

Fruit Science Lab



DEPARTMENT OF FRUIT SCIENCE

Course No. H/FS - 111
hours - (2+1) 3

Course Title: Fundamentals of Horticulture Credit
Semester: I

Theory: Scope and importance, classification of horticultural crops and nutritive value, area and production, exports and imports, fruit and vegetable zones of India and of different states, nursery techniques and their management, soil and climate, vegetable gardens, nutrition and kitchen garden and other types of gardens – principles, planning and layout, management of orchards, planting systems and planting densities. Production and practices for fruit, vegetable and floriculture crops. Principles objectives, types and methods of pruning and training of fruit crops, types and use of growth regulators in horticulture, water management– irrigation methods, merits and demerits, weed management, fertility management in horticultural crops– manures and fertilizers, different methods of application, cropping systems, intercropping, multi-tier cropping, mulching– objectives, types merits and demerits, Classification of bearing habits of fruit trees, factors influencing the fruitfulness and unfruitfulness. Principles of organic farming.

Practical: Features of orchard, planning and layout of orchard, tools and implements, identification of various horticultural crops, 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, assessment of bearing habits, maturity standards, harvesting, grading, packaging and storage.

Lesson/Course Plan-Theory

Lecture No.	Topic	Weightage (%)
1-2	Economic importance and classification of horticultural crops	10
3	Culture and nutritive value, area and production, exports and imports	5
4-5	Fruit and vegetable zones of India and of different states, soil and climate,	10
6-8	Vegetable gardens, nutrition and kitchen garden and other types of gardens	10
9-10	Principles, planning and layout, management of orchards, planting systems and planting densities	10
11-12	Production and practices for fruit, vegetable and floriculture crops, nursery techniques and their management.	10
13-14	Principles objectives, types and methods of pruning and training of fruit crops	5
15-16	Types and use of growth regulators in horticulture	5
17	Water management– irrigation methods, merits and demerits	5
18 -20	Weed management	3
15 -16	Fertility management in horticultural crops-manures and fertilizers, different methods of application	8
17-20	Cropping systems, intercropping, multi-tier cropping, mulching– objectives, types merits and demerits,	8
21-23	Classification of bearing habits of fruit trees, factors influencing the fruitfulness and unfruitfulness.	5
24 -28	Principles of organic farming	4
29- 32	Recommendations of Joint Agresco	2

Practical
Features of orchard, planning and layout of orchard
Identification of tools and implements
Layout of nutrition garden.
preparation of nursery beds for sowing of vegetable seeds
Digging of pits for fruit plants
Study of planting systems
Training and pruning of orchard trees.
Preparation of fertilizer mixtures and field application.
Preparation and application of growth regulators (Powder form).
Preparation and application of growth regulators (Lanolin Paste)
Layout of different irrigation systems.
Identification and management of nutritional disorder in fruits.
Assessment of bearing habits.
Maturity standards of horticultural crops,
Study of harvesting and grading of horticultural crops
Study of packaging and storage of horticultural crops

Suggested Reading:**Reference Books:**

- Chadha, K.L. (ICAR), 2002, 2001. *Handbook of Horticulture*, ICAR, New Delhi
- D.K. Salunkhe and S.S. Kadam, 2013. *A handbook of Fruit Science and Technology*. CRC Press.
- Denisen E.L., 1957. *Principles of Horticulture*. Macmillan Publishing Co., New York.
- Edmond, J.B., Sen, T.L., Andrews, F.S. and Halfacre R.G., 1963. *Fundamentals of Horticulture*. Tata McGraw Hill Publishing Co., New Delhi.
- Gardner/Bardford/Hooker. J.R., 1957. *Fundamentals of Fruit Production*. Mac Graw Hill Book Co., New York.
- Jitendra Singh, 2002. *Basic Horticulture*. Kalyani Publishers, Hyderabad.
- K.V. Peter, 2009. *Basics Horticulture*. New India Publishing Agency
- Kausal Kumar Misra and Rajesh Kumar, 2014. *Fundamentals of Horticulture*. Biotech Books.
- Kumar, N., 1990. *Introduction to Horticulture*. Rajyalakshmi publications, Nagarcoil, Tamilnadu
- Neeraj Pratap Singh, 2005. *Basic concepts of Fruit Science* 1st Edn. IBDC Publishers.
- Prasad and Kumar, 2014. *Principles of Horticulture* 2nd Edn. Agrobios (India).
- S. Prasad and U. Kumar, 2010. *A handbook of Fruit Production*. Agrobios (India).

e-reading: <http://ecourses.iasri.res.in/>

Course No. H/FS–122

Course Title: Plant Propagation and Nursery Management

Credit hours - (1+1) 2

Semester: II

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, polyhouses, 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. 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, corm, runners, suckers. Micrografting, Nursery registration act. Insect/pest/disease control in nursery Cost of establishment of propagation structures.

Practical: Media for propagation of plants in nursery beds, pot and mist chamber. 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 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. Top grafting, bridge grafting and nursery management. Nutrient and plant protection applications during nursery.

Lesson/Course Plan- Theory

Lectures No.	Topic	Weightage (%)
1	Definition and need of plant propagation, potentials of plant multiplication.	10
2	Sexual and asexual methods of plant propagation and their advantages and disadvantages.	10
3	Seed germination and dormancy - internal and external factors affecting seed dormancy and seed treatment (Scarification and stratification)	10
4	Apomixis - definition, monoembryony, polyembryony, chimera etc.	5
5	Nursery techniques and nursery management cuttings, layerings grafting, budding, runners, tubers, corms, rhizomes off sets, stolons and other specification organs.	10
6	Propagations structures - mist chamber, humidifiers, green house, glass house, cold frames, hot beds, polyhouses, etc. and cost of establishment of structure.	5
7	Use of growth regulators in plant propagation.	5
8	Selection of mother trees, maintenance of mother trees & budwood certification.	10
9	Factors affecting vegetative propagation,	5
10	Anatomical study of bud union and rooting (Physiological and biochemical basis)	3

11	Scion stock relationship	5
12	Micrografting	5
13	Hardening of plants in nurseries.	4
14	Insect - pest & disease control in nursery	5
15	Nursery registration act and record keeping	5
16	Cost of establishment of propagation structures.	3
	Total	100

Practical programme

Practical No.	Particulars
1	Study of different media for plant propagation.
2	Preparation of nursery beds and sowing seeds.
3	Seed treatments for breaking seed dormancy, including germination and growth of seedlings.
4	Raising root stock in various containers.
5	Potting reporting and preparation of plant material for potting.
6	Practicing different types of cutting, layering
7	Practicing different types of runner, offsets and other specialized plant organs for propagation.
8	Practicing different budding method.
9	Practicing different grafting methods.
10	Preparation growth regulators for seed germination and vegetative propagation.
11	Use of mist chamber in plant propagation and hardening of plants.
12	Digging, labeling and packing of nursery plant.
13	Nutrients application and plant protection measures in nursery.
14	Raising, maintenance and cost of different nursery structure.
15	Maintenance of nursery record.
16	Visit to tissue culture laboratory. Visit to established model Govt. and Private Nurseries of adjoining areas

Suggested readings :

Reference Books:

- Chadha, K.L. (ICAR) 2002, 2001. *Hand book of Horticulture*. ICAR, New Delhi.
- Chundawat, B.S. 1990. *Arid fruit culture*. Oxford and IBH, New Delhi.
- Ganner, R.J. and Choudhri, S.A. 1972. *Propagation of Tropical fruit trees*. Oxford and IBN publishing Co., New Delhi.
- Guy W. Adriance and Feed R. Brison. *Propagation of Horticultural Plants*. Axis Books (India).
- Hartman, H.T and Kester, D.E. 1976. *Plant Propagation Principles and practices*. Prentice hall of India Pvt.Ltd., Bombay.
- 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
- Mukherjee, S.K. and Majumdar, P.K. 1973. *Propagation of fruit crops*. ICAR, New Delhi.
- 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, Pitampura, New Delhi-110088.
- Sadhu, M.K. 1996. *Plant Propagation*. New age International Publishers, New Delhi.
- Sarma, R.R. 2002. *Propagation of Horticultural Crops*. Kalyani Publishers, (Principles and practices) New Delhi.
- Symmonds, 1996. *Banana*. II edition Longman, London.

Course Title: Tropical and Sub-Tropical Fruits

Credit hours - (2+1) 3

Semester: III

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, pomegranate, pineapple, jackfruit, avocado, mangosteen, kokum, litchi, carambola, durian, rambutan, bilimbi, loquat, rose apple, breadfruit. Bearing in mango and citrus, causes and control measures of special production problems, alternate and irregular bearing overcome, control measures. Seediness and kokan 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 pomegranate, carissa, West Indian cherry.

Lesson/Course Plan -

Lectures No.	Topics	Weightage (%)
1	Scope and importance of fruit growing in India and Maharashtra	10
2	Horticultural classification of fruits including genome classification	5
3	Horticultural zones of India and Maharashtra 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.	5
4-5	Mango, Banana	10
6-7	Grapes, Citrus	10
8-10	Papaya, Sapota, Guava	10
11-13	Pomegranate, Litchi, Pineapple	5
14-15	Amla, Bael, Anona and Ber	5
16-17	Fig, Jackfruit, Avocado and Mangosteen	
18-19	Carambola, Durian, Rambutan and Bilimbi	5
20-21	Loquat and Rose apple, Breadfruit and Passion fruit.	
22	Special production problems in mango (Spongy tissue, Black tip, Malformation etc and their control measures	4

23	Bearing in mango, causes: Alternate and irregular bearing, control measures.	4
24	Seediness and kokan disease in banana.	4
25	Citrus decline and casual factors and their management.	3
26	Bud forecasting in grapes	3
27-28	Sex expression and seed production in papaya Latex extraction and crude papain production in papaya and economics of production	4
29	Rainfed horticulture	4
30	Importance and scope of arid and semi-arid zones of India.	3
31	Characters and special adaptation of crops: ber, aonla, annona, jamun, wood apple, bael, pomegranate.	3
32	Characters and special adaptation of crops: Carissa, date palm, phalsa, fig, west Indian cherry and tamarind and Joint Agresco recommendations	3
Total		100

Practical programme

Practical No.	Topics
1	Description and identification of varieties based on flower and fruit morphology in tropical crops.
2	Description and identification of varieties based on flower and fruit morphology in subtropical crops.
3	Training and pruning of grapes, mango, guava and citrus.
4	Selection of site and planting system
5	Pre-treatment of banana suckers, desuckering in banana
6	Sex forms in papaya, seed production in papaya, latex extraction and preparation of crude papain
7	Use of plastics in fruit production
8	Visit to commercial orchards and diagnosis of maladies
9	Manure and fertilizer application including bio-fertilizer in fruit crops
10	Preparation and application of growth regulators in banana, grapes and mango.
11	Ripening of fruits
12	Grading and packaging,
13	Production economics for tropical and sub-tropical fruits.
14	Mapping of arid and semi-arid zones of India.
15	Botanical description and identification of ber, fig, jamun, pomegranate, carissa, phalsa
16	Botanical description and identification of wood apple, West Indian cherry, tamarind, aonla, bael and annona

Suggested Reading:

Text Books:

T.K.Chattopadhyay, 1997. *Text book on pomology*. Kalyani Publishers, New Delhi. udyog-Kolkata

Reference Books:

Bose, T.K., Mitra, S.K. and Sanyal, D., 2002. *Tropical and Sub-Tropical-Vol-I*. Naya

H.P.Singh and M.M.Mustafa, 2009. *Banana*-new innovations. Westville PublishingHouse, New Delhi.

K.L.Chadda, 2009. *Advanced in Horticulture*. Malhotra Publishing House, New Delhi. M.S.Ladaniya, 2013. *Citrus Fruits*. Elsevier, India post ltd, New Delhi

R.E.Litz, 2009. *The Mango* 2nd Edn. Cabi Publishing, Willingford, U.K.

Radha T and Mathew L., 2007. *Fruit crops*. New India Publishing Agency.

Rajput, CBS and Srihari babu, R., 1985. *Citriculture*. Kalyani Publishers, New Delhi.

S.P. Singh, 2004. *Commercial fruits*. Kalyani Publishers, New Delhi. Symmonds, 1996. *Banana*. II Edn. Longman, London.

W.S. Dhillon, 2013. *Fruit Productionin India*. Narendra Publishing House.

e-reading: <http://ecourses.iasri.res.in/>

Course No: H/ FS -359

Course Title: Orchard and Estate Management

Credit hours: (1+1) 2

Semester: V

Theory: Orchard and estate management, importance, objectives, merits and demerits, clean cultivation, sod culture, Sod mulch, herbicides and inorganic and organic mulches. Tropical, sub-tropical and temperate horticultural systems, competitive and complimentary effect of root and shoot systems. Biological efficiency of cropping systems in horticulture, systems of irrigation. Soil management in relation to nutrient and water uptake and their effect on soil environment, moisture, organisms and soil properties. Factors influencing the fruitfulness and unfruitfulness. Rejuvenation of old orchards, top working, frame working, Integrated nutrient and pest management. Utilization of resources constraints in existing systems. Crop model and crop regulation in relation to cropping systems. Climate aberrations and mitigation measures of Horticultural crops.

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

Lesson/Course Plan- Theory

Lecture No.	Topics	Weightage (%)
1	Orchard and estate management, importance, objectives, merits and demerits	10
2	Clean cultivation, sod culture, Sod mulch, herbicides and inorganic and organic mulches.	8
3	Wind break and Shelter belts	5
4	Tropical, sub-tropical and temperate horticultural planting systems,	8
5	High Density Planting, Use of rootstocks	5
6	Competitive and complimentary effect of root and shoot systems.	5
7	Biological efficiency of cropping systems in horticulture,	5
8	Systems of irrigation.	8
9	Soil management in relation to nutrient and water uptake and their effect on soil environment, moisture, organisms and soil properties.	8
10	Factors influencing the fruitfulness and unfruitfulness	8
11	Special Horticulture Practices	5
12	Rejuvenation of old orchards, top working, frame working,	8
13	Integrated nutrient and pest management.	5
14	Utilization of resources constraints in existing systems.	4
15	Crop model and crop regulation in relation to cropping systems.	4
16	Climate aberrations and mitigation measures of Horticultural crops.	4
Total		100

Practical programme -

Practical No.	Topics
1	Layout of different systems of orchard
2	Layout of different systems of estate
3	Soil management Practices
4	Study of Clean cropping
5	Study of Inter cropping and Fillers crop
6	Study of Cover cropping
7	Study of Mixed cropping
8	Moisture conservation measures
9	Study of methods of weed control
10	Use of organic and inorganic mulch materials
11	Types of weed and weed control
12	In situ grafting
13	Layout of various irrigation systems.
14	Integrated nutrient pest management
15	Rejuvenation of old orchards, top working and frame working
16	Visit to GAP orchard/Estate

Suggested Reading:

Reference Books:

- B .C. Mazumdar. 2004. *Principles and Methods of Orchard Establishment*. DayaPublishing House, New Delhi.
- Chadha,K.L. (ICAR)2002,2001.*Hand book of Horticulture*. ICAR, New Delhi
- Kumar, 1990. *Introduction to Horticulture crops*. Rajyalakshmi Publications, Nagercoil, Tamilnadu.
- Palaniappan, S.P. and Sivaraman, K. 1996. *Cropping systems in the Tropics*. New age International (P) Ltd., Publishers, New Delhi.
- Shanmugavelu, K.G.1989. *Production Technology of Fruit Crops*. Oxford & IBH Publishing Co. Pvt.Ltd., New Delhi.
- T. Pradeep Kumar, B. Suma, JyothiBhaskar and K.N.Satheson. 2008. *Management of Horticultural Crops*.New India Publishing Agency, New Delhi.
- W. S. Dhillon and Bhatt. 2011. *Fruit Tree Physiology*. Narendra Publishing House, New Delhi.

e-reading: <http://ecourses.iasri.res.in/>

Course No: H/ FS -358

Course Title: Plantation crops

Credit hours: (2+1) 3

Semester: V

Theory – History and development, scope and importance, area and production, export and import potential, role in national and state economy, uses, industrial importance, by products utilization, soil and climate, varieties, propagation: principles and practices of seed, vegetative and micro-propagation, planting systems and method, gap filling, systems of cultivation, mulching, shade regulation, weed and water management, training, pruning and handling, nutrition, foliar feeding, role of growth regulators, soil management, liming practices, tipping practices, top working, physiological disorders, harvesting, post-harvest handling and processing, packaging and marketing, yield and economics of coconut, arecanut, oil palm, palmyrah palm, cacao, cashew nut, coffee, tea, beetel vine and rubber.

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

Lesson/Course plan- Theory

Lecture No.	Topics	Weightage (%)
1-2	History, definition , importance and scope of plantation crops in India	8
3-4	Export, import, by-products industrial uses	8
	Study of following plantation crops in respect to their soil and climate, varieties, propagation: principles and practices of seed, vegetative and micro-propagation, planting systems and method, gap filling, systems of cultivation, mulching, shade regulation, weed and water management, training, pruning and handling, nutrition, foliar feeding, role of growth regulators, soil management, liming practices, tipping practices, top working, physiological disorders, harvesting, post-harvest handling and processing, packaging and marketing, yield and economics including Joint Agresco Recommendation	
5-9	i) Coconut	15
10-11	ii) Arecanut	08
12-13	iii) Oil palm	05
14	iv) Palmyrah palm	05
15-17	v) Cocoa	10
18-21	vi) Cashew nut	10
22-24	vii) Coffee	10
25-26	viii) Tea	08
27-29	ix) beetel vine	05
30-32	x) Rubber	08
Total		100

Practical programme-

Practical No.	Topics
1	Identification and description of plantation crops
2	Propagation methods and nursery techniques in coconut and arecanut.
3	Propagation methods and nursery techniques in datepalm, oilpalm & palmyrah palm
4	Propagation methods and nursery techniques in cocoa, coffee, tea.
5	Propagation methods and nursery techniques in cashew nut and rubber.
6	Description of coconut and arecanut varieties.
7	Description of oil palm, palmyrah palm and date palm varieties.
8	Description of coffee, cocoa and tea varieties.
9	Description of cashewnut, rubber varieties.
10	Harvesting, processing, grading in Arecanut, coconut.
11	Harvesting, processing and grading in oil palm, palmyrah palm, beetel vine.
12	Harvesting, processing and grading in cocoa , coffee and tea
13	Tapping and processing of latex in rubber.
14	Harvesting, processing and grading in cashewnut.
15	Insect-pests and Diseases their control measures in plantation crops.
16	Visit to processing unit

Suggested Reading:

Reference Books:

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

Kumar, N.J.B. M. Md. Abdul Khaddar, RangaSwamy, P. and Irrulappan, I. 1997.

Introduction to spices, Plantation crops and Aromatic plants. Oxford & IBH, New Delhi.

Nair 1979. *Cashew*. CPCRI, Kerala

Ranganadhan, V. 1979. *Hand Book of Tea Cultivation*. UPASI Tea Research Station, Cinchona.

Thampan, P.K. 1981.*Hand Book of Coconut Palm*. Oxford IBH, New Delhi.

Thompson, P.K. 1980. *Coconut*. Oxford & IBH Publishing Co. Ltd., New

Delhi. Wood, GAR, 1975. *Cacao*. Longmen, London

e-reading: <http://ecourses.iasri.res.in/>

Course No. : H/ FS -234

Course Title: Temperate Fruit Crops

Credit hours–(1+1) 2

Semester: III

Theory- Importance, Scope, Classification of temperate fruits, detailed study of areas, production, varieties, climate and soil requirements, propagation, planting density, cropping systems, after care training and pruning, self-incompatibility and pollinizers, use of growth regulators, nutrient and weed management, harvesting, post-harvest handling and storage of apple, pear, peach, apricot, plum, cherry, persimmon, strawberry, kiwi, Queens land nut (Mecademia nut), almond, walnut, pecan nut, hazel nut and chest nut. Re-plant problem, rejuvenation and special production problems like pre-mature leaf fall, physiological disorders, important insect – pests and diseases and their control measures. Special production problems like alternate bearing problem and their remedies. Low productivity of apples in India and their remedial measures.

Practical- Nursery management practices, description and identification of varieties of above crops, manuring and fertilization, planting systems, preparation and use of growth regulators, training and pruning in apple, pear, plum, peach and nut crops. Working out economics for apple, pear, plum and peach.

Lesson /Course Plan: Theory

Lectures No.	Topic	Weightage (%)
1	Importance, scope and Classification of temperate fruits detailed study of areas, production, varieties, climate and soil requirements, Propagation in temperate fruits, planting density & cropping systems, After care of orchard, Training and pruning, Self-incompatibility and pollinizers, Use of growth regulators, Nutrient and weed management, harvesting, post-harvest handling and storage of following crops.	8
2–3	Apple	10
4	Pear	8
5	Peach	8
6	Apricot	8
7	Plum	5
8	Cheery	5
9	Persimmon	5
10	Strawberry	10
11	Kiwi	4
12	Queens land nut (Macadamia nut)	
13	Almond, walnut, pecan nut, hazel nut and chest nut	8
14	Re-plant problem, rejuvenation and special production problems like pre-mature leaf fall, physiological disorders	8
15	important insect – pests and diseases and their control measures	5
16	Special production problems like alternate bearing problem and their remedies. Low productivity of apples in India and their remedial measures	8
	Total	100

Practical programme:

Practical No.	Topics
1	Nursery management practices
2	Description and identification of varieties of temperate fruits crops (Pome and Nut)
3	Description and identification of varieties of temperate fruits crops (Berry and others)
4	Manuring and fertilization of temperate fruits (Pome and Nut)
5	Manuring and fertilization of temperate fruits (Berry and others)
6	Planting systems
7	Preparation and use of growth regulators (Powder form)
8	Preparation and use of growth regulators (Lanolin Paste)
9	Intercultural operations, plum, peach and nut crops
10	Training in apple, pear
11	Pruning in apple, pear
12	Training in plum, peach and nut crops
13	Pruning in plum, peach and nut crops
14	Working out economics for apple, pear,
15	Working out economics for plum and peach
16	Working out economics for nut crops

Suggested Reading:

Text Books:

Chattopadhyay, T.K. 2000. *A Text Book on Pomology (Temperate Fruits)* Vol. IV Kalyani Publishers, Hyderabad

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

Reference Books:

Banday F.A. and Sharma M.K.2010.*Advances in Temperate Fruit Production.* Kalyani Publishers.B-1/292, Rajinder Nagar, Ludhiana-141008.

Chadha, T.R, 2001. *Text Book of Temperate Fruits.* Indian Council of Agricultural Research, New Delhi.

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

David Jackson & N.E. Laone, 1999 *Subtropical and Temperate Fruit Production.* CABI, Publications.

Handbook of Horticulture, ICAR(2011)

Kaushal Kumar Misra.2014.*Text book of Advanced Pomology.* Biotech Books.4762-63, Ansari Road, Darya Ganj, New delhi-11002.

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

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

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

e-reading: <http://ecourses.iasri.res.in/>

Course No: H/ FS -235

Course Title: Weed Management in Horticultural Crops

Credit hours: (1+1) 2

Semester-III

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

Practical- Identification of weeds; Survey of weeds in crop fields and other habitats; Preparation of herbarium of weeds; Calculations on weed control efficiency and weed index; Herbicide label information; Computation of herbicide doses; Study of herbicide application equipment and calibration; Demonstration of methods of herbicide application; Preparation of list of commonly available herbicides; Study of phytotoxicity symptoms of herbicides in different crops; Biology of nut sedge, bermuda grass, parthenium and celosia; Economics of weed control practices; Tours and visits of problematic weed areas .

Lesson/Course Plan- Theory

Lecture No.	Topic	Weightage (%)
1	Weeds: Introduction, harmful and beneficial effects	08
2	Classification of weeds	08
3	Propagation and dissemination of weeds	5
4	Weed biology and ecology, crop weed association	08
5	Crop weed competition and allelopathy	08
6	Concepts of weed prevention, control and eradication	5
7	Methods of weed control: physical, cultural, chemical and biological methods	08
8	Integrated weed management	08
9	Herbicides: advantages and limitation of herbicide usage in India	08
10	Herbicide classification, formulations, methods of application;;	08
11	Introduction to Adjuvants and their use in herbicides	5
12	Introduction to selectivity of herbicides;	5
13	Compatibility of herbicides with other agro chemicals	5
14	Weed management in major field and horticultural crops,	5
15-16	Shift of weed flora in cropping systems, aquatic and problematic weeds and their control.	06
Total		100

Practical programme

Practical No.	Topics
1	Identification of weeds;
2	Survey of weeds in orchard other habitats
3	Survey of weeds in other habitats
4	Preparation of herbarium of weeds
5	Calculations on weed control efficiency and weed index
6	Herbicide label information;
7	Computation of herbicide doses and use of Herbicides
8	Study of herbicide application equipment and calibration
9	Demonstration of methods of herbicide application
10	Various methods of weed control in orchard
11	Mechanical method of weed control
12	Chemical method of weed control
13	Biological method of weed control
14	Study of phytotoxicity symptoms of herbicides in different crops
15	Biology of nut sedge, bermuda grass, parthenium and celosia
16	Economics of weed control practices

Suggested reading:

Reference Books:

- Crafts, A.S. and Robbins, W.W. 1973. *Weed Control*. Tata McGraw-Hill Publishing Co. Ltd., New Delhi.
- Chadha, K.L. (ICAR) 2002, 2001. *Hand book of Horticulture*. ICAR, New Delhi
- Gupta, O.P. 1984. *Scientific Weed Management*. Today and Tomorrow Printers and Publishers, New Delhi.
- Gupta, O.P. 2015. *Modern Weed Management*. Agro Bios (India), Jodhpur.
- Naidu, V.S.G.R., *Handbook of Weed Identification*. Directorate of Weed Research, Jabalpur.
- Rajagopal, A., Aravindan, R. and Shanmugavelu, K.G., 2015. *Weed management of Horticultural Crops*. Agrobios (India), Jodhpur.
- Ramamoorthy, K. and Subbian, P., *Predominant Weed flora in hill –ecosystems*. Agrobios (India), Jodhpur.
- Rao, V.S. 2000. *Principles of Weed Science*. Oxford & IBH Publishing Co., New Delhi.
- Subramanian, S., Mohammed Ali, A. and Jayakumar, R. 1991. *All About Weed Control*. Kalyani Publishers, Ludhiana.
- Tadulingam, C. and Venkatnarayana, D. 1955. *A Handbook of Some South Indian Weeds*. Government Press, Madras.
- Thakur, C. 1977. *Weed Science*. Metropolitan Book Co. Pvt. Ltd., New Delhi.

e-reading: <http://ecourses.iasri.res.in/>

Course No : H/FS-247

Course title- Breeding of Fruit and Plantation crops

Credit hours: (2+1) 3

Semester-IV

Theroy- Fruit breeding - History, importance, scope in fruit production, distribution, domestication and adaptation of commercially important fruits and plantation crop, variability for economic traits, breeding strategies, clonal selection, bud mutations, mutagenesis and its application in crop improvement – policy manipulations – *in vitro* breeding tools (important fruit and plantation crops).

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

Lesson / Course Plan–

Lectures No.	Particulars	Weightages (%)
1-2	History of Fruit Breeding and Importance and scope of Fruit breeding	8
3	Objectives of breeding of fruit crops & plantation crops	8
	Centres of origin, Distribution, domestication and adaptatation of commercially important fruits, Modes of Reproduction, Apomixis and its types, Self incompatibility, Male sterility, Specific Breeding objectives, Floral Biology, inheritance pattern and achievements by different breeding methods	
4-5	Mango	8
6-8	Banana, Mandarin, Sweet orange, Acid lime, Grapes	8
9-11	Guava, Sapota, Papaya	8
12-14	Ber, Annona, Aonla	8
15	Tea and Coffee	8
16	Pomogranate	4
17-18	Coconut	8
19-21	Cashew, Rubberand Pistchonut	4
22-23	Date palm, Arecanut, Oil palm	4
24-25	Karonda Jackfruit and Jamun	4
26	Apple	4
27-29	Pear, Plum, Peach Apricot and Strawberry	4
30	Mutagenesis and its applications	4
31	Invitro breeding tools in fruit plantation crops.	4
32	Recommendations of Joint Agresco	4
Total		100

Practical programme -

Practical No.	Particulars
1	Study of Breeding kit
2	Methods of emasculation and pollination procedures
	Floral biology -
3	Mango
4	Banana andMandarin, Sweet orange, Acid lime
5	Grape and Papaya

6	Cashew nut, Pomegranate and Fig
7	Ber and Aonla
8	Aonla and Tamarind
9	Arecanut and Coconut
10	Apple, Apricot
11	Pear, Plum, Peach
12	Pistachonut and Strawberry
13	Pollen viability
14	Hybrid seed germination
15	Raising of segregating populations.
16	Evaluation of segregation population. Use of mutagens to induce. Mutagens and polyploidy.

Suggested Reading:

Reference Books:

- Anil Kumar Shukla 2004. *Fruit breeding approaches & Achievements*. India Publishing Agency, New Delhi. International Book Distributing Co. New Delhi.
- Chadha, K.L. (ICAR) 2002, 2001. *Hand book of Horticulture*. ICAR, New Delhi
- Kumar, N. 1997. *Breeding of Horticultural Crops, Principles and Practices*. New Delhi.
- Nijar 1985. *Fruit breeding in India*, Oxford & IBH Publishing Co. New Delhi
- Singh, B.D. 1983. *Plant Breeding Principles and methods*. Kalyani Publishers
- Abraham, Z. 2017. *Fruit Breeding*. Astral International (P) Ltd., New Delhi.
- Ray, P.K. 2002. *Breeding of Tropical and Subtropical Fruits*. Narosa Publishing House, New Delhi.

e-reading: <http://ecourses.iasri.res.in/>

Course No. : H/FS-248

Course Title: Dryland Horticulture

Credit hours: (1+1) 2

Semester: IV

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

Lesson/Course Plan

Lecture No.	Topic	Weightage (%)
1	Definition, importance and limitation of dry land horticulture	10
2	Present status and future scope. Constraints encounter in dry lands.	10
3	Agro-climatic features in rain shadow areas, scarce water resources, high temperature, soil erosion, run-off losses etc.	05
4,5	Techniques and management of dry land horticulture: watershed development, soil and water conservation methods-terraces, contour bunds, etc. Methods of control and impounding of run-off water-farm ponds, trenches, macro catch pits,etc <i>in-situ</i> water harvesting methods, micro catchment, different types of tree basins etc	05
6	Methods of reducing evapotranspiration, use of shelter belts, mulches, antitranspirants, growth regulators, etc	05
	Water use efficiency-need based, economic and conjunctive use of water, Micro systems of irrigation etc. Special techniques, planting and after care-use of seedling races, root stocks, <i>in-situ</i> grafting, deep pitting/planting, canopy management etc drought resistance Characters and special adaptation of the following crop	
7	Ber and Aonla	10
8	Annona and Jamun	10
9	Pomegranate	5
10	Tamarind and Loquat	5
11	Fig and Phalsa	10
12	Wood apple, bael	5
13	Date palm	5
14	Charoli	5
15	Carambola, Durian, Marking Nut	5
16	Rambutan, Bilimbi	5

		Total	100
--	--	--------------	------------

Practical programme

Practical No.	Topics
1	Study of rainfall patterns
2	Contour bunding
3	Trenching
4	Micro catchments
5	Soil erosion and its control.
6	Study of evapotranspiration,
7	Mulching
8	Irrigation systems-Surface
9	Irrigation systems-Sub Surface
10	Micro irrigation
11	Special techniques of planting and aftercare in dry lands
12	Special horticultural practices in dry land plants
13	Training in dry land plants
14	Pruning in dry land plants
15	Study of morphological and anatomical features of drought tolerant fruit crops.
16	Study of morphological and anatomical features of salinity tolerant fruit crops.

Suggested reading:

Reference Books:

- Chadha, K. L. (ICAR)2002, 2001.*Hand book of Horticulture*. ICAR, New Delhi
- Chundawat, B.S. 1990. *Arid Fruit Culture*. Oxford and IBH, New Delhi.
- P.L. Taroj, B.B. Vashishtha, D.G.Dhandar. 2004. *Advances in Arid Horticulture*. Internal Book Distributing Co., Lucknow.
- T. Pradeep Kumar, B. Suma, Jyothi Bhaskarand K.N.Sathesan. 2008. *Management of Horticultural Crops*. New India Publishing Agency.
- Fruit culture in India , Shyam Singh , S. Krishnamurthy & S. L. Katyal .
- Production technology of fruit crops, K. G. Shanmmugavellu .

e-reading: <http://ecourses.iasri.res.in/>