

FRUIT SCIENCE

Course Title: Fundamentals of Horticulture (FSC-111: (2+1)

Sl. No.	Theory Topic	No. of Class
1	Scope and importance, classification of horticultural crops and nutritive value.	2
2	Area and production, exports and imports, fruit and vegetable zones of India and of different states.	3
3	Nursery techniques and their management, soil and climate.	2
4	Vegetable gardens, nutrition and kitchen garden and other types of gardens – principles, planning and layout.	3
5	Management of orchards, planting systems and planting densities.	2
6	Production and practices for fruit, vegetable and floriculture crops.	2
7	Principles objectives, types and methods of pruning and training of fruit crops,	2
8	Types and use of growth regulators in horticulture.	2
9	Water management– irrigation methods, merits and demerits, weed management, fertility management in horticultural crops.	2
10	Manures and fertilizers, different methods of application,	1
11	Cropping systems, intercropping, multi-tier cropping,	2
12	Mulching– objectives, types merits and demerits	2
13	Classification of bearing habits of fruit trees,	1
14	Factors influencing the fruitfulness and unfruitfulness	2
15	Rejuvenation of old orchards, top working, frame working,	2
16	Principles of organic farming, market chain management	2
	Total	32
Sl. No.	Practical Portion Topics	No. of Class
1	Features of orchard, planning and layout of orchard	2
2	Tools and implements, identification of various horticultural crops	1
3	Layout of nutrition garden	1
4	Preparation of nursery beds for sowing of vegetable seeds	2
5	Digging of pits for fruit plants, planting systems	1
6	Training and pruning of orchard trees	1
7	Preparation of fertilizer mixtures and field application	2
8	Preparation and application of growth regulators	1
9	Layout of different irrigation systems	2
10	Identification and management of nutritional disorder in fruits	1
11	Assessment of bearing habits	1
12	Maturity standards, harvesting, grading, packaging and storage.	1
	Total	16

Suggested Reading:

- 1) Prasad and Kumar, 2014. *Principles of Horticulture* 2nd Edn. Agrobios (India).
- 2) Neeraj Pratap Singh, 2005. *Basic concepts of Fruit Science* 1st Edn. IBDC Publishers.
- 3) Gardner/Bardford/Hooker. J.R., 1957. *Fundamentals of Fruit Production*. Mac Graw Hill Book Co., New York.
- 4) Edmond, J.B, Sen, T.L, Andrews, F.S and Halfacre R.G., 1963. *Fundamentals of Horticulture*. Tata Mc Graw Hill Publishing Co., New Delhi.
- 5) Kumar, N., 1990. *Introduction to Horticulture*. Rajyalakshmi publications, Nagarcoil, Tamilnadu
- 6) Jitendra Singh, 2002. *Basic Horticulture*. Kalyani Publishers, Hyderabad.
- 7) Denisen E.L., 1957. *Principles of Horticulture*. Macmillan Publishing Co., New York.
- 8) Chadha, K.L. (ICAR), 2002, 2001. *Handbook of Horticulture*. ICAR, New Delhi

- 9) K.V.Peter, 2009. *Basics Horticulture*. New India Publishing Agency
- 10) Kausal Kumar Misra and Rajesh Kumar, 2014. *Fundamentals of Horticulture*. Biotech Books.
- 11) D.K. Salunkhe and S.S. Kadam, 2013. *A handbook of Fruit Science and Technology*. CRC Press.
- 12) S. Prasad and U. Kumar, 2010. *A handbook of Fruit Production*. Agrobios (India).
- 13) Jitendra Singh, 2011. *Basic Horticulture*. Kalyani Publications, New Delhi.

B. Sc. (Hons.) Horticulture: 2nd Year 2nd Semester

FSC-121: Plant Propagation and Nursery Management 2(1+1) [Session: Jan-Jun, 2020]

Sr. No.	Topics Theory Class:	Class (No.)
1	Propagation: Need and potentialities for plant multiplication, sexual and asexual methods of propagation, advantages and disadvantages.	2
2	Seed dormancy types of dormancy (scarification & stratification) internal and external factors,	1
3	Nursery techniques nursery management, apomixes– mono-embryony, polyembryony, chimera & bud sport.	2
	Propagation Structures: Mist chamber, humidifiers, greenhouses, glasshouses, cold frames, hot beds, poly-houses, phytotrons nursery (tools and implements)	1
4	Use of growth regulators in seed, types and stages of seed germination with examples and vegetative propagation	1
5	Methods and techniques of division-stolons, pseudobulbs, offsets, runners, cutting, layering, grafting, formation of graft union, factor affecting, healing of graftage and budding	2
6	Physiological & bio chemical basis of rooting, factors influencing rooting of cuttings and layering.	2
7	Graft incompatibility. Anatomical studies of bud union, selection and maintenance of mother trees, collection of scion wood stick, scion-stock relationship, and their influences.	1
8	Bud wood certification, techniques of propagation through specialized organs, corm, runners, suckers.	1
9	Micrografting, meristem culture, callus culture, anther culture, organogenesis, somaclonal variation.	1
10	Hardening of plants in nurseries. Nursery registration act.	1
11	Insect/pest/disease control in nursery, Cost of establishment of propagation structures.	1
Total Credit Hours		16

Practical

Sr. No.	Topics: Practical Class	Class (No.)
1	Media for propagation of plants in nursery beds, potting and repotting.	02
2.	Preparation of nursery, beds and sowing of seeds.	02
3.	Raising of rootstock. Seed treatments for breaking dormancy and inducing vigorous seedling growth.	02
4.	Preparation of plant material for potting. Hardening plants in the nursery.	01
5.	Practicing different types of cuttings, layering, graftings and buddings including opacity and grafting, top grafting and bridge grafting etc.	01
6.	Use of mist chamber in propagation and hardening of plants.	01
7.	Preparation of plant growth regulators for seed germination and vegetative propagation	01

8.	Visit to a tissue culture laboratory. Digging, labelling and packing of nursery fruit plants.	02
9.	Maintenance of nursery records. Use of different types of nursery tools and implements for general nursery and virus tested plant material in the nursery.	02
10.	Cost of establishment of a mist chamber, greenhouse, glasshouse, polyhouse and their maintenance.	01
11.	Nutrient and plant protection applications during nursery.	01
Total Credit Hours		16

Suggested Reading:

- 1) 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
- 2) 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.
- 3) Hartman,H.T and Kester,D.E.1976.*Plant Propagation Principles and practices*. Prentice hall of India Pvt.Ltd., Bombay.
- 4) Sadhu,M.K.1996. *Plant Propagation*. New age International Publishers, New Delhi.
- 5) 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.

Course Title: FSC- 212: Tropical and Sub-Tropical Fruits 3 (2+1)

Sl. No.	Theory Topic	No. of Class
	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.	
1	Mango, banana	3
2	Grapes, citrus,	3
3	Papaya, sapota, guava,	3
4	Pomegranate, bael, ber, amla,	3
5	Anona, fig, pineapple, jackfruit, durian,	2
6	Avocado, mangosteen, litchi, carambola, rambutan	3
7	Bilimbi, loquat, rose apple breadfruit and passion fruit.	2
8	Bearing in mango and citrus, causes and control measures of special production problems, alternate and irregular bearing overcome, control measures.	3
9	Seediness and kokkan disease in banana,	2
10	Citrus decline and casual factors and their management.	2
11	Bud forecasting in grapes,	2
12	Sex expression and seed production in papaya, latex extraction and crude papain production,	2
13	Economic of production.	2
Total		32
Sl. No.	Practical Portion Topics	No. of Class
1	Description and identification of varieties based on flower and fruit morphology in	1

	above crops.	
2	Training and pruning of grapes, mango, guava and citrus.	1
3	Selection of site and planting system,	1
4	pre-treatment of banana suckers, desuckering in banana,	1
5	sex forms in papaya.	1
6	Use of plastics in fruit production.	1
7	Visit to commercial orchards and diagnosis of maladies.	1
8	Manure and fertilizer application including bio-fertilizer in fruit crops,	1
9	Preparation and application of growth regulators in banana, grapes and mango.	1
10	Seed production in papaya, latex extraction and preparation of crude papain.	2
11	Ripening of fruits, grading and packaging, production economics for tropical and sub-tropical fruits.	2
12	Mapping of arid and semi-arid zones of India.	1
13	Botanical description and identification of ber, fig, jamun, pomegranate, carissa, phalsa, wood apple, West Indian cherry, tamarind, aonla, bael and annona.	2
	Total	16

Suggested Reading:

- 1) H.P.Singh and M.M.Mustafa, 2009. *Banana*-new innovations. Westville PublishingHouse, New Delhi.
- 2) M.S.Ladaniya, 2013. *Citrus Fruits*. Elsevier, India post ltd.
- 3) Bose, T.K., Mitra, S.K. and Sanyal, D., 2002. *Tropical and Sub-Tropical-Vol-I*. Naya udyog-Kolkata
- 4) Rajput, CBS and Srihari babu, R., 1985. *Citriculture*. Kalyani Publishers, New Delhi.
- 5) Chundawat, B.S., 1990. *Arid fruit culture*. Oxford and IBH, New Delhi.
- 6) Chadha,K.L. (ICAR) 2002, 2001. *Hand book of Horticulture*. ICAR, New Delhi.
- 7) Symmonds, 1996. *Banana*. II Edn. Longman, London.
- 8) Radha T and Mathew L., 2007. *Fruit crops*. New India Publishing Agency.
- 9) W S Dhillon, 2013. *Fruit Productionin India*. Narendra Publishing House, New Delhi
- 10) T.K.Chattopadhyay, 1997. *Text book on pomology*. Kalyani Publishers, New Delhi.
- 11) R.E.Litz, 2009. *The Mango* 2nd Edn. Cabi Publishing, Willingford, U.K.
- 12) K.L.Chadda, 2009. *Advanced in Horticulture*. Malhotra Publishing House, New Delhi.
- 13) S.P. Singh, 2004. *Commercial fruits*. Kalyani Publishers, New Delhi.
- 14) F.S. Davies and L.G.Albrigo, 2001. *Citrus*, Cab International.

Course Title: FSC- 311: Orchard and Estate Management 2(1+1)

Sl. No.	Theory Topic	No. of Class
1	Orchard & estate management, importance, objectives,	1
2	Merits and demerits, clean cultivation, sod culture, Sod mulch, herbicides and inorganic and organic mulches.	2
3	Tropical, sub-tropical and temperate horticultural systems, competitive and complimentary effect of root and shoot systems.	2
4	Biological efficiency of cropping systems in horticulture, systems of irrigation.	1
5	Soil management in relation to nutrient and water uptake and their effect on soil environment, moisture, organisms and soil properties.	2
6	Factors influencing the fruitfulness and unfruitfulness.	1
7	Rejuvenation of old orchards, top working, frame working,	1
8	Integrated nutrient and pest management.	1
9	Utilization of resources constraints in existing systems.	2
10	Crop model and crop regulation in relation to cropping systems.	2
11	Climate aberrations and mitigation measures of Horticultural crops.	1
	Total	16

Sl. No.	Practical Portion Topics	No. of Class
1	Layout of different systems of orchard and estate,	4
2	soil management, clean, inter, cover and mixed cropping, fillers	4
3	Use of mulch materials, organic and inorganic, moisture conservation, weed control	4

Theory

4	Layout of various irrigation systems	4
	Total	16

Suggested Reading:

- 1) Kumar, 1990. *Introduction to Horticulture crops*. Rajyalakshmi Publications, Nagercoil, Tamilnadu.
- 2) Palaniappan, S.P. and Sivaraman, K. 1996. *Cropping systems in the Tropics*. New age International (P) Ltd., Publishers, New Delhi.
- 3) Shanmugavelu, K.G.1989. *Production Technology of Fruit Crops*. Oxford & IBH Publishing Co. Pvt.Ltd., New Delhi.
- 4) WS. Dhillon and Bhatt. 2011. *Fruit Tree Physiology*. Narendra Publishing House, New Delhi.
- 5) B .C. Mazumdar. 2004. *Principles and Methods of Orchard Establishment*. Daya Publishing House, New Delhi.
- 6) T. Pradeep Kumar, B. Suma, Jyothi Bhaskar and K.N.Satheson. 2008. *Management of Horticultural Crops*.New India Publishing Agency, New Delhi.
- 7) B .C. Mazumdar. 2004. *Orchard Irrigation and Soil Management Practices* Daya Publishing Agency, New Delhi. Daya Publishing Agency, New Delhi

Course No. FSc-221 -3 (2+1): Plantation Crops

Topic	No. of lectures
Coffee, Oilpalm, Palmyrah palm	10
Tea, Datepalm, Rubber	10
Cashew, Arecanut, Coconut, Cocoa	12
TOTAL	32
Practical	
Selection of coconut and arecanut mother palm and seed nut. Planting of seed nuts in nursery, layout and planting of coconut, arecanut, oil palm, cashewnut, cocoa	3
Manuring, irrigation, mulching, raising masonary nursery for palm, nursery management in cocoa	1
Description and identification of coconut varieties. Description and identification of species and varieties in coffee	3
Harvesting, grading, pulping, fermentation, washing, drying and packing of coffee, seed berry collection, seed extraction, treatment and sowing of coffee. Epicotyl, soft wood grafting and top working in cashew	3
Mother plant selection, preparation of cutting and rooting of tea under specialized structure, training, centering, pruning, tipping and harvesting of tea	3
Working out the economics and project preparation for coconut, arecanut, oil palm, cashew nut, cocoa etc.	3
TOTAL	16

Course Title: FSC- 221: Temperate Fruit Crops 2(1+1)

Sl. No.	Theory Topic	No. of Class
	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 pollinisers, use of growth regulators, nutrient and weed management, harvesting, post-harvest handling & storage and 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 of-	
1	Apple, pear,	3
2	Peach, apricot, plum,	3
3	Cherry, persimmon, strawberry, kiwi,	3
4	Queens land nut (Mecademia nut), almond,	3
5	Walnut, pecan nut,	2
6	Hazel nut and chest nut.	2
	Total	16
Sl. No.	Practical Portion Topics	No. of Class
1	Nursery management practices,	2
2	Description and identification of varieties of above crops,	3

3	Manuring and fertilization,	2
4	Planting systems	1
5	Preparation and use of growth regulators,	2
6	Training and pruning in apple, pear, plum, peach and nut crops.	2
7	Visit to private orchards to diagnose maladies.	1
8	Working out economics for apple, pear, plum and peach.	3
	Total	16

Suggested Reading:

- 1) Chattopadhyay T.K.2009.*A text book on Pomology-IV Devoted to Temperate fruits*. Kalyani Publishers.B-1/292,Rajinder Nagar,Ludhiana-141008
- 2) Banday F.A. and Sharma M.K.2010.*Advances in Temperate Fruit Production*. Kalyani Publishers.B-1/292, Rajinder Nagar, Ludhiana-141008.
- 3) Kaushal Kumar Misra.2014.*Text book of Advanced Pomology. Biotech Books*.4762-63, Ansari Road, Darya Ganj, New delhi-11002.
- 4) Das B.C and Das S.N .*Cultivation of Minor Fruits*. Kalyani Publishers.B-1/292, Rajinder Nagar, Ludhiana-141008.
- 5) Pal J.S.2010. *Fruit Growing* .2010. Kalyani Publishers.B-1/292,Rajinder Nagar, Ludhiana-141008.
- 6) Mitra S.K, Rathore D.S and Bose T .K. 1992. *Temperate Fruit Crops. Horticulture and Allied Publishers*, Calcutta.
- 7) Chattopadhyay, T.K. 2000. *A Text Book on Pomology (Temperate Fruits) Vol. IV* Kalyani Publishers, Hyderabad
- 8) Chadha, T.R, 2001. *Text Book of Temperate Fruits*. Indian Council of Agricultural Research, New Delhi.
- 9) David Jackson & N E Laone, 1999 *Subtropical and Temperate Fruit Production*. CABI, Publications.
- 10) W S Dhillon. 2013. *Fruit Production In India*. Narendra Publishing House. New Delhi

Course Title: FSC- 313: Weed Management in Horticultural Crops 2(1+1)

Sl. No.	Theory Topic	No. of Class
1	Weeds: Introduction, harmful and beneficial effects	1
2	Classification, propagation and dissemination;	1
3	Weed biology and ecology,	1
4	Crop weed association, crop weed competition and allelopathy	1
5	Concepts of weed prevention, control and eradication;	2
6	Methods of weed control: physical, cultural, chemical and biological methods.	1
7	Integrated weed management;	1
8	Herbicides: advantages and limitation of herbicide usage in India,	1
9	Herbicide classification, formulations, methods of application;	2
10	Introduction to Adjuvants and their use in herbicides;	2
11	Introduction to selectivity of herbicides; Compatibility of herbicides with other agro chemicals;	1
12	Weed management in major field and horticultural crops,	1
13	Shift of weed flora in cropping systems, aquatic and problematic weeds and their control.	1
	Total	16
Sl. No.	Practical Portion Topics	No. of Class
1	Identification of weeds;	2
2	Survey of weeds in crop fields and other habitats;	1

3	Preparation of herbarium of weeds;	1
4	Calculations on weed control efficiency and weed index;	2
5	Herbicide label information; Computation of herbicide doses;	1
6	Study of herbicide application equipment and calibration;	2
7	Demonstration of methods of herbicide application;	1
8	Preparation of list of commonly available herbicides;	1
9	Study of phytotoxicity symptoms of herbicides in different crops;	1
10	Biology of nut sedge, bermuda grass, parthenium and celosia	1
11	Economics of weed control practices	2
12	Tours and visits of problem areas	1
	Total	16

Suggested reading:

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

Course Title: BSH-123 (Principles of Plant Breeding)-(2+1)

THEORY

Sl.No	Topics to be covered	No. Of lecture
1.	Plant Breeding as a dynamic science, Genetic basis of Plant Breeding – classical, quantitative and molecular, Plant breeding in India – limitation, major achievements, and Goals setting for future.	2
2.	Modes of reproduction (Sexual-Self and cross- mechanism promoting self and cross pollination), (Asexual-vegetative reproduction and Apomixis classification and its significance in Plant Breeding)	2
3.	Pollination control mechanism (incompatibility and sterility and implications of reproductive systems on population structure).	4
4.	Genetics components of polygenic variation and breeding strategies	2
5.	Selection as a basis of crop breeding and marker assisted selection.	2
6.	Hybridization and selection – goals of hybridization, selections of plants; Population developed by hybridization – simple crosses, bulk crosses and complex crosses.	5
7.	General and special breeding techniques.	2
8.	Heterosis – concepts, estimation and its genetic basis. Calculation of heterosis, heterobeltois	2
9.	GCA, SCA, inbreeding depression, heritability and genetic advance	2
10.	Breeding for resistance to biotic and abiotic stresses	4

11.	Mutation in plant breeding	1
12.	Polyploidy in plant breeding	2
13	Emasculation, Pollination techniques in important horticultural crops	2

PRACTICALS

1	Breeding Objectives and techniques in important horticultural crops.	1
2	Floral biology – its measurement, emasculation, crossing and selfing techniques in major crops	7
3	Determination of mode of reproduction in crop plants, Handling of breeding material, segregating generations (pedigree, bulk and back cross methods)	2
4	Field layout, and maintenance of experimental records in self and cross pollinated crops.	1
5	Demonstration of hybrid variation and production techniques	1
6	Hardy Weinberg Law and calculation	1
7	Male sterility and incompatibility studies in horticultural crops	1
8	Calculation of inbreeding depression, heterosis, heterobeltiosis, GCA, SCA, GA, heritability.	2

Suggested Books for Reading

- Principles of Plant Breeding (Allard, R.W) from John Wiley and Sons, New York.
- Plant Breeding: Principles and Methods (B.D. Singh) from Kalyani Publishers, New Delhi
- Essentials of Plant Breeding (Phundan Singh) from Kalyani Publishers, New Delhi
- Breeding Asian Field Crops (Jhon Milton Poehlman and David Allen Sleeper) from Blackwell Publishing Professional, Amens, IOWA
- Introduction to Plant Breeding (R. C. Chaudhary) from Oxford and IBH Publishing Co., New Delhi.
- Genetic Improvement of field crops (C.B. Singh and D. Khare) from Scientific publishers, Jodhpur
- Genetics and Breeding of Vegetables (K. V. Peter and T. Pradeep kumar) from ICAR, New Delhi
- Vegetable Breeding-Principles and Practices (Hari Har Ram) from Kalyani Publishers, New Delhi
- Practical Plant Breeding (S.K. Gupta) from Agribios (India) Jodhpur
- Principles and Practice of Plant Breeding (J.R. Sharma). Tata McGraw Hill, Publishing Company Ltd., New Delhi.
- A Manual of Genetics and Plant Breeding-Experimental Techniques (R. K. Singh and P. K. Singh) from Kalyani Publishers, New Delhi

Course Title: BSH-115 (Principles of Genetics and Cytogenetics)-(2+1)

THEORY

SL. No	Topics to be covered	No. of lecture
1.	History of genetics and hypothesis-theories	2
2.	Physical basis of heredity, cell reproduction-Mitosis and its significance	2
3.	Meiosis and its significance	2
4.	Gametogenesis and syngamy in plants	1
5.	Mendels principles of heredity	2
6.	Deviation from Mendelian inheritance	2
7.	Pleiotropy, threshold characters, co-dominance penetrance and expressivity	2
8.	Gene interaction : modification of monohybrid and dihybrid ratios.	2
9.	Multiple alleles and quantitative inheritance	1
10.	Chromosomes theory of inheritance	2
11.	Linkage and crossing over	2
12.	Sex determination- theories, sex linked inheritance and characters	2

13.	Cytoplasmic inheritance and maternal effects.	2
14.	Chemical basis of heredity: structure of DNA and its replication	2
15.	Evidences to prove DNA as genetic material	2
16.	Mutation and its classification	2
17.	Chromosomal aberration: changes in chromosome structure and number	2

PRACTICALS

SL. No	Practical exercise to be done	Each class for batch A & batch B
1.	Study of fixatives and stains	1A+1B
2.	Demonstration of Permanent slides and cell division, illustration in plant cell	2A+2B
3.	Preparation of slides showing various stages of mitosis and meiosis	4A+4B
4.	Testing the viability and germination of pollen grains	1A+1B
5.	Determination of gametes	1A+1B
6.	Solving the problems on monohybrid, dihybrid and test cross ratio using chi-square test, Gene interaction	4A+4B
7.	Estimation of linkages using three point test cross from F ₂ data and construction of linkage map	2A+2B
8.	Genetic variation in Pea	1A+1B

Suggested Books for Reading

- 1-Genetics by *Strickberger*, published from Prentice Hall India Pvt. Ltd., New Delhi
- 2- Principles of Genetics by *Sinnot, Dunn and Dobzhansky*, Published from Tata mc Graw Hill Co. Ltd., New Delhi
- 3- Concept of Genetics by *Klug and Cummings*, Published from Pearson Education, India Branch, N. Delhi
- 4-Genetics by *P. K. Gupta*, Published from Rastogi Publication, Merrut
- 5-Genetics by *B. D. Singh*, Published from Kalyani Publication, New Delhi
- 6-Cell Biology, Genetics, Molecular Biology, Evolution and Ecology by *Verma and Agarwal*, Published from S. Chand Publishing, N. Delhi
- 7-Genetic Analysis by *B. D. Singh*, Published from Kalyani Publishers, New Delhi
- 8- Principles of Genetics by *R. P. Singh and A. P. Singh*, Published from Kalyani Publishers, N. Delhi

Course No. FSc-222- 3 (2+1): Breeding of Fruits & Plantation Crops

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

Crops	No. of lectures	Course teachers
Arecanut, Coconut, Coffee, Tea, Cashewnut, Pomegranate, Pistachionzut, Sapota, Strawberry, Banana	13	Dr. S. Romen Singh
Apple, Pear, Plum, Peach, Apricot, Ber, Oilpalm	7	Dr. Barun Singh
Mango, Citrus, Grapes, Guava, Aonla, Litchi, Papaya, custard apple, Jamun	12	Dr. PK Nimbolkar
TOTAL	32	

Practical portion: Exercises on floral biology, pollen viability, emasculation and pollination procedures; hybrid seed germination; raising and evaluation of segregation population; use of mutagens to induce mutation and polyploidy (Important fruit and plantation crops)

Crops	No. of lectures	Course teachers
Arecanut, Coconut, Coffee, Tea, Cashewnut, Pomegranate, Pistachionut, Sapota, Strawberry, Banana	6	Dr. S. Romen Singh
Apple, Pear, Plum, Peach, Apricot, Ber, Oilpalm	4	Dr.Barun Singh
Mango, Citrus, Grapes, Guava, Aonla, Litchi, Papaya, custard apple, Jamun	6	Dr.PK Nimbolkar
TOTAL	16	

FSC-223: DRYLAND HORTICULTURE 2(1+1)

Theory Class:

Sr. No.	Topics	Class (No.)
1	Definition, importance and limitation of dry land horticulture, present status and future scope.	02
2.	Constraints encounter in dry lands	01
3.	Agro-climatic features in rain shadow areas, scarce water resources, high temperature, soil erosion, run-off losses etc.	02
4.	Techniques and management of dry land horticulture.	01
5.	Watershed development, soil and water conservation methods-terraces, contour bunds, etc.	01
6.	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.	02
7.	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.	02
8.	Selection of plants having drought resistance.	01
9.	Special techniques, planting and after care-use of seedling races, root stocks, <i>in-situ</i> grafting, deep pitting/planting, canopy management etc.	02
10.	Characters and special adaptation of crops: ber, aonla, annona, jamun, wood apple, bael, pomegranate, carissa, date palm, phalsa, fig, west Indian cherry and tamarind.	02
Total Credit Hours		16

Practical:

Sr. No.	Topics	Class (No.)
1	Study of rainfall patterns. Contour bunding/ trenching, micro catchments, soil erosion and its control	06
2	Study of evapotranspiration, mulches and micro irrigation systems. Special techniques of planting and aftercare in dry lands.	04
3	Study of morphological and anatomical features of drought tolerant fruit crops.	06
Total Credit Hours		16

Suggested Reading:

- a) Chundawat, B.S. 1990. *Arid Fruit Culture*. Oxford and IBH, New Delhi.
- b) P.L. Taroj, B.B. Vashishtha, D.G.Dhandar. 2004. *Advances in Arid Horticulture*. Internal Book Distributing Co., Lucknow.

- c) T. Pradeep Kumar, B. Suma, Jyothi Bhaskar and K.N.Sathesan. 2008. *Management of Horticultural Crops*. New India Publishing Agency.

VEGETABLE SCIENCE

Subject: VSC-211- Tropical and Sub-Tropical Vegetables 3(2+1)

S.N.	Topic	No. of Lectures
	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	3
	Brinjal	3
	Chillies & Capsicum	2
	Okra	2
	Amaranth	1
	Cowpea & Cluster bean	2
	Lab-lab bean & Snap bean	1
	Bottle gourd & Bitter gourd	2
	Sponge gourd & Ridge gourd	1
	Snake gourd & Ash gourd	1
	Pointed gourd & Ivy gourd	1
	Cucumber & Pumpkin	3
	Summer squash & Winter squash	1
	Muskmelon & Watermelon	2
	Long melon & Snap melon	1
	Round melon & Chow- chow	1
	Moringa & Curry leaf	2
	Portulaca, Basella, Sorrel & Roselle	3
	Total	32
	Practical	
S.N.	Topic	No. of Lectures
1.	Identification and description of tropical and sub-tropical vegetable crops	1
2.	Nursery practices and transplanting of tropical and sub-tropical vegetable crops	1
3.	Preparation of field & sowing/planting for direct sown & planted tropical & sub-tropical vegetable	2
4.	Herbicide use in tropical and sub-tropical vegetable crops	1
5.	Top dressing of fertilizers & intercultural operation in tropical & sub-tropical vegetable crops	2
6.	Use of growth regulators in tropical and sub-tropical vegetable	1

7.	Identification of nutrient deficiencies in tropical and sub-tropical vegetable crops	1
8.	Physiological disorder in tropical and sub-tropical vegetable crops	1
9.	Harvest indices and maturity standards of tropical and sub-tropical vegetable crops	1
10.	Post-harvest handling and storage of tropical and sub-tropical vegetable crops	1
11.	Marketing of tropical and sub-tropical vegetable crops	1
12.	Seed extraction of tropical and sub-tropical vegetable crops	1
13.	Cost of cultivation for tropical and sub-tropical vegetable crops	1
14.	Project preparation for commercial cultivation for tropical and sub-tropical vegetable crops	1
	Total	16

Reference Books:

- 1) Textbook of Vegetable, Tuber Crops & Spices- S. Thamburaj & N. Singh.
- 2) Vegetable Crops Vol. I, II, III-T. K. Bose & M.G. Som.
- 3) Hand book of Horticulture- K. L. Chadha .
- 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.

VSG-221- Spices & Condiments

3(2 + 1)

Theory

Sl. No.	Topic	No. of lecture
1.	History, scope and importance of spices and condiments	1
2.	Research centers in R&D, Economics of cultivation, Role of Spice Board & Pepper Export Promotion Council in spices research & promotion	1
3.	Classification of spices and condiments, Value added products in spices	1
4.	Methods of extraction of essential oil and oleoresins	1
	Present status, Area, production , uses, export potential and role in national economy, origin, soil, climate, propagation – seed, vegetative and micro propagation systems and methods of planting, nutrient management, irrigation practices, weed control, mulching and cover cropping, training and pruning practices, role of growth regulators, shade crops and shade regulation, harvesting, post harvest technology, packaging, storage & economics of cultivation of following spices and condiments:	
	A. Major spices	
	i. Black pepper	3
	ii. Small cardamom	2
	iii. Large cardamom	1
	iv. Ginger	2
	v. Turmeric	3
	B. Seed spices	
	i. Coriander, Cumin	2
	ii. Fennel	1
	iii. Fenugreek, Bishop's weed	2
	iv. Dill, Celery	1

	C. Tree spices	i. Clove	2
		ii. Nutmeg	2
		iii. Cinnamon	2
		iv. Allspice, Curry leaf	1
	D. Herbal spices	Rosemary, Thyme	2
	E. Other spices	Vanilla, saffron and betel vine	2
Sl. No	<u>Practical</u> – Topic		No. of lectures
1	Identification of spices and condiments		1
2	Propagation, training and pruning		2
3	Field preparation, layout, seed treatment & sowing/planting		3
4	Manuring and Use of weedicides		2
5	Interculture-hoeing & earthing up		1
6	Maturity standards		1
7	Harvesting and curing		2
8	Processing and grading of spices		1
9	Methods of extraction of essential oils & oleoresins		1
10	Visit to commercial plantations		1

Reference books

- 1) Production technology of spices and plantation crops – Shanmugavelu, K.G. Kumar, N and Peter, K.V.
- 2) Introduction to Spices, Plantation Crops, and aromatic crops. Kumar, N. J.B. M. Md. Abdul khaddar, Ranga Swamy, P. and Irulappan, I.,
- 3) Major spices- J.S. Pruthi.
- 4) Minor spices- J.S. Pruthi.
- 5) Spice and plantation crops – Shanmugavelu, K.G. and Madhava Rao

Subject: VSC-311- Breeding of Vegetables, Tuber and Spice crops

3(2+1)

Sl. No	<u>Theory</u> Topic	No. of lectures
1.	Breeding objectives and important concepts of breeding self pollinated, cross pollinated and vegetatively propagated crops.	1
2.	Plant genetic resources, their conservation and utilization in crop improvement.	2
3.	Breeding for insect resistance, breeding for disease resistance, breeding for abiotic resistance	3
4.	Male sterility and incompatibility and their utilization in development of hybrids. Origin, distribution of species, wild relatives and forms of vegetable crops	2 1
5.	Tomato	2
6.	Brinjal,	2
7.	Capsicum, Chilli	1
8.	Bhendi,	1
9	Cucurbits,	4
10.	Cabbage, Cauliflower	3

11.	Tuber crops	2
12.	Potato	2
13.	Carrot, Radish,	1
14.	Spice crops (Ginger, Turmeric).	1
15.	Breeding procedures for development of hybrids/varieties in various crops	3
	Genetic basis of adaptability and stability	1
	Total	32
	Practical	
Sl. No	Topic	No. of lectures
1.	Floral biology and pollination mechanism in self and cross pollinated vegetables, tuber crops and spices.	3
2.	Working out phenotypic and genotypic heritability, genetic advance.	2
3.	GCA, SCA, combining ability,	2
4.	Heterosis, heterobeltosis, standard heterosis,	2
5.	GxE interactions (stability analysis)	2
6.	Preparation and uses of chemical and physical mutagens. Polyploidy	2
7.	breeding and chromosomal studies.	2
8.	Techniques of F1 hybrid seed production.	2
9.	Maintenance of breeding records.	1
	Total	16

Reference books: Genetics & Breeding of Vegetables – K.V. Peter

1. Vegetable Breeding (Vol. I-III) – G. Kalloo
2. Plant Breeding – B.D. Singh
3. Vegetable Breeding: Principle & Practices– Hari Har Ram
4. Vegetable Crops- Breeding and Seed Production M.S.Fageria, etc
5. Blue Fairy- Breeding of Olericulture P. Muthuswamy and others

Course: VSC-321- Seed Production of Vegetables, Tuber and Spices crops 3(2+1)

Theory		
Sl. No	Topic	No. of lectures
1.	Introduction and history of seed industry in India	1
2.	Definition of seed. Differences between grain and seed	1
3.	Importance and scope of Vegetable seed production in India	1
4.	Principles of Vegetable seed production	2
5.	Role of temperature, humidity and light in vegetable seed production	1
6.	Seed legislation	2
7.	Field and seed standards	1
8.	Seed germination and purity analysis	2
9.	Seed drying and extraction	1
10.	Method of seed production of cole crops	3
11.	Method of seed production of root vegetables	2
12.	Method of seed production of solanaceous vegetables	3
13.	Method of seed production of okra	1
14.	Method of seed production of cucurbits	3
15.	Method of seed production of bulb crops	2
16.	Method of seed production of leafy vegetables	2
17.	Method of seed production of leguminous vegetables	2
18.	Method of seed production of exotic vegetables	2

Practical		
Sl. No	Topic	No. of lectures
1.	Study of structure, colour, size, shape and texture of vegetable seed	1
2.	Field inspection of seed crops and practices of rouging	1
3.	Harvesting and seed extraction in vegetable crops	1
4.	Vegetable seed purity analysis	1
5.	Vegetable seed germination analysis	1
6.	Method of seed production of cole crops	1
7.	Method of seed production of root vegetables	1
8.	Method of seed production of solanaceous vegetables	1
9.	Method of seed production of okra	1
10.	Method of seed production of cucurbits	1
11.	Method of seed production of bulb crops	1
12.	Method of seed production of leafy vegetables	1
13.	Method of seed production of leguminous vegetables	1
14.	Method of seed production of exotic vegetables	1
15.	Seed processing machines	1
16.	Visit to seed production unit	1

Reference books:

1. Seed Production Technology of Vegetable Crops. B.S. Asati etc
2. Vegetable Crops –Breeding and Seed Production M.S. Fageria ets.
3. Seed Technology Dharendra Khare etc
4. Principles of Seed Technology: Agrawal, P.K,
5. Seed Production of Commercial Vegetables: Singh, S.P.
6. Olericulture-I K.P. Singh and Anant Bahadur
7. Vegetable Crops T.K. Bose and Som

VSC-222: Temperate Vegetable Crops 2 (1+1)

<u>THEORY</u>		
S.N.	Topic	No. of Lectures
1.	Importance of cool season vegetable crops in nutrition & national economy	1
	Area, production, export potential, description of varieties & hybrids, origin, climate and soil, production technologies, post harvest technology & marketing of following crops	
2.	Cabbage	1
3.	Cauliflower	1
4.	Knolkhol	1
5.	Sprouting broccoli & Brussels sprout	1
6.	Onion	1
7.	Garlic & Leek	1
8.	Radish	1
9.	Carrot	1
10.	Turnip	1
11.	Beetroot	1
12.	Peas & Broad bean	1
13.	Palak & Spinach	1
14.	Lettuce & Chinese cabbage	1
15.	Rhubarb & Vegetable Kale	1

16	Asparagus & Globe artichoke	1
	Total	16
<u>PRACTICAL</u>		
S.N.	Topic	No. of Lectures
15.	Identification & description of varieties/hybrids of temperate vegetables	1
16.	Methods of propagation of temperate vegetables	2
17.	Raising & management of vegetable nursery	2
18.	Field layout & preparation	3
19.	Sowing/ transplanting of temperate vegetables	2
20.	Identification of physiological disorders & nutrition disorders & their corrections	2
21.	Post Harvest Handling	2
22.	Calculation of cost of cultivation	1
23.	Field visits to commercial farms	1
	Total	16

Reference Books:

1. Textbook of Vegetable, Tuber Crops & Spices: By S. Thamburaj
2. Hand book of Horticulture: By K. L. Chaddha
3. Modern Technology in Vegetable Production : By P. Hazara
4. Olericulture in India: By M.K. Rana
5. A Text Book on Production Technology of Vegetables: By B.R. Choudhary
6. Production technology of vegetable crops: By K.G. Shanmugavelu

VSC-312: Potato & Tuber Crops 2 (1+1)

<u>THEORY</u>		
S.N.	Topic	No. of Lectures
	Origin, area, production, economic importance, export potential, varieties & hybrids, soil, climate, season, seed rate, field preparation, planting practices, spacing, water, nutrient & weed management, nutrient deficiencies, use of chemical & growth regulators, cropping systems, harvesting practices, yield, seed production, economics of cultivation, post-harvest handling & storage, field & seed standards and marketing of following tuber crops:	
1.	Potato	2
2.	Sweet potato	2
3.	Cassava	2
4.	Yams	1
5.	Taro (Colocasia)	1
6.	Tannia (Xanthosoma)	1
7.	Elephant foot yam (Amorphophallus)	1
8.	Arrowroot	1
9.	Giant taro	1
10.	Winged bean	1
11.	Jerusalem artichoke	1
12.	Horse radish	1
13.	Other under-exploited tuber crops- Chinese potato, Pachyrrhizus	1
<u>PRACTICAL</u>		

S.N.	Topic	No. of Lectures
1.	Identification of nutrient deficiencies in tuber crops	1
2.	Identification, description & morphology of potato	1
3.	Identification, description & morphology of sweet potato	1
4.	Rapid multiplication technique of cassava	1
5.	Identification, description & morphology of edible aroids & yams	1
6.	Working out cost of cultivation of tuber crops	1
7.	Physiological disorders of potato & tuber crops	1
8.	Use of herbicides and plant growth regulators in tuber crops	1
9.	Rapid multiplication technique in yams and aroids	1
10.	Maturity indices in tuber crops	1
11.	Field preparation and sowing/planting of potato & other tuber crops	1
12.	Fertilizer application in tuber crops	1
13.	Planting systems in potato & other tuber crops	1
14.	Post harvest handling, storage & marketing of tuber crops	1
15.	Seed / planting material collection of tuber crops	1
16.	Preparation & presentation of project for commercial cultivation of tuber crops	1

Reference books:

1. Production technology of tuber crops: CR Mohan Kumar, G M Nair, James George, C S Ravindran & V Ravi.
2. Potato in India: P C Das
3. Tropical root and tuber crops: R C Mandal
4. Olericulture in India: M.K. Rana
5. Vegetables: B.R. Choudhary

VSC-223 3 (2+1) Precision Farming & Protected Cultivation

Sl. No.	Topics	No. of classes
Theory		
1	Precision farming – laser leveling, mechanized direct seed sowing; seedling and sapling transplanting	2
2	Mapping of soils and plant attributes, site specific input application.	2
3	Weed management, insect pests and disease management, yield mapping in horticultural crops.	2
4	Green house technology, Introduction, Types of Green Houses.	2
5	Plant response to Greenhouse environment, Planning and design of greenhouses.	2
6	Design criteria of greenhouse for cooling and heating purposes.	3
7	Green house equipment, materials of construction for traditional and low cost green houses.	3
8	Irrigation systems used in greenhouses.	2
9	Typical applications, passive solar green house, hot air greenhouse heating systems, green house drying.	3
10	Cost estimation and economic analysis.	2
11	Choice of crops for cultivation under greenhouses, problems / constraints of greenhouse cultivation and future strategies.	3
12	Growing media including rock wool and other inert media.	2

13	Soil culture, type of soil required, drainage, flooding and leaching, soil pasteurization in peat moss and mixtures.	2
14	Nutrient film technique (NFT) / hydroponics	2
Total		32
Practical*		
14	Study of different types of greenhouses based on shape, construction and cladding materials.	2
15	Calculation of air rate exchange in an active summer winter cooling system.	2
16	Calculation of rate of air exchange in an active winter cooling system.	1
17	Estimation of drying rate of agricultural products inside green house.	2
18	Testing of soil and water to study its suitability for growing crops in greenhouses.	2
19	The study of fertigation requirements for greenhouses crops and estimation of E.C. in the fertigation solution.	2
20	The study of various growing media used in raising of greenhouse crops and their preparation and pasteurization / sterilization.	2
21	Visit to commercial green houses.	1
22	Economics of protected cultivation.	1
Total		16

Reference Books

- Balraj Singh. 2006. Protected cultivation of vegetable crops. Kalyani Publishers, Ludhiana.
- Brahma Singh, 2014. Advances in Protected Cultivation. New India Publishing Agency. New Delhi.
- Reddy P. Parvatha, 2003. Protected Cultivation. Springer Publications. USA.
- Reddy, P. Parvatha. 2011. Sustainable crop protection under Protected Cultivation. Springer Publications. USA.
- Jitendra Singh, 2015. Precision Farming in Horticulture. New India Publishing Agency. New Delhi.
- Prasad S. 2005. Greenhouse Management for Horticultural Crops. Agrobios. Jodhpur.
- Jitendra Singh, S.K. Jain, L.K. Dashora, B.S. Cundawat. 2013. Precision forming in Horticulture. New India Publishing Agency, New Delhi.
- T. Pradeep Kumar, B. Suma, Jyothi Bhaskar and K.N.Satheson. 2008. Management of Horticultural crops. New India Publishing Agency, New Delhi.
- Aldrich RA & Bartok JW. 1994. NRAES, Riley, Robb Hall. Green House Engineering. Cornell University, Ithaca, New York.
- Pant V Nelson. 1991. Green House Operation and Management. Bali Publ.

POST HARVEST TECHNOLOGY

Course-PHM - 311 Postharvest Management of Horticultural Crops3 (2+1)

Sl. No.	Topic	No. of Lectures
1	Importance of postharvest technology in horticultural crops	2
2	Maturity, types of maturity and factors affecting maturity of horticultural crops	3
3	Harvesting, handling, grading of fruits, vegetables & cut flowers	2
4	Harvesting, handling, grading of plantation crops and spices & medicinal and aromatic plants	2

5	Pre-harvest factors affecting quality	1
6	Factors responsible for deterioration of horticultural crops	1
7	Physiological and bio-chemical changes during ripening	2
8	Hastening and delaying ripening process	2
9	Postharvest treatments of horticultural crops –VHT, HWT, irradiation, fungicidal and chemical	2
10	Quality parameters and specification in fruits, vegetables and cut flowers	1
11	Structure of fruits and vegetables related to physiological changes after harvest	2
12	Structure of cut flowers related to physiological changes after harvest	1
13	Methods of storage for local market and export	2
14	Pre-harvest treatment and pre-cooling, pre-storage treatments	2
15	Different systems of storage	2
16	Packaging methods and types of packages	2
17	Recent advances in packaging-vacuum packaging, poly shrink packaging & grape guard	1
18	Types of containers and cushioning materials, packing treatments and cold storage	1
19	Modes of transport	1
	Total Lectures	32
	Practicals	
1	Maturity indices of fruits	1
2	Maturity indices of vegetables	1
3	Maturity indices of flowers	1
4	Maturity indices of Plantation crop	1
5	Maturity indices of Spices	1
6	Determination of physiological loss in weight and quality	1
7	Grading of horticultural produce (manual)	1
8	Grading of horticultural produce (Mechanical)	1
9	Post-harvest treatment of horticultural crops- physical and chemical methods	1
10	Packaging in fruits, vegetables by using different packaging materials	1
11	Packaging in plantation crops and cut flowers by using different packaging materials	1
12	Methods of storage	1
13	Post-harvest disorders in horticultural produce	1
14	Identification of storage pests and diseases in horticulture crops	1
15	Visit to packaging houses	1
16	Visit to cold storage	1
	Total Practical Classes	16

Reference books:

1. Thompson, A.K. 1996. Postharvest Technology of fruits and vegetables. Blackwell Science Ltd. Oxford, UK.
2. Wills, R.B.H., McGlasson, W.B. and Hall, E.G. 1999. Postharvest. CBS publishers, New Delhi.
3. Ranganna, S. 1999. Handbook of analysis and quality control for fruits and vegetable products, 3rd edn. Tata McGraw-Hill Publishing Company Ltd, New York.
4. Verma, L.R. and Joshi, V.K. 2000. Postharvest Technology of Fruits and Vegetables. Vol. I & II. Indus Publishing Co., New Delhi.

5. Pruthi, J.S. 2001. Minor Spices and Condiments – Crop Managements and Post Harvest Technology. ICAR, New Delhi.
6. Battacharjee, S.K. and De, L.C. 2005. Post Harvest Technology of Flowers and Ornamentals Plants. Ponteer Publisher, Jaipur, India

Course-PHM - 321 PROCESSING OF HORTICULTURAL CROPS3 (1+2)

Sl. No.	Topic	No. of Lectures
1	Importance and scope of fruit and vegetable preservation industry in India	1
2	Food pipe line, losses in post-harvest operations	1
3	Unit operations in food processing	1
4	Principles and guidelines for the location of processing units	1
5	Principles and methods of preservation by heat - pasteurization, canning, bottling.	1
6	Methods of preparation of juices, squashes, syrups, cordials and fermented beverages.	1
7	Methods of preparation of Jam, jelly and marmalade	1
8	Preservation by sugar and chemicals, candies, crystallized fruits, preserves chemical preservatives	2
9	Preservation with salt and vinegar, pickling, chutneys and sauces, tomato and mushrooms	1
10	Freezing preservation	1
11	Processing of plantation crops, products	1
12	Spoilage in processed foods	1
13	Quality control of processed products	1
14	Govt. policy on import and export of processed fruits	1
15	Food laws	1
	Total Lectures	16
1	Equipments used in food processing units	2
2	Physico-chemical analysis of fruits and vegetables	5
3	Preparation of squash	1
4	Preparation of RTS	1
5	Preparation of syrup	1
6	Preparation of jam and jelly	1
7	Preparation of pickles (hot and sweet).	2
8	Cut out analysis of processed foods	5
9	Preparation of candies	1
10	Processing of plantation crops	2
11	Preparation of chutneys	1
12	Preparation of sauces	1
13	Preparation of marmalade	1
14	Preparation of cordial	1
15	Canning of fruits and vegetables	2
16	Dehydration of fruits and vegetables	2
17	Refrigeration and freezing	1
18	Visit to processing units	2
	Total Practical Classes	32

Reference books:

1. Ranganna, S. 1999. Handbook of analysis and quality control for fruits and vegetable products, 3rd edn. Tata McGraw-Hill Publishing Company Ltd, New York.
2. Lal, G., Siddappa, G.S. and Tandon, G.L. 1996. Preservation of Fruits and Vegetable – ICAR, New Delhi.

3. Srivastava, R. P. & Sanjeev Kumar. 2002. Fruits and vegetable Preservation – Principles and Practice. International Book Distributing Co., Lucknow.
4. Verma, L. R. and Joshi, V. K. 2000. Post Harvest Technology of Fruits and Vegetables. Vol. I & II. Indus Publishing Co., New Delhi.

Course No- PHM-211 Fundamental of Food Technology- 2 (1+1)

Sl.No	Topic	No. of lectures
1	Food and its function	1
2	physico-chemical properties of foods	1
3	food preparation techniques	1
4	nutrition, relation of nutrition of good health	1
5	Characteristics of well and malnourished population	1
6	Energy, definition, determination of energy requirements	1
7	food energy, total energy needs of the body	
8	Mineral nutrition: macro and micro-minerals	1
9	(Ca, Fe and P), function, utilization, requirements, sources, effects of deficiency	1
10	effects of deficiency	1
11	Vitamins: functions,	1
12	sources, effects of deficiency	1
13	requirements of water soluble and fat-soluble vitamins	1
14	Balanced diet	1
15	recommended dietary allowances for various age groups	1
16	assessment of nutritional status of the population	1
Total lectures		16

PRACTICAL

Sl No.	Experiments	No. of Lecture
1	Methods of measuring food ingredients	2
2	effect of cooking on volume and weight	2
3	determination of percentage of edible portion	2
4	Browning reactions of fruits and vegetables	2
5	Microscopic examination of starches,	2
6	estimation of energy	2
7	value proteins and fats of foods	2
8	Planning diet for various age groups.	2

Reference books:

1. Dr. Swaminathan, M. 1985. Food and Nutrition Vol. I & II. BAPPCO, Bangalore.
2. Manoranjan, K. and Sangita, S. 1996. Food Preservation and Processing. Kalyani Publishers 978-81-272-4262-6.
3. Anita, T. 1996. Food and Nutrition. Oxford 0198327668.
4. Devendra, K. B. and Priyanka, T. 2006. An Introduction to Food Science and technology and Quality Management. Kalyani Publishers 81-272-2521-5.
5. Monoranjam, K. and Sangita, S. 2008. Food Preservation and Processing. Kalyani Publishers 978-81-272-4262-6.

FLORICULTURE AND LANDSCAPE ARCHITECTURE

COURSE: ORNAMENTAL HORTICULTURE

FLS -221

3 (2+1)

Lec. No.	Topic of Lecture	No. of classes
1.	History, importance and scope of gardening	1
2.	Popular gardens in India	1
3.	Floriculture Industry: importance, area production and industrial importance	1
4.	Basic principles and elements of gardening	3
5.	Types of gardens: formal and informal gardens	1
6.	Garden styles - i : hindu type gardens (vanams), natural garden, wild garden	2
7.	Garden styles - ii : mughal gardens, persian gardens, italian gardens, french gardens, english gardens, japanese gardens	2
8.	Components and features of landscaping - plant and non-plant components	1
9.	Special types of gardens - i: roof garden, sunken garden, vertical garden, terrace garden	3
10.	Special types of gardens - ii: water garden, bog garden, shade garden, rock garden	2
11.	Special types of gardens - iii: terrarium, bottle and dish gardens, window garden	2
12.	Significance of trees, shrubs, flowering annuals, climbers and creepers in landscaping	1
13.	Significance of palms, ferns, selaginellas, cycads, cacti and succulents in landscaping	1
14.	Landscape design for a home garden	1
15.	Landscape design for recreational gardens and children's parks	1
16.	Landscape design for educational institutions	1
17.	Landscape design for industrial areas	1
18.	Landscaping of public places- railway stations, bus terminals, dam sites, hydroelectric stations, river banks, cemeteries	2
19.	Lawn grasses, establishment and maintenance of lawns	1
20.	Bonsai - styles, plants and containers	1
21.	Bonsai - cultural practices, special practices, care and maintenance	1
22.	Flower arrangement - principles & styles	1
23.	Bioaesthetic planning: need for round country planning	1

Practical

Exercise No.	Topic of Exercise	No. of classes
1.	Identification and description of trees and shrubs	1
2.	Identification and description of flowering Annuals, bulbous ornamentals, climbers and Creepers	1
3.	Identification and description of palms, ferns, cycads, ornamental grasses, cacti and succulent	1

4.	Identification and description of indoor plants, foliage plants and water plants	1
5.	Visit to ornamental plant nurseries	1
6.	Description and designing of garden structures - edges and hedges, flower beds, flower borders, arboretum, rosary, fernery, palmatum, carpet garden	1
7.	Description and designing of garden structures - arches, bowers, pergolas, roads, walks, paths, bridges, fountains and statues	1
8.	Planning and designing a house garden	1
9.	Planning and designing of roadside planting	1
10.	Layout of gardens in industrial areas	1
11.	Visit to public gardens and parks to study different features and styles of gardening	1
12.	Layout of terrarium / bottle garden, dish garden	1
13.	Lawn making - preparation of land and planting	1
14.	Designing and layout of rockery, water garden, terrace garden, roof garden	1
15.	Practicing flower arrangement and bouquet making	1
16.	Practicing the art of bonsai	1

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 andInformationdivision.ICAR,NewDelhi.

Course: FLS -322

Breeding and Seed Production of Ornamental Plants 3 (2+1)

Lecture No. and Topic	No. of classes
Topic: 1 History of Improvement of Ornamental Plants	2
Topic: 2 Objectives in Plant Breeding, Methods of crop Improvement	1
Topic: 3 Plant Introduction and Methods	1
Topic: 4 Selection, Mass selection	1
Topic: 4 Hybridization: procedures of hybridization	1
Topic: 5 Mutation Breeding and its Applications	1

Topic: 6 Biotechnological Techniques for the Improvement of Ornamental Plants	2
Topic: 7 Breeding for Disease Resistance	1
Topic: 8 Role of Heterosis and its exploitation	1
Topic: 9 Use of Inbred Lines for the Development of New Varieties	1
Topic: 10 Techniques of hybrid seed production, methods of making a cross and Production of F1 hybrids	2
Topic: 11 Hybrid Seed Production in some important annual flower Crops	3
Topic: 12 Utilization of male sterility for hybrid Seed Production	1
Topic: 13 Seed production of open pollinated varieties	1
Topic: 14 Harvesting of Seeds, Stages of Seed harvesting of different annual flower Crops	1
Topic: 15 Seed Processing, Cleaning, Sizing and Packaging, Seed Storage	1
Topic: 16 Storage Conditions for different flower Crops and Seed Certification	1
Topic:17 Breeding of Rose: Objectives and techniques	1
Topic: 18 Breeding of Gladiolus: Objectives and techniques	1
Topic: 19 Breeding of Tuberoses and Dahlia: Objectives and techniques	1
Topic: 20 Breeding of Chrysanthemum and Carnation: Objectives and techniques	2
Topic: 21 Breeding of Orchids: Objectives and techniques	1
Topic: 22 Breeding of Lilium :Objectives and techniques	1
Topic: 23 Breeding of Marigold and Jasmine : objectives and techniques	1
Topic: 24 Breeding of China aster and Bougainvillea Hibiscus: objectives and techniques	1
Topic: 25 Distinguished characters of improved cultivars of ornamental Crops	1
Total Classes	32

PRACTICAL

Exercise	No. of practical classes
Exercise 1: To study the floral biology of some important ornamental plants	4
Exercise 2: Methods of emasculation, pollination Pollen collection and storage of ornamental plants	2
Exercise 3: Determining the pollen viability through staining tests	1
Exercise 4: Determination of stigma receptivity stage	1
Exercise 5: Hybridization of some important ornamental plants	4
Exercise 6: To study about harvesting & storage methods of seeds in important ornamental plants	2
Exercise 7: To study seed viability test of ornamental plants	1
Exercise 8: Seed production methods of ornamental plants	1
Total Classes	16

Suggested Reading:

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

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

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

D.J. Callaway and M.B. Callaway. 2000. Breeding Ornamental Plants. Timber Press
 J. Harding, F.Singh and J.N. Mol. 1991. Genetics and Breeding of Ornamental Species. Springer Publishers
 A. Vainstein. 2002. Breeding for Ornamental: Classical and Molecular Approaches. Springer Publishers
 Singh,B.D. 1983.BreedingPrinciplesandMethods.KalyaniPublishers,NewDelhi.
 R.L. Agarwal. 1996. Seed Technology. Oxford&IBHPublishers, New Delhi
 P.K. Agarwal. 1994. Principles of Seed Technology. ICAR Publication, NewDelhi

Course No: FLS -111 (1 +1)Course title: Principles of Landscape Architecture

THEORY

Lecture No. and Topic	No. of classes
Topic: 1 Historical Importance of Indian gardens, Gardens of ancient world, Famous gardens of India and abroad,	1
Topic :2 Factors affecting landscape design viz. initial approach, view, human choice, simplicity, topography etc.	1
Topic:3 Formal, informal, free style and wild gardens, basic themes of gardens viz. circular, rectangular and diagonal themes	1
Topic: 3 Steps in preparation of garden design.	1
Topic: 4 Use of Auto CAD and Arch CAD in designing gardens.	1
Topic: 5 Principles of Landscape gardens viz. Axis, rhythm, balance, time and light, space, texture, form, mass effect, focal point, mobility, emphasis, unity and harmony etc..	1
Topic: 6 Elements of landscape gardens viz. tangible and intangible elements.	1
Topic: 7 Bio-aesthetic planning, definition, objectives, Planning and designing of home gardens, colonies, country planning, urban landscape	1
Topic: 8 Development of institutional gardens, planning and planting of avenues, beautifying schools, factories, corporate play grounds	1
Topic: 9 Planning and planting of railway lines railway stations air ports bus stands	1
Topic: 10 Planning and planting of dams, hydro electric stations, river banks,	1
Topic: 11 Gardens for places of religious importance viz. temples, churches, mosques, tombs etc	1
Topic: 12 Importance, features and establishment of English garden , Japanese gardens , Mughal gardens, French garden	2
Topic: 13 Importance, features and establishment of Persian garden, Italian gardens, Hindu gardens and Buddhist gardens	1
Topic: 14 Xeriscaping, definition, principles and practice	1
Total	16

PRACTICAL

Lecture No. and Topic	No. of classes
Topic: 1 Study of garden equipments. Use of drawing equipments, graphic symbols and notations in landscaping designing, ,	2
Topic: 2 Study and designing of different styles of gardens, Study and designing of gardens based on different themes,	2
Topic: 3 Study of Graphic language and Designing gardens using Auto-cad/ archi-cad,	2

Topic: 4 Designing gardens for home, traffic islands, schools and colleges, public buildings, factories, temples, churches, play grounds, corporate buildings/ malls.	5
Topic: 5 Designing and planting of avenues for state and National highways, railway stations, air ports,	2
Topic: 6 Design and establishment of Japanese, English and Mughal gardens.	2
Topic: 7 Visit to public, institutional and botanical gardens.	1
Total	16

Suggested Reading:

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

H.S.Grewal and Parminder Singh. 2014. *Landscape designing and ornamental plants*

R.K. Roy. *Fundamentals of Garden designing*.2013.New India publishing agency, Pitampura, New Delhi.

Rajesh Srivastava. 2014. *Fundamentals of Garden designing*. Agrotech press, Jaipur, New Delhi.

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

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

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

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

FLS -211 (2 +1)

Commercial Floriculture

Lecture No. and Topic	No. of classes
Topic: 1 Scope and Importance of commercial floriculture in India	1
Topic :2 Production technology of rose	2
Topic: 3 Production technology of chrysanthemum	2
Topic: 4 Production technology of orchid	2
Topic: 5 Production technology of carnation	2
Topic: 6 Production technology of gladiolus	1
Topic: 7 Production technology of marigold	2
Topic: 8 Production technology of jasmine	2
Topic: 9 Production technology of dahlia	1
Topic: 10 Production technology of tuberose	2
Topic: 11 Production technology of bird of paradise	1
Topic: 12 Production technology of china aster	1
Topic: 13 Production technology of gerbera	1
Topic: 14 Protected cultivation of flowers	4
Topic: 15 Post harvest technology of commercial flower crops	3
Topic :16 Dehydration technique for drying of flowers	3
Topic: 16 Production techniques for bulbous ornamentals	2
Total	32

Practical

Exercise	No. of practical class
Excercise 1: Identification of commercially important floricultural crops	2
Excercise 2: Propagation practices in chrysanthemum	1
Excercise 3: Sowing of seeds and raising of seedlings of annuals	2
Excercise 4: Propagation by cutting, layering	2
Excercise 5: Propagation by budding and grafting	2
Excercise 6: Training and pruning of roses	1
Excercise 7: Use of chemicals and other compounds for prolonging the vase life of cut flowers	2
Excercise 8: Drying and preservation of flowers	2
Excercise 9: Flower arrangement practices	2
Total	16

Suggested Reading:

A.K.Singh.2006.*Flower crops, cultivation and management*. New India publishing agency, Pitampura, New Delhi.

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

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

Dewasish Choudhary and Amal Mehta. 2010. *Flower crops cultivation and management*. Oxford book company Jaipur, India.

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

Arora, J.S. 2006.Introductory Ornamental Horticulture.Kalyani Publishers, Ludhiana - 141 008.

Prof. Bhattacharjee, S.K. Advanced Commercial Floriculture. Aavishkar Publishers Distributors, Jaipur - 320 003

Prof. V.L. Sheela, 2008. Flower for trade . New India Publishing Agency, Pitampura, New Delhi-110088

FLS-321 (2+1) Medicinal And Aromatic Crops

Theory

Lecture No.	Topic of Lecture	No. of Classes
1.	History, scope, opportunities and constraints in the cultivation and maintenance of medicinal and aromatic plants in India.	2
	Importance, origin, distribution, area, production, climatic and soil requirements, propagation and nursery techniques, planting and after care, cultural practices, training and pruning, nutritional and water requirements. Plant protection, harvesting and processing of under mentioned important medicinal and aromatic plants. Study of chemical composition of a few important medicinal and aromatic plants, extraction, use and economics of drugs and essential oils in medicinal and aromatic plants. Therapeutic and pharmaceutical uses of important species. Storage techniques of essential oils. Marketing.	
	Medicinal plants	
2.	Withania	1
3.	Periwinkle	1
4.	Rauvolfia	1
5.	Disocorea	1

6.	Isabgol	1
7.	Opium poppy	1
8.	Ammi majus	1
9.	Belladonna	1
10.	Cinchona	1
11.	Pyrethrum	1
12.	Other species relevant to local condition	5
Aromatic Crops		
13.	Citronella grass	1
14.	Khus grass	1
15.	Sweet Flag (Bach)	1
16.	Lavender	1
17.	Geranium	1
18.	Patcholi	1
19.	Bursera	1
20.	Mentha	1
21.	Musk mallow	1
22.	Ocimum	1
23.	Other species relevant to local condition	5

Practical

Lecture No.	Topic of Lecture	No. of Classes
1	Collection and Identification of medicinal plants from their natural habitat	2
2	Collection and Identification of aromatic Plants from their natural habitat	2
3	Study their morphological description of medicinal and aromatic plants	2
4	Layout of nursery and medicinal and aromatic field	2
5	Nursery techniques	2
6	Harvesting and curing of medicinal and aromatic plants	2
7	Processing techniques	2
8	Extraction of essential oils	2

Suggested Reading:

Chadha, K.L. ICAR, 2001. Hand Book of Horticulture. Directorate of Information and Publications of Agriculture, Pusa, New Delhi.

Azhar Ali Farooqui and Sreeramu, B.S. 2001. Cultivation of medicinal and aromatic plants. United Press Limited.

Atal, E.K. and Kapur, B. 1982. Cultivation and Utilization of Medicinal and Aromatic plants. CSIR, New Delhi.

Kumar, N. J.B.M. Md. Abdul Khaddar, Ranga Swamy, P. and Irulappan, I. 1997. Introduction to Spices, Plantation Crops Medicinal and Aromatic Plants. Oxford & IBH, New Delhi.

Jain, S.K. 1968. Medicinal Plants .National Book Trust New Delhi. Oxford & IBH, New Delhi.

Dastur, J.F. 1982. Medicinal plants of India Pakistan Taraprevala sons and co-private Ltd, Bombay.

PLANT PROTECTION

PPS-121 3(2+1) Fundamentals of Plant Pathology

Theory

SL. No.	Subject	Lecture No.
1.	Introduction to the science of phytopathology its objectives, scope.	02
2.	Historical background	03
	Symptoms, signs, and related terminology	02
3.	Classification of plant diseases	02
4.	Parasitic causes of plant diseases fungi and their characteristics and classification	02
5.	Bacteria, their characteristics and classification.	02
6.	Viruses, Phytoplasma, their characteristics and classification.	03
7.	Protozoa, algae and flowering parasitic plants, their characteristics and classification	03
8.	Non-parasitic causes of plant diseases	01
9.	Infection process	01
10.	Survival and dispersal of plant pathogens	02
11.	Plant disease epidemiology, forecasting	02
12.	Plant disease assessment	01
13.	Principles and methods of plant disease management	02
14.	Integrated plant disease management	02
15.	Fungicides classification based on chemical nature management.	02
16.	Commonly used fungicides, bactericides and nematocides	01

Practical No	Topic	Lecture No.
1.	Familiarity with general plant pathological laboratory.	1
2.	Familiarity with general plant pathological field equipments.	1
3.	Study of disease symptoms and signs caused by fungi, bacteria and virus	1
4.	Host parasite relationship.	1
5.	morphological and microscopically based Identification of plant pathogens	1
6.	Isolation of plant pathogens	1
7.	Koch's postulates.	1
8.	Plant disease assessment	1
9.	Study of yield loss assessment	1
10.	Preparation of fungicidal dose calculation	1
11.	Study of fungicides.	1
12.	Foliar method of application	1
13.	How to preserve the diseased symptoms	1
14.	Dissection of plant pathogens	1
15.	Field visit to diagnose the symptoms	1
16.	Field visit to diagnose the symptoms	1

REFERENCE BOOK

- N.G. Ravichandra, 2013. Fundamentals of Plant Pathology. PHI Hall of India, New Delhi
- R.S. Mehrotra, Ashok Agarwal. *Fundamental of Plant Pathology- Sambamurthy A textbook of Plant Pathology-*
- R.S. Singh *Introduction to principles of plant pathology*
- Alexopoulos, C.J. Mims, C.W. and Blackwell, M. 1996. Introduction to Mycology Wiley Eastern Ltd., New York.
- Mandahar, C.L. 1987. Introduction to Plant Viruses. Chand and Co. Pvt. Ltd., New Delhi.
- Mehrotra, R.S. and Aneja, K.R. 1990. . An Introduction to Mycology. New Age International (P) Ltd., New Delhi.
- Singh, R.S. 1982. Plant Pathogens - The Fungi. Oxford and IBH Publishing Co., New Delhi.
- Singh, R.S. 1989. Plant Pathogens - The Prokaryotes .Oxford and IBH Publishing Co., New Delhi.
- Dhingra and Sinclair 1993. Basic Plant Pathology Methods. CBS, Publishers & Distributors, New Delhi.
- Agrios, G.N. 2006. Plant Pathology. Elsevier Academic press, London.

PPS-212 Diseases of fruit, plantation, medicinal and aromatic plants. 3(2+1)

Theory:

Etiology, symptoms, mode of spread, survival, epidemiology and management of the diseases of the following crops.

S.No.	Topic	Lecture No.
1.	Mango, banana	02
2.	Grape, citrus, guava	03
3.	Sapota, papaya, jack fruit	02
4.	Pineapple, pomegranate, Ber	02
5.	Apple, pear	02
6.	Peach, plum, almond	02
7.	Walnut, strawberry, arecanut	02
8.	Coconut, oil palm	02
9.	Coffee, tea, Cocoa	02
10.	Cashew, rubber	02
11.	Betelvine, Senna, neem	01
12.	Hemp , Belladonna	01
13.	Pyrethrum, camphor, costus	02
14.	Crotalaria, datura, dioscorea	02
15.	Mint, opium, <i>Salanum khasianum</i> and Tephrosia	02
16.	Important Post-harvest disease of fruit, plantation and medicinal and aromatic and their management	02
	Total	32

Practical Schedule: Observations of disease symptoms, identification of casual organisms and host parasite relationship, examination of scrapings and cultures of important pathogens of fruits, plantation, medicinal and aromatic crops.

Practical No.	Topic	No. of lectures
1.	Mango, banana Grape, Sapota,	1

2.	citrus, guava papaya, jack fruit	1
3.	Pineapple, pomegranate, Ber Apple, pear	1
4.	Peach, plum, almond Walnut, strawberry,	1
5.	Coffee, tea, Cocoa Cashew, rubber	1
6.	Coconut, oil palm, Arecanut	1
7.	Bordeaux mixture preparation and its use in fruit disease management	1
8.	Copper based fungicidal mixture preparation	1
9.	Special methods of application like stem injection root feeding, corm application	1
10.	Study of spray equipment and its use	1
11.	Field visit 1	1
12.	Field visit 2	1
13.	morphological and microscopically based Identification of plant pathogens	1
14.	Culturing of important pathogens	1
15.	Dissection of important pathogens	1
16.	Fungicidal dose calculation	1

Suggested Reading:

- L.R. Verma and R.C. Sharma. *Diseases of horticultural Crops-*, Indus Publishers
- Srikant Kulkarni, Yashoda R. Hedge, *Diseases of Plantation crops and their management-* Agrotech publication Academy.
- S.L. Godara, BBS Kapoor, B.S. Rathore *Disease management of spice crops-*, Madhu Publications.
- Alfred Steferud *Diseases of Plantation Crops-*, Biotech books.
- R.S.Singh, *Plant diseases* –Oxford and IBH Publishing Co. Pvt. Ltd.
- L.Darwin Christdhar Henry and H. Lewin Devasahayam. *Crop diseases: Identification, Treatment and Management*. An Illustrated Handbook, New India publishing.Agency.
- Anna L A colour atlas of Post Harvest Diseases and Disorders of fruits and vegetables -. Snowdon, CRC Press.
- Pathak, V.N. 1980.*Diseases of Fruit Crops*.Oxford IBH Publishing Co. Pvt. Ltd., New Delhi.
- Ranga Swamy, G. 1988.*Diseases of Crop Plants in India*. Prentice Hall of India Pvt. Ltd., New Delhi.
- Singh, R.S. 1996.*Plant Diseases*. Oxford IBH Publishing Co. Pvt. Ltd., New Delhi.
- Saha, L.R. 2002.*Hand Book of Plant Diseases*. Kalyani Publishers, New Delhi.
- Arjunan, Karthikeyan, Dinakaran, Raghuchander, 1999.*Diseases of Horticultural Crops*. Dept. of Plant Pathology, TNAU, Coimbatore
- Chadha, K.L. 2002.*Hand Book of Horticulture*. ICAR, New Delhi.
- Anna L.Snowdon A colour atlas of Post Harvest Diseases and Disorders of fruits and vegetables .CRC Press, New Delhi.
- L.R. Verma and R.C. Sharma.*Diseases of horticultural Crops.*, Indus Publishers,New Delhi.
- Yashoda R. Hedge. *Diseases of Plantation crops and their management* .Srikant Kulkarni, Agrotech publication Academy.
- S.L. Godara, BBS Kapoor, B.S. Rathore. *Disease management of spice crops.*, Madhu Publications.
- Ranga Swamy, G. 1988.*Diseases of crop plants in India*. Prentice Hall of India Pvt. Ltd., New Delhi
- R.S.Singh, *Plant diseases*.Oxford and IBH Publishing Co. Pvt. Ltd.

L. Darwin Christdhar Henry and H. Lewin Devasahayam, *An Illustrated Handbook*.
New India publishing.Agency

PPS-311 -: Diseases of vegetables, Ornamental and Spice Crops Credit hours: 3(2+1)

Etiology, symptoms, mode of spread, epidemiology and integrated management of diseases of the following crops:

Lecture No	Topic	No. of lecture(s)
1.	Tomato	1
2.	Brinjal	1
3.	Chilli	1
4.	<i>Bhindi</i>	1
5.	Cabbage	1
6.	Cauliflower	1
7.	Radish	1
8.	Knolkhol	1
9.	Pea	1
10.	Beans	1
11.	Beetroot	1
12.	Onion	1
13.	Garlic	1
14.	Ginger	1
15.	Potato	1
16.	Fenugreek	1
17.	Turmeric	1
18.	Pepper	1
19.	Cumin	1
20.	Cardamom	1
21.	Nutmeg	1
22.	Coriander	1
23.	Clove	1
24.	Cinnamon	1
25.	Jasmine	1
26.	Rose	1
27.	Crossandra	1
28.	Tuberose,	1
29.	Geranium	1
30.	Gerbera	1
31.	Anthurium	1
32.	Important post-harvest diseases of vegetables ornamental crops and Their management.	1

Practical Schedule: Observations of symptoms, causal organisms and host parasitic relationship of important diseases, examination of cultures of important pathogens of vegetables, ornamental and spice crops in field as well as in protected cultivation.

Practical No	Topic	No. of lecture(s)
1.	Study on disease of Potato, Tomato	1
2.	Study on disease of brinjal, Chilli, bhindi	1
3.	Study on disease of Cabbage, cauliflower, Radish, knol-khol, beet root	1
4.	Study on disease of Onion, garlic, Ginger, turmeric	1
5.	Study on disease of Fenugreek, coriander, Pea, beans	1
6.	Study on disease of Pepper, Cardamom, Clove, cinnamon	1

7.	Study on disease of Rose, anthurium, Tuberose	1
8.	Study on disease of jasmine, crossandra Gerebera, geranium	1
9.	Seed treatment to kill seed borne diseases	1
10.	Soil treatment to management the soil borne diseases	1
11.	Study of important pathogenic organism	1
12.	Study of mode of action of fungicides	1
13.	Study of fungicides and tradenames	1
14.	Isolation & dissection of plant pathogen	1
15.	Study of yield loss assessment.	1
16.	Fungicidal dose calculation and field visit	1

Reference:

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

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

L.Darwin Christdhar Henry and H.Lewin Devasahayam *Crop diseases: Identification, Treatment and Management. An Illustrated Handbook –*, New India publishing Agency

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

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

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

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

Saha, L.R. 2002. *Hand Book of Plant Diseases*. Kalyani Publishers

Arjunan, G. Karthikeyan, G. Dinakaran, D. Raguchander, T. 1999. *Diseases of Horticultural Crops*. Dept. of Plant Pathology, Tamilnadu Agricultural University Coimbatore.

PPS – 122: Fundamentals of Entomology 3(2+1)

THEORY

L. No.	Subject	No. of lectures
1	Introduction to Phylum Arthropoda. Importance of class Insecta	1
2	Insect Dominance. History of Entomology in India	1
3	Importance of Entomology in different fields. Definition, Division and Scope of Entomology.	1
4	Comparative account of External Morphology-types of Mouth parts and Antennae	3
5	Insect Legs, Wings and Genitalia	3
6	Structure and Function of Cuticle	1
7	Moulting and Body segmentation in Insects	2
8	Anatomy of Digestive, Circulatory, Sensory, Respiratory, Glandular, Excretory, Nervous and Reproductive systems	7
9	Types of Reproduction. Postembryonic development- Eclosion	2
10	Matamorphosis. Types of Eggs, Larvae and Pupa	2
11	Classification of Insects up to Orders, Sub-order and Families of Economic importance and their distinguished characters	8
12	Plant Mites – Morphological features, important families with examples	1
	Total	32

PRACTICAL

L. No.	Subject	No. of practical's
1	Insect Collection and Preservation	1
2	Identification of important Insects. General body organization of Insects	2
3	Study on Morphology of Grasshopper or Cockroach	1
4	Preparation of permanent mounts of Mouth parts, Antennae	2
5	Preparation of permanent mounts of Legs and Wings	2
6	Dissection of Grasshopper and Caterpillar for study of Internal Morphology	4
7	Observations on Metamorphosis of Larvae and Pupae	2
8	Dissection of Cockroaches	2
	Total	16

Suggested Reading:

1. Chapman, R.F. 1981. The Insects: Structure and function. Edward Arnold (Publishers) Ltd, London, 919p.
2. Nayar, K.K., T.N. Ananthkrishnan and B.V. David. 1976. *General and applied entomology*, Tata McGraw Hill Publishing Company Limited, New Delhi, 589p.
3. Richards, O.W. and R.G. Davies. 1977. *Imm's general text book of entomology*, Vol.1&2, Chapman and Hall Publication, London, 1345p.
4. Tembhare, D.B. 1997. *Modern Entomology*. Himalaya Publishing House, Mumbai, 623p.
5. Pant, N.C. and Ghai, S. 1981. *Insect physiology and anatomy*, ICAR, New Delhi

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

Theory		
Sl. no.	Topics	No. of classes
1	Definition of nematode and economic importance of plant parasitic nematode	1
2	History of development of nematology	1
3	Position of nematode in animal kingdom and General characters of plant parasitic nematodes	1
4	Morphology of plant parasitic nematodes: outer body tube and Inner body tube	1
5	Nematode muscles layer and its classification	1
6	Reproductive, nervous and excretory system in nematodes	1
7	Taxonomy of important plant parasitic nematodes	1
8	Classification of plant parasitic nematodes	1
9	Above and ground symptoms on plants caused by plant parasitic nematodes	1
10	Biology, symptomatology and control of important plant parasitic nematodes of fruits crops.	1
11	Biology, symptomatology and control of important plant parasitic nematodes of vegetables crops.	1
12	Biology, symptomatology and control of important plant parasitic nematodes of tuber crops.	1
13	Biology, symptomatology and control of important plant parasitic nematodes of ornamental crops.	1
14	Biology, symptomatology and control of important plant parasitic nematodes of spice crops.	1

15	Biology, symptomatology and control of important plant parasitic nematodes of plantation crops	1
16	Role of nematodes in plant disease complex.	1

Practical		No. classes
1	Methods of survey and sampling of nematodes	1
2	Collection of soil and plant samples; Extraction of nematodes from soil and plant tissues	1
3	Cobb's sieving and decanting method	1
4	Baermann funnel technique	1
5	Extraction of cyst nematode through Fen-wick can method	1
6	Extraction of nematode through centrifugal sugar floatation technique	1
7	Counting and estimation of plant parasitic nematodes	1
8	Draw a neat and clean diagram of male and female plant parasitic nematode	1
9	Symptoms caused by plant parasitic nematodes in horticultural crops	1
10	Difference between rhizobium nodules and root knot gall	1
11	Killing and fixing of plant parasitic nematodes	1
12	Mounting of nematode: temporary and permanent nematode mounts	1
13	Methods of nematicides treatments	1
14	Preparation of spray fluid	1
15	Collection and Preservation of 10 plant species/parts damaged by plant parasitic nematodes.	1
16	Collection and Preservation of 10 plant species/parts damaged by plant parasitic nematodes.	1

PPS – 221: Insect Pests of Fruit, Plantation, Medicinal and Aromatic Crops 3(2+1)

L. No.	Subject	No. of lectures
1	General – Economic Classification of Insects	1
2	Principles of Applied Entomology	1
3	Pests Categories- Causes of pest outbreak, Pest Management concept Method of pest control, Integrated Pest Management	2
4	Pest surveillance, Pest monitoring	2
5	Insecticides, classification and their mode of action	1
6	Biological control in Pest Management	2
7	Pesticide Application methods	1
8	Distribution, Host range, Bio-ecology, Injury, Integrated Management of important Insect Pests affecting Tropical Fruits	8
9	Sub-tropical and Temperate fruits	4
10	Plantation crops: Coconut, Areca nut	1
11	Oil palm, Cashew nut, Cocoa	1

12	Tea, Coffee, Rubber	2
13	Medicinal and Aromatic crops: Betel vine, Cinchona, Senna, Neem, Belladonna, Pyrethrum, Costus, Crotalaria, Datura, Dioscorea, Mint, Opium and <i>Solanum khasianum</i>	3
10	Storage insects – Distribution, Host range, Bio-ecology, Injury, Integrated Management of important Insect Pests attacking Stored Fruits	1
11	Plantation, Medicinal and Aromatic crops and their Processed products	1
13	Insecticide Residue problems in Fruit, Plantation, Medicinal and Aromatic crops and their Maximum Residue Limits (MRLs)	1

PRACTICAL

L. No.	Subject	No. of practical's
1	Study of symptoms of Insect Damage	1
2	Collection, Identification, Preservation of Insects	1
3	Assessment of Damage and Population of important Insect-pests in Field and Storage.	2
4	Fruit Crop Insect Pests	8
5	Plantation Crop Insect Pests	3
6	Medicinal and Aromatic Crop Insect Pests	1

PPS 321: Apiculture, sericulture and lac culture 2 (1+1)

Sl. No.	Topic	No. of Lectures
1	Introduction to beneficial insects, importance and history of apiculture, bee pasturage	1
2	Species of honey bees, Rock bee, Little bee, Indian bee, European bee, Italian bee and Dammar bee, lifecycle and caste determination	1
3	Bee colony activities, starting of new colony, location site, transferring colony, replacement of queen, combining colonies, swarm prevention	2
4	Bee colony maintenance and management in different seasons	1
5	Equipment for apiary, types of bee hives and their description	1
6	Honey extraction, honey composition and value, bee wax and tissues	1
7	Importance, history and development of silkworm in India, silkworms kinds and their hosts	1
8	Systematic position, distribution, lifecycles in brief, silk glands	1
9	Mulberry silkworm-morphological features, races, rearing house and equipment, disinfection and hygiene	1
10	Grainage acid treatment, packing and transportation of eggs, Incubation, black boxing, hatching of eggs	1
11	Silkworm rearing young age /chawki rearing and old age rearing of silkworms, feeding, spacing, environmental conditions and sanitation	1
12	Cocoon characters colour, shape, hardness and shell ratio, defective cocoons and stifling of cocoons	1
13	Uses of silk and by-products, economics of silk production	1
14	Moriculture-Mulberry varieties, package of practices, Pests and diseases and their management	2
15	Lac growing areas in India, biology, behaviour	2
16	Laccultivation, food plants, pruning, inoculation, cropping, kinds of lac	1
17	Enemies of lac-insects	1
	Total	16

Practical

Sl.	Topic	No. of Practical's
1	Honey bee colony, different bee hives and apiculture equipment	2
2	Summer and Winter management of colony.	1
3	Honey extraction and bottling.	1
4	Study of pests and diseases of honeybees.	1
5	Establishment of mulberry garden. Preparation of mulberry cuttings, planting methods under irrigated and rainfed conditions.	2
6	Maintenance of mulberry garden-pruning, fertilization, irrigation and leaf harvest.	1
7	Mulberry pests and diseases and their management and nutritional disorders.	1
8	Study of different kinds of silkworms and mulberry silkworm morphology, silk glands	1
9	Sericulture equipments for silkworm rearing. Mulberry silkworm rearing room requirements	1
10	Rearing of silkworms-chalky rearing. Rearing of silkworms late age silkworm rearing and study of mountages	1
11	Study of silkworm pests and their management. Study of silkworm diseases and its management	1
12	Lac insects-biology and behaviour	1
13	Lac cultivation, food plants, pruning, inoculation and cropping,	1
14	Kinds of lac	1
15	Enemies of lac insects	1

Suggested Reading:

Singh, S., 1975. Bee keeping in India – ICAR, New Delhi., 214p.

Sunita, N.D, Guled ,M.B, Mulla S.R and Jagginavar, 2003, Beekeeping, UAS Dharwad

Mishra, R.C. and Rajesh Gar. 2002. Prospective in Indian Apiculture. Agrobios, Jodhpur.

Singh, D and Singh, D.P. 2006. A hand book of Beekeeping, Agrobios (India).

Paul DeBach and Devid Rosen 1991. Biological control by natural enemies. Cambridge University Press; 2 edition (27 June 1991)

YA Shinde and BR Patel. Sericulture in India

Tribhuvan Singh. Principles and Techniques of Silkworm Seed Production, Discovery publishing House Pvt. Ltd

PPS – 221: Insect Pests of Vegetable, Ornamental and Spice Crops 3(2+1)

THEORY

L. No.	Subject	No. of lectures
1	Economic importance, Distribution, Host range, Bio-ecology, Injury, Integrated management of insect pests in Vegetable, Ornamental and Spice crops	2
2	Pest surveillance in important Vegetable, Ornamental and Spice crops	1
3	Insect-pests of Vegetable crops	16
4	Insect-pests of Ornamental crops	3
5	Insect-pests of Spice crops	4
6	Important storage insect-pests, their host range, bio-ecology, injury and integrated management	3
7	Insect-pests of processed Vegetables and management	1
8	Insecticidal residue problems in Vegetables and Ornamental crops, Tolerance limits	2
	Total	32

PRACTICAL

L. No.	Subject	No. of practical's
1	Study of symptoms and damage by insect pests	2
2	Collection, Identification, Preservation of Insect pests	2
3	Assessment of Damage and Population of important Insect-pests in Field and Storage	2
4	Vegetable Crop Insect Pests	8
5	Spice Crop Insect Pests	1
6	Ornamental Crop Insect Pests	1

Suggested Reading:

1. A. S. Atwal. Agricultural pests of south Asia and their management
2. David B V and Kumarswami, T, 1982. Elements of Economic Entomology. Popular Book Department, Madras, 536p.
3. Metcalf, R. Land Luckman, W. H. 1982. Introduction to Insect pest management.
4. Rachna and Benna kumari. Pest management and residual analysis in horticultural crop
5. Reddy, P. P., 2010, Plant Protection in Horticulture Vol. 1, 2 & 3, Scientific Publishers, Jodhpur

NATURAL RESOURCE MANAGEMENT

NRM 111 – Fundamentals of Soil Science (1+1)

Sl. No.	Topic	No. Of classes
1.	Composition of earth's crust, soil as a natural body, major components of soil	1
2.	Soil forming rocks and minerals – classification	
3.	Soil physical properties – soil texture - definition, methods of textural analysis; Stoke's law - assumptions, limitations; textural classes, use of textural triangle	1
4.	Absolute specific gravity and apparent specific gravity – definition, factors influencing BD & PD; relationship between BD and PD,	1
5.	Pore space – definition, factors affecting capillary and non-capillary porosity	1
6.	Soil colour – definition, its significance; colour variables - hue, value and chroma; Munsell colour chart; factors influencing soil colour	1
7.	Soil structure – definition, classification, importance; factors influencing the genesis of soil structure	1
8.	Soil consistency, plasticity - Atterberg's constants	1
9.	Soil air – air capacity, composition, renewal of gases, factors influencing soil air, amount of air space, soil air renewal	1
10.	Soil temperature – sources & distribution of heat, factors influencing soil temperature, measurement	1
11.	Soil water – forms - hygroscopic, capillary and gravitational; soil moisture constants - hygroscopic coefficient, wilting point, field capacity, moisture equivalent, maximum water holding capacity; energy concepts, PF scale	1
12.	Soil water measurement – gravimetric, electric and tensiometric, pressure plate and pressure membrane apparatus, neutron probe methods, soil water movement – saturated and unsaturated	1
13.	Soil chemical properties – soil colloids – inorganic - secondary silicate	1

	clay, hydrous oxides; organic colloids, Ion exchange – importance; cation & anion exchange	
14.	Soil biology – beneficial and harmful effects	1
15.	Soil classification – aerial photography – satellite of soil features – their interpretation; soil orders; land capability classification	1
16.	Methods and objectives of soil survey, remote sensing applications in soil and plant studies	1
17.	Soils of different ecosystems and their properties	1
18.	Objectives of soil science research institutes and projects in India (NBSS&LUP, IISS, IISWC, CSSRI, LTFE & NISLTFE)	
19.	Management of soil crusting, soil compaction and soil compression Soil degradation	

PRACTICAL

Sl. No.	Topic	No. Of classes
1.	Collection and preparation of soil samples for laboratory analysis	1
2.	Estimation of moisture content in soil (gravimetric method)	1
3.	Estimation of soil moisture using gypsum block and neutron probe method	1
4.	Determination of bulk density of soil	1
5.	Determination of pore space of soil	1
6.	Determination of maximum water holding capacity of soil	1
7.	Determination of soil texture (hydrometer method)	1
8.	Determination of soil texture (feel method)	1
9.	Determination of soil colour	1
10.	Estimation of infiltration rate using double ring infiltrometer method	1
11.	Determination of field capacity and permanent wilting point of soil	1
12.	Determination of soil water potential characteristic curves by tensiometer	1
13.	Study of aggregate size distribution analysis of soil	1
14.	Estimation of soil pH (Potentiometric Method)	1
15.	Estimation of electrical conductivity of soil (Conductometric Method)	1
16.	Study of soil profile and soil forming rocks and minerals	1
	Total no of classes	16

NRM-121 2 (1+1) Soil Fertility and Nutrient Management

Sl No	Topic (theory)	No. of Class
1	Definition of Soil Fertility and Productivity Factors affecting soil fertility and productivity difference between soil fertility and productivity	2
2	Essential plant Nutrient Elements Criteria of Essentiality of nutrients Form of nutrient element taken by plants Functions, Deficiency symptoms of Nutrient elements	2
3	Nutrient element transformation and their availability	1
4	Definition Acid soil : characteristic and management of acid soils	1
5	Salt affected Soil: characteristic and management of salt affected soil	1
6	Calcareous soil, its properties and management	1

7	Role of microorganism in organic matter decomposition and humus formation	2
8	C:N ratio and its Importance for plant nutrition	1
9	pH and its Importance for plant nutrition	1
10	Integrated Nutrient management	1
11	Soil Fertility evaluation methods : soil test, plant tissue test, biology test and Deficiency symptoms	1
12	Critical limit of plants nutrients and hunger sign	1
13	NPK fertilizer and their composition Fertilizer application methodology	1
14	Nutrient Interaction	1
	Total	16

Practical Classes

Sl No	Topic	No of class
1	Collection and preparation of soil samples	2
2	Determination of Organic matter	2
3	Determination of soil pH and EC	2
4	Determination available Nitrogen	2
5	Determination available- P	1
6	Determination available K	1
7	Determination important Micronutrients	3
8	Gypsum requirement of saline and alkaline soil	2
9	Lime requirement	1
	Total	16

Text book/Reference Books

1. Basak, R.K. *Fertilizer – A Text Book*, Kalyani Publishers, New Delhi.
2. Singh, S.S. *Soil Fertility and Nutrient Management*. Kalyani Publishers, New Delhi.
3. Panda, S.C. *Soil Management and Organic Farming*. Agrobios, India
4. Havlin., Beaton., Tisdal , and Nelson. *Soil Fertility and Fertilizer – An Introduction to Nutrient management*. Pearson Education, New Delhi.
5. Das, D.K. *Micronutrient: Their Behaviour in Soil and Plants*, Kalyani Publishers, New Delhi
6. Gupta, P.K. *A Handbook of Soil, Fertilizer and Manure*. Agrobios, India
7. Basak, R.K. *Soil Testing and Recommendation- A text book*. Kalyani Publishers, New Delhi
8. Baruah and Barthakur, *A Text book of Soil Analysis*. Vikash publishing , New Delhi

NRM 312 - Environmental Studies and Disaster Management 3 (2+1)

Theory

Sl. No.	Topic	No. Of classes
1.	Multidisciplinary nature of environmental studies - Definition, scope and importance	1
2.	Natural Resources: Renewable and non-renewable resources, Natural resources and associated problems	1
3.	Natural Resources: Forest resources, Water resources, Mineral resources, Food resources, Energy resources,, Land resource	1
4.	Ecosystems: Concept of an ecosystem, Structure and function of an ecosystem, Producers, consumers and decomposers, Energy flow in the ecosystem	1
5.	Ecological succession, Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of the Forest, Grassland, Desert and Aquatic ecosystems	1

6.	Biodiversity and its conservation: - Introduction, definition, genetic, species & ecosystem diversity and biogeographical classification of India	1
7.	Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values	1
8.	Biodiversity at global, National and local levels, India as a mega-diversity nation. Hot-spots of biodiversity	1
9.	Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts	1
10.	Endangered and endemic species of India. Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity	
11.	Environmental Pollution: definition, causes, effects and control measures of Air pollution	
12.	Environmental Pollution: definition, causes, effects and control measures of Water pollution	
13.	Environmental Pollution: definition, causes, effects and control measures of Soil pollution	1
14.	Environmental Pollution: definition, causes, effects and control measures of Marine pollution & Noise pollution	1
15.	Environmental Pollution: definition, causes, effects and control measures of Thermal pollution and Nuclear hazards	1
16.	Solid Waste Management: causes, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution	1
17.	Environmental ethics: Issues and possible solutions, climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust.	1
18	Social Issues and the Environment: From Unsustainable to Sustainable development, Urban problems related to energy, Water conservation, rain water harvesting, watershed management	1
19	Environment Protection Act, Air (Prevention and Control of Pollution) Act, Water (Prevention and control of Pollution) Act, Wildlife Protection Act, and Forest Conservation Act – Issues involved in enforcement of environmental legislation, Public awareness	1
20	Human Population and the Environment: population growth, variation among nations, population explosion, Family Welfare Programme	1
21	Environment and human health: Human Rights, Value Education, HIV/AIDS	1
22	Women and Child Welfare. Role of Information Technology in Environment and human health	1
23	Wasteland reclamation. Consumerism and waste products	1
24	Natural Disasters- Meaning and nature of natural disasters, their types and effects : Floods, drought, cyclone, earthquakes and landslides	1
25	Avalanches, volcanic eruptions, Heat and cold waves	1
26	Climatic change: global warming, Sea level rise, ozone depletion	1
27	Man Made Disasters - Nuclear disasters, chemical disasters, biological disasters	1
28	Man Made Disasters - building fire, coal fire, forest fire, oil fire, air pollution, water pollution, deforestation, industrial waste water pollution	1
29	Man Made Disasters - road accidents, rail accidents, air accidents, sea accidents	1
30	Disaster Management- Effect to migrate natural disaster at national and global levels	1
31	International strategy for disaster reduction. Concept of disaster management, National disaster management framework; financial arrangements; role of NGOs, community based organizations and media	1
32	Central, state, district and local administration; Armed forces in disaster	1

	response; Disaster response; Police and other organizations	
	Total	32

Practical

Sl. No.	Topic	No. Of classes
1.	Visit to a local area to document environmental assets - River	1
2.	Visit to a local area to document environmental assets - Forest	1
3.	Visit to a local area to document environmental assets - Grassland	1
4.	Visit to a local area to document environmental assets	1
5.	Visit to a local polluted urban site	1
6.	Visit to a local polluted rural site	1
7.	Pollution – Case Study 1	1
8.	Visit to a local polluted industrial site	1
9.	Pollution – Case Study 2	1
10.	Visit to a local polluted agricultural site	1
11.	Pollution – Case Study 3	1
12.	Study of common Plants, Insects and Birds	1
13.	Study of Solid Waste Management I	1
14.	Study of Solid Waste Management I	1
15.	Study of Human Population and the Environment	2
	Total	16

References

Agarwal, K.C. (2009) Biodiversity – Concepts, Conservation and Management. Nidhi Publishers, (India), Bikanar.

Agarwal, A.K. and Purohit, S.S. (2006) Environmental Pollution – Causes, Effects and Control. Agrobios (India), Jodhpur.

Gupta, H.K. (2003) Disaster Management. Indian National Science Academy, Orient Blackswan Pvt. Ltd., Hyderabad.

Hodgkinson, P.E and Stewart, M. (1991) Coping with catastrophe: Hand Book of Disaster Management, Routledge, Delhi.

Negi, S.S. (2008) Biodiversity and Its Conservation in India. Indus Publishing Company, New Delhi.

Sharma, V.K. (2014) Disaster Management. National Centre for Disaster Management, IIPA, New Delhi.

Trivedi, P.R. (2004) Environmental Pollution and Control. APH Publishing Corporation, New Delhi.

Vinita, K and Verma, S.K. (2014) Environmental degradation, Issues and Challenges. New Delhi Publishers, New Delhi.

NRM 221 – Soil, Water and Plant Analysis 2 (1+1)

Theory

Sl. No.	Topic	No. Of classes
1.	Methods of Soil and Plant Sampling, Processing and Analysis	1
2.	Characterization of Hydraulic Mobility – Diffusion and Mass Flow	1
3.	Renewal of Gases in Soil and their Abundance and Methods of Estimation of Oxygen Diffusion Rate and Redox Potential	1
4.	Soil Fertility Evaluation Methods	1
5.	Use of Radio Tracer Techniques in Soil Fertility Evaluation	1
6.	Soil Micro-organisms and their Importance	1
7.	Saline, Alkali, Saline-Alkali soils, their Appraisal and Management	1
8.	Acid soils, their Appraisal and Management	1
9.	Waterlogged and Sandy soils, their Appraisal and Management	1

10.	Chemical and Mineral Composition of Horticultural crops	1
11.	Leaf Analysis Standards, Index Tissue, Interpretation of Leaf Analysis Values	1
12.	Quality of Irrigation Water – I	1
13.	Quality of Irrigation Water – II	1
14.	Management of poor quality irrigation water in Crop Management	1
15.	Application of Radio Tracer technology / techniques in Plant Nutrient Studies	1
16.	Soil and Water Pollution	1
	Total no of classes	16

Practical

Sl. No.	Topic	No. Of classes
1.	Introduction to Analytical Chemistry	1
2.	Collection and Preparation of Soil Samples for Laboratory Analysis	1
3.	Estimation of Soil pH (Potentiometric Method)	1
4.	Determination of Electrical Conductivity of Soil (Conductometric Method)	1
5.	Determination of Available Nitrogen in Soil [Alkaline Permanganate / Subbiah and Asija (1956) Method]	1
6.	Determination of Available Phosphorus in Soil [Bray' Method / Bray and Kurtz (1945) Method]	1
7.	Determination of Available Potassium in Soil [Ammonium Acetate / Hanway and Heidel (1952) Method]	1
8.	Estimation of Ca & Mg in Soil [Complexometric / Versenate Titration Method]	1
9.	Determination of Available S in Soil [Turbidimetric / Williams and Steinbergs (1959) Method]	1
10.	Determination of Available Micronutrients in Soil [DTPA / Lindsay and Norvell (1978) Method]	1
11.	Collection and Preparation of Plant Samples for Laboratory Analysis	1
12.	Estimation of Total N in Plants (Micro Kjeldahl / Kjeldahl Method)	1
13.	Estimation of Total P in Plants (Colorimetric / Vanadomolybdate Yellow Colour Method)	1
14.	Estimation of Total K in Plants (Flame Photometric Method)	1
15.	Determination of Micronutrients in Plants	1
16.	Study on Irrigation Water Quality Analysis – I	1
17.	Study on Irrigation Water Quality Analysis – I	1
	Total no of classes	17

References

- Anonymous (2009) Fundamentals of Soil Science. Indian Society of Soil Science. New Delhi.
- Baruah, T.C., Barthakur, H.P. (1998) A Text Book of Soil Analysis. Vikas Publishing House Pvt. Ltd., New Delhi.
- Biswas, T.D. and Mukherjee, S.K. (2008) Text Book of Soil Science. Tata McGraw-Hill Publishing Co. Ltd., New Delhi.
- Brady, Nyle C., Well Ray R. (2007) The Nature and Properties of Soils. Dorling Kindersley (India) Pvt. Ltd, New Delhi.
- Das, D.K. (2011) Introductory Soil Science. Kalyani Publishers, Ludhiana.
- Dhyan Singh, Chhonkar, P.K. and Dwivedi, B.S. (2007) Manual on Soil, Plant and Water Analysis. Westville Publishing House, New Delhi.

- Durai, M.V. (2014) Handbook of soil plant, water, fertilizers and manure analysis. New India Publishing Agency, New Delhi.
- Gupta, P.K. (2007) Soil, Plant, Water and Fertilizer Analysis. Agrobios (India), Jodhpur.
- Halvin, J.L., Beaton, J.D, Tisdale, S.L. and Nelson, W.L. (2014) Soil Fertility and Fertilizers. An Introduction to Nutrient Management. Pearson Education Pvt. Ltd., Delhi.
- Hesse, P.R. (1998) A Text Book of Soil Analysis. CBNS Publishers and Distributors, Delhi.
- Jaiswal, P.C. (2011) Soil, Plant and Water Analysis. Kalyani Publishers, Ludhiana.
- Mani, A.K., Shanthi, R. and Sellamuthu, K.M. (2007) A Hand Book of Laboratory Analysis. A.E. Publishers, Coimbatore.
- Saha, A.K. and Saha, A. (2012) Text Book of Soil Physics. Kalyani Publishers, Ludhiana.
- Tan, K.H. (2005) Soil Sampling, Preparation and Analysis. CRC Press, Inc., Boca Raton, FL, USA.
- Tan, K.H. (2013) Principles of Soil Chemistry, CRC Press, Inc., Boca Raton, FL, USA.
- Tandon, H.L.S. (2013) Method of analysis of soil, plant and water and fertilizers. FDCO, New Delhi.
- Troeh, F.R. and Thompson, L.M. (2005) Soil and Soil Fertility. John Wiley & Sons, New York.

NRM-211 2 (1+1) Farm Power and Machinery

Sl. No.	Topics	No. of Classes
Theory		
1.	Basic concepts of various forms of energy, unit and dimensions of force energy and power, calculations with realistic examples.	1
2.	IC Engines: Basic principles of operation of compression, ignition and spark ignition engines	1
3.	Two stroke and four stroke engines	2
4.	Cooling and lubrication system	1
5.	Power transmission system	2
6.	Broad understanding of performance and efficiency	1
7.	Tractors, power tillers and their types and uses	1
8.	Tillage: objectives, method of ploughing	1
9.	Primary tillage implements: construction and function of indigenous ploughs, improved indigenous ploughs	2
10.	Mould board ploughs, disc and rotary ploughs	2
11.	Secondary tillage implements: construction and function of tillers, harrows, levelers, ridgers and bund formers	2
12.	Sowing and transplanting equipment: seed drills, potato planters, seedling transplanter	2
13.	Grafting, pruning and training tools and equipment. Inter-culture equipment: sweep. Junior hoe, weeders, long handle weeders.	2

14.	Crop harvesting equipments: potato diggers, fruit pluckers, tapioca puller and hoists.	2
15.	Electric motors: types, construction and performance comparison	2
	Total	24
Practical		
1.	Calculation on force, power and energy	1
2.	IC engines – showing the components of dismantled engines	2
3.	Study of Tractors and Power Tillers	2
4.	Operation of Tractors and Power Tillers	2
5.	Primary and secondary tillage implements, hitching, adjustments and operations	2
6.	Study of seed drill & its calibration	1
7.	Spraying equipment, calibration and operation	2
8.	Plant protection equipment, calculation of dilution ratio and operation.	2
9.	Study of Grafting, pruning and training tools and equipment. Inter-culture equipment: sweep. Junior hoe, weeders, long handle weeders, etc.	2
	Total	16

References:

1. [T. P. Ojha](#) and [A.M.Michael](#). 2005. *Principles of Agricultural Engineering* (Volume - 1), Jain Brothers
2. Manoj Kumar Ghoshal and Dharendra Kumar Das. 2008. *Farm Power*, Kalyani Publishers.
3. Surendra Singh. 2007. *Farm Machinery Principles and Applications*. ICAR Publications
4. Roth / Field. 1992. *Introduction to Agricultural Engineering - Problem Solving Approaches*, 2nd. Edition. CBS publishers & distributors Pvt. Ltd.
5. Surendra Singh & Verma. 2009. *Farm Machinery Maintenance & Management*. ICAR Publication.
6. M.M. Pandey & Others. 2012. *Handbook of Agricultural Engineering*. ICAR publication
7. Jagadishwar Sahay. 1992. *Elements of Agricultural Engineering*. AgroBook Agency, Patna.
8. Michal, A. M. and Ojha, T.P. 1993. *Vol.II. Principles of Agricultural Engineering*. Jain Brothers, New Delhi.
9. Kepner R. A. Roy Bainer and Barger B.L. 1978. *Principles of Farm Machinery*. CBS Publisher and Distributors, Delhi.
10. Jain S.C. 2003. *Farm Machinery - An approach*. Standard Publishers and Distributors, New Delhi
11. Nakra, C.P. 1986. *Farm Machinery and Equipment*. Dhanpat Rai and Sons, New Delhi
12. Klenin, N.I. Popov, I.F. and Sakun, V.A. 1985. *Agricultural Machines*. Amerind publishing Co. Pvt. Ltd., New Delhi.

NRM-122 2(1+1) Water management in horticultural crops

Sl. No.	Topics	No. of classes
Theory		
1.	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	2
2.	Available and unavailable soil moisture, distribution of soil moisture, water budgeting, rooting characteristics, moisture extraction pattern	1
3.	Water requirement of horticultural crops, lysimeter studies, plant water potential climatological approach, use of pan evaporimeter	2
4.	Factor for crop growth stages, critical stages of crop growth for irrigation	1
5.	Irrigation scheduling, different approaches	1
6.	Methods of irrigation, surface and subsurface, pressurized methods viz. sprinkler and drip irrigation, their suitability, merits and limitations	3
7.	Fertigation, economic use of irrigation water	1
8.	Water management problems, soils quality of irrigation water	1
9.	Irrigation management practices for different soils and crops	2
10.	Layout of different irrigation systems, drip and sprinkler	1
11.	Layout of underground pipeline system	1
Total		16
Practical		
12.	Measurements of irrigation water by using water measuring devices, use of common formula in irrigation practices	3
13.	Practicing land levelling and land shaping implements	2
14.	Layout of different irrigation systems	2
15.	Estimation of soil moisture constants and soil moisture by using different methods and instruments	2
16.	Estimation of irrigation efficiency and water requirements of horticultural crops	2
17.	Irrigation planning and scheduling	2
18.	Soil moisture conservation practices	3
Total		16

Reference Books:

1. Michael, A.M. 2008. Irrigation Theory and Practice, Vikas Publishing House Pvt. Ltd., Noida, U.P.
2. Mal, B.C. (1995) Introduction to Soil and Water Conservation Engineering, Kalyani Publishers, Ludhiana
3. Michael, A.M. and Ojha, T.P. (1999) Principles of Agricultural Engineering, Vol-II, Jain Brothers, New Delhi
4. Murty, V.V.N. (2008) Land and Water Management Engineering, Kalyani Publishers, Ludhiana.
5. Subramanya, K. (2008) Engineering Hydrology, Tata McGraw Hill Publishing Company Ltd., New Delhi
6. Suresh, R. (2006) Soil and Water Conservation Engineering, Standard Publishers Distributors, 1705-B, Nai Sarak, Delhi-110006.
7. G.H.S. Reddi and T.Y.Reddy (2014) Efficient use of irrigation water, Kalyani publishers, New Delhi

NRM-311 3(2+1) Organic Farming

S No	Topic (Theory)	No of class
1.	Introduction of organic farming Concept of Organic farming Relevance of organic farming in present context and for NEH region	3
2.	Organic production requirements in india Organic product in different state and distribution	2
3.	Types and characteristics Crops suitable for green manuring Methods of green manuring Techniques of Green manuring in-situ	2
4.	Vermicompost Definition and methods of vermi compost Properties of Vermi compost	3
5.	Recycling of organic residues: Properties and methods of preparation of bulky Manures	2
6.	Farm Yard Manure- Definition and classification Factors affecting the composition of manure Methods of preparation of farmyard Manure Losses during handling & storage and their management Important properties of FYM	4
7.	Definition biofertilizers, type and classification	2
8.	Soil improvement and amendments through organically	2
9.	Integrated diseases and pest management – use of biocontrol agents, biopesticides, pheromones, trap crops and bird perches	3
10.	Weed management under organic mode of production	3
11.	Quality considerations, certification and labeling of organic produce	3
12.	Accreditation processors, marketing, exports organic products	3
13.		32
Practical		
1.	Raising of vegetable crops organically through nutrient	4
2.	Diseases and pest management in organically	2
3.	Preparation of enrich compost, vermicompost	4
4.	Vegetable and ornamental nursery raising	3
5.	Macro quality analysis, grading, packaging, postharvest management	3
6.		16

Reference books:

- 1.A.K.Dahama. 2007. *Organic farming for sustainable agriculture*. Agrobios (India), Jodhpur.
- Arun. K. Sharma. 2011. *Handbook of Organic farming*. Agrobios (India), Jodhpur.
2. S.P. Palaniappan and K.Annadurai. 2010. *Organic farming – Theory and Practice*. Scientific Publishers. Jodhpur.
- 3.U.Thapa and P. Tripathy. 2006. *Organic farming in India- Problems and Prospects*. Agrotech publishing agency, Udaipur.
- 4.G.K.Veeresh. 2006. *Organic farming*. Foundation Books. New Delhi.
- 5.Purshit,S.S.2006.*Trends in Organic Farming in India*. Agros Bios(INDIA), Jodhpur.
- 6.Thampan,P. K.1995.*Organic Agriculture*. Peckaytree Crops Development Foundation, Cochin, Kerala.
- 7.Sathe,T.V.2004.*Vermiculture and Organic Farming*.Days Publishing House, NewDelhi.

NRM 314 – Agro-meteorology and Climate Change 2 (1+1)**Theory**

Sl. No.	Topic	No. Of classes
1.	Agricultural Meteorology- Introduction, definition of meteorology, scope and practical utility of Agricultural meteorology	1
2.	Composition and structure of atmosphere and definition of weather and climate, aspects involved in weather and climate	1
3.	Atmospheric temperature, soil temperature, solar radiation, atmospheric pressure, atmospheric humidity, evaporation and transpiration	1
4.	Monsoons, rainfall, clouds, drought, weather disasters and their management	1
5.	Atmospheric pollution and role of meteorology	1
6.	Basics of weather forecasting	1
7.	Climate change-causes; Global warming - causes and remote sensing, Effect of climate change on horticulture	1
8.	Past and future changes in greenhouse gases within the atmosphere	1
9.	Sources and sinks for greenhouse gases. Atmospheric chemistry	1
10.	Plants sense and respond to changes in CO ₂ concentration; Measurement of short-term effects and mechanisms underlying the observed responses in C3 and C4 species	1
11.	Plant development affected by growth in elevated CO ₂ ; Physiology of rising CO ₂ on nitrogen use and soil fertility, its implication for production	1
12.	Methodology for studying effect of CO ₂ ; Change in secondary metabolites and pest disease reaction of plants	1
13.	The mechanisms of ozone and UV damage and tolerance in plants	1
14.	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	1
15.	Mitigation strategies and prospects for genetic manipulation of crops to maximize production in the future atmosphere	1
16.	Modifying Rubisco, acclimation, metabolism of oxidizing radicals, and sink capacity as potential strategies	1
	Total no of classes	16

Practical

Sl. No.	Topic	No. Of classes
1.	Site Selection for Agromet Observatory	1
2.	Lay out Plan of Standard Meteorological Observatory	1
3.	Visit to Meteorological Observatory	1
4.	Study of Temperature Instruments	1
5.	Study of Rainfall Instruments	1
6.	Study of Pressure Instruments	1
7.	Study of Solar Radiation Instruments	1
8.	Study of Weather Forecasting	1
9.	Study of Measurement of Wind direction and Speed	1
10.	Study of Measurement of Relative Humidity	1
11.	Study of Measurement of Evaporation (Atmospheric / Soil)	1
12.	Measurement of Sunshine Duration and Solar Radiation	1
13.	Measurement of Air and Soil Temperature , Atmospheric Pressure	1

14.	Measurement of Radiation and Components	1
15.	Measurement of Rainfall using Raingauges	1
16.	Study of Preparation of Synoptic Charts and Weather Reports	1
		16

References

- David D. Houghton. (2002) Introduction to Climate Change, WMO, Geneva
 Ghadekar, S.R. (2003) Meteorology . Agromet Publishers, Nagpur
 Lenka,D. (1997) Climate, weather and crop in India. Kalyani Publishers, New Delhi
 Mavi, H.S. (1994) Agrometeorology . Oxford & IBH, New Delhi
 Rao, GSLHVP (2003) Agrometeorology, KAU, Thrissur, Kerala,
 Seemann, J., Chirkov, Y.I., Lomas, J., and Primault, B. (2012) Agrometeorology. Springer Berlin Heidelberg
 Varshney, M.C. and Pillai, P.B. (2003) Textbook of Agrometeorology. ICAR , New Delhi.

NRM-313 2(1+1) Introductory Agroforestry (NRM -313)

Theory

Sr. no.	Topic	No. of Class
1.	Agroforestry – definition, objectives and potential.	1
2.	Distinction between agroforestry and social forestry. Status of Indian forests and role in India farming systems.	1
3.	<i>Agroforestry system, sub-system and practice: agri-silviculture, silvipastoral, horti-silviculture, horti-silvipastoral</i>	2
4.	<i>Agroforestry system, sub-system and practice: shifting cultivation, taungya, home gardens, alley cropping.</i>	2
5.	<i>Agroforestry system, sub-system and practice: intercropping, wind breaks, shelterbelts and energy plantations.</i>	1
6.	Planning for agroforestry – constraints, diagnosis and design methodology,	2
7.	Selection of tree crop species for agro-forestry. Agroforestry projects – national, overseas,	1
8.	MPTS – their management practices	1
9.	Economics of cultivation – nursery and planting (<i>Acacia catechu, Dalbergia sissoo, Tectona, Populus, Morus, Grewia, Eucalyptus, Quercus spp.</i> and bamboo, tamarind, neem etc.).	5
	Total	16

Practical

Sr. no.	Topic	No. of Class
1.	Identification and seeds and seedlings of multipurpose tree species.	3
2.	Nursery practices for poplar, <i>Grewia optiva, Morus alba, Acacia catechu, Dalbergia sissoo, robinia, leucaena</i> etc.	5
3.	Visit to agro-forestry fields to study the compatibility of MPTS with agricultural crops: silvipastoral, alley cropping, horti-silviculture, agro-silvipasture, fuel and fodder blocks.	2
4.	Visit to social forestry plantations – railway line plantations, canal plantations, roadside plantations, industrial plantations and shelterbelts.	2
5.	Rapid assessment of farmers needs for green manure, fodder, fuel wood in selected	3

	villages.	
6.	Economics and marketing of products raised in agro-forestry systems.	1
	Total	16

NRM-123: Introduction to Major Field Crops 2(1+1)

Sl. No.	Theory	Number of classes
1.	Classification and distribution of field crops,	1
2.	Definition and concept of multiple cropping, crop rotation, Mixed cropping, intercropping, relay cropping and alley cropping,	2
3.	Cultural practices for raising major oilseeds.	3
4.	Green manuring	1
5.	Cultural practices for raising major cereals	4
6.	Cultural practices for raising major pulses	3
7.	Cultural practices for raising major fodder crops	2
	Total class	16
	Practical	
1.	Application of herbicides in field	3
2.	Preparation of cropping scheme	4
3.	Identification of crop plants (cereals, pulses, oilseeds, fodder crops),	3
4.	Identification of weeds	3
5.	Identification of crop seeds (cereals, pulses, oilseeds, fodder crops)	3
	Total class	16

BASIC SCIENCES

Lecture Schedule of Elementary Statistics and Computer Applications with Credit Hrs 3 (2+1)

Theory	Hours	Practical	Hours
1. Introduction; Data types and Sources of data collection; Grouped and Ungrouped data; Graphical representation	2	1. Grouped data representation; Histogram, Frequency polygon; Bar and Pie Chart; Multiple components graphs and charts	1
2. Measures of Central Tendency (MCT) ; AM, GM, HM, Percentiles, Quartiles	2	2. Measures of Central Tendency – Mean Median and Mode; Measures of Dispersion-Standard deviation. Coefficient of Variation	2
3. Measures of Dispersion-Range, Mean Deviation, Standard Deviation, Quartile Deviation	3	3. Large sample test-z-test	1
4. Probability; Theoretical probability distribution; Discrete and Continuous probability distribution; Normal, Poisson and Binomial distribution	2	4. Small sample test – t-test for single mean, Paired t-test, Chi square; Test of Goodness of Fit; Test of independence of attributes	3
5. Complete enumeration, Sampling, Simple random sampling (SRSWR and SRSWOR); Stratified sampling	3	5. Simple Correlation and fitting of linear regression analysis	2
6. Statistical Inference-Tests of significance; Large sample test; Small sample test; paired t-test, Chi-square test, Goodness of fit	4	6. MS-Office-MSWord, Power point and MS-Excel.	1
7. Correlation; Scatter diagram; Regression analysis; Test of significance of Correlation	3	7. Statistical functions in MS-Excel	1

and regression analysis			
8. Design of experiments- Principles, Assumptions, Models; Basic designs-CRD, RCBD and LSD; Layout, analysis of variance (ANOVA); Advantages and limitations	5	8. Visual Basic and BASIC programming languages	1
9. Factorial experiments, Split plot design; Strip plot design, Long Term experiments	2		
10. Introduction to Computer, OS, Windows; Applications of MS Office suite, MS Word, Excel, PowerPoint, Winword, Multi media	2		
11. MS Excel – Electronic spreadsheet, in-built statistical functions, graphs and charts	1		
12. Programming languages-BASIC, Visual Basic- Programming technique, Internet	1		
Total	30		12

BSH112 (Elementary Plant Biochemistry)

Credit= 2(1+1)

Theory:

S.No.	Topic	No. of lectures
1	Importance of Biochemistry	1
2	Carbohydrate (Classification, structure, property, metabolism)	3
3	Lipids (Importance, classification; Structures, properties, metabolism)	2
4	Enzymes (Classification, Mechanism of action)	3
5	Protein (Importance, classification; Structures, properties)	2
6	Nucleic Acid (Importance, classification; Structures)	2
7	Replication, transcription and translation	2
8	Plant pigments	1
Total lectures		16
Practical		
1	Preparation of solution	1
2	Determination of Saponification number of oils/fats	1
3	Qualitative tests of carbohydrates and amino acids	3
4	Quantitative estimation of glucose/ proteins	3
5	Determination of Iodine number of fatty acids	1
6	Effect of pH, temperature and substrate concentration on enzyme action	2
7	Paper chromatography/ TLC demonstration for separation of amino acids/ Monosaccharides. Sterilization techniques. Composition of various tissue culture media and preparation of stock	2
8	Estimation of nucleic acid	1
9	Estimation of Protein	1
10	Estimation of Ascorbic acid	1
Total practical classes		16

Suggested reading

Lehninger. (2004). Lehninger Principles of Biochemistry, W H Freeman & Co
 Robert, C. B. (1983). Modern concepts in Biochemistry. Allyn and Bacon Inc. London
 William, H.E. and Daphne, C.E.(2005). Biochemistry and Molecular Biology, Oxford University Press.

BSH 211 (1+1) Elementary Plant Biotechnology

S. No.	Course	No. of Class
1	Concepts of Plant Biotechnology: History of Plant Tissue Culture and Plant Genetic Engineering; Scope and importance in Crop Improvement	2
2	Totipotency and Morphogenesis, Nutritional requirements of in-vitro cultures;	1
3	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	3
4	Somaclonal variation, Types, Reasons	1
5	Somatic embryogenesis and synthetic seed production technology	1
6	Protoplast isolation, Culture, Manipulation and Fusion; Products of somatic hybrids and cybrids, Applications in crop improvement.	2
7	Genetic engineering; Restriction enzymes; Vectors for gene transfer – Gene cloning – Direct and indirect method of gene transfer – Transgenic plants and their applications.	2
8	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.	2
9	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.	2

Practical

S. No.	Course	No. of Class
1	Requirements for Plant Tissue Culture Laboratory; Techniques in Plant Tissue Culture; Media components and preparations; Sterilization techniques and Inoculation of various explants;	2
2	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	3
3	Somatic embryogenesis and synthetic seed production; Isolation of protoplast; Demonstration of Culturing of protoplast;	2
4	Demonstration of Isolation of DNA; Demonstration of Gene transfer techniques, direct methods; Demonstration of Gene transfer techniques, indirect methods;	3
5	Demonstration of Confirmation of Genetic transformation; Demonstration of gel-electrophoresis techniques.	2

REFERENCE BOOKS:

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.

Course- BSH-113 (Introductory Crop Physiology)

Credit=2(1+1)

S.No.	Topic	No. of lectures
1	Introduction, Importance in Horticulture	1
2	Crop Water Relations	4
3	Stress Physiology	2
4	Mineral Nutrition	2
6	Biological Nitrogen Fixation	1
7	Photosynthesis, Herbicide Action	4
8	Secondary Metabolite and Plant Defence	2
Total lectures		16
Practical		
1	Preparation of solutions	1
2	Measurement of water potential by Chardakov's method	1
3	Study of stomata -Stomatal frequency and index	1
4	Demonstration of Plasmolysis	1
5	Measurement of transpiration by potometer	1
6	Preparation of Hoagland solution and Hydroponic experiment	2
7	Measurement of relative water content (RWC)	2
8	Extraction of Plant pigments	1
9	Measurement of absorption spectrum of chloroplastic pigments and fluorescence	1
10	Leaf anatomy of C3 and C4 plants	1
11	Paper Chromatography	1
12	Measurement of photosynthesis	2
13	Plant movements	1
Total practical classes		16

Suggested reading

Edward E. Durna. 2014. Principles Of Horticultural Physiology. CABI, UK.
 Lincoln Taiz and Eduards Zeiger (5th Edition). 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

BSH 121 (Growth and Development of Horticultural Crops)

Credit= 2(1+1)

S.No.	Topic	No. of lectures
1	Growth and development- definitions, components, photosynthetic productivity, Canopy photosynthesis and productivity, leaf area index (LAI), growth curves, growth analysis in horticultural crops.	2
2	Plant Growth Regulator	3
3	Flowering-factors affecting flowering, physiology of flowering, photoperiodism-long day, short day and day neutral plants, vernalisation and its application in horticulture	3
4	Pruning and training physiological basis of training and pruning-source and sink relationship, translocation of assimilates	2

5	Physiology of fruit growth and development, fruit setting, factors affecting fruit set and development	2
6	Physiology of seed development and maturation, seed dormancy and bud dormancy, causes and breaking methods in horticultural crops.	2
7	Physiology of ripening of fruits-climatic and non-climacteric fruits. Physiology of fruits under post-harvest storage.	2
Total lectures		16
Practical		
1	Estimation of photosynthetic potential of horticultural crops	2
2	Estimation of LAI	1
3	Growth Analysis parameters	2
4	Bioassay of plant hormones	2
5	Identification of synthetic plant hormones and growth retardant	1
6	Preparations of hormonal solution	1
7	Induction of rooting in cuttings	1
8	Study of important physiological disorders and their remedial measures in fruits and vegetables	2
9	Study of Seed Dormancy, Seed Germination Test, Methods to break Seed Dormancy	2
10	Control of flower and fruit drop	1
11	Control of Ripening	1
Total practical classes		16

Suggested reading

Edward E. Durna. 2014. Principles Of Horticultural Physiology. CABI, UK.

Lincoln Taiz and Eduards Zeiger (5th Edition). Plant physiology

Salisbury and Ross. Plant Physiology

Course Title: Introductory Microbiology

Course No: BSH - 114

S. No.	Topic	Lect
1.	History and Scope of Microbiology	1
2.	The discovery of micro-organism, spontaneous generation conflict,	1
3.	Germ theory of diseases, microbial effect on organic and inorganic matter.	1
4.	Development of microbiology in India and composition of microbial world	1
5.	Microscopy and Specimen Preparation:	1
6.	The bright field microscope, fixation, dyes and simple staining, differential staining.	1
7.	Difference between prokaryotic and eukaryotic cells.	1
8.	Prokaryotic cell structure and functions.	1
9.	Types of culture media and pre-culture techniques.	1
10.	Microbial growth in models of bacterial, yeast and mycelia growth curve.	1
11.	Measurement of bacterial growth. General properties of viruses and brief description of bacteriophages.	1
12.	DNA as genetic material.	1
13.	Antibiosis, symbiosis, intra-microbial and extra-microbial association.	1
14.	Sterilization methods-Physical and chemical, Isolation of pure cultures and preservation of cultures, Plant growth promoting microorganisms and mushrooms.	1
15.	Economical importance, industrially important microorganisms in large scale production and common microbial fermentations.	1
16.	Mushrooms-edible and poisonous types, nutritive values, Culturing and production techniques.	1

Practical

S.No.	Topic	Lect
1.	Examination of natural infusion and living bacteria	01
2.	Examination of stained cells by	01
3.	Simple staining and gram staining	01
4.	Methods for sterilization and	01
5.	Nutrient agar preparation. Broth culture	01
6.	Agar slopes, streak plates and	01
7.	Pour plates	01
8.	Turbid metric estimation of microbial growth	01
9.	Mushroom culture	01
10.	Spawn production	01
11.	Culture and production techniques	01
12.	Mushroom harvesting	01
13.	Mushroom packing	01
14.	Mushroom and storage	01
15.	Identification of wild and edible mushroom	01
16.	Insect-pest, diseases, nematodes and weed mould of mushroom.	01

Reference books:

- M T Madigan, and J M Martinko, 2014.*Brock Biology of Microorganisms* 14th Edn. Pearson.
- M J Pelczar, 1998.*Microbiology* 5th Edn. Tata McGraw Hill Education Pvt. Ltd.
- Stainer, R, 1987.*General Microbiology*. Palgrave Macmillan.
- Edward Alchano, 2002. *Introduction to Microbiology*. Jones and Bartlett hearing.
- R P Singh, 2007.*General Microbiology*. Kalyani Publishers.
- J Heritage, E G V Evans, R A Killington, 2008.*Introductory Microbiology*. Cambridge University press P. date.
- Pelczar, jr. M.J.E.C.S.Chan and Krieg, N.R. 1996. *Microbiology*. Mc Graw Hill Publishers, Newyork.
- Prescott, L.M. Harley, J.P. and Klein, D.A (5ed) 2002.*Microbiology*. Mc Graw Hill Publishers, Newyork.
- Madigan, M. Martinkoj, M. and Parker (10 ed.) 2003. *Biology of Microorganisms*. Prentice Hall of India Pvt. Ltd., New Delhi.
- Jamaluddin, M. Malvidya, N. and Sharma, A. 2006.*General Microbiology*. Scientific Publishers, Washington.
- Sullia, S.B, and Shantaram 1998.*General Microbiology*. Oxford and IBH

SOCIAL SCIENCES

SSC-111 3 (2+1) Economics and Marketing: SSC-111

Theory:

Sl. No.	Name of the topics	Number of classes
1.	Nature and scope of economics, definition and concepts, divisions of economics, economic systems, approaches to the study of economics.	3
2.	Consumption – theory of consumer behaviour, laws of consumption, classification of goods.	1
3.	Wants – their characteristics and classification, utility and its measurement, cardinal and ordinal	1
4.	Law of diminishing marginal utility, law of equi-marginal utility, indifference curve and its properties, consumer equilibrium	3
5.	Theory of demand, demand schedule and curve, market demand.	2

	Price, income and cross elasticities,	
6.	Engel's law of family expenditure – consumer's surplus.	1
7.	Theory of firm, factors of production – land and its characteristics, labour and division of labour, theories of population. .	3
8.	Capital and its characteristics – classification and capital formation. Enterprises – forms of business organization – merits and demerits	2
9.	Laws of return – law of diminishing marginal return – cost concepts. Law of supply – supply schedule and curve elasticities.	3
10.	Market equilibrium, distribution – theories of rent, wage, interest and profit. Price determination and forecasting under various market structures.	3
11.	Marketing- definition – Marketing Process – Need for marketing – Role of marketing — Marketing functions – Classification of markets	3
12.	Marketing of various channels – Price spread – Marketing Efficiency – Integration	3
13.	Constraints in marketing of agricultural produce. Market intelligence	1
14.	Basic guidelines for preparation of project reports	1
15.	Bank norms – Insurance	1
16.	SWOT analysis – Crisis management	1

Practical:

Sl. No.	Name of the topics	Number of classes
1.	Techno-economic parameters for preparation of projects	4
2.	Preparation of Bankable projects for various agricultural products and its value added products.	3
3.	Identification of marketing channel	2
4.	Calculation of Price Spread	1
5.	Identification of Market Structure	2
6.	Visit to different Markets	4

Suggested Reading

1. H L Ahuja. S. Chand and Company Limited. *Advanced Economic Theory*. Micro Economic Analysis.
2. Chandra P. 1984. *Projects: Preparation, Appraisal & Implementation*. McGraw Hill Inc.
3. Dewett, K.K. and Chand, A.1979. *Modern Economic Theory*. S.Chand and Co., New Delhi
4. Dewett, K.K. and Varma, J.D. 1986. *Elementary Economics*. S.Chand and Co., New Delhi.
5. Gupta RD & Lekhi RK. 1982. *Elementary Economic Theory*. Kalyani Publishers.
6. Kotler Philip and Armstrong. *Principles of Marketing*.Prentice-Hall.
7. Jhingan, M.L. 2012. *Macro Economic Theory*. Vrinda publishers, New Delhi .
8. Kotler Philip and Armstrong. *Principles of Marketing*.Prentice-Hall.
9. SS Acharya and N L Agarwal. 2005. *Agricultural Marketing in India*. Oxford and IBH Publishing Co. Pvt. Ltd
10. Sampat Mukherjee. 2002. *Modern Economic Theory*. New Age International.
11. Subba Reddy, S., Raghu ram, P., Neelakanta Sastry T.V., Bhavani Devi. I., 2010, *Agricultural Economics*, Oxford & IBH Publishing Co. Private Limited, New Delhi
12. Willium J. Stanton. 1984. *Fundamentals of Marketing*. Tata McGraw-Hill Publication, New Delhi.
13. C.N. Sontakki. *Marketing Management*.Kalyani Publishers, New Delhi.
14. John Daniels, Lee Radebaugh, Brigham, Daniel Sullivan. *International Business*, 15th Ed., Pearson Education Aswathappa. *International Business*. Tata McGraw-Hill Education, New Delhi
15. Fransis Cherunilam. *International Business: Text and Cases*, 5th Ed. PHI Learning, New Delhi.

16. Prasanna Chandra. *Projects*. Tata McGraw-Hill Publication, New Delhi
17. John M. Nicholas. *Project Management for Business and Technology – Principles and Practices*. Pearson Prentice Hall
18. Harold Kerzner. *Project Management – A System Approach to Planning, Scheduling, and Controlling*. CBS Publishers & Distributors.
19. Prasanna Chandra. *Projects – Planning, Analysis, Selection, Financing, Implementation, and Review*. Tata McGraw-Hill Publishing Company Ltd.
20. P. Gopalakrishnan and V.E. Rama Moorthy. *Textbook of Project Management*. Macmillan.

SSC-321 2 (2+0)

Horti-Business Management

Theory

Sl. No.	Name of the topics	Number of classes
1.	Farm management - definition, nature, characteristics and scope.	1
2.	Farm management principles and decision making, production function, technical relationships,	2
3.	Cost concepts, curves and functions	1
4.	Factor-factor relationship Optimum conditions,	1
5.	Factors- product relationship Optimum conditions,	1
6.	Product-Product relationship, Optimum conditions	1
7.	Principles of opportunity cost-equi-marginal returns and comparative advantages,	2
8.	Time value of money, economic of scale, returns to scale,	1
9.	Cost of cultivation and production,	1
10.	Break even analysis,	1
11.	Decision making under risk and uncertainty.	1
12.	Farming systems and types.	1
13.	Planning – meaning, steps and methods of planning, types of plan, characteristics of effective plans.	2
14.	Organizations – forms of business organizations, Organizational principles, division of labour.	1
15.	Unity of command, scalar pattern, job design, span of control responsibility, power authority and accountability.	1
16.	Direction – guiding, leading, motivating, supervising, coordination – meaning, types and methods of controlling –evaluation, control systems and devices.	2
17.	Budgeting as a tool for planning and control. Record keeping as a tool of control.	1
18.	Functional areas of management – operations management – physical facilities, implementing the plan, scheduling the work, controlling production in terms of quantity and quality.	2
19.	Materials management – types of inventories, inventory costs, managing the inventories, economic order quantity (EOQ).	2
20.	Personnel management – recruitment, selection and training, job specialization.	2
21.	Marketing management – definitions, planning the marketing programmes, marketing mix and four P's.	2
22.	Financial management – financial statements and ratios, capital budgeting.	1
23.	Project management –project preparation evaluation measures	2

Suggested Reading

1. Heady Earl O and Herald R. Jenson, 1954, *Farm Management Economics*. Prentice Hall, New Delhi
2. S.S. Johl, J.R. Kapur, 2006, *Fundamentals of Farm Business Management*.
3. Kalyani Publishers, New Delhi
4. Karan Singh and Kahlon A S. *Economics of Farm Management in India*. Theory and Practice. New Delhi. Allied
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6. Koontz Harold. *Principles of Management*. Tata McGraw-Hill Education Private Limited, New Delhi.
7. P.C. Thomas. *Managerial Economics*, 9th Ed. Kalyani Publishers.
8. K.K. Dewett and M.H. Navalur. *Modern Economic Theory*. S. Chand & Sons, New Delhi.
9. P. Subba Rao. *Human Resource Management*. Himalaya Publications.
10. S.P. Jain. *Financial Accounting*. Kalyani Publications, Ludhiana.
11. Shapiro E. *Macroeconomic analysis*. Galgotia Publications Delhi
12. Barry P J, Hopkins J A and Baker C B. *Financial Management in Agriculture*, 6th ed. Danville, IL Interstate Publishers.
13. Gittiner, J P., *Economic analysis of agricultural projects*. The John Hopkins University Press Baltimore, USA, 1982
14. Benjamin Mc Donald P 1985. *Investment Projects in Agriculture- Principles and Case studies*. Longman Group Limited. Essex. UK
15. Pandey U K 1990. *An Introduction to Agricultural Finance*. Kalyani Publishers New Delhi.

SSC-323 2 (1+1) Fundamentals of Extension Education: SSC- 323 2(1+1)

Sl. No.	Topic	No. Of classes
1.	Extension education: meaning, definition, nature, scope, objectives, principles, approaches and history	1
2.	Horticulture extension: process, principles and selected programmes of leading national and international forest institutes	1
3.	People's participation in Horticulture programmes.	1
4.	Motivation of Farmers, rural youth and voluntary organizations for Horticulture extension work Rural Development: meaning, definition, objectives and genesis	1
5.	Transfer of technology programmes like lab to land programme (LLP) national demonstration (ND), front line demonstration (FLD) Krishi Vigyan Kendras (KVK), Technology Assessment and Refinement Programme (TARP) etc. of ICAR	1
6.	Communication: meaning, definition, elements and selected models.	1
7.	Teaching and learning-concepts and principles, Teaching steps	1
8.	Diffusion and Adoption of Innovations(-Meaning, Definition, Innovation Decision Process)	1
9.	Types of Innovation, Adoption Process, Adopter categories and their characteristics	1
10.	Factors influencing adoption process - social, personal and situational	1
11.	Programming planning process – meaning, scope, principles and steps.	1
12.	Evaluation: meaning, importance and methods	1
13.	Scope and importance of Participatory Rural Appraisal (PRA) & Rapid Rural Appraisal (RRA).	1
14.	Management and administration: meaning, definition, principles and functions.	1
15.	Concepts of human resource development (HRD)	1

16.	Concepts of human resource development (HRD)	1
17.	ICT in Extension education, ICT use in rural India.	1
	Total no of classes	17

Practical		
Sl.No	Topic	No. Of Class
1.	Visits to study structure, functions, linkages and extension programmes of ICFRE institutes/voluntary organizations/Mahila Mandal, Village Panchayat, State Dept. of Horticulture /All India Radio (AIR	2
2.	Exercises on distortion of message	1
3.	script writing for farm broadcasts and telecasts	2
4.	script writing for farm broadcasts and telecasts	2
5.	Use of AVA like OHP & 35 mm slide projector transparencies	1
6.	. Identification of local leaders to study their role in extension work	2
7.	Evaluation of some selected case studies of horticultural extension programmes	2
8.	. Preparation of Village Agricultural productions plan.	2
9.	Identification of profitable horticultural enterprise in a village	2
	Total No. of classes	16

SSC-322 2 (1+1) Entrepreneurship Development and Business Management

Sl. No	Topic	No. Of classes
1.	Sensitivity analysis: Assessing overall business environment in the Indian economy, International Trade WTO, GATT, Blue Box Policies, etc., provisions related to agreements in agricultural and food commodities, Agreement on Agriculture(AOA)-Domestic supply, market assess, export subsidies agreements, sanitary & Phyto sanitary measures, Trade Related intellectual property rights(TRIPS)	1
2.	Capital(working capital, fixed capital...etc)	1
3.	Financial management,its importance, balance sheet, profit & loss statement, analysis of financial statements-liquidity ratios, leverage ratios, Coverage ratios,turnover ratios, profitability ratios	1
4.	Project, project cycle, project appraisal appraisal & evaluation technique	1
5.	Discounted measures, undiscounted measures, payback period, proceeds per rupee of outlay Net Present Value(NPV), Benefit Cost Ratio (BCR), Internal rate of return(IRR), Net Benefit Investment ratios(N/K), break even point(BEP)	1
6.	Overview of Indian social, political and economic systems and their implications for decision making by individual entrepreneurs	1
7.	Globalization and the emerging business / entrepreneurial environment (* Include: Different enterprise- micro-enterprise and others)	1
8.	Concept of entrepreneurship; entrepreneurial and managerial characteristics; managing an enterprise	1
9.	Motivation and entrepreneurship development, Social Responsibility of Business	1
10.	Importance of planning, monitoring, budgeting, evaluation and follow up(* Include Management), managing competition	1
11.	SWOT analysis, Moral ethics in enterprise management,	1
12.	Entrepreneurship Development Programmes (EDP)	1

13.	Generation, incubation and commercialization of ideas and innovations	1
14.	Government schemes and incentives for promotion of entrepreneurship. Government policy on Small and Medium Enterprises (SMEs) / SSIs. Export and Import Policies relevant to horticulture sector	1
15.	Venture capital. Contract farming and joint ventures, public-private partnerships	1
16.	Overview of horti inputs industry. Characteristics of Indian horticultural processing and export industry, Supply chain management and total quality management, Role of ED in economic Development of the country	1
	Total No. Of Classes	16

	PRACTICALS	No. Of Classes
1.	Analysis of financial statements (Balance sheet, profit lost statement)	1
2.	Compounding and discounting	1
3.	Break Even analysis	1
4.	Study on Ago-industries Development Corporation	1
5.	Ratio Analysis I & II	1
6.	Application on Project appraisal technique I (Undiscounted measures) Application on Project appraisal technique II (Discounted measures)	1
7.	Preparation of project feasibility reports	1
8.	Dream Project & SWOT Analysis	1
9.	Importance of Problem solving skill of an entrepreneur	1
10.	Important characteristics of an entrepreneur for performing smooth business	1
11.	Study on different skill of of entrepreneur	1
12.	Various institution promoting entrepreneurship in agri-allied	1
13.	Govt. schemes & policies for entrepreneurship development	1
14.	Govt. Programmes for agribusiness	1
15.	Govt incentives for promotion of entrepreneurship.	1
16.	Scope of entrepreneurship in Indian horticultural scenario	1
	Total Classes	16

BSH-116: Communication Skills and Personality Development – 2 (1+1)

No.	Theory Topic	No. of lectures
1	Introduction to Word Classes	1
2	Structure of Verb in English	1
3	Uses of Tenses	1
4	Study of Voice	1
5	Study of Conjunctions and Prepositions	1
6	Sentence Patterns in English	1
7	The concept of stress; stress shift in words and sentences	1
8	silent letters in words and pronunciation of words with silent letters	1
9	the basic intonation patterns	1
10	Reading and comprehension of general and technical articles	1
11	Précis writing, summarizing, abstracting	1
12	Presentation: Individual and group presentations	1
13	impromptu presentation;	1
14	public speaking	1
15	Group discussion	1
16	Organizing seminars and conferences	1
	TOTAL	16

PRACTICAL

No.	Topic	No. of lectures
1	Introduction to Word Classes	1
2	Structure of Verb in English	1
3	Uses of Tenses	1
4	Study of Voice	1
5	Study of Conjunctions and Prepositions	1
6	Sentence Patterns in English	1
7	the concept of stress; stress shift in words and sentences	1
8	silent letters in words and pronunciation of words with silent letters	1
9	the basic intonation patterns	1
10	Reading and comprehension of general and technical articles	1
11	Précis writing, summarizing, abstracting	1
12	Presentation: Individual and group presentations	1
13	impromptu presentation; public speaking	1
14	Group discussion	1
15	Organizing seminars and conferences	1
16	Preparing an address	1
17	Writing: a) report writing b) letter writing (different types of letters)	1
TOTAL		17

Reference Books:

- Balasubramanian T. 1989. *A Text book of Phonetics for Indian Students*. Orient Longman, New Delhi.
- Balasubramanyam, M. 1985. *Business communication*. Vani Educational Books, New Delhi.
- Bharati, T., Hariprasad, M., & Prakasam, V. *Personality Development and Communicative English*. New Delhi: Neelkamal Publications.
- Carnegie, Dale. 2012. *How to Win Friends and Influence People in the Digital Age*. Simon & Schuster.
- Covey Stephen R. 1989. *The Seven Habits of Highly Successful People*. Free Press.
- Fiske, John. (1990). *Introduction to Communication Studies*, 2nd ed. London & NY: Routledge.
- Krishna Mohan and Meera Banerjee 1990. *Developing Communication Skills*. Macmillan India Ltd.
- Krishnaswamy, N and Sriraman, T. 1995. *Current English for Colleges*. Macmillan India Ltd. Madras.
- Lewis, Norman. 1978. *Word Power Made Easy*. New York: Random House.
- Mohan Krishna and Meera Banerjee. 1990. *Developing Communication Skills*. Macmillan India Ltd. New Delhi.
- Naterop, Jean, B. and Rod Revell. 1997. *Telephoning in English*. Cambridge University Press, Cambridge.
- Raymond Murphy, *English Grammar in Use*. Cambridge University Press
- Sharma R C and Krishna Mohan. 1978. *Business Correspondence*. Tata Mc Graw Hill publishing Company, New Delhi.
- Spitzberg B, Barge K & Morreale, Sherwyn P. 2006. *Human Communication: Motivation, Knowledge & Skills*. Wadsworth.
- The Official Guide to the TOEFL Test-IV Edition*, Educational Testing Services. McGraw Hill, New Delhi.
- Verma, KC. 2013. *The Art of Communication*. Kalpaz.
- Wren and Martin, S. *High School English Grammar and Composition*- S. Chand and Company Ltd., New Delhi.

BSH-124 2(1+1) NC* Information and Communication Technology*

Sl. No	Topic	No. of lectures
1.	IT and its importance. IT tools, IT-enabled services and their impact on society	01
2.	Computer fundamentals; hardware and software; input and output devices	01
3.	Word and character representation	01
4.	Features of machine language, assembly language, high-level language and their advantages and disadvantages	02
5.	Principles of programming- algorithms and flowcharts	03
6.	Operating systems (OS) - definition, basic concepts, Introduction to WINDOWS and LINUX Operating Systems	01
7.	Local area network (LAN), Wide area network(WAN), Internet and World Wide Web, HTML and IP	02
8.	Introduction to MS Office - Word, Excel, Power Point.	03
9.	Audio visual aids - definition, advantages, Classification and choice of A.V aids; Cone of experience and criteria for selection and Evaluation of A.V aids, video conferencing. Communication process, Berlo's model, feedback and barriers to communication.	02
Total lectures		16
1.	Exercises on binary number system	02
2.	Algorithm and flow chart	02
3.	Microsoft Word	03
4.	Microsoft Excel (Analysis of fisheries data using MS Excel)	03
5.	Microsoft PowerPoint	02
6.	Internet applications: Web Browsing, Creation and operation of Email account	02
7.	Handling of audio visual equipments. Planning, preparation, presentation of posters, charts, overhead transparencies and slides. Organization of an audio visual programme.	02
Total practical classes		16

Reference books:

1. Pradeep K. sinha Foundation of computer
 2. P.K. Sinha Computer Fundamentals
 3. Judd Robbins Mastering DOS 6.0 & 6.2
 4. Office Complete 2000/2007
- P.K Pasricha A first course in Computer Science for Class XI and Class XII

