedies measures. Soil test crop response and targeted yield concept. Biofertilizer. Nutrient use efficiency and management. Secondary and micronutrient fertilizer. Fertilizer control order. Manures and fertilizers classification and manufacturing process. Properties and fate of major and micronutrient in soils. Fertilizer use efficiency 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 of organic carbon content in soil. Determination of Boron and chlorine content In soil. Determination of Calcium, Magnesium and Sulphur in soil. Sampling of organic manure and fertilizer for chemical analysis. Physical properties of organic manure and fertilizers. Total nitrogen in urea and farmyard manure. Estimation of ammonical nitrogen and nitrate nitrogen in ammonical fertilizer. Estimation of water soluble P₂O₅, Ca and S in SSP, Lime and Gypsum. Estimation of Potassium 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..
- Seetharaman S, Biswas B C, Yadav D S and Matheswaru S. Usage 1996. *Hand Book on Fertilizers*. Oxford and IBH Publishing Company, New Delhi.
- The fertilizer Association of India, Shaheed Jit singh marg, New Delhi, 1985. Fertilizer control order
- Ranjan Kumar Basak , 2000. *Fertilizers A Text book*. Kalyani publishers, New Delhi.
- British Crop Production Council, U.K., 1995. *The Pesticide Manual, A – World Compendium*.
- Sree Ramulu US, 1991. *Chemistry of Insecticides*. Oxford and IBH Publishing and Fungicides Company, New Delhi.
- Nene Y L and Thapliyal P N, 1991. *Fungicides in plant disease control*. Oxford and IBH Publishing company, New Delhi.
- Havlin *et al.* 2014. *Soil Fertility and Fertilizers: An Introduction to Nutrient Management* (8th Edition), PHI Learning Pvt. Ltd., Delhi.
- Binkley, D. and R. Fisher, 2012. *Ecology and Management of Forest Soils* (4th Edition), John Wiley & Sons Singapore Pvt. Ltd., Singapore
- Reddy M. V., 2001. *Management of Tropical Plantation Forests and Their Soil Litter System- Litter, Biota and Soil Nutrient Dynamics*, Science Publishers, U. S.
- Khan, T. O., 2013. *Forest Soils: Properties and Management*. Springer International Publishing, Switzerland
- Brady, N. C. and Weil, R. R., 2010. *Elements of the Nature and Properties of Soils* (3rd Edition.), Pearson Education, New 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.
- Pritchett and Fisher RF, 1987. *Properties and Management of Forest Soils*. John Wiley, New York.
- Gupta, P.K., 2009. *Soil, Plant, Water and Fertilizer Analysis* (2nd Edition), AGROBIOS, Jodhpur (India).
- Jaiswal, P.C., 2006. *Soil, Plant and Water Analysis* (2nd Edition), Kalyani Publishers, Ludhiana.
- Jackson, M. L., 2012. *Soil Chemical Analysis: Advanced Course*, Scientific Publisher
- [J. Benton Jones, Jr.](#), 2012. *Plant Nutrition and Soil Fertility Manual* (2nd Edition), CRC Press, USA.
- Mengel, *et al.*, 2001. *Principles of Plant Nutrition* (5th Edition), Springer
- Kanwar, J.S. (Ed.), 1976. *Soil Fertility: Theory and Practice*, ICAR, New Delhi
- Bear, F.E., 1964. *Chemistry of the Soil*. Oxford and IBH Publishing Co., New Delhi
- Richards, L.A., 1968. *Diagnosis and Improvement of Saline and Alkaline Soils*. Oxford & IBH Publishing Co. New Delhi (USDA Handbook No. 60)
- Chopra, S. and Kanwar, J.S., 1976. *Analytical Agricultural Chemistry*. Kalyani Publishers, Ludhiana.
- Tisdale, S.L., Nelson, W.L. and Beaton, J.D., 1993. *Soil Fertility and Fertilizers*. Macmillan Publishing Company, New York
- Yawalkar, K.S., Agarwal, J.P. and Bokde, S., 1977. *Manures and Fertilizers*. Agricultural Publishing House, Nagpur
- Seetharaman, S., Biswas, B.C., Maheswari, S. and Yadav, D.S., 1986. *Handbook on Fertilizers Technology*. The Fertilizers Association of India, New Delhi

ABT(H) 159: Fundamentals of Plant Biotechnology

2(1+1)

Theory

Concepts of Plant Biotechnology: History of Plant Tissue Culture and Plant Genetic Engineering; 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; Somaclonal variation, 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 gene transfer – Gene cloning – Direct and indirect method of gene transfer – Transgenic plants and their 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 crop improvement. Nanotechnology: Definition and scope, types of nano material and their synthesis, green synthesis. Tools and techniques to characterize the nano particles. Nano-biotechnological applications with examples, Nano toxicology and safety.

Practical

Requirements for Plant Tissue Culture Laboratory; Techniques in Plant Tissue Culture; Media components and preparations; Sterilization techniques and Inoculation of various explants; Aseptic manipulation of various explants; Callus induction and Plant Regeneration; Micro propagation of important crops; Anther, Embryo and Endosperm culture; Hardening / Acclimatization of regenerated plants; Somatic embryogenesis and synthetic seed production; Isolation of protoplast; Demonstration of Culturing of protoplast; Demonstration of Isolation of DNA; Demonstration of Gene transfer techniques, direct methods; Demonstration of Gene transfer techniques, indirect methods; Demonstration of Confirmation of Genetic transformation; Demonstration of gel-electrophoresis techniques. 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.
- Gautam V K, 2005. *Agricultural Biotechnology*. Sublime Publications
- Thomar, R.S., Parakhia, M.V., Patel, S.V. and Golakia, B.A., 2010. *Molecular markers and Plant biotechnology*, New Publishers, New Delhi.
- Purohit, S.S., 2004. *A Laboratory Manual of Plant Biotechnology* 2nd Edn. Agribios, India.
- Singh, B.D. 2012. *Plant biotechnology*. Kalyani publishers, Ludhiana
- Bilgrami, K.S. and Pandey, A.K.1992. *Introduction to biotechnology*. CBS Pub. New Delhi
- Gupta, P.K. 1994. *Elements of biotechnology*. Rastogi Pub. Meerut.
- Chahal, G.S. and Gosal, S.S.2003. *Principles and procedures of plant approaches breeding Biotechnological and conventional*. Narosa Publishing House, New Delhi

AEC(H) 160: Introductory Economics

2(2+0)

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. 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 its characteristics – classification and capital formation. Enterprises – forms of business organization – merits and demerits. Laws or return – law of diminishing marginal return – cost concepts. Law of supply – supply schedule and curve elasticities. Market equilibrium, distribution – theories of rent, wage, interest and profit. Price determination and forecasting under various market structures. Marketing-definition – Marketing Process – Need for marketing – Role of marketing — Marketing functions – Classification of markets – Marketing of various channels – Price spread – 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

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- Chandra P. 1984. *Projects: Preparation, Appraisal & Implementation*. McGraw Hill Inc.
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- Kotler Philip and Armstrong. *Principles of Marketing*. Prentice-Hall.
- Jhingan, M.L. 2012. *Macro Economic Theory*. Vrinda publishers, New Delhi .
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- Subba Reddy, S., Raghu ram, P., Neelakanta Sastry T.V., Bhavani Devi. I., 2010, *Agricultural Economics*, Oxford & IBH Publishing Co. Private Limited, New Delhi

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- Aswathappa. *International Business*. Tata McGraw-Hill Education, New Delhi
- Fransis Cherunilam. *International Business: Text and Cases*, 5th Ed. PHI Learning, New Delhi.
- Prasanna Chandra. *Projects*. Tata McGraw-Hill Publication, New Delhi
- John M. Nicholas. *Project Management for Business and Technology – Principles and Practices*. Pearson Prentice Hall
- Harold Kerzner. *Project Management – A System Approach to Planning, Scheduling, and Controlling*. CBS Publishers & Distributors.
- Prasanna Chandra. *Projects – Planning, Analysis, Selection, Financing, Implementation, and Review*. Tata McGraw-Hill Publishing Company Ltd.
- P. Gopalakrishnan and V.E. Rama Moorthy. *Textbook of Project Management*. Macmillan.