FIFTH DEANS' COMMITTEE REPORT

Syllabus and Lecture Schedule for

B.Sc. (Hons) Horticulture

AGRICULTURE UNIVERSITY, KOTA

RAJASTHAN- 324 001

B.Sc. (Hons.) Horticulture
Semester wise distribution of courses

S.N.	Course Code	Title of the Course	Credit Hours
		Semester – I	
1	FRS-111	Fundamentals of Horticulture	3(2+1)
2	FRS-112	Principles of Genetics and Cytogenetics	3(2+1)
3	NRM-111	Fundamental of Soil Science	**3(2+1)**
4	BAS-111	Elementary Statistics and Computer Application	3(2+1)
5	BAS-112	Economics and Marketing	3(2+1)
6	BAS-113	Elementary Plant Biochemistry	2(1+1)
7	BAS-114	Introductory Crop Physiology	2(1+1)
8	BAS-115	Introductory Microbiology	2(1+1)
9	BAS-116	Communication Skills and Personality Development[#]	2(1+1)
10	NSS-I/ NCC-I	National Service Scheme/National Cadet Corp	1 (0+1)(NC)*
		Total	**24(14+10)**
		Semester – II	
1.	FRS-121	Tropical and Subtropical Fruits	3(2+1)
2.	FRS-122	Principles of Plant Breeding	3(2+1)
3.	FRS-123	Plant Propagation and Nursery Management	2(1+1)
4.	VEG-121	Summer Vegetable Crops	3(2+1)
5.	FLS-121	Principles of Landscape Architecture	2(1+1)
6.	PHT-121	Fundamentals of Food Technology and Nutrition	2(1+1)
7.	NRM-121	Soil Fertility and Nutrient Management	2(1+1)
8.	NRM-122	Water Management in Horticultural Crops	2(1+1)
9.	BAS-121	Growth and Development of Horticultural Crops	2(1+1)
10.	BAS-122	Information and communication technology[#*]	2(1+1) (NC)*
11.	NSS-II/ NCC-II	National Service Scheme/National Cadet Corp	1 (0+1)(NC)*
12.	BAS-126	Physical and Health Education	1(0+1) (NC)*
		Total	**25(13+12)**
		Semester – III	
1.	FRS-211	Temperate Fruit Crops	2(1+1)
2.	VEG-211	Winter Vegetable Crops	2(1+1)
3.	VEG-212	Precision Farming and Protected Cultivation	3(2+1)
4.	FLS-211	Commercial Floriculture	3(2+1)
5.	PPR-211	Fundamentals of Plant Pathology	3(2+1)

6.	PPR-212	Fundamentals of Entomology	3(2+1)
7.	BAS-211	Fundamentals of Extension Education	2 (1+1)
8.	BAS-212	Elementary Plant Biotechnology	2(1+1)
9.	NRM-211	Environmental Studies and Disaster Management[#]	3(2+1)
10.	NSS-III/ NCC-III	National Service Scheme/National Cadet Corp	1 (0+1)(NC)*
		Total	**24(14+10)**
Semester – IV			
1.	FRS-221	Plantation Crops	3(2+1)
2.	FRS-222	Breeding of Fruit and Plantation Crops	3(2+1)
3.	VEG-221	Spices and Condiments	3(2+1)
4.	FLS-221	Ornamental Horticulture	3(2+1)
5.	PPR-221	Insect Pests of Fruit, Plantation, Medicinal & Aromatic Crops	3(2+1)
6.	PPR-222	Diseases of fruit, Plantation, Medicinal and Aromatic Crops	3(2+1)
7.	NRM-221	Soil, Water and Plant Analysis	2(1+1)
8.	NRM-222	Farm Power and Machinery	2(1+1)
9.	NSS-IV/ NCC-IV	National Service Scheme/National Cadet Corp	1 (0+1) (NC)*
		Total	**23(14+9)**
Semester – V			
1.	FRS-311	Orchard and Estate Management	2(1+1)
2.	FRS-312	Weed Management in Horticultural Crops	2(1+1)
3.	VEG-312	Potato and tuber crops	2 (1+1)
4.	FLS-311	Medicinal and Aromatic crops	3 (2+1)
5.	PHT-311	Postharvest Management of Horticultural Crops	3(2+1)
6.	PPR-311	Insect Pests of Vegetable, Ornamental and Spice Crops	3(2+1)
7.	PPR-312	Diseases of Vegetables, Ornamentals and Spice Crops	3 (2+1)
8.	NRM-311	Introduction to Major Field Crops	2 (1+1)
9.	NRM-312	Introductory Agroforestry	2 (1+1)
10.	NRM-313	Agro-meteorology and Climate Change	2 (1+1)
		Total	**24(14+10)**
Semester – VI			
1.	FRS-321	Dry land Horticulture	2(1+1)
2.	VEG-321	Breeding of Vegetable, Tuber and Spice Crops	3 (2+1)
3.	VEG-322	Seed production of Vegetable, Tuber and Spice Crops	3(2+1)

5.	FLS-321	Breeding and Seed Production of Flower and Ornamental Plants	3(2+1)
6.	PHT-321	Processing of Horticultural Crops	3(1+2)
7.	PPR-321	Apiculture, Sericulture and Lac culture	2(1+1)
8.	PPR-322	Nematode pests of horticultural crops and their Management	2(1+1)
9.	BAS-321	Horti-Business Management	2(2+0)
10.	BAS-322	Entrepreneurship Development and Business Management	2(1+1)
11.	NRM-321	Organic Farming	2 (1+1)
		Total	**24 (14+10)**
Semester – VII **Rural Horticultural Work Experience Programme**			
1.	HWE-411	STUDENT READY - Placement in Industries	0+10
2.	HWE-412	STUDENT READY- Placement in Villages	0+10
		Total	**20 (0+20)****
Semester – VIII			
STUDENT READY: Experimental Learning programme			**20(0+20)**
1.	ELP-421	Commercial Horticulture	-
2.	ELP-422	Protective Cultivation of High Value Horticulture Crops	-
3.	ELP-423	Processing of Fruits and Vegetables for Value Addition	-
4.	ELP-424	Floriculture and Landscape Architecture	-
5.	ELP-425	Bio-inputs: Bio-fertilizers and Bio-pesticides.	-
6.	ELP-426	Mass Multiplication of Plant And Molecules through Tissue Culture	-
7.	ELP-427	Mushroom culture	-
8.	ELP-428	Bee keeping	-
		Total	**20 (0+20)**
		Grand Total	**184(83+101)**

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

** Out of 20 Credits of each Semester VII & VIII, 5 credits will be creditential.

*Non Credit Course and # Common Course

FRS-111 Fundamentals of Horticulture 3 (2+1)

Theory

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

Practical

Identification of various horticultural crops, tools and implements, features of orchard, planning and layout of orchard, layout of nutrition garden, preparation of nursery beds for sowing of vegetable seeds, digging of pits for fruit plants, planting systems, training and pruning of orchard trees, preparation of fertilizer mixtures and field application, preparation and application of growth regulators, layout of different irrigation systems, identification and management of nutritional disorder in fruits, assessment of bearing habits, maturity standards and harvesting.

Lecture Schedule: Theory

S. No.	Topics	Tentative dates
1.	Scope and importance of horticultural crops	
2.	Classification of horticultural crops and nutritive value, area and production, exports and imports	
3.	Classification of horticultural crops and nutritive value, area and production, exports and imports	
4.	Classification of horticultural crops and nutritive value, area and production, exports and imports	
5.	Fruit and vegetable zones of India and of different states	
6.	Nursery techniques and their management	
7.	Nursery techniques and their management	
8.	Soil and climate	
9.	Vegetable gardens, nutrition and kitchen garden and other types of gardens	

10.	Principles, planning and layout, management of orchards, planting systems and planting densities	
11.	Principles, planning and layout, management of orchards, planting systems and planting densities	
12.	Production and practices for fruit, vegetable and floriculture crops	
13.	Production and practices for fruit, vegetable and floriculture crops	
14.	Principles objectives, types and methods of pruning and training of fruit crops	
15.	Principles objectives, types and methods of pruning and training of fruit crops	
16.	Types and use of growth regulators in horticulture	
17.	Water management– irrigation methods, merits and demerits	
18.	Weed management in horticultural crops	
19.	Weed management in horticultural crops	
20.	Fertility management in horticultural crops	
21.	Fertility managementin horticultural crops	
22.	Manures and fertilizers	
23.	Different methods of application	
24.	Cropping systems, intercropping, multi-tier cropping	
25.	Mulching– objectives, types merits and demerits	
26.	Classification of bearing habits of fruit trees	
27.	Factors influencing the fruitfulness and unfruitfulness	
28.	Rejuvenation of old orchards, top working, frame working	
29.	Principles of organic farming	
30.	Market chain management	

Lecture Schedule: Practicals

S. No.	Topics	Tentative dates
1.	Identification of various horticultural crops, tools and implements	
2.	Features of orchard	
3.	Planning and layout of orchard,	
4.	Layout of nutrition garden,	
5.	Preparation of nursery beds for sowing of vegetable seeds	
6.	Digging of pits for fruit plants	
7.	Planting systems	
8.	Training of orchard trees	
9.	Pruning of orchard trees	
10.	Preparation of fertilizer mixtures and field application	
11.	Preparation of fertilizer mixtures and field application	
12.	Preparation and application of growth regulators	
13.	Layout of different irrigation systems, Identification and management of nutritional disorder in fruits	

14.	Assessment of bearing habits	
15.	Maturity standards, Harvesting	

Suggested Reading:

Prasad and Kumar, 2014. *Principles of Horticulture* 2nd Edn. Agrobios (India).

Neeraj Pratap Singh, 2005. *Basic concepts of Fruit Science* 1st Edn. IBDC Publishers.

Gardner/Bardford/Hooker. J.R., 1957. *Fundamentals of Fruit Production*. Mac Graw Hill Book Co., New York.

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.

Kumar, N., 1990. *Introduction to Horticulture*. Rajyalakshmi publications, Nagarcoil, Tamilnadu

Jitendra Singh, 2014. *Basic Horticulture*. Kalyani Publishers, Ludhiana.

Denisen E.L.,1957. *Principles of Horticulture*. Macmillan Publishing Co., New York.

Chadha,K.L.(ICAR),2002,2001. *HandbookofHorticulture* . ICAR, NewDelhi

K.V.Peter, 2009. *Basics Horticulture.* New India Publishing Agency

Kausal Kumar Misra and Rajesh Kumar, 2014. *Fundamentals of Horticulture* .Biotech Books.

D.K. Salunkhe and S.S. Kadam, 2013. *A handbook of Fruit Science and Technology*. CRC Press.

S. Prasad and U. Kumar, 2010. *A handbook of Fruit Production*. Agrobios (India).

Amar Singh (2009) Fruit Physiology, Kalyani Publishers, Ludhiana

FRS-112 Principles of Genetics and Cytogenetics 3 (2+1)

Theory

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

Practical

Study of fixatives and stains. Squash and smear techniques. Demonstrations of permanent slides and cell division, illustration in plant cells, pollen fertility and viability, determination of gametes, Solving problems of monohybrid, dihybrid, and test cross ratios using chi-square test, gene interactions, estimation of linkages using three point test cross from F_2 data and construction of linkage maps. Genetics variation in pea.

Lecture Schedule: Theory

S.No.	Topics	Tentative Dates
1.	Historical background of genetics, theories and hypothesis…	
2.	…Continue…	
3.	Physical basis of heredity…	
4.	…cell reproduction…	
5.	…mitosis...	
6.	…meiosis and its significance.	
7.	Gametogenesis and syngamy in plants	
8.	Mendelian genetics–Mendel's principles of heredity, deviation from Mendelian inheritance, pleiotropy, threshold characters, co-dominance, penetrance and expressivity	
9.	--do--	
10.	--do--	
11.	--do--	
12.	Chromosome theory of inheritance, gene interaction	
13.	Modification of monohybrid and dihybrid rations.	
14.	Multiple alleles, quantitative inheritance linkage and crossing over, sex linked inheritance and characters.	
15.	Cytoplasmic inheritance and maternal effects.	
16.	Chemical basis of heredity, structure of DNA and its replication.	
17.	Evidence to prove DNA and RNA – as genetic material.	
18.	Mutations and their classification.	
19.	Chromosomal aberrations, changes in chromosome structure and number.	

Lecture Schedule: Practicals

S.No.	Topics	Tentative Dates
1	Study of fixatives and stains.	
2	Squash and smear techniques.	
3	Demonstrations of permanent slides and cell division,	
4	Illustration in plant cells, Pollen fertility and viability,	
5	Determination of gametes,	
6	Solving problems of monohybrid, dihybrid, and test cross ratios using chi -square test, gene interactions,	
7	--do--	
8	Estimation of linkages using three point test cross from F_2 data and construction of linkage maps.	
9	--do--	
10	Genetics variation in pea.	

Suggested Reading:

Gardner E J, Simmons M J &Snustard D P. *Principles of Genetics (VIII Edn)*. John Wiley & Sons, New York.

Strickberger. *Genetics*. Macmillan Publishing Company, New York.

William D. Stansfield. *Theory and Problems of Genetics (3rd Ed).* Schaum's Outline series - McGraw-Hill Inc.

Benjamin Lewin. *Genes (II edn)*. John Wiley & Sons, New York.

Phundan Singh. *Elements of Genetics*. Kalyani publishers, New Delhi.

Swanson & Webster. *The Cell* (V edn). Prentice Hall of India Pvt. Ltd, New Delhi

Norman,V. Rothwell. *Understanding Genetics* (IV Ed.). Oxford University Press, Oxford.

Sinnut, Dunn & Dobzhansky. *Principles of Genetics* XIX reprint. Tata McGraw-Hill Publishing Co. Ltd., New Delhi.

Griffiths, Miller, Suzuki Lewontin & Gelbart. *An introduction to Genetic Analysis* (V *Ed.).* W.H.Freeman & Company, Newyork

Robert Schieif. *Genetics & Molecular Biology* (1986). The Benjamin/cummings publishing Co, Inc, California.

Swanson, Merz & Young. *Cytogenetics* (II ed.). Prentice Hall of India Pvt. Ltd. New Delhi.

Joseph Jahier& INRA working group. *Techniques of Plant Cytogenetics* (1986). Oxford & IBH Publishing Co Pvt.Ltd., New Delhi

Loewy & Siekevitz. *Cell Structure & Function* (II Ed.). Oxford & IBH Publishing Co. Pvt. Ltd, New Delhi.

Stent & Calendar. *Molecular Genetics* (II Ed.). CBS Publishers, New Delhi

Singh B D. *Fundamentals of Genetics*. Kalyani Publishers, New Delhi

Srivastava&Tyagi. *Selected Problems in Genetics* (Vol.1-3). Anmol Publications Pvt. Ltd., New Delhi

Khanna VK. Genetics–*Numerical Problems*. Kalyani Publishers, New Delhi.

Farook& Khan. *Genetics & Cytogenetics* (I Ed.). Premier Publishing House, Hyderabad.

Shukla. *Cell Biology* (2001). Dominant publishers, New Delhi

George Acquaah. *Principles of Plant Genetics and Breeding*. Blackwell

B.D. Singh. *Fundamental of Genetics*. Kalyani. India

Gupta, P.K. 1985.*Cytology, genetics and cytogenetics*. Rastogi Publication, India.

NRM-111 Fundamental of Soil Science 3 (2+1)

Theory

Composition of earth's crust, soil as a natural body – major components. Soil forming rocks and minerals; weathering and processes of soil formation. Physical parameters; texture – definition, methods of textural analysis, stock's law, assumption, limitations, textural classes, use of textural triangle; absolute specific gravity/particle density, definition, apparent specific gravity/bulk density – factors influencing, field bulk density. Relation between BD (bulk density), PD (particle Density). Pore space – definition, factors affecting capillary and non-capillary porosity.Soil colour – definition, its significance, colour variables-hue, value and chroma. Munsellcolour chart, factors influencing-parent material, soil moisture, organic matter.Soil structure-definition, classification-type, class & grade of structure, factors influencing genesis of soil structure.Soil consistency, plasticity, Atterberg's constants. Soil air, air capacity, composition, factors influencing, amount of air space, soil air renewal.Soil temperature, sources and distribution of heat, factors influencing, measurement.Chemical properties- soil colloids, organic, humus, inorganic, secondary silicate, clay, hydrous oxides. Ion exchange, cation-anion, importance.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.Measurement- gravimetric, electric and tensiometer methods, pressure plate and pressure membrane apparatus, Neutron probe, soil water movement.Soil Classification–Taxonomy- soil orders & characteristics, aerial photography–satellite images of soil features–their interpretation; land capability classification; soil of different eco-systems and their properties. Objectives of soil science research institute in India (NBSS&LUP, IISS, LTFE& NSSTL). Management of Soil Crusting, Soil Compaction and Soil Compression. Methods and objective of soil survey, Remote sensing application in soil and plant Studies, Soil degradation.

Practical

Collection and preparation of soil samples, Description of soil profile in the field. Estimation of moisture, EC, pH, bulk density and particle density.Determination of pore space of soil. Textural analysis of soil by Hydrometer method.Identification of minerals and their abundance. Determination of Soil colour using Munsell Chart. Estimation of water holding capacity and hydraulic conductivity of soils. Estimation of Infiltration rate using double ring infiltrometer method. Estimation of soil moisture using gypsum block and neutron probe method. Soil compaction measurement with Pentrometer. Determination of filed capacity and permanent wilting point of soil. Determination of soil water potential characteristic curves by tensiometer and pressure plate apparatus. Aggregate size distribution analysis of soil. Air capacity of soil by field method.

Lecture Schedule: Theory

S.No.	Topics	Tentative Dates
1.	Soil as a natural body – major components	
2.	Composition of earth's crust	
3.	Soil forming rocks-classification and their properties	
4.	Soil forming minerals-classification and their properties	
5.	Weathering and processes of soil formation	
6.	**Physical Parameters** –Texture, definition, methods of textural analysis	

7.	Soil texture – Stock's law, assumption, limitations, textural classes, use of textural triangle;	
8.	Absolute specific gravity/particle density, definition, apparent specific gravity/bulk density – factors influencing, field bulk density. Relation between **BD**(bulk density),**PD**(particleDensity).	
9.	Pore space -definition, factors affecting, capillary and no n-capillary porosity	
10.	Soil colour – definition, its significance, colour variables- hue, value and chroma. Munsell colour chart, factors influencing -parent material, soil moisture, organic matter.	
11.	Soil structure -definition, classification -type, class & grade of structure, factorsinfluencing genesis of soil structure.	
12.	Soil consistency, plasticity, Atterberg's constants	
13.	Soil air, air capacity, composition, factors influencing, amount of air space, soil air renewal	
14.	Soil temperature,sources and distribution of heat, factors influencing, measurement	
15.	**Chemical properties-** Soil colloids, organic, humus	
16.	Soil colloids- inorganic, secondary silicate, clay, hydrous oxides	
17.	Ion exchange, cation-anion, importance	
18.	Soil reaction pH and its measurement, Buffering, effect of pH on nutrient availability	
19.	Soil water, forms-hygroscopic, capillary and gravitational	
20.	Soil moisture constants, hygroscopic coefficient, wilting point, field capacity, moisture equivalent, maximum water holding capacity, energy concepts, P^F scale	
21.	Measurement- gravimetric, electric and tensiometer methods, pressure plate and pressure membrane apparatus, Neutron probe	
22.	Soil water movement -saturated, unsaturated and water vapour movement	
23.	Soil Classification–Taxonomy- soil orders & characteristics	
24.	Aerial photography –satellite images of soil features –their interpretation	
25.	Land capability classification (LCC)	
26.	Soil of different agro eco-systems and their properties	
27.	Objectives of soil science research institute in India (NBSS&LUP, IISS, LTFE& NSSTL).	
28.	Management of Soil Crusting, Soil Compaction and Soil Compression	
29.	Methods and objective of soil survey, Remote sensing application in soil and plant Studies	
30.	Soil degradation.	

Lecture Schedule: Practicals

S.No.	Topics	Tentative Dates
1.	Collection, processing and storage of soil samples	
2.	Description of soil profile in the field	
3.	Identification and description of rocks and Minerals	
4.	Estimation of soil moisture by Gravimetric method	

5.	Determination of pH and EC in soil and irrigation water	
6.	Determination of Bulk Density of soil by core sampler	
7.	Determination of Particle Density of soil and calculation of pore space	
8.	Textural analysis of soil by Hydrometer method	
9.	Determination of soil colour by Munsell colour chart	
10.	Estimation of Infiltration rate using double ring infiltrometer method	
11.	Estimation of soil moisture using gypsum block and neutron probe method	
12.	Soil compaction measurement with Pentrometer	
13.	Determination of filed capacity and permanent wilting point of soil	
14.	Determination of soil water potential characteristic curves by tensiometer and pressure plate apparatus	
15.	Aggregate size distribution analysis of soil	
16.	Air capacity of soil by field method	

Suggested reading:

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

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

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

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

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

Brady, N.C., 1995. *The Nature and properties of Soils*. Macmillan Publishing Co, New York.

Ghildyal, B.P. and Tripathi, R.P., 1987. *Soil Physics*. Acad. Press. New York.

Kolay, A.K., 1983. *Basic concepts of Soil Science*. Wiley Eastern Ltd., New Delhi

Brady, N. C. and Weil, R. R., 2010. *Elements of the Nature and Properties of Soils* (3rd Edition), Pearson Education, New Delhi.

Foth, H.D., 1991. *Fundamentals of Soil Science* (8th Edition), John Wiley & Sons, New Delhi.

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

Khan, T. O. 2013 Forest Soils: *Properties and Management*. Springer International Publishing, SwitzerlandPritchett and Fisher RF, 1987. *Properties and Management of Forest Soils*. John Wiley, New York.

Gupta, P.K. 2009. *Soil, Plant, Water and Fertilizer Analysis* (2nd Edition), AGROBIOS, Jodhpur (India).

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

Jackson, M. L. 2012. Soil Chemical Analysis: Advanced Course, Scientific Publisher

Mehra, R. K. 2004. *Textbook of Soil Science*, ICAR Publication, New Delhi.

BAS-111 Elementary Statistics and Computer Application 3(2+1)

Theory

Introduction to statistics, limitations of statistics. Basic concepts:Variables Statistics, types and sources of data, classification and tabulation of data, construction of frequency distribution, tables, graphic representation of data, simple, multiple component and percentage bar diagram, pie diagram, histogram, frequency polygon and frequency curve average and measures of location, mean, mode, median, geometric mean, harmonic mean, percentiles and quadrilles, for raw and grouped data. Dispersion: Range, standard deviation, variance, coefficient of variation for raw and grouped data. Probability: Random experiments, event, mathematical probability, statistical probability, Basic concept, additive and multiplicative laws. Theoretical distributions, binominal, poison and normal distributions. Sampling: basic concepts, sampling vs. complete enumeration parameter and statistic, sampling methods, simple random sampling and stratified random sampling. Tests of Significance: Basic concepts, tests for equality of means, and independent and paired t-tests. Chi-square test for application of attributes and test for goodness of fit of Mendalian ratios. Correlation: Scatter diagram, correlation co-efficient and its properties, regression, fitting of simple linear regression, test of significance of correlation and regression coefficient. Experimental designs: Principles of design of experiments, Basic concepts: completely randomized design, randomized block design, latin square designs, factorial experiments.Basic concepts: Analysis of factorial experiments up to 3 factors, split plot design, strip plot design, long term experiments, plot size.Computer application: Introduction to computers and personal computers, basic concepts, operating system, Windows, MS Word-Features of word processing, creating document and tables and printing of document, MS Excel-Concept of electronic spreadsheet, creating, editing and saving of spreadsheet, inbuilt statistical functions and formula bar, MS Power point-preparation, presentation of slides and slide show. Introduction to multi-media and its application. Introduction to internet, use, application.

Practical

Construction of frequency distribution table and its graphical representation, histogram, frequency polygon, frequency curve, bar chart, simple, multiple, component and percentage bar charts, pie chart. Mean, mode, median for row and grouped data. Problem based on Range, standard deviation, variance, coefficient of variation for raw and grouped data coefficient of variation, Examples of 't' test for independent, paired 't' test, Chi-square test for contingency tables and theoretical ratios. Correlation and linear regression. Studies on computer components MS Office: World, Excel, power point, Internet.

Lecture Schedule: Theory

S.No.	Topics	Tentative Dates
1.	Introduction to statistics, limitations of statistics.	
2.	Basic concepts: Variables Statistics, types and sources of data, classification and tabulation of data,	
3.	Construction of frequency distribution, tables	
4.	Graphic representation of data, simple, multiple component and percentage bar diagram	
5.	Pie diagram, histogram, frequency polygon and frequency curve average	
6.	Measures of location: mean and modefor raw and grouped data	
7.	Median, geometric mean, harmonic mean, percentiles and quadrilles, for raw and grouped data	
8.	Dispersion: Range, standard deviation for raw and grouped data	

9.	Variance and coefficient of variation for raw and grouped data	
10.	Probability: Ra ndom experiments, event, mathematical probability, statistical probability, Basic concept, additive and multiplicative law	
11.	Theoretical distributions: binominal and poison distribution	
12.	Normal distribution	
13.	Sampling: basic concepts, sampling vs. comp lete enumeration parameter and statistic	
14.	Sampling methods, simple random sampling and stratified random sampling	
15.	Tests of Significance: Basic concepts, tests for equality of means, and independent and paired t-tests	
16.	Chi-square test for applicatio n of attributes and test for good ness of fit of Mendalian ratios	
17.	Correlation: Scatter diagram, correlation co -efficient and its properties	
18.	Regression: fitting of simple linear regression	
19.	Test of significance of correlation and regression coefficient	
20.	Experimental designs: Principles of design of experiments	
21.	Basic concepts: completely randomized design, randomized block design	
22.	Latin square designs and factorial experiments	
23.	Basic concepts of split plot design, strip plot design, long term experiments, plot size.	
24.	Computer application: Introduction to computers and personal computers, basic concepts	
25.	Operating system: Windows and Ubuntu	
26.	Introduction to LibreOffice/MS Word - Features of word processing, creating document and tables and printing of document	
27.	MS Excel -Concept of electronic spreadsheet, creating, editing and saving of spreadsheet, inbuilt statistical functions and formula bar	
28.	MS Power point-preparation, presentation of slides and slide show	
29.	Introduction to multi-media and its application	
30.	Introduction to internet, use and application	

Lecture Schedule: Practicals

S.No.	Topics	Tentative Dates
1.	Construction of frequency distribution table and its graphical representation	
2.	Histogram, frequency polygon, frequency curve	
3.	Bar chart, simple, multiple, comp onent and percentage bar charts; pie chart.	
4.	Mean and mode for row and grouped data	
5.	Mode for row and grouped data	
6.	Median for row and grouped data	
7.	Problem based on range, variance and standard deviation	
8.	Coefficient of variation for raw and grouped data	
9.	Examples of ‘t’ test for independent	
10.	Examples of paired ‘t’ test	

11.	Chi-square test for contingency tables and theoretical ratios	
12.	Examples of Correlation and regression coefficient	
13.	Introduction to computer components	
14.	LibreOffice/MS Office: World, Excel, power point	
15.	Internet.	

Suggested Reading:

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

NageswaraRao,G.2007.*StatisticsforAgriculturalSciences*. BSPublications,Hyderabad.

Rangaswamy,R.1995.*ATextBookofAgriculturalStatistics*. NewAgeInternationalPublishingLimited, Hyderabad.

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

Parmar,A.Mathur,N.DeeptiP.U.andPrasanna, V. B.,2000.*WorkingwithWINDOWS A HandsonTutorials*. TataMcGrawHillPublishingCo.,NewDelhi.

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

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

BAS-112 **Economics and Marketing** **3(2+1)**

Theroy

Nature and scope of economics, definition and concepts, divisions of economics, economic systems, Consumption – theory of consumer behaviour, laws of consumption, classification of goods. Wants – their characteristics and classification, utility and its measurement, cardinal and ordinal, law of diminishing marginal utility, law of equi-marginal utility, indifference curve and its properties, consumer equilibrium. Theory of demand, demand schedule and curve, market demand. Price, income and cross elasticities, Engil's law of family expenditure – consumer's surplus. Theory of firm, factors of production – land and its characteristics, labour and division of labour, theories of population. Capital and its characteristics – classification and capital formation. Enterprises – forms of business organization – merits and demerits. Laws of return – law of diminishing marginal return – cost concepts. Law of supply – supply schedule and curve elasticities. Market equilibrium, distribution – theories of rent, wage, interest and profit. Price determination and forecasting under various market structures. Marketing- definition – Marketing Process – Need for marketing – Role of marketing — Marketing functions – Classification of markets – Marketing of various channels – Price spread – Marketing Efficiency – Integration – Constraints in marketing of agricultural produce. Market intelligence – Basic guidelines for preparation of project reports- Bank norms – Insurance – SWOT analysis – Crisis management.

Practical

Techno-economic parameters for preparation of projects. Case studies of Bankable projects for various agricultural products and its value added products. Identification of marketing channel– Calculation of Price Spread – Identification of Market Structure – Visit to different Markets. Estimation of demand and supply of horticulture produce.

Lecture Schedule: Theory

S.No.	Topics	Tentative Dates
1.	Nature and scope of economics, definition and concepts	
2.	Divisions of economics, economic systems	
3.	Consumption – theory of consumer behaviour	
4.	Laws of consumption, classification of goods	
5.	Wants – their characteristics and classification	
6.	Utility and its measurement, cardinal and ordinal	
7.	Law of diminishing marginal utility	
8.	Law of equi-marginal utility	
9.	Indifference curve and its properties	
10.	Consumer equilibrium	
11.	Theory of demand	
12.	Demand schedule and curve	
13.	Market demand	
14.	Price, income and cross elasticities	
15.	Engil’s law of family expenditure – consumer’s surplus	

16.	Theory of firm, factors of production	
17.	Land and its characteristics	
18.	Labour and division of labour	
19.	Theories of population	
20.	Capital and its characteristics–classification and capital formation	
21.	Enterprises–forms of business organization – merits and demerits	
22.	Laws of return–law of diminishing marginal return–cost concepts	
23.	Law of supply – supply schedule and curve elasticities	
24.	Market equilibrium, distribution – theories of r ent, wage, interes t and profit	
25.	Price determination and forecasting under various market structures	
26.	Marketing- definition, Marketing Process, Need for marketing, Role of marketing, Marketing functions	
27.	Classification of markets, Marketing of various channels – Price spread	
28.	Marketing Efficiency, Integration, Constraints in marketing of agricultural produce. Market intelligence	
29.	Basic guidelines for preparation of project reports- Bank norms	
30.	Insurance – SWOT analysis – Crisis management	

Lecture Schedule: Practicals

S.No.	Topics	Tentative Dates
1.	Techno-economic parameters for preparation of projects.	
2.	Case studies of Bankable projects for various agricultural products	
3.	Case studies of Bankable projects for various agricultural value added products	
4.	Identification of marketing channel	
5.	Calculation of Price Spread	
6.	Identification of Market Structure	
7.	Visit to different Markets	
8.	Estimation of demand and horticulture produce	
9.	Estimation of supply of horticulture produces	

Suggested Reading

H L Ahuja. S. Chand and Company Limited. *Advanced Economic Theory*. Micro Economic Analysis.

Chandra P. 1984. *Projects: Preparation, Appraisal & Implementation*. McGraw Hill Inc.

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

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

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

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

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

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

Sampat Mukherjee. 2002. *Modern Economic Theory*. New Age International.

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

Willium J. Stanton. 1984. *Fundamentals of Marketing*. Tata McGraw-Hill Publication, New Delhi.

C.N. Sontakki. Marketing Management. Kalyani Publishers, New Delhi.

John Daniels, Lee Radebaugh, Brigham, Daniel Sullivan. International Business, 15th Ed., Pearson Education Aswathappa. International Business. Tata McGraw-Hill Education, New Delhi

Fransis Cherunilam. International Business: Text and Cases, 5th Ed. PHI Learning, New Delhi.

Prasanna Chandra. Projects. Tata Mc Graw-Hill Pu blication, New Delhi

BAS-113 Elementary Plant Biochemistry 2(1+1)

Theory

Carbohydrates: Occurrence, classification and structure, physical and chemical properties of carbohydrates, isomerism, optical activity, reaction with acids and alkalis, ozone formation. Lipids: Classification, important fatty acids, essential fatty acids. Physical and chemical control of oils, Fats constants, their rancidity, Plant pigments–structure and function of chlorophyll and carotenoids, sterols, Proteins: Classification, function and solubility, amino acids – classification and structure, essential amino acids, properties of amino acids, colour reactions, structure of proteins –primary, secondary tertiary and quaternaryproperties and reaction of proteins. Enzymes: Classification and mechanism of action; factors affecting enzyme action, co-factors and coenzymes. Vitamins and minerals as co-enzymes/co-factors.Carbohydrate metabolism–glycolysis and TCA-cycle; metabolism of lipids, fatty acid oxidation, biosynthesis of fatty acids, electron transport chain. structure and function of nucleic acid replication, transcription and translation.

Practical

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

Lecture Schedule: Theory

S.No.	Topics	Tentative Dates
1.	-Occurrence, classification & structure of Carbohydrates.	
2.	-Physical and chemical properties of Carbohydrates.	
3.	-Isomerism, optical activity, reducing property, reaction with acid and alkalis, ozone formation with Carbohydrates.	
4.	-Classification of Lipids, important fatty acids and triglycerides, essential fatty acids.	
5.	-Physical and chemical control of oils, their rancidity, phospholipids, types and importance.	
6.	-Structure and f unction of Chlorophyll and Carotenoids (plant pigments), Sterols, basic structure, role of Brassino-sterols in plants.	
7.	-Classification and structure of Amino-acids.	
8.	-Essential amino acids, properties of amino acids.	
9.	-Classification, function and solubility of Proteins.	
10.	-Primary, secondary,tertiary and quaternary structure of proteins.	

11.	-Properties and reaction of proteins.	
12.	-Classification and mechanism of Enzyme action; factors affecting enzyme action.	
13.	-Co-factors and Co -enzymes. Vitamin s and Minerals as coenzymes/cofactors.	
14.	-Glycolysis and TCA cycle.	
15.	-Metabolism of lipids, fatty acid oxidation.	
16.	-Biosynthesis of fatty acids and Electron transfer chain.	
17.	-Bioenergetics of glucose and fatty acids.	
18.	-Structure and function of nucleic acids,	
19.	-DNA replication	
20.	-Transcription and Translation.	

Lecture Schedule:Practical

S.No.	Topics	Tentative Dates
1.	Instruments required in Biochemistry laboratory.	
2.	Preparation of standard solutions and reagents.	
3.	Qualitative test of total Carbohydrates.	
4.	Quantitative estimation of starch.	
5.	Qualitative analysis of reducing sugars.	
6.	Qualitative analysis of non reducing sugars.	
7.	Quantitative analysis of reducing and non reducing sugars from fruits.	
8.	Reactions of aminoacids.	
9.	Quantitative estimation of Proteins by Lowery method.	
10.	Determination of iodine number of vegetable oils.	
11.	Estimation of Ascorbic acid.	
12.	Isolation and quantitative estimation of DNA from onions.	
13.	Extraction of oil from oil seeds.	
14.	Qualitative analysis of Lipids.	
15.	Paper Chromatography.	
16.	Enzyme assay.	

Suggested Reading:

Lehninger, Nelson, D. L. and Michael, M. C. 2004. *Principles of Biochemistry.* Freeman Publishers

Narayanan L M. Biochemistry. Saras Publications

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

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

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

Voet, D. and Voet, J.G. 2004. (3rd edit). Biochemistry. John Wiley & sons Incl.USA.

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

Buchanan, B. B., Gruissem, W. and Jones, R. L. 2002. Biochemistry and molecular biology of plants. 2nd edition. Blackwell publications, UK.

BAS-114 Introductory Crop Physiology 2(1+1)

Theroy

Water Relations in Plants: Role of water in plant metabolism, osmosis imbibition, diffusion, water potential and its components, measurement of water potential in plants, absorption of water, mechanism of absorption and ascent of sap. Stomata: Structure, distribution, classification, mechanism of opening and closing of stomata. Osmotic pressure, guttation, stem bleeding; transpiration methods, mechanism and factors affecting transpiration. Drought: Different types of stresses; water, heat and cold tolerance; mechanism of tolerance. Plant Nutrition: Essentiality, mechanism of absorption and its role in plant metabolism. Biological Nitrogen Fixation Photosynthesis, structure and function of chloroplast, dark and light reactions, cyclic and non-cyclic electron transfer, CO_2 fixation – C3, C4 and CA metabolism, advantages of C4 pathway. Photorespiration and its implications, factors affecting photosynthesis. Secondary metabolites and plant defense.

Practical

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

Lecture Schedule: Theory

S.No.	Topics	Tentative Dates
1.	Water Relations in Plants: Role of water in plant metabolism,	
2.	Osmosis imbibition, diffusion, water potential and its components	
3.	Measurement of water potential in plants,	
4.	Absorption of water, mechanism of absorption and ascent of sap.	
5.	Stomata: Structure, distribution, classification, mechanism of opening and closing of stomata.	
6.	Osmotic pressure, guttation, stem bleeding;	
7.	Transpiration methods, mechanism and factors affecting transpiration.	
8.	Drought: Different types of stresses; water, heat and cold tolerance; mechanism of tolerance.	
9.	Plant Nutrition: Essentiality, mechanism of absorption and its role in plant metabolism.	
10.	Biological Nitrogen Fixation Photosynthesis,	
11.	Structure and func tion of chloroplast, dark and light reactions, cyclic and non-cyclic electron transfer,	
12.	CO_2 fixation – C3, C4 and CA metabolism, Advantages of C4 pathway.	
13.	Photorespiration and its implications,	
14.	Factors affecting photosynthesis.	
15.	Secondary metabolites and plant defense.	

Lecture Schedule: Practicals

S.No.	Topics	Tentative Dates
1.	Measurement of water potential	
2.	Osmosis	
3.	Root pressure	
4.	Structure of the stomata	
5.	Distribution, opening and closing of the stomata	
6.	Measurement of transpiration pull demonstration	
7.	Transpiration of transpiration pull demonstration	
8.	Calculation of transpiration pull demonstration	
9.	Importance of light in photosynthesis	
10.	chlorophyll in photosynthesis	
11.	Pigment identification in horticultural crops	
12.	Pigment identification in horticultural crops	
13.	Measurement of relative water content (RWC)	
14.	Studying plant movements	
15.	Studying plant movements	

Suggested Reading:

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

Taiz, L. 2010.Plant Physiology. SINAUR. USA.

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

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

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

Jacobs, W. P. 1979. Plant Hormones And Plant Development. Cambridge Univ. London.

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Noggle G.R and Fritz T.G. Introductory Plant Physiology

Pandey and Sinha. Plant Physiology

Salisbury and Ross. Plant Physiology

Carl fedtke. Biochemistry and Physiology of Herbicide Action

Aswani pareek, S.K. Sopory, Hans Bohnert Govindjee. Abiotic stress adaptation in plants: Physiological, Molecular and Genomic foundation

Horst Marschner, Mineral Nutrition of Higher plants

BAS-115 Introductory Microbiology 2(1+1)

Theroy

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

Practical

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

Lecture Schedule: Theory

S.No.	Topics	Tentative Dates
1.	Prokaryotic cell -structure and functions.	
2.	Difference between prokaryotic and eukaryotic cells.	
3.	History and scope of microbiology, The discovery of micro-organism.	
4.	Spontaneous generation conflict, germ theory of diseases, Microbial effect on organic and inorganic matter.	
5.	Development of Microbiology in India and composition of microbial world.	
6.	Microscopy and specimen preparation, The Bright field microscope.	
7.	Fixation, dyes and simple staining, differential staining.	
8.	Types of culture media and pre-culture techniques, Microbial growth of bacteria as a model organism.	
9.	Measurement of bacterial, Yeast and Mycelia growth curve.	
10.	General properties of viruses, Brief description of Bacteriophages.	
11.	General principle of bacterial genetics and DNA as a genetic material.	
12.	Antibiosis, symbiosis, intra-microbial and extra-microbial association.	

13.	Sterilization methods – Physical and chemical.	
14.	Isolation of pure cultures and preservation of cultures.	
15.	Plant growth promoting microorganisms and mushrooms, Economical importance.	
16.	Industrially important microorganisms in large scale production and common microbial fermentations.	
17.	Mushrooms- edible and poisonous types, nutritive values.	
18.	Culturing and production techniques.	

Lecture Schedule: Practicals

S.No.	Topics	Tentative Dates
1.	Understanding and study of laboratory rules for Microbiology laboratory.	
2.	Instruments required in microbiology laboratory.	
3.	Sterilization methods.	
4.	Nutrient agar preparation.	
5.	Broth culture preparation.	
6.	Demonstration of Agar-slopes preparation.	
7.	Demonstration of Streak plates preparation.	
8.	Demonstration of Pour plates preparation.	
9.	Turbidimetric estimation of microbial growth.	
10.	Demonstration of the Simplestaining.	
11.	Demonstration of Gram staining.	
12.	Temporary wet mount (TWM) technique for microscopic observation of living microorganisms.	
13.	Spawn production.	
14.	Mushroom Culture and production techniques.	
15.	Harvesting, packing and storage of mushrooms.	

Suggested Reading:

M T Madigan, and J M Martinko, 2014. *Brock Biology of Microorganisms* 14th Edn. Pearson.

M J Pelczer, 1998. *Microbiology* 5th Edn. Tata McGrow 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.

BAS-116 Communication Skills and Personality Development[#] 2(1+1)

Theroy

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

Practical

Structural Grammar: Exercises in word classes, identification and study of verbs in sentences, application of tenses and voice, exercises in conjunctions and prepositions, other structural grammar exercises, report writing, letter writing (different types of letters). Spoken English: Conversations of everyday life, the concept of stress; stress shift. Silent letters in words, basic intonation patterns, preparing and address.

Lecture Schedule: Theory

S.No.	Topics	Tentative Dates
1.	Structural Grammar: Introduction of Word Classes	
2.	Structure of Verb in English	
3.	Uses of Tenses	
4.	Study of Voice	
5.	Study of Conjunctions and Prepositions	
6.	Sentence Patterns in English	
7.	Spoken Engli sh: Conversations of different situations in everyday life	
8.	The concept of stress; stress shift in words and sentences	
9.	Silent letters in words and pronunciation of words with silent letters	
10.	The basic intonation patterns	
11.	Reading and comprehension of general and technical articles	
12.	Précis writing, summarizing, abstracting	
13.	Individual and group presentations	
14.	Important presentation, public speaking	
15.	Group discussion,organizing seminars and conferences	

Lecture Schedule: Practicals

S.No.	Topics	Tentative Dates
1.	Exercises in word classes	
2.	Identification and study of verbs in sentences	
3.	Application of tenses and voice	
4.	In conjunctions and prepositions	
5.	Other structural grammar exercises	
6.	Report writing	

7.	Letter writing (different types of letters)	
8.	Conversations of everyday life	
9.	The concept of stress	
10.	Stress shift	
11.	Silent letters in words	
12.	Basic intonation patterns	
13.	Preparing and address	

Suggested Reading:

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

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

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

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

Krishnaswamy,. N and Sriraman, T. 1995. *Current English for Colleges*. Macmillan India Ltd. Madras.

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

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

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

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

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

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Wren and Martin, S. High School English Grammar and Composition- Chand and Company Ltd., New Delhi

Raymond Murphy, English Grammar in Use. Cambridge University Press

The Official Guide to the TOEFL Test-IV Edition, Educational Testing Services. Mc Graw Hill, New Delhi.

Bala subramanyam,M.1985. Business communication. Vani Educational Books Ansariroad,NewDelhi.

Krishna Mohanand Meera Banerjee 1990. Developing Communication Skills. Macmillan India Ltd.

FRS-121 Tropical and Sub-Tropical Fruits 3 (2+1)

Theory

Horticultural classification of fruits including genomic classification. Horticultural zones of India, detailed study of area, production and export potential, varieties, climate and soil requirements, propagation techniques, planting density and systems, after care, training and pruning. Management of water, nutrient and weeds. Special horticultural techniques including plant growth regulators, their solution preparation and use in commercial orchards. Physiological disorders. Post-harvest technology, harvest indices, harvesting methods, grading, packaging and storage of the following crops:

Mango, banana, grapes, citrus, papaya, sapota, guava, pomegranate, bael, ber, amla, anona, fig,pineapple, jackfruit, avocado, mangosteen, litchi, carambola**,** karonda, tamarind, phalsa, loquat, jamun, lasoda and passion fruit. Bearing in mango and citrus, causes and control measures of special production problems, alternate and irregular bearing overcome/control measures. Seediness and kokkan disease in banana, citrus decline and casual factors and their management. Bud forecasting in grapes. Sex expression and seed production in papaya, latex extraction and crude papain production, economics of production.

Practical

Description and identification of varieties based on flower and fruit morphology in above crops. Training and pruning of ber, phalsa, grapes, mango, guava and citrus. Selection of site and planting system, pre-treatment of banana suckers, desuckering in banana, sex forms in papaya. Use of plastics in fruit production. Visit to commercial orchards and diagnosis of maladies. Manure and fertilizer application including bio-fertilizer in fruit crops, preparation and application of growth regulators in citrus, guava and mango. Seed production in papaya, latex extraction and preparation of crude papain. Ripening of fruits, grading and packaging, production economics for tropical and sub-tropical fruits. Mapping of arid and semi-arid zones of India. Botanical description and identification of ber, fig, jamun, pomegranate, carissa, phalsa, wood apple, citrus, tamarind, aonla, bael and annona.

Lecture Schedule: Theory

S.No.	Topics	Tentative Dates
1.	Horticultural classification of fruits including genomic classification	
2.	Horticultural zones of India	
3.	Detailed study of area, production and export potential	
4.	Detailed study of varieties, climate and soil requirements	
5.	Detailed study of, propagation techniques, planting density and systems	
6.	Detailed study ofafter care, training and pruning	
7.	Management of water, nutrient and weeds	
8.	Special horticultural techn iques including plant growth regulators, their solution, preparation and use in commercial orchards.	
9.	Physiological disorders	
10.	Post-harvest technology, harvest indices, harvesting methods, grading, packaging and storage of Mango, banana and grapes	
11.	Post-harvest technology, harvest indices, harvesting methods, grading, packaging and storage of citrus and papaya	
12.	Post-harvest technology, harvest indices, harvesting methods, grading, packaging and storage of pomegranate, bael and guava	

13.	Post-harvest technology, harvest indices, harvesting methods, grading, packaging and storage of sapota and ber	
14.	Post-harvest technology, harvest indices, harvesting methods, grading, packaging and storage of anona, and amla	
15.	Post-harvest technology, harvest indices, harvesting methods, grading, packaging and storage offig and pineapple	
16.	Post-harvest technology, harvest indices, harvesting methods, grading, packaging and storage of, jackfruit and avocado	
17.	Post-harvest technology, harvest indices, harvestin g methods, grading, packaging and storage ofphalsa and mangosteen	
18.	Post-harvest technology, harvest indices, harvesting methods, grading, packaging and storage ofloquat and tamarind	
19.	Post-harvest technology, harvest indices, harvesting methods, grading , packaging and storage of litchi and carambola	
20.	Post-harvest technology, harvest indices, harvesting methods, grading, packaging and storage of jamun and karonda	
21.	Post-harvest technology, harvest indices, harvesting methods, grading, packaging and storage of, , lasoda and passion fruit	
22.	Bearing in mango and citrus	
23.	Causes and control measures of special production problems	
24.	Alternate and irregular bearing overcome/control measures	
25.	Seediness and kokkan disease in banana.	
26.	Citrus decline and casual factors and their management.	
27.	Bud forecasting in grapes	
28.	Sex expression and seed production in papaya	
29.	Latex extraction and crude papain production in Papaya	
30.	Economics of production of Papaya	

Lecture Schedule: Practicals

S.No.	Topics	Tentative Dates
1.	Description and identification of varieties based on flower and fruit morphology in Mango, banana, papaya, citrus, sapota, guava and pomegranate,anona, fig and pineapple	
2.	Description and identification of varieties based on flower and fruit morphology in bael,ber,amla, jackfruit, avocado, mangosteen litchi, grapes,phalsaand loquat	
3.	Description and identification of varieties based on flower and fruit morphology incarambola , karonda, jamun, tamarind, lasoda and passion fruit	
4.	Selection of site and planting system, pre -treatment of banana suckers	
5.	Training and pruning of ber, phalsa , grapes, mango, guava and citrus	
6.	Selection of site and planting system, pre -treatment of banana suckers, desuckering in banana, sex forms in papaya	
7.	Use of plastics in fruit production	
8.	Visit to commercial orchards and diagnosis of maladies.	

9.	Manure and fertilizer application includin g bio-fertilizer in fruit crops	
10.	Preparation and application of growth regulators in citrus, guava and mango	
11.	Seed pr oduction in papaya, latex extraction and preparation of crude papain	
12.	Ripening of fruits, grading and pa ckaging , production economicsfor tropical and sub-tropical fruits	
13.	Mapping of arid and semi-arid zones of India.	
14.	Botanical description and ident ification of ber, fig, jamun, pomegranate and carissa	
15.	Botanical description and identification of phalsa, wood apple, citrus, tamarind, aonla, bael and annona.	

Suggested Reading:

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FRS-122 Principles of Plant Breeding 3 (2+1)

Theory

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

Practical

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

Lecture Schedule: Theory

S.No.	Topics	Tentative Dates
1.	Plant breeding as a dynamic science, genetic basis of Plant Breeding – classical, quantitative and molecular	
2.	Plant Breeding in India – limitations, major achievements, goal setting for future.	
3.	Sexual reproduction (cross and self-pollination),	
4.	asexual reproduction	
5.	pollination control mechanism - incompatibility and sterility	
6.	Pollination control mechanism- implications of reproductive systems on population structure	
7.	Genetic components of polygenic variation and breeding strategies	
8.	Selection as a basis of crop breeding	
9.	Selection as a basis ofmarker assisted selection	
10.	Hybridization and selection	
11.	Goals of hybridization, selection of plants	
12.	Population developed by hybridization – simple crosses	
13.	Population developed by hybridization- bulk crosses	
14.	Population developed by hybridization- complex crosses	
15.	General and special breeding techniques	
16.	Heterosis – concepts, estimation and its genetic basis.	

17.	Calculation of heterosis	
18.	Calculation of heterobeltosis	
19.	Calculation ofGCA	
20.	Calculation ofSCA	
21.	Calculation of inbreeding depression	
22.	Calculation ofheritability	
23.	Calculation ofgenetic advance	
24.	Emasculation in important horticultural crops.	
25.	Emasculation in important horticultural crops	
26.	pollination techniquesin important horticultural crops	
27.	pollination techniquesin important horticultural crops	
28.	Breeding for resistance of biotic and abiotic stresses.	
29.	Polyploidy breeding	
30.	Mutation breeding	

Lecture Schedule: Practicals

S.No.	Topics	Tentative Dates
1.	Breeding objectives and techniques in important horticultural crops	
2.	Floral biology – its measurement and emasculation in major crops.	
3.	Floral biology – its measurement and emasculation in major crops.	
4.	Floral biology – crossing and selfing techniques in major crops.	
5.	Floral biology – crossing and selfing techniques in major crops.	
6.	Determination of mode of reproduction in crop plants , handling of breeding material	
7.	segregating generations pedigree, bulk and back cross methods	
8.	Field layout, and maintenance of experimental records in self and cross pollinated crops	
9.	Demonstration of hybrid variation and production techniques	
10.	Hardy Weinberg Law and calculation	
11.	Male sterility and incompatibility studies in horticultural crops	
12.	calculation of inbreeding depression,	
13.	calculation of Heterosis and heterobeltioses	
14.	calculation of GCA and SCA	
15.	calculation ofGA, heritability	

Suggested Reading:

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FRS-123 Plant Propagation and Nursery Management 2 (1+1)

Theory

Propagation: Need and potentialities for plant multiplication, sexual and asexual methods of propagation, advantages and disadvantages. Seed dormancy types of dormancy (method to overcome dormancy- scarification and stratification), internal and external factors, phytotrons nursery, nursery techniques, nursery management, apomixes, monoembryony, polyembrony, chimera and bud sport. Propagation Structures: Mist chamber, humidifiers, greenhouses, glasshouses, cold frames, hot beds, poly-houses, use of growth regulators in seed (types and stages of seed germination with examples) and vegetative propagation, methods and techniques of propagation through specialized organs (corm, runners, suckers), division-stolons, pseudobulbs, offsets, cutting, layering, grafting, formation of graft union, factor affecting, healing of graftage and budding, physiological and bio chemical basis of rooting, factors influencing rooting of cuttings and layering, graft incompatibility. Anatomical studies of bud union, selection and maintenance of mother trees, collection of scion stick, scion-stock relationship, and their influences, bud wood certification. Micrografting, meristem culture, callus culture, anther culture, organogenesis, somaclonal variation, hardening of plants in nurseries. Nursery registration act. Insect/pest/disease control in nursery.

Practical

Identification of nursery tools use of media for propagation of plants in nursery beds. Preparation of nursery beds and sowing of seeds. Raising of rootstock and use of virus testing plant material. Seed treatments for breaking dormancy and inducing vigorous seedling growth. Preparation of plant material for potting and repotting. Hardening plants in the nursery. Practicing different types of cuttings, layering, graftings and buddings including opacity and grafting, top grafting and bridge grafting etc. Use of mist chamber in propagation and hardening of plants. Preparation of plant growth regulators for seed germination and vegetative propagation. Visit to a tissue culture laboratory. Lifting, labelling and packing of nursery fruit plants. Maintenance of nursery records. Cost of establishment of a mist chamber, greenhouse, glasshouse, polyhouse and their maintenance. Nutrient and plant protection applications during nursery.

Lecture Schedule: Theory

S.No.	Topics	Tentative Dates
1.	Propagation: Need and potentialities for plant multiplication	
2.	sexual and asexual methods of propagation	
3.	advantages and disadvantages of sexual and asexual methods of propagation	
4.	Seed dormancy types of dormancy (method to overcome dormancy-scarification and stratification), internal and external factors	
5.	phytotrons nursery, nursery techniques, nursery management	
6.	apomixes, monoembryony, polyembrony, chimera and bud sport	
7.	Propagation Structures: Mist chamber, humidifiers, greenhouses, glasshouses, cold frames, hot beds, poly-houses,	
8.	use of growth regulators in seed (types and stages of seed germination with examples) and vegetative propagation,	
9.	methods and techniques of propagation through specialized organs (corm, runners, suckers), division-stolons, pseudobulbs, offsets,	
10.	methods and techniques of propagation through cutting and layering	

11.	methods and techniques of propagation through grafting and budding,	
12.	formation of graft union, factor affecting, healing of graftage and budding	
13.	physiological and bio chemical basis of rooting, factors influencing rooting of cuttings and layering,	
14.	graft incompatibility	
15.	Anatomical studies of bud union, selection and maintenance of mother trees,	
16.	collection of scion stick, scion -stock relationship, and their influences, bud wood certification	
17.	Micrografting, meristem culture, callus culture, anther culture, organogenesis, somaclonal variation, hardening of plants in nurseries	
18.	Nursery registration act. Insect/pest/disease control in nursery.	

Lecture Schedule: Practicals

S.No.	Topics	Tentative Dates
1.	Identification of nursery tools use of media for propagation of plants in nursery beds.	
2.	Preparation of nursery beds and sowing of seeds	
3.	Raising of rootstock and use of virus testing plant material	
4.	Seed treatments for breaking dormancy and inducing vigorous seedling growth	
5.	Preparation of plant material for potting and repotting	
6.	Hardening plants in the nursery	
7.	Practicing different types of cuttings, layering	
8.	Practicing different types of grafting s and buddings including top grafting and bridge grafting etc	
9.	Use of mist chamber in propagation and hardening of plants	
10.	Preparation of plant growth regulators for seed germination and vegetative propagation	
11.	Visit to a tissue culture laboratory	
12.	Cost of establishment of a mist chamber, greenhouse, glasshouse, polyhouse and their maintenance.	
13.	Nutrient and plant protection applications during nursery	
14.	Lifting, labelling and packing of nursery fruit plants	
15.	Maintenance of nursery records.	

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VEG-121 Summer Vegetable Crops 3(2+1)

Theory

Area, production, economic importance and export potential of tropical and sub-tropical vegetable crops. Description of varieties and hybrid, climate and soil requirements, seed rate, preparation of field, nursery practices; transplanting 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, **harvesting**, yield, post-harvest handling, economics and marketing of tropical and sub-tropical vegetable crops such as tomato, brinjal, chillies, capsicum, okra, amaranthus, cluster beans, cowpea, lab-lab, snap bean, cucurbits, moringa, portulaca, basella, sorrel and roselle.

Practical

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

Lecture Schedule: Theory

S.No.	Topics	Tentative Dates
1	tropical and sub-tropical vegetable crops.	
	Description of v arieties and hybrid, climate and soil requirements, seed rate, preparation of field, nursery practices of **Tomato**	
2	Transplanting, Spacing, planting systems, water and weed management; nutrient management and deficiencies, and physiological disorder of **Tomato**	
3	Use of chemicals and growth regulators. Cropping systems, harvesting, yield, post-harvest handling, economics and marketing of **Toamato**	
4	Description of varieties and hybrid, climate and soil requirements, seed rate, preparation of field, nursery practices of **Brinjal**	
5	Transplanting, s pacing, planting systems, water and weed management; nutrient management and deficiencies, use of chemicals and growth regulators. Cropping systems, harvesting, yield, post-harvest handling, economics and marketing of **Brinjal**	
6	Description of varieties and hybrid, climate and soil requirements, seed rate, preparation of field, nursery practices of **Chilies and Capsicum**	
7	Transplanting, Spacing, planting systems, water and weed management; nutri ent management, defi ciencies and disorders of **Chilies and Capsicum**	
8	Use of chemicals and growth regulators. Cropping systems, harvesting, yield, post-harvest handling, economics and marketing of **Chilies and Capsicum**	

9	Description of varieties and hybrid, climate and soil r equirements, seed rate, preparation of field for **Okra**	
10	Sowing, s pacing, water and weed management; nutrient management and deficiencies, use of chemicals and growth regulators. Cropping systems, harvesting, yield, post -harvest handling, economics and marketing of **Okra**	
11	Description of varieties and hybrid, climate and soil requirements, seed rate, preparation of field , sowing,s pacing, water and weed management; nutrient management and deficiencies, use of chemicals and growth regulators. Cropping syste ms, harvesting, yield, post -harvest handling, economics and marketing of **Amaranthus**	
12	Description of varieties and hybrid, climate and soil requirements, seed rate, preparation of field , sowing, s pacing, water and weed management; nutrient management and deficiencies, use of chemicals and growth regulators. Cropping systems, harvesting, yield, post -harvest handling, economics and marketing of **Cluster beans**	
13	Description of varieties and hybrid, climate and soil requirements, seed rate, preparation of field for **Cowpea**	
14	Sowing, s pacing, planting systems, water and weed management; nutrient management and deficiencies, use of chemicals and growth regulators. Cropping systems, harvesting, yield, post-harvest handling, economics and marketing of **Cowpea**	
15	Description of varieties and hybrid, climate and soil requirements, seed rate, preparation of field , sowing, s pacing, water and weed management; nutrient management and deficiencies, use of chemicals and growth regulators. Cropping systems, harvesting, yield, post-harvest handling, economics and marketing of **Lab-Lab**	
16	Description of varieties and hybrid, climate and soil requirements, seed rate, preparation of field , sowing, s pacing, water and weed management; nutrient management and deficiencies, use of chemicals and growth regulators. Cropping systems, harvesting, yield, post -harvest handling, economics and marketing of **Snap bean**	
17	Description of varieties and hybrid, climate and soil requirements of different **Cucurbitaceous** crops.	
18	Seed rate, prep aration of field, nursery practices ,transplanting/ directly sowing, spacing, planting systems, water and weed management; nutrient management and deficiencies, use of chemicals and growth regulators. Cropping systems, harvesting, yield, post -harvest handli ng, economics and marketing of **Cucumber**	
19	Seed rate, preparation of field, nursery practices ,transplanting/ directly sowing, s pacing, planting systems, water and weed management; nutrient management and deficiencies, use of chemicals and growth regulator s. Cropping systems, harvesting, yield, post -harvest handling, economics and marketing of **Bottle gourd**	

20	Seed rate, preparation of field, nursery practices ,transplanting/ directly sowing, spacing, planting systems, water and weed management; nutrient man agement and deficiencies, use of chemicals and growth regulators. Cropping systems, harvesting, yield, post -harvest handling, economics and marketing of **Bitter gourd**	
21	Seed rate, preparation of field, nursery practices ,transplanting/ directly sowing, spacing, planting systems, water and weed management; nutrient management and deficiencies, use of chemicals and growth regulators. Cropping systems,harvesting, yield, post -harvest handling, economics and marketing of **Sponge and ridge gourd**	
22	Seed rate, preparation of field, nursery practices,transplanting/ directly sowing, spacing, planting systems, water and weed management; nutrient management and deficiencies, use of chemicals and growth regulators. Cropping systems, harvesting, yield, post -harvest han dling, economics and marketing of **Water melon**	
23	Seed rate, preparation of field, nursery practices ,transplanting/ directly sowing, s pacing, planting systems, water and weed management; nutrient management and deficiencies, use of chemicals and growth reg ulators. Cropping systems, harvesting, yield, post -harvest handling, economics and marketing of **Musk melon**	
24	Seed rate, preparation of field, nursery practices ,transplanting/ directly sowing, spacing, planting systems, water and weed management; nutrient management and deficiencies, use of chemicals and growth regulators. Cropping systems, harvesting, yield, post-harvest handling, economics and marketing of **Pumpkin**	
25	Seed rate, preparation of field, nursery practices ,transplanting/ directly sowing, spacing, planting systems, water and weed management; nutrient management and deficiencies, use of chemicals and growth regulators. Cropping systems, harvesting,yield, post -harvest handling, economics and marketing of**Round melon and others**	
26	Description of varieties and hybrid, climate and soil requirements, seed rate, preparation of field, sow ing, s pacing, planting systems, water and weed management; nutrient management and deficiencies, use of chemicals and growth regulators. Cropping systems, harvesting, yield, post -harvest handling, economics and marketing of**Moringa**	
27	Description of varieties and hybrid, climate and soil requirements, seed rate, preparation of field, sowing, s pacing, planting systems, water and weed management; nutrient management and deficiencies, use of chemicals and growth regulators. Cropping systems, harvesting, yield, post -harvest handling, economics and marketing of **Portulaca**	

28	Description of varieties and hybrid, climate and soil requirements, seed rate, preparation of field, sowing, spacing, planting systems, water and weed management; nutrient management and deficiencies, use of chemicals and growth regulators. Cropping systems, harvesting, yield, post -harvest handling, economics and marketing of **Basella**	
29	Description of varieties and hybrid, climate and soil requirements, seed rate, preparation of field, sowing, spacing, planting systems, water and weed management; nutrient management and deficiencies, use of chemicals and growth regulators. Cropping systems, harvesting, yield, post -harvest handling, economics and marketing of **Sorrel**	
30	Description of varieties and hybrid, climate and soil requirements, seed rate, preparation of field, sowing, spacing, planting systems, water and weed management; nutrient management and deficiencies, use of chemicals and growth regulators. Cropping systems, harvesting, yield, post -harvest handling, economics and marketing of **Roselle**	

Lecture Schedule: Practicals

S.No.	Topics	Tentative Date
1	Study of Identification and description of tropical vegetable crops.	
2	Study of Identification and description of sub-tropical vegetable crops.	
3	Preparation of raised nursery bed and sowing of seeds.	
4	Transplanting of seedlings and after care.	
5	Preparation of field and sowing.	
6	Preparation of solution and spraying of Herbicide in vegetable crops	
7	Practice on top dressing of fertilizers in vegetables crop.	
8	Preparation of solution and spraying of plant growth regulators in vegetables crops.	
9	Identification of nutrient deficiencies and Physiological disorder of vegetable crops.	
10	Study of Maturity indices and harvesting of vegetable crops.	
11	Post-harvest handling, storage and marketing of vegetables.	
12	Seed extraction of vegetable crops.	
13	Study of cost of cultivation for tropical sub-tropical vegetable crops.	
14	Project preparation for commercial cultivation of vegetable crops.	

Suggested Reading:

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FLS- 121 Principles of Landscape Architecture 2(1 +1)

Theory:

Historical importance of Indian gardens, gardens of ancient world, definitions, famous gardens of India and abroad; formal, informal, free style and wild gardens. Basic themes of gardens *viz.* circular, rectangular and diagonal themes. Steps in preparation of garden design. Use of Auto-CAD and Arch-CAD in designing gardens. Factors affecting landscape design *viz.* initial approach, view, human choice, simplicity, topography, etc. Principles of landscape gardens *viz.* axis, rhythm, balance, time and light, space, texture, form, mass effect, focal point, mobility, emphasis, unity and harmony, etc. Elements of landscape gardens *viz.* tangible and intangible elements. Bio-aesthetic planning- definition and objectives. Planning and designing of home gardens, colonies, country planning, urban landscape, institutional gardens, planning and planting of avenues, beautifying schools, railway lines, railway stations, factories, bus stands, air ports corporate buildings, dams, hydro electric stations, river banks, play grounds, gardens for places of religious importance *viz.* temples, churches, mosques, tombs, etc. Importance and features of English gardens, Japanese gardens, Mughal gardens, French and Persian gardens, Italian gardens, Hindu gardens and Buddhist gardens. Xeriscaping- definition, principles and practices.

Practical:

Study of garden equipments. Study of graphic language, symbols and notations in landscape designing. Use of drawing equipments. Study and designing of different styles of gardens. Study and designing of gardens based on different themes. Designing gardens using Auto-CAD/Archi-CAD. Designing gardens for home, institutes and public places. Designing and planting of avenues for state and National highways. Designing of Japanese, English and Mughal gardens. Visit to public, institutional and botanical gardens.

Lecture Schedule: Theory

No. of Lectures	Topic of Lectures	Date
1	History of Indian and ancient world garden	
2	Types of Garden	
3	Basic Themes of gardens	
4	Use of Auto CAD and Arch CAD in designing of garden	
5	Factor affecting landscape design	
6	Principles of landscape design	
7	Elements of landscape garden	
8	Bio- aesthetic planning	

9	Planning and designing of special types of garden e.g, , institutional gardens, schools, railway lines, factories, bus stands, air ports corporate buildings, dams, hydro electric stations, river banks, play grounds	
10	Country planning and urban landscaping	
11	Planning and planting of avenues in different locations	
12	Planning and designing of gardens for places of religious importance *viz.* temples, churches, mosques, tombs, etc	
13	Features of English gardens, French and Italian gardens,	
14	Features of Mughal gardens and Persian gardens	
15	Features of Japanese gardens Hindu gardens and Buddhist gardens	
16	Xeriscaping- definition, principles and practices.	

No. of Practicals	**Practicals**	**Date**
1	Study of garden tools and equipments	
2	Study of graphic language	
3	Symbols and notations in landscape designing	
4	Use of drawing equipments	
5	Study and designing of different styles of gardens.	
6	Study and designing of gardens based on different themes	
7	Designing gardens using Auto-CAD	
8	Designing gardens using Archi-CAD.	
9	Layout plan of home garden	
10	Layout plan for a school building	
11	Designing gardens using, institutes and public places	
12	Designing and planting of avenues for state and National highways	
13	Designing of Japanese gardens	
14	Designing of English gardens	
15	Designing of Mughal gardens	
16	Visit to public, institutional and botanical gardens.	

PHT- 121 Fundamentals Of Food Technology And Nutrition 2(1+1)

Theory:

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

Practical:

Acquaintance with equipments used in food technology, Methods of measuring food ingredients, effect of cooking on volume and weight, determination of percentage of edible portion. Browning reactions of fruits and vegetables. Microscopic examination of starches, estimation of energy value, quality of protein and fats content of foods. Planning diet for various age groups.Survey of population for nutritional status.

Lecture Schedule: Theory

S.No.	Topics	Tentative Date
1.	Food and its function: physiological, social and psychological	
2.	Physical properties of foods	
3.	Chemical properties of food	
4.	Food preparation techniques	
5.	Nutrition, relation of nutrition of good health	
6.	Characteristics of well and malnourished population	
7.	Energy, definition, determination of energy requirements, food energy, and total energy needs of the body.	
8.	Carbohydrates: functions, source, requirements, digestion, absorption and utilization	
9.	Protein: functions, sources, requirements, digestion, absorption, essential and non-essential amino acids,	
10.	Quality of proteins, PER/NPR/NPU, supplementary value of proteins and deficiency.	
11.	Lipids: functions, sources, requirements, digestion, absorption and utilization	
12.	Saturated and unsaturated fatty acids, deficiency, rancidity, refining of fats.	
13.	Mineral nutrition: macro and micro-minerals (Ca, Fe and P), function, utilization, requirements, sources, effects of deficiency.	
14.	Functions, sources, effects of deficiency, requirements of water soluble vitamins	
15.	Functions, sources, effects of deficiency, requirements of fat-soluble vitamins.	
16.	Balanced diet: recommended dietary allowances for various age groups, assessment of nutritional status of the population.	

Lecture Schedule: Practicals

S.No.	Topics	Tentative Date
1.	Identification and application of equipments in laboratory	
2.	Identification and uses of chemicals in laboratory	
3.	Methods of measuring solid food ingredients	
4.	Methods of measuring liquid food ingredients	
5.	Effect of cooking on volume and weight	
6.	Determination of percentage of edible portion of different types of food.	
7.	Qualitative estimation of browning in vegetables by enzyme test	
8.	Microscopic examination of starches	
9.	Numerical exercise on estimation of food energy	
10.	Numerical exercise on energy need of the body	
11.	Numerical exercise on the estimation of biological value, PER, NPR and NPU of protein food	
12.	Planning diet for adult male and female	
13.	Planning diet for pregnant women and nursing mother	
14.	Survey of school going children for finding out their diet pattern	
15.	Trip to nearby village for identifying types of malnutrition and educating the population for balanced diet	

Suggested Readings:

1. Jain, S.K. 2010. *Teaching manual on fundamentals of foods and nutrition*. CH&F, Jhalawar 72p.
2. Manay, N. Shakuntala and Shadaksharaswamy, M. *Foods: Facts & Principles,* New Age International (P) Limited Publishers, New Delhi.
3. Mudambi, Sumati R. and Rajagopal, M.V. *Fundamentals of Foods & Nutrition, Third Edition,* New Age International (P) Limited Publishers, New Delhi.
4. Potter, Norman N. and Hotchkiss, Joseph H. *Food Science, Fifth Edition*, CBS Publishers & Distributors, New Delhi.

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

Theory

Introduction to soil fertility and productivity- factors affecting. Essential plant nutrient elements-functions, deficiency **symptoms**, transformations and availability. Acid, calcareous and salt affected soils – characteristics and management. Soil organic matter, Role of microorganisms in organic matter-decomposition – humus formation. Importance of C:N ratio and pH in plant nutrition, soil buffering capacity. Integrated plant nutrient management. Soil fertility evaluation methods, critical limits of plant nutrient elements and hunger signs. NPK,**Secondary and micronutrient**fertilizers: composition and application methodology.Luxury consumption, nutrient interactions, deficiency symptoms, visual diagnosis. Soil test crop response and targeted yield concept. Manuresclassification and Biofertilizer. Fertilizer control order. Properties and fate of major and micronutrient in soils. Fertilizer use efficiency and management.Plant nutrient toxicity symptoms and remedies measures. Effect of potential toxic elements in soil productivity.

Practical

Analysis of soil for organic matter, available N,P,K and Micronutrients and interpretations. Gypsum requirement of saline and alkali soils. Lime requirement of acid soils. Determination of Calcium, Magnesium and Sulphur in soil. Sampling of organic manure and fertilizer for chemical analysis. Physical properties of organic manure and fertilizers. Total nitrogen in urea and farmyard manure. Estimation of ammonical nitrogen and nitrate nitrogen in ammonical fertilizer. Fertilizer testing laboratory visits.

Lecture Schedule: Theory

S.No.	Topics	Tentative Dates
1.	Introduction to soil fertility and productivity-factors affecting	
2.	Essential plant nutrient elements-functions, deficiency symptoms,	
3.	Essential plant nutrient elements- transformations and availability	
4.	Acid soils- characteristics and management	
5.	Calcareous soils- characteristics and management	
6.	Salt affected soils- characteristics and management	
7.	Soil organic matter and its importance	
8.	Role of microorganisms in organic matter decomposition-humus formation	
9.	Importance of C:N ratio and pH in plant nutrition, soil buffering capacity	
10.	Integrated plant nutrient management (INM)	
11.	Soil fertility evaluation methods	
12.	Critical limits of plant nutrient elements and hunger signs	
13.	NPK fertilizers: composition and application methodology	
14.	Secondary fertilizers: composition and application methodology	
15.	Micronutrient fertilizers: composition and application methodology	
16.	Luxury consumption, nutrient interactions, deficiency symptoms, visual diagnosis	
17.	Soil test crop response and targeted yield concept	
18.	Manures classification and Biofertilizer	
19.	Fertilizer control order; Properties and fate of major and micronutrient in soils, Fertilizer use efficiency and management	
20.	Plant nutrient toxicity symptoms and remedies measures	
21.	Effect of potential toxic elements insoil productivity	

Lecture Schedule: Practicals

S.No.	Topics	Tentative Dates
1.	Analysis of soil for organic matter content	
2.	Determination of available nitrogen content in soils	
3.	Determination of available phosphorus content in soils	
4.	Determination of available K content in soils	
5.	Determination of available micronutrient in soils	
6.	Evaluation of gypsum requirement of saline and alkali soils	
7.	Evaluation of lime requirement of acid soils	
8.	Determination of Calcium, Magnesium and Sulphur in soil	
9.	Sampling of organic manure and fertilizer for chemical analysis	
10.	Identification of common manures & fertilizers and their composition	
11.	Physical properties of organic manure and fertilizers	
12.	Total nitrogen in urea and farmyard manure	
13.	Estimation of ammonical nitrogen and nitrate nitrogen in ammonical fertilizer	
14.	Fertilizer testing laboratory visits	

Suggested readings:

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

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

Seetharaman S, Biswas B C, Yadav D S and Matheswaru S. Usage 1996. *Hand Bookon Fertilizers*. Oxford and IBH Publishing Company, New Delhi.

The fertilizer Association of India, Shaheed Jit singh marg, New Delhi, 1985. Fertilizer control order Ranjan Kumar Basak , 2000. *Fertilizers A Text book.* Kalyani publishers, New Delhi.

British Crop Production Council, U.K., 1995. The Pesticide Manual, A – World Compendium.

Sree Ramulu US, 1991. *Chemistry of Insecticides*. Oxford and IBH Publishing and Fungicides Company, New Delhi.

Nene Y L and Thapliyal P N, 1991. *Fungicides in plant disease control*. Oxford and IBH Publishing company, New Delhi.

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

Binkley, D. and R. Fisher, 2012. *Ecology and Management of Forest Soils* (4th Edition), John Wiley & Sons Singapore Pvt. Ltd., Singapore

Reddy M. V., 2001. *Management of Tropical Plantation Forests and Their Soil Litter System- Litter, Biota and Soil Nutrient Dynamics*, Science Publishers, U. S.

Khan, T. O., 2013. *Forest Soils: Properties and Management*. Springer International Publishing, Switzerland

Brady, N. C. and Weil, R. R., 2010. E*lements of the Nature and Properties of Soils* (3rd Edition.), Pearson

Education, New Delhi

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

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

Pritchett and Fisher RF, 1987. *Properties and Management of Forest Soils*. John Wiley, New York.

Gupta, P.K., 2009. *Soil, Plant, Water and Fertilizer Analysis* (2nd Edition), AGROBIOS, Jodhpur (India).

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

Jackson, M. L., 2012. Soil Chemical Analysis: Advanced Course, Scientific Publisher

J. Benton Jones, Jr., 2012. *Plant Nutrition and Soil Fertility Manual* (2nd Edition), CRC Press, USA.

Mengel, *et al.,* 2001. *Principles of Plant Nutrition* (5th Edition), Springer

Kanwar,J.S.(Ed).,1976. *Soil Fertility: Theory and Practice*, ICAR, New Delhi

Bear,F.E.,1964. *Chemistry of the Soil.* Oxford and IBH Publishing Co., New Delhi

Richards ,L.A., 1968. *Diagnosis and Improvement of Saline and Alkalinesoils*.

Oxford & IBH PublishingCo.New Delhi (USDA Hand Book No. 60)

Chopra,S.Cand Kanwar, J.S., 1976. *Analytical Agricultural Chemistry*. Kalyani Publishers, Ludhiana.

Tisdale, S.L. Nelson,W.L. and Beaton, J.D., 1993. *Soil Fertility and Fertilizers*.

Macmillan Publishing Company, New York

Yawalkar, K.S. Agarwal, J.P. and Bokde, S., 1977. *Manures and Fertilizers*. Agri Horticultural Publishing House, Nagpur

Seetharamaan, S.Biswas, B.C. Maheswari, S. and Yadav, D.S., 1986.

Hand Book on Fertilizers Technology. The Fertilizers Association of India, New Delhi.

NRM-122 Water Management in Horticultural Crops 2(1+1)

Theory

Importance of water, water resources in Rajasthan. Area of different crops under irrigation, function of water for plant growth, effect of moisture stress on crop growth. Available and unavailable soil moisture – water budgeting–distribution of soil moisture –rooting characteristics – moisture extraction pattern. Water requirement of horticultural crops – lysimeter studies – Plant water potential climatological approach – use of pan evaporimeter – Irrigation scheduling – different approaches-- factor for crop growth stages – critical stages of crop growth for irrigation. Methods of irrigation – surface and sub-surface, pressurized methods viz., sprinkler and drip irrigation, their suitability, merits and limitations, fertigation, economic use of irrigation water,layout of different irrigation systems, drip, sprinkler. Layout of underground pipeline system. Water management problems, quality of irrigation water, irrigation management practices for different soils and crops.

Practical

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

Lecture Schedule: Theory

Lecture Nos.	Topics	Tentative dates
THEORY		
1	Explanation of whole course content in brief	
2	Irrigation Management- problems & practices for different soils and crops	
3	Water resources in India,	
4	Importance of irrigation water in agriculture	
5	Study of different hydrologic properties	
6	Water budgeting	
7	Rooting characteristics – moisture extraction pattern.	
8	Water requirement-NIR & GIR, lysimeter studies	
9	Plant water potential climatological approach – use of pan evaporimeter	
10	Study of different irrigation efficiencies	
11	Irrigation scheduling – different approaches	
12	Methods of irrigation – surface and sub -surface, their layouts, suitability, merits and limitations,	
13	Pressurized irrigation methods - sprinkler and drip irrigation their layouts, suitability, merits and limitations, Fertigation	
14	Layout of underground pipeline system.	

Practical		
1	Measurement of irrigation water by various method	
2	Practicing of land levelling and land shaping implements,	
3	layout for different surface and sub -surface irrigation methods on farm	
4	layout for Pressurized irrigation methods-sprinkler and drip on farm	
5	Estimation of soil moisture constants and soil moisture by using different methods and instruments;	
6	Measurement of evaporation by using Pan evaporimeter	
7	Measurement of infiltration by using double cylinder infiltrometer	
8	Scheduling of irrigation, different approaches	
9	Estimation of irrigation efficiency	
10	Estimation of water requirements of horticultural crops,	
11	Soil moisture conservation practices.	
12	Use of common formula in irrigation practices,	

Suggested Readings:

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

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

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

Carr M. K. V. and Elias Fereres. 2012. *Advances in Irrigation Agronomy*. Cambridge University Press.

Michael, A.M. 2015. *Irrigation Theory and practices*. Vikas publishing house Pvt., Ltd.

BAS-121 Growth and Development of Horticultural Crops 2(1+1)

Theroy

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

Practical

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

Lecture Schedule: Theory

S.No.	Topics	Tentative Dates
1.	Growth and development -definitions, components, photosynthetic productivity,	
2.	Canopy photosynthesis and productivity,	
3.	Leaf area index (LAI) - optimum LAI in horticultural crops,	
4.	canopy development; different stages of growth, growth curves,	
5.	Crop development stages and dynamics (Case studies of annual/perennial horticultural crops),	
6.	Growth analysis in horticultural crops.	
7.	Plant bio -regulators- auxin, gibberellin, cytokinin, ethylene inhibitors and retardants,	
8.	Basic functions, biosynthesis, role in crop growth and development,	
9.	Propagation, flowering, fruit setting, fruit thinning, fruit development, fruit drop, and fruit ripening.	
10.	Tuvenitity,	
11.	Flowering-factors affecting flowering, physiology of flowering,	

12.	Photoperiodism-long day, short day and day neutral plants,	
13.	Vernalisation and its application in horticulture,	
14.	Pruning and training physiological basis of training and pruning - source and sink relationship, translocation of assimilates.	
15.	Physiology of seed development and maturation, seed dormancy and bud dormancy,	
16.	causes and breaking methods in horticultural crops.	
17.	Physiology of fruit growth and development, fruit setting, factors affecting fruit set and development,	
18.	Physiology of ripening of fruits-climacteric and non -climacteric fruits.	
19.	Physiology of fruits under post-harvest storage**.**	

Lecture Schedule: Practicals

S.No.	Topics	Tentative Dates
1.	Estimation of photosynthetic potential of horticultural crops,	
2.	Leaf area index,	
3.	Growth analysis parameters including harvest index,	
4.	Bioassay of plant hormones,	
5.	Identification of synthetic plant hormones and growth retardants,	
6.	Preparations of hormonal solution and induction of rooting in cuttings,	
7.	Ripening of fruits and control of flower and fruit drop.	
8.	Important physiological disorders and their remedial measures in fruits	
9.	Important physiological disorders and their remedial measures in vegetables	
10.	Seed dormancy, seed germination and	
11.	Breaking seed dormancy with chemicals and growth regulators.	

Suggested Reading:

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

Taiz, L. 2010.Plant Physiology. SINAUR. USA.

Zeiger. 2003.Plant Physiology. PANIMA. New Delhi.

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

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

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

Jacobs, W. P. 1979. Plant Hormones And Plant Development. Cambridge Univ. London.

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

Lincoln Taiz and Eduards Zeiger (5th Edition). Plant physiology. Sinauer Associates, Inc.

Noggle G.R and Fritz T.G.1944. Introductory Plant Physiology.

Pandey and Sinha. Plant Physiology.

JKA Bleasdale, Plant Physiology in relation to Horticulture

Amarjit Basra, Plant Growth Regulators in Agriculture and Horticulture: Their role & Commercial Uses

C.Rajendran, K.Ramamoorthy and S. Juliet Hepziba, Nutritional and Physiological Disorders in Crop Plants

BAS-122 Information and Communication Technology 2(1+1)

Theroy

IT and its importance. IT tools, IT-enabled services and their impact on society; computer fundamentals; hardware and software; input and output devices; Features of machine language, assembly language, high-level language and their advantages and disadvantages; principles of programming-algorithms and flowcharts; Operating systems (OS) - definition, basic concepts, introduction to WINDOWS and LINUX Operating Systems; Local area network (LAN), Wide area network(WAN), Internet and World Wide Web, HTML and IP; Introduction to MS Office - Word, Excel, Power Point. Audio visual aids - definition, advantages, classification and choice of A.V aids; video conferencing. Communication process, Berlo' s model, feedback and barriers to communication.

Practical

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

Lecture Schedule: Theory

S.No.	Topics	Tentative Dates
1.	IT and its importance	
2.	IT tools	
3.	IT-enabled services and their impact on society	
4.	Computer fundamentals; hardware and software; input and output devices	
5.	Features of machine language, assembly language	
6.	High-level language and their advantages and disadvantages	
7.	Principles of programming- algorithms and flowcharts	
8.	Operating systems (OS) - definition, basic concepts	
9.	Introduction to WINDOWS and LINUX Operating Systems	
10.	Local area network (LAN), Wide area networ k(WAN), Internet and World Wide Web , HTML and IP	
11.	Introduction to MS Office - Word, Excel, Power Point	
12.	Audio visual aids - definition, advantages, classification and choice of A.V aids	
13.	Video conferencing	
14.	Communication process Berlo' s model	
15.	Feedback and barriers to communication	

Lecture Schedule: Practicals

S.No.	Topics	Tentative Dates
1.	Exercises on binary number system	
2.	Algorithm and	
3.	Flow chart	
4.	MS-word	
5.	MS-excel	
6.	MS-power point	
7.	Internet applications	
8.	Web browsing	
9.	Creation and operation of email account	
10.	Analysis of horticulture/agriculture data using ms excel	
11.	Analysis of horticulture/agriculture data using ms excel	
12.	Handling of audio visual equipments	
13.	Planning, preparation,	
14.	Presentation of posters, charts, overhead transparencies and slides	
15.	Organization of an audio visual programme	

Suggested Readings

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

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

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

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

FRS-211 **Temperate Fruit Crops** **2 (1+1)**

Theory

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 and storage of apple, pear, peach and **nectarine**, apricot, plum, cherry, persimmon, strawberry, kiwi, queens land nut (macademia nut), almond, walnut, pecan nut, hazel nut and chest nut. Re-plant problem, rejuvenation and special production problems like pre-mature leaf fall, physiological disorders, important insect – pests and diseases and their control measures. Special production problems like alternate bearing problem and their remedies.

Practical

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

Lecture Schedule: Theory

S.No.	Topics	Tentative Dates
1	Introduction to temperate zone of India	
2	Classification of temperate fruits- Taxonomy	
3	Pome fruits ,Stone Fruits, Nuts trees	
4	Apple- areas, production, varieties, rootstocks, climate and soil requirements, propagation, planting density, cropping systems, after care training and pruning, self incompatibility and pollinisers.	
5	Pear- area, production, varieties, climate and soil requirements, propagation, planting density, cropping systems, after care training and pruning, self incompatibility and pollinisers	
6	Peach - area, production, varieties, climate and soil requirements, propagation, planting density, cropping systems, after care training and pruning, self incompatibility and pollinisers	
7	Apricot- area, production, varieties, climate and soil requirements, propagation, planting density, cropping systems, after care training and pruning, self incompatibility and pollinisers.	
8	Cherry-- area, production, varieties, climate and soil requirements, propagation, planting density, cropping systems, after care training and pruning, self incompatibility and pollinisers.	
9	Persimmon- area, production, varieties, climate and soil requirements, propagation, planting density, varietal classification on the basis of astringency.	

10	Strawberry- area, production, varieties, climate and soil requirements, propagation, planting density.	
11	Kiwifruit- area, production, varieties, climate and soil requirements, propagation, planting density.	
12	Queens land nut (Macademia nut) varieties, climate and soil requirements, propagation, planting density.	
13	Pecan nut, hazel nut and chest nut- area, production, varieties, climate and soil requirements, rootstocks, propagation, planting density.	
14	Re- plant problem, rejuvenation and special production problems like pre-mature leaf fall	
15	Physiological disorders, Important insect – pests and diseases and their control measures.	

Lecture Schedule: Practicals

S.No.	Topics	Tentative Dates
1	Nomenclature of temperate fruits	
2	Description and identification of varieties of apple	
3	Description and identification of varieties of Pear	
4	Description and identification of varieties of Peach	
5	Description and identification of varieties of Apricot	
6	Description and identification of varieties of Almond	
7	Description and identification of varieties of Walnut	
8	Description and identification of varieties of Plum	
9	Manuring and fertilization practices in temperate fruits	
10	Planting systems in temperate fruits	
11	Preparation and use of growth regulators	
12	Training and pruning in apple, pear, plum, peach and nut crops	
13	Visit to private orchards to diagnose maladies	
14	Working out economics for apple, pear, plum and peach.	
15	Nursery management practices.	

Suggested Reading:

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

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

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

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

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

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

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

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

VEG-211 Winter Vegetable Crops 2(1+1)

Theroy

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

Practical

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

Lecture Schedule: Theory

S.No.	Topics	Tentative Dates
1	Importance of cool season vegetable crops in nutrition and national economy. Area, production, export potential of cool season vegetable crops.	
2	Description of varieties and hybrids, origin, climate and soil, production technologies, post-harvest technology and Marketing of cabbage.	
3	Description of varieties and hybrids, origin, climate and soil, production technologies, post-harvest technology and Marketing of cauliflower.	
4	Description of varieties and hybrids, origin, climate and soil, production technologies, post-harvest technology and Marketing of knol-khol.	
5	Description of varieties and hybrids, origin, climate and soil, production technologies, post -harvest technology and Marketing of sprouting broccoli.	
6	Description of varieties and hybrids, origin, climate and soil, production technologies, post-harvest technology and Marketing of, Brussels' sprout.	
7	Description of varieties and hybrids, origin, climate and soil, production technologies, post-harvest technology and Marketing of lettuce.	
8	Description of varieties and hybrids, origin, climate and soil, production technologies, post-harvest technology and Marketing of palak.	
9	Description of varieties and hybrids, origin, climate and soil, production technologies, post-harvest technology and Marketing of Chinese cabbage .	
10	Description of varieties and hybrids, origin, climate and soil, production technologies, post-harvest technology and Marketing of garlic .	
11	Description of varieties and hybrids, origin, climate and soil, production technologies, post-harvest technology and Marketing of onion.	

12	Description of varieties and hybrids, origin, climate and soil, production technologies, post-harvest technology and Marketing of leek .	
13	Description of varieties and hybrids, origin, climate and soil, production technologies, post-harvest technology and Marketing of radish and carrot, cabbage.	
14	Description of varieties and hybrids, origin, climate and soil, production technologies, post-harvest technology and Marketing of turnip and beet root .	
15	Description of varieties and hybrids, origin, climate and soil, production technologies, post-harvest technology and Marketing of peas.	
16	Description of varieties and hybrids, origin, climate and soil, production technologies, post-harvest technology and Marketing of broad beans.	
17	Description of varieties and hybrids, origin, climate and soil, production technologies, post-harvest technology and Marketing of rhubarb.	
18	Description of varieties and hybrids, origin, climate and soil, production technologies, post-harvest technology and Marketing of asparagus.	
19	Description of varieties and hybrids, origin, climate and soil, production technologies, post-harvest technology and Marketing of globe artichoke.	
20	Description of v arieties and hybrids, origin, climate and soil, production technologies, post -harvest technology and Marketing of Vegetable kale.	

Lecture Schedule: Practicals

S.No.	Topics	Tentative Dates
1	Study of Identification and description of varieties/hybrids of cool season vegetables.	
2	Study of propagation methods of cool season vegetables.	
3	Preparation of raised nursery bed of cool season vegetable crops.	
4	Sowing methods of cool season vegetable crops.	
5	Transplanting of cool season vegetable crops.	
6	Field preparation of cool season vegetable crops.	
7	Identification of physiological and nutritional disorders and their corrections of vegetable crops.	
8	Study of post-harvest handling of cool season vegetable crops.	
9	Study of cost of cultivation of vegetable crops.	

Suggested Reading:

S. Thamburaj. 2014. *Text book of vegetable, tuber crops and Spices*. ICAR, New Delhi.

B.R.Choudhary 2009.*AText book on production technology of vegetables*. Kalyani Publishers. Ludhiana.

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VEG-212 Precision Farming& Protected Cultivation 3 (2+1)

Theroy

Precision farming – laser leveling, mechanized direct seed sowing; seedling and sapling transplanting, mapping of soils and plant attributes, site specific input application, weed management, insect pests and disease management, yield mapping in horticultural crops. Green house technology, Introduction, Types of Green Houses; Plant response to Greenhouse environment, Planning and design of greenhouses, Design criteria of greenhouse for cooling and heating purposes. Green house equipment, materials of construction for traditional and low cost green houses. Irrigation systems used in greenhouses, Typical applications, passive solar green house, hot air greenhouse heating systems, green house drying. Cost estimation and economic analysis. Choice of crops for cultivation under greenhouses, problems / constraints of greenhouse cultivation and future strategies. Growing media, soil culture, type of soil required, drainage, flooding and leaching, soil pasteurization in peat moss and mixtures, rock wool and other inert media, nutrient film technique (NFT) / hydroponics.

Practical

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

Lecture Schedule: Theory

S.No.	Topics	Tentative Dates
1.	Precision farming – laser leveling, mechanized ; mapping of soils and plant attributes, site specific input application, weed management, yield mapping in horticultural crops…	
2.	…Continue…	
3.	…Continue…	
4.	…Continue.	
5.	Direct seed sowing; seedling and sapling transplanting…	
6.	…Continue.	
7.	Insect pests and disease management…	
8.	…Continue…	
9.	…Continue.	
10.	Green house technology, Introduction, Types of Green Houses …	
11.	…Continue…	
12.	…Continue.	
13.	Plant response to Greenhouse environment	
14.	Planning and design of greenhouses	
15.	Design criteria of greenhouse for cooling and heating purposes…	
16.	…Continue.	
17.	Green house equipment, materials of construction for traditional and low cost green houses…	
18.	…Continue…	
19.	…Continue.	
20.	Irrigation systems used in greenhouses	

21.	Typical applications, passive solar green house, hot air greenhouse , heating systems, green house drying…	
22.	…Continue.	
23.	Cost estimation and economic analysis…	
24.	…Continue.	
25.	Choice of crops for cultivation under greenhouses, problems / constraints of greenhouse cultivation and future strategies…	
26.	…Continue…	
27.	…Continue.	
28.	Growing media, soil culture, type of soil required,	
29.	Drainage, flooding and leaching	
30.	Soil pasteurization in peat moss and mixtures, rock wool and ot her inert media,	
31.	Nutrient film technique (NFT) / hydroponics…	
32.	…Continue.	

Lecture Schedule: Practicals

S.No.	Topics	Tentative Dates
1.	Study of different types of greenhouses based on shape, construction and cladding materials	
2.	Study of different types of greenhouses based on shape, construction and cladding materials	
3.	Study of different types of greenhouses based on shape, construction and cladding materials	
4.	Calculation of air rate exchange in an active summer winter cooling system	
5.	Calculation of rate of air exchange in an active winter cooling system	
6.	Estimation of drying rate of agricultural products inside green house	
7.	Testing of soil and water to study its suitability for growing crops in greenhouses	
8.	The study of fertigation requ irements for greenhouses crops and estimation of E.C. in the fertigation solution	
9.	The study of fertigation requirements for greenhouses crops and estimation of E.C. in the fertigation solution	
10.	The study of various growing media used in raising of gre enhouse crops and their preparation and pasteurization / sterilization	
11.	The study of various growing media used in raising of greenhouse crops and their preparation and pasteurization / sterilization	
12.	The study of various growing media used in raising of greenhouse crops and their preparation and pasteurization / sterilization	
13.	Visit to commercial green houses	
14.	Visit to commercial green houses	
15.	Economics of protected cultivation	
16.	Economics of protected cultivation	

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FLS- 211 **Commercial Floriculture** **3 (2+1)**

Theory:

Scope and importance of commercial floriculture in India. Production techniques of commercial flower crops *viz.* rose, marigold, chrysanthemum, orchid, carnation, gladiolus, jasmine, gaillardia, anthurium, dahlia, tuberose, bird of paradise, china aster and gerbera for domestic and export markets. Production techniques of flowers and foliage filler materials *viz.* asparagus, *Murraya penniculata* and cycus. Growing of flowers under protected environments *viz.* rose, chrysanthemum, anthurium, carnation and gerbera. Postharvest technology of commercial cut flower crops. Dehydration techniques for drying of flowers. Production techniques for bulbous plants *viz.* tulip, amaryllis, spider lily and crinum.

Practical:

Identification of commercially important floricultural crops. Propagation practices in major flower crops. Sowing of seeds and raising of seedlings of annuals. Propagation by cutting, layering, budding and grafting. Training and pruning of roses. Use of chemicals and other compounds for prolonging the vase life of cut flowers. Drying and preservation of flowers. Flower arrangement practices.

Lecture Schedule: Theory

S.No.	Topics	Tentative date
1.	Importance and scope of commercial floriculture in India	
2.	Production techniques of ornamental flower crops for domestic and export markets: Rose- introduction, types and classification, important varieties	
3.	Rose- soil and climate, manuring and fertilization, propagation, planting, training pruning and other cultural operations	
4.	Rose- disorders, diseases and pests, harvesting and yield	
5.	Chrysanthemum- introduction, types and classification, important varieties	
6.	Chrysanthemum- soil and climate, manuring and fertilization, propagation, planting, cultural operations, diseases and pests, harvesting and yield	
7.	Marigold: introduction, species and important varieties, soil and climate, manuring and fertilization, propagation, planting, cultural operations, diseases and pests, harvesting and yield	
8.	Carnation: introduction, types, important varieties, soil and climate, manuring and fertilization, propagation, planting, pinching and stacking, other cultural operations, disorders, diseases and pests, harvesting and yield	
9.	Gladiolus: introduction, species and types, important varieties, soil and climate, manuring and fertilization, propagation, planting, cultural operations, diseases and pests, harvesting and yield	
10.	Jasmines- introduction, origin, cultivated jasmine species and varieties	
11.	Jasmines- soil and climatic, manuring and fertilization, propagation, planting, cultural operations, diseases and pests, harvesting and yield	
12.	Dahlia- introduction, types and classification, varieties	
13.	Dahlia- soil and climate, manuring and fertilization, propagation, planting, cultural operations, diseases and pests, harvesting and yield	

14.	Tuberose: introduction, types and important varieties, soil and climate, manuring and fertilization, propagation, planting, cultural operations, diseases and pests, harvesting and yield	
15.	Bird of paradise: introduction, varieties, soil and climate, manuring and fertilization, propagation, planting, cultural operations, diseases and pests, harvesting and yield	
16.	China aster: introduction, varieties, soil and climate, manuring and fertilization, propagation, planting, cultural operations, diseases and pests, harvesting and yield	
17.	Gerbera: introduction, varieties, soil and climate, manuring and fertilization, propagation, planting, cultural operations, diseases and pests, harvesting and yield	
18.	Gaillardia: introduction, varieties, soil and climate, manuring and fertilization, propagation, planting, cultural operations, diseases and pests, harvesting and yield	
19.	Anthurium; introduction, varieties, soil and climate, manuring and fertilization, propagation, planting, cultural operations, diseases and	
20.	Orchids- introduction, types and classification, important orchids in cultivation and their varieties	
21.	Orchids- growing media, feeding and fertilization, planting and propagation, cultural operations, diseases and pests, harvesting and yield	
22.	Production techniques of flowers and foliage filler materials: asparagus, *Murraya penniculata* and cycus	
23.	Growing of flowers under protected environments: types and classification of protected structures	
24.	Protected cultivation of rose, chrysanthemum, anthurium, carnation and gerbera: growing media, fertigation and environmental conditions	
25.	Protected cultivation: crop planting, cultural practices, diseases and pests, and harvesting and yield of rose, chrysanthemum, anthurium, carnation and gerbera	
26.	Post-harvest technology of commercial cut-flower crops: rose, chrysanthemum, gladiolus, carnation and tuberose	
27.	Post-harvest technology of cut-flowers: anthurium, orchids, china aster, gerbera and dahlia	
28.	Dehydration techniques for drying of flowers- air drying, embedded drying, embedding media and their properties	
29.	Dehydration techniques: oven and microwave oven drying of important flowers	
30.	Production techniques for bulbous plants: tulip, amaryllis, spider lily and crinum	

Lecture Schedule: Practicals

S.No.	Topics	Tentative Dates
1	Identification and brief description of commercial flower crops	
2	Propagation of chrysanthemum by cuttings	
3	Preparation of raised nursery beds, sowing of seeds and raising of seedlings of rainy season annuals	
4	Propagation of jasmine by layering	
5	Propagation of rose by budding	
6	Preparation of flat nursery beds, sowing of seeds and raising of seedlings of winter season annuals	
7	Propagation of gladiolus by corms	
8	Propagation of gerbera by division	
9	Propagation of tuberose by bulbs	
10	Practice of training and pruning in rose	
11	Preparation of holding solution with use of chemicals and other compounds for prolonging vase life of cut flowers	
12	Practice in oven drying and preservation of flowers	
13	Practice in microwave oven drying of flowers	
14	Practice in flower arrangement- Ikebana	
15	Practice in flower arrangement- western arrangement	

Suggested Readings :

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PPR-211 Fundamentals of Plant Pathology 3(2+1)

Theory

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

Practical

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

Lecture Schedule: Theory

S.No.	Topics	Tentative Dates
1	Introduction to the science of phytopathology: its importance, scope and causes of plant diseases	
2	History of plant pathology (early developments and role of fungi in plant diseases)	
3	History of plant pathology (role of other plant pathogens)	
4	General concepts and classification of plant diseases	
5	Symptoms and signs of plant diseases	
6	General characteristics of fungi and fungal-like organisms causing plant diseases	
7	Reproduction in fungi and fungal like organisms causing plant diseases	
8	Classification of fungal plant pathogens	
9	General characteristics and reproduction of bacterial plant pathogens	
10	Classification of bacterial plant pathogens	
11	General characteristics and classification of viral plant pathogens	
12	Algae and flagellate protozoa causing plant diseases	
13	Flowering parasitic plants	
14	Non-parasitic causes of plant diseases	
15	Infection process	
16	Role of enzymes and toxins in plant disease development	
17	Host parasite interaction	
18	Variability in plant pathogens	
19	Disease resistance and defense mechanisms in plants	
20	Dissemination of plant pathogens	
21	Survival of plant pathogens	
22	Effect of environmental factors on disease development	
23	Plant disease epidemiology	
24	Plant disease forecasting	
25	Measurement of plant diseases and yield loss	

26	Principles of plant disease management	
27	Physical and legislative methods of plant disease management	
28	Cultural methods of plant disease management	
29	Biological methods of plant disease management	
30	Chemical control of plant diseases: Fungicides classification based on chemical nature, commonly used fungicides, bactericides and nematicides.	
31	Use of resistant varieties in plant disease management	
32	Integrated plant disease management	

Lecture Schedule: Practicals

S.No.	Topics	Tentative Dates
1	General plant pathological laboratory equipments	
2	Plant pathological field equipments	
3	Diseases caused by plasmodiophoromycota, chytridiomycota and oomycota	
4	Diseases caused by oomycota and zygomycota	
5	Diseases caused by ascomycota - powdery mildews	
6	Diseases caused by ascomycota - wilts and root rots	
7	Diseases caused by ascomycota –stem, leaf and fruit diseases	
8	Post harvest diseases of fruits and vegetables	
9	Diseases caused by basidiomycota- rusts	
10	Diseases caused by basidiomycota-smuts	
11	Bacterial plant diseases	
12	Viral diseases of horticultural plants	
13	Parasitic algae and flowering plants	
14	Culture media and sterilization	
15	Isolation of fungal and bacterial plant pathogens	
16	Fungicidal solutions, slurries and pastes, and their applications	

Suggested Readings:

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Alexopoulos, C.J. Mims, C.W. and Blackwell, M. 1996. Introduction to Mycology Wiley Eastern Ltd., New York.

Alice, D., Jeyalaksmi, C. and Sethuraman, K (2007). Hand book on introductory Plant Pathology. A.E. Publication Coimbatore pp 178

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Rangaswamy, G. and A. Mahadevan. 2008. Diseases of Crop Plants in India (4th Edition). PHI Learning Private Limited, New Delhi. 536 p.

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PPR-212 Fundamentals of Entomology 3(2+1)

Theory

Introduction to phylum arthropoda. Importance of class Insecta. Insect dominance. History of entomology in India, Importance of entomology in different fields. Definition, division and scope of entomology. Comparative account of external morphonology-types of mouth parts, antennae, legs, wings and genetalia. Structure, function of cuticle &moulting and body segmentation, Anatomy of digestive, Circulatory, Sensory, respiratory, glandular, excretory, nervous and reproductive systems. Types of reproduction. Postembryonic development-eclosion. Matamorphosis. Types of egg larvae and pupa. Classification of insectsupto orders, sub-order and families of economic importance and their distinguished characters. Plant mites – morphological features, important families with examples.

Practical

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

S.No.	Topics	Tentative Date
1	Definition, Historyin India and importance of Entomology in respect of classinsect and other fields.	
2	Introduction to Phylum Arthropoda, Class Insecta and their characteristics.	
3	Division,and scope of Entomology, insect dominance with characteristics in detail	
4	Taxonomy, principles and procedures. Nomenclature and identification	
5	Classification of class insecta into different orders	
6	Identification of Agricultural/Horticultural important insect orders with their important characters	
7	Comparative account of insect external morphology and body segmentation in detail and structure, function and moulting of cuticle	
8	Study of insect orders: Protura, Collembola, Diplura, Microcoryphia	
9	Study of insect order: Thysanura, and it's important families	
10	Study of insect order: Orthoptera and it's important families	
11	Study of insect order: Lepidoptera and it's important families	
12	Study of insect order: Coleoptera and it's important families	
13	Study of insect order: Isoptera and it's important families	
14	Study of insect order: Diptera and it's important families	
15	Study of insect order: Hymenoptera and it's important families	
16	Study of insect order: Hemiptera and it's important families	
17	Study of insect orders: Odonata, Dictioptera and Neuroptera	
18	Structure of Insect head and it' orientation	
19	Study of different parts of insect antenna and it's modifications	
20	Study of insect mouth part and types of mouth parts	
21	Insect thorax: segmentation of thorax.	
22	Insect leg structure and its modifications	

23	Insect wing: structure and its modifications	
24	Insect abdomen: structure and its modifications	
25	Male and female genetalia	
26	Anatomy: Digestive system	
27	Anatomy: Excretory system	
28	Anatomy: Respiratory system	
29	Anatomy: Nervous system & Sense organs	
30	Anatomy: Reproductive system and it's type	
31	Post embryonic development and it's types, Metamorphosis and types of larva& pupa	
32	Plant mites – morphological features, important families with examples.	

Lecture Schedule: Practicals

S.No.	Topics	Tentative Date
1	Method of collection, Preservation, Pinning, Setting and Labeling of insect-pests	
2	External features of Grasshopper / Beetle	
3	Identification of insect orders of Agricultural/Horticultural importance	
4	Identification of beneficial insect orders: Neuroptera, Odonata and Dictyoptera	
5	Study of Exoskeleton or body wall	
6	Generalized structure of Insect head and it's orientation	
7	Study of mount of mouth parts and their modification	
8	Preparation of permanent mount of mouth parts	
9	Preparation of permanent mount of types of antenna	
10	Study of appendages of thorax: Wings	
11	Study of appendages of thorax: legs and their permanent mount	
12	Study abdominal appendages: male and female genetalia	
13	Study of Digestive system of grasshopper	
14	Study of Nervous system of grasshopper	
15	Study of Excretory system	
16	Study of important mites of horticulture crops	

Suggested Reading:

Awasthi, V.B. 1997. *Introduction to general and applied entomology*. Scientific Publishers, Jodhpur, 379 p.

Borror, D.J., C.A. Triple Horn and N.F.Johnson. 1987. *An introduction to the study of insects (VI Edition)*. Harcourt Brace College Publishers, New York, 875p.

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

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Richards, O.W. and R.G. Davies. 1977. *Imm's general text book of entomology*, Vol.1&2, Chapman and Hall Publication, London, 1345p.

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Selvanarayanan, V. and Arivudainambi, S., (2005) Introductory Entomology, Manivasagarpathippagam Chennai pp 262.

Snodgrass, R.E. 2001.Principles of Insect Morphology.CBS Publishers and Distributors, New Delhi

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

Tembhare, D.B. 1997. *Modern Entomology*. Himalaya Publishing House, Mumbai, 623p.

Wilson, G.F. (2010) Horticultural pest Detection and their control, Biotech Book Delhi pp 240.

BAS-211 Fundamentals of Extension Education 2 (1+1)

Theroy

Extension education: meaning, definition, nature, scope, objectives, principles, approaches and history. Horticulture extension: process, principles and selected programmes of leading national and international forest institutes. People's participation in Horticulture programmes. Motivation of Farmers, rural youth and voluntary organizations for Horticulture extension work Rural Development: meaning, definition, objectives and genesis. 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, ATMA, RKVY. Communication: meaning, definition, elements and selected models. Audio – visual aids: importance, classification and selection. Adoption and diffusion process, Teaching and learning-concepts and principles, Teaching steps, Programming planning process – meaning, scope, principles and steps. Evaluation: meaning, importance and methods. Scope and importance of Participatory Rural Appraisal (PRA) & Rapid Rural Appraisal (RRA). Management and administration: meaning, definition, principles and functions. Concepts of human resource development (HRD), rural leadership. ICT in Extension education, ICT use in rural India

Practical

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

Lecture Schedule: Theory

S.No.	Topics	Tentative Dates
1.	Extension education: Meaning, Definition, Nature	
2.	Extension education: Scope, Objectives, Principles, Approaches, History	
3.	Horticulture extension: Process, Principles, Sele cted programmes of leading national and international forest institutes	
4.	People's participation in Horticulture programmes. Motivation of Farmers, rural youth and voluntary organizations for Horticulture extension work	
5.	Rural development: Meaning, Definition, Objectives, Genesis	
6.	Transfer of technology programme of ICAR: (All programmes): Lab to land programme (LLP),National demonstration (ND), Front line demonstration (FLD), Krishi Vigyan Kendra (KVK), Technology Assessment and Refinement Programme (TARP)	
7.	Transfer of technology programme of ICAR: (All programmes): Technology Assessment and Refinement Programme (TARP), ATMA, RKVY.	
8.	Communication: Meaning, Definition, Elements, Selected models	
9.	Audio – visual aids: Importance, Classification, Selection	
10.	Adoption and diffusion process, Teaching and learning -concepts and principles, Teaching steps,	
11.	Programme planning process: Meaning, Scope, Principles, Steps	

12.	Evaluation: Meaning, Importance, Methods	
13.	Participatory rural appraisal (PRA): Meaning, Scope. Rapid rural appraisal (RRA): Meaning, Scope	
14.	Management and administration: Meaning, Definition, Principles, Function	
15.	Human resource development (HRD): Concepts, Rural leadership	

Lecture Schedule: Practicals

S.No.	Topics	Tentative Dates
1.	To study structure, functions, linkages and extension programmes of Village panchayat	
2.	To study structure, functions, linkages and extension programmes of Krishi Vigyan Kendra	
3.	To study structure, functions, linkages and extension programmes of ICFRE institutes	
4.	To study structure, functions, linkages and extension programmes of Voluntary organisations	
5.	To study structure, functions, linkages and extension programmes of Mahila mandals/SHG	
6.	To exercise on script writing for farm broadcasts and telecasts	
7.	To exercise on planning, preparation & use of poster	
8.	To exercise poster making	
9.	To exercise on planning, preparation & use of chart & flash cards	
10.	To exercise on planning, preparation & use of AVA like OHP & 35 mm like projector transparencies	
11.	Identification of local leaders to study their role in extension work	
12.	To study structure, functions, linkages and extension programmes of State Department of forests/ All India Radio (AIR)	
13.	To exercise on distortion of message, script writing for farm broadcasts and telecasts	
14.	To exercise on planning, preparation & use of folders	
15.	Evaluation of some selected case studies of forestry extension programmes	
16.	Preparation of village agricultural productions plan	

Suggested Reading:

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

Dahama, O. P. and Bhatnagar, O.P., 1998, *Education and Communication for Development*, Oxford and IBH publishing Co. Pvt. Ltd., New Delhi.

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

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

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

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

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

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

M Hilaris Indian agriculture and information: Soundari, New century ublications, 2011and communication technology (ICT)

BAS-212 Elementary Plant Biotechnology 2(1+1)

Theroy

Concepts of Plant Biotechnology: History of Plant Tissue Culture and Plant Genetic Engineering; Scope and importance in Crop Improvement. Totipotency and Morphogenesis, Nutritional requirements of in-vitro cultures; Techniques of In-vitro cultures, Micropropagation, Anther culture, Pollen culture, Ovule culture, Embryo culture, Test tube fertilization, Endosperm culture, Factors affecting above in-vitro culture.Applications and Achievements; Somatic embryogenesis and synthetic seedproduction technology. Protoplast isolation, Culture, and Fusion;Products of somatic hybrids and cybrids, Applications in crop improvement. Genetic engineering; Restriction enzymes; Vectors for gene transfer, Gene cloning, Direct and indirect method of gene transfer. Transgenic plants and their applications. Blotting techniques, DNA finger printing, DNA based markers: RFLP, AFLP, RAPD, SSR and DNA Probes, Mapping QTL: Future prospects. MAS, and its application in crop improvement. Nanotechnology: Definition and scope, types of nano material and their synthesis, Tools and techniques to characterize the nano particles. Nano-biotechnological applications with examples. Nano toxicology and safety.

Practical

Requirements for Plant Tissue Culture Laboratory; Techniques in Plant Tissue Culture; Media components and preparations; Sterilization techniques and Inoculation of various explants; Aseptic manipulation of various explants; Callus induction and Plant Regeneration; Micro propagation of important crops; Anther, Embryo and Endosperm culture; Hardening / Acclimatization of regenerated plants; Somatic embryogenesis and synthetic seed production;Isolation of protoplast; Demonstration of Culturing of protoplast; Demonstration of Isolation of DNA; Demonstration of Gene transfer techniques, direct methods; Demonstration of Gene transfer techniques, indirect methods; Demonstration of Confirmation of Genetic transformation; Demonstration of gel-electrophoricsis techniques. Green

Lecture Schedule: Theory

S.No.	Topics	Tentative Dates
1.	-Concepts of Plant Biotechnology, History of Plant Tissue Culture.	
2.	-History of Plant Genetic Engineering , Scope and importance of Plant Tissue Culture and Plant Genetic Engineering in forestry.	
3.	-Totipotency and Morphogenesis , Nutritional requirements of invitro cultures.	
4.	-Techniques of *In-vitro* cultures, Micro propagation.	
5.	-Anther-culture and Pollen-culture.	
6.	-Ovule-culture and Embryo-culture.	
7.	-Test tube fertilization, Endosperm culture.	
8.	-Factors affecting all types of in-vitro culture , Applications and Achievements of *in-vitro* culture techniques.	.
9.	-Soma clonal variation, Types, Reasons.	
10.	-Somatic embryogenesis and Synthetic seed production technology.	
11.	-Protoplast isolation, Culture, Protoplast Manipulation and Fusion.	
12.	-Somatic hybrids and Somatic cybrids, Applications of somatic hybridization in tree improvement	
13.	-Basic concepts in Genetic engineering , Restriction enzymes , Vectors for gene transfer.	
14.	-Gene cloning and Direct and indirect method of gene transfer , Transgenic plants and their applications.	

15.	-Blotting techniques, DNA finger printing.	
16.	-DNA based markers –RFLP, AFLP, RAPD, SSR and DNA Probes.	
17.	-Mapping QTL – Future prospects, MAS, and its application in Crop improvement.	
18.	-Nanotechnology: Definition and scope, types of nano ma terial and their synthesis,	
19.	-Tools and techniques to characterize the nano particles.	
20.	-Nano-biotechnological applications with examples	

Lecture Schedule: Practicals

S.No.	Topics	Tentative Dates
1.	Lab setup of good plant tissue culture laboratory.	
2.	Instruments required in plant tissue culture laboratory.	
3.	Study of sterilization techniques.	
4.	Study of commonly available antibiotics and plant growth hormones.	
5.	Demonstration of Surface sterilisation.	
6.	Mathematic Calculations for the preparations of standard solutions.	
7.	Composition and preparation of different growth media used in Plant tissue culture laboratory.	
8.	Inoculation of various explants.	
9.	Demonstration of Anther culture.	
10.	Demonstration of node culture.	
11.	Callus induction and Plant Regeneration.	
12.	Preparation of Buffers and solutions used in Molecular Biology.	
13.	Demonstration of Isolation of genomic DNA.	
14.	Demonstration of gel-electrophoresis technique.	
15.	Demonstration of Hardening / Acclimatization of regenerated plants.	
16.	Demonstration of Gene transfer techniques.	
17.	Green synthesis of nano particles and their size characterization.	

Suggested Reading:

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

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

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

Gautam V K, 2005. *Agricultural Biotechnology*. Sublime Publications

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

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

Singh, B.D. 2012. *Plant biotechnology*. Kalyani publishers, Ludhiana

Bilgrami, K.S. and Pandey, A.K.1992. *Introduction to biotechnology*. CBS Pub. New Delhi

Gupta, P.K. 1994. *Elements of biotechnology*. Rastogi Pub. Meerut.

Chahal, G.S. and Gosal, S.S.2003. *Principles and procedures of plant approaches breeding Biotechnological and conventional*. Narosa Publishing House, New Delhi

NRM-211 Environmental Studies and Disaster Management 3(2+1)

Theory

Multidisciplinary nature of environmental studies: Definition, scope and importance. Natural Resources: Renewable and non-renewable resources. Natural resources and associated problems. a) Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people. b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies. d) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. e) Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Equitable use of resources for sustainable lifestyles. Ecosystems, Concept of an ecosystem. Structure and function of an ecosystem. Producers, consumers and decomposers. Energy flow in the ecosystem. Ecological succession. Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of the following ecosystem:- a. Forest ecosystem, b. Grassland ecosystem, c. Desert ecosystem d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries). Biodiversity and its conservation:- Introduction, definition, genetic, species & ecosystem diversity and biogeographical classification of India. Value of biodiversity - consumptive use, productive use, social, ethical, aesthetic and option values. Biodiversity at global, National and local levels, India as a mega-diversity nation. Hot-spots of biodiversity. Threats to biodiversity - habitat loss, poaching of wildlife, man-wildlife conflicts. Endangered and endemic species of India. Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity. Environmental Pollution: definition, cause, effects and control measures of - Air, Water, Soil, Marine, Noise and Thermal pollution and Nuclear hazards. Solid Waste Management: causes, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution. Social Issues and the Environment: From Unsustainable to Sustainable development, Urban problems related to energy, Water conservation, rain water harvesting, watershed management, Environmental ethics: Issues and possible solutions, climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust dies. Wasteland reclamation, Consumerism and waste products, Environment Protection Act, Air, Water, Wildlife and Forest Conservation Acts, Issues involved in enforcement of environmental legislation and Public awareness. Human Population and the Environment: population growth, variation among nations, population explosion, Family Welfare Programme. Environment and human health: Human Rights, Value Education, HIV/AIDS. Women and Child Welfare. Role of Information Technology in Environment and human health. Natural Disasters- Meaning and nature of natural disasters, their types and effects. Floods, drought, cyclone, earthquakes, landslides, avalanches, volcanic eruptions, Heat and cold waves, Climatic change: global warming, Sea level rise, ozone depletion. Man Made Disasters- Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire, oil fire, air pollution, water pollution, deforestation, industrial waste water pollution, road accidents, rail accidents, air accidents, sea accidents. Disaster Management- Effect to migrate natural disaster at national and global levels. International strategy for disaster reduction. Concept of disaster management, national disaster management framework; financial arrangements; role of NGOs, community –based organizations and media. Central, state, district and local administration; Armed forces in disaster response; Disaster response; Police and other organizations.

Practical

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

Lecture Schedule: Theory

S.No.	Topics	Tentative Dates
1.	Multidisciplinary nature of environmental studies : Definition, scope and importance. Natural Resources: Renewable and non -renewable resources.	
2.	Forest resources: Use and over -exploitation, deforestation, case studies.	
3.	Water resources: Use and over -utilization of surface and ground water, floods, drought, conflicts over water , dams -benefits and problems.	
4.	Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.	
5.	Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer -pesticide problems, water logging, salinity, case studies.	
6.	Energy resources: Growing energy needs, renewable and non - renewable energy sources, use of alternate energy sources. Equitable use of resources for sustainable lifestyles.	
7.	Ecosystems, Concept of an ecosystem.Structure and function of an ecosystem. Producers, consumers and decomposers.	
8.	Energy flow in the ecosystem. Ecological succession. Food chains, food webs and ecological pyramids.	
9.	Introduction, types, characteristic features, structure and function of the following ecosystem: - a. Forest eco system, b. Grassland ecosystem	
10.	Introduction, types, characteristic features, structure and function of the following ecosystem: - c. Desert ecosystem d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)	
11.	Biodiversity and its conservation: - Introduction, definition, genetic, species & ecosystem diversity and biogeographical classificat ion of India.	
12.	Value of biodiversity - consumptive use, productive use, social, ethical, aesthetic and option values.	
13.	Biodiversity at global, National and local levels, India as a mega - diversity nation. Hot-spots of biodiversity.	
14.	Threats to biodi versity - habitat loss, poaching of wildlife, man - wildlife conflicts. Endangered and endemic species of India. Conservation of biodiversity: In -situ and Ex -situ conservation of biodiversity.	
15.	Environmental Pollution: definition, cause, effects and control measures of - Air, Water, Soil, Marine, Noise and Thermal pollution and Nuclear hazards	
16.	Solid Waste Management: causes, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution.	
17.	Social Issues and the Environment: From Unsustainable to	

Lecture Schedule: Practicals

S.No.	Topics	Tentative Dates
1.	Visit to local areas – riverto document components of ecosystem.	
2.	Visit to local areas - forest to document components of ecosystem	
3.	Visit to local areas - grassland to document components of ecosystem	
4.	Visit to local areas - catchment to document components of ecosystem	
5.	Study of common plants Study of insects	
6.	Study of birds	
7.	Study of animals	
8.	Visit to industries to study pollution abatement techniques and	
9.	case studies - solid waste management	
10.	case studies - Human population	
11.	case studies - Environment	

Suggested Readings:

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

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

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

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

Krishnamurthy. *An Advanced Textbook on Biodiversity*.

S. Deshwal A. Deshwal. *A Basic Course in Environmental Science.*

Erach Bharucha 2005.Textbook of environmental studies for under graduate courses.UGC, University press, Hyderabad.

Manohara Chary and Jayaram Reddy 2004.Principles of Environmental studies BBpublishers, Hyderabad.

William, P. Cunning Ham and Mary Ann. Inquiry and applications Cunningham 2005.Principles of Environmental science. Tata MCG raw-hill publishing company limited, New Delhi.

Gupta, P.K. 2004 Methods in environmental analysis-water, soil and Air. Agro Bios (India). Jodhpur.

Spencer R. Weart. The discovery of global warming.

Daniel B. Botkin, Edward A. Keller. Environmental Science .

Richard T. Wright and Bernard J. Nebel Environmental science: toward a sustainableagriculture.

Linfield C.Brown. Pollution prevention and control.

FRS-221 **Plantation Crops** **3 (2+1)**

Theory

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

Practical

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

Lecture Schedule: Theory

S.No.	Topics	Tentative Dates
1.	History and development, scope and importance, area and production, export and import potentia l, role in national and state economy, uses, industrial importance , by-products utilization, soil and climate, varieties of coconut.	
2.	propagation: principles and practices of seed,Vegetative and M icro-propagation, planting systems and method , gap filling, systems of cultivation, mulching, shade regulation , weed and water management of coconut.	
3.	Training, pruning and handling ,nutrition, foliar feeding, role of growth regu lators, soil management, liming practices, tipping practices, top working, physiological disorders, harvesting, post - harvest handling and processing, packaging and marketing, yield and economics of coconut.	
4.	History and development, scope and importance, area and production, export and import potentia l, role in national and state economy, uses, industrial importance , by-products utilization, soil and climate, varieties ofarecanut.	
5.	propagation: principles and practices of seed ,Vegetative and M icro-propagation, planting systems and method , gap filling, systems of cultivation, mulching, shade regulation , weed and water management ofarecanut.	

6.	Training, pruning and handling ,nutrition, foliar feeding, role of growth regulators, soil management, liming pra ctices, tipping practices, top working, physiological disorders, harvesting, post - harvest handling and processing, packaging and marketing, yield and economics ofarecanut.	
7.	History and development, scope and importance, area and production, export and im port potentia l, role in national and state economy, uses, industrial importance , by-products utilization, soil and climate, varieties ofoil palm.	
8.	propagation: principles and practices of seed ,Vegetative and M icro-propagation, planting systems and method , gap filling, systems of cultivation, mulching, shade regulation , weed and water management ofoil palm.	
9.	Training, pruning and handling ,nutrition, foliar feeding, role of growth regulators, soil management, liming practices, tipping practices, top work ing, physiological disorders, harvesting, post - harvest handling and processing, packaging and marketing, yield and economics ofoil palm.	
10.	History and development, scope and importance, area and production, export and import potentia l, role in national an d state economy, uses, industrial importance , by-products utilization, soil and climate, varieties ofpalmyrah palm.	
11.	propagation: principles and practices of seed ,Vegetative and M icro-propagation, planting systems and method , gap filling, systems of cultivation, mulching, shade regulation , weed and water management ofpalmyrah palm.	
12.	Training, pruning and handling ,nutrition, foliar feeding, role of growth regulators, soil management, liming practices, tipping practices, top working, physiological disord ers, harvesting, post - harvest handling and processing, packaging and marketing, yield and economics ofpalmyrah palm.	
13.	History and development, scope and importance, area and production, export and import potentia l, role in national and state economy, use s, industrial importance , by-products utilization, soil and climate, varieties ofcacao.	
14.	propagation: principles and practices of seed ,Vegetative and M icro-propagation, planting systems and method , gap filling, systems of cultivation, mulching, shade reg ulation, weed and water management ofcacao.	
15.	Training, pruning and handling ,nutrition, foliar feeding, role of growth regulators, soil management, liming practices, tipping practices, top working, physiological disorders, harvesting, post - harvest handli ng and processing, packaging and marketing, yield and economics ofcacao.	
16.	History and development, scope and importance, area and production, export and import potentia l, role in national and state economy, uses, industrial importance , by-products utiliz ation, soil and climate, varieties ofcashew nut.	

17.	propagation: principles and practices of seed ,Vegetative and M icro-propagation, planting systems and method , gap filling, systems of cultivation, mulching, shade regulation , weed and water management ofcashew nut.	
18.	Training, pruning and handling ,nutrition, foliar feeding, role of growth regulators, soil management, liming practices, tipping practices, top working, physiological disorders, harvesting, post - harvest handling and processing, packaging and m arketing, yield and economics of cashew nut	
19.	History and development, scope and importance, area and production, export and import potentia l, role in national and state economy, uses, industrial importance , by-products utilization, soil and climate, varieties of coffee	
20.	propagation: principles and practices of seed ,Vegetative and M icro-propagation, planting systems and method , gap filling, systems of cultivation, mulching, shade regulation , weed and water management ofcoffee.	
21.	Training, pruning and ha ndling ,nutrition, foliar feeding, role of growth regulators, soil management, liming practices, tipping practices, top working, physiological disorders, harvesting, post - harvest handling and processing, packaging and marketing, yield and economics ofcoffee.	
22.	History and development, scope and importance, area and production, export and import potentia l, role in national and state economy, uses, industrial importance , by-products utilization, soil and climate, varieties oftea.	
23.	propagation: principles and practices of seed,Vegetative and M icro-propagation, planting systems and method , gap filling, systems of cultivation, mulching, shade regulation , weed and water management oftea.	
24.	Training, pruning and handling ,nutrition, foliar feeding, role of growth regulators, soil management, liming practices, tipping practices, top working, physiological disorders, harvesting, post - harvest handling and processing, packaging and marketing, yield and economics oftea.	
25.	History and development, scope and importanc e, area and production, export and import potentia l, role in national and state economy, uses, industrial importance , by-products utilization, soil and climate, varieties ofDate palm.	
26.	propagation: principles and practices of seed ,Vegetative and M icro-propagation, planting systems and method , gap filling, systems of cultivation, mulching, shade regulation , weed and water management ofDate palm.	
27.	Training, pruning and handling ,nutrition, foliar feeding, role of growth regulators, soil management, liming practices, tipping practices, top working, physiological disorders, harvesting, post - harvest handling and processing, packaging and marketing, yield and economics ofDate palm	

28.	History and development, scope and importance, area and production, export a nd import potentia l, role in national and state economy, uses, industrial importance , by-products utilization, soil and climate, varieties ofrubber.	
29.	propagation: principles and practices of seed ,Vegetative and M icro-propagation, planting systems and met hod, gap filling, systems of cultivation, mulching, shade regulation , weed and water management ofrubber.	
30.	Training, pruning and handling ,nutrition, foliar feeding, role of growth regulators, soil management, liming practices, tipping practices, top wor king, physiological disorders, harvesting, post - harvest handling and processing, packaging and marketing, yield and economics ofrubber.	

Lecture Schedule: Practicals

S.No.	Topics	Tentative Dates
1.	Description and identification of coconut varieties,	
2.	Selection of coconut andarecanut mother palmand seed nut	
3.	planting of seed nuts in nursery,layout and planting of coconut	
4.	layout and planting of arecanut, oil palm, cashew nut,	
5.	Cacao gardens, manuring, irrigation; mulching, raising masonry nursery for palm, nursery management in cacao.	
6.	Description and identification of species and varieties in coffee, harvesting.	
7.	Grading, pulping, fermenting, washing of coffee.	
8.	Drying and packing of coffee,	
9.	Seed berry collection, seed extraction, treatment and sowing of coffee	
10.	Epicotyl, softwood, grafting and top working in cashew	
11.	working out the economics and project preparation for coconut, arecanut,	
12.	Working out the economics and project preparation foroil palm, cashew nut, cacao, etc.	
13.	Mother plant selection, preparation of cuttings and rooting of tea.	
14.	Under specialized structure, training, centering of tea	
15.	pruning, tipping and harvesting of tea	

Suggested Reading:

Kumar, N.J.B. M. Md. Abdul Khaddar, Ranga Swamy, P. and Irrulappan, I. 1997. *Introduction to spices, Plantation crops and Aromatic plants*. Oxford & IBH, New Delhi.

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

Nair 1979. *Cashew*. CPCRI, Kerala

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

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

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

T.K. Bose, J. Kabir, P.P. Joy and P. Das (2000) Tropical Horticulture, Vol. II, Naya Prokash, Kolkata

FRS- 222 Breeding of Fruit and Plantation Crops 3 (2+1)

Theory

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 – **ploidy** manipulations – *in vitro* breeding tools (important fruit and plantation crops).

Practical

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

Lecture Schedule: Theory

S.No.	Topics	Tentative Dates
1.	Fruit breeding- History	
2.	Fruit breeding- importance in fruit production	
3.	Distribution of commercially important fruits	
4.	Distribution of commercially important fruits	
5.	Domestication of commercially important fruits	
6.	Domestication of commercially important fruits	
7.	Adaptation of commercially important fruits	
8.	Adaptation of commercially important fruits	
9.	Variability for economic traits	
10.	Breeding strategies	
11.	Clonal selection	
12.	Bud mutations	
13.	Mutagenesis	
14.	Mutagenesis - Application in crop improvement	
15.	**ploidy** manipulations – *in vitro* breeding tools (important fruit and plantation crops)	
16.	**ploidy** manipulations – *in vitro* breeding tools (important fruit and plantation crops)	

Lecture Schedule: Practicals

S.No.	Topics	Tentative Dates
1.	Exercises on floral biology and pollen viability	
2.	Exercises on emasculation and pollination procedures	
3.	Hybrid seed germination	
4.	Raising and evaluation of segregating populations	
5.	use of mutagens to induce mutations and polyploidy in Mango, and Banana	
6.	Use of mutagens to induce mutations and polyploidy in Citrus and Grapes	
7.	Use of mutagens to induc e mutations and polyploidy in Guava and Sapota	
8.	Use of mutagens to induce mutations and polyploidy in Papaya and Custard apple	
9.	Use of mutagens to induce mutations and polyploidy inAonla, Ber	
10.	Use of mutagens to induce mutations and polyploidy in, L itchi and Pomegranate	
11.	Use of mutagens to induce mutations and polyploidy inCoconut and Arecanut	
12.	Use of mutagens to induce mutations and polyploidy in Jamun and Cashewnut	
13.	Use of mutagens to induce mutations and polyploidy in Apple and Peach	
14.	Use of mutagens to induce mutations and polyploidy in Pear and Plum	
15.	Use of mutagens to induce mutations and polyploidy inApricot and Strawberry	

Suggested Reading:

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Anil Kumar Shukla 2004. *Fruit breeding approaches and Achievements,* IBDH, Lucknow.

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

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

VEG-221 Spices and Condiments 3(2+1)

Theory

History, scope and importance, Present status, area and production, uses, export potential and role in national economy. Classification, soil and climate, propagation-seed, vegetative and micropropagation systems and methods of planting. Nutritional 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, value added products, methods of extraction of essential oil and oleoresins. Economics of cultivation, role of Spice Board and Pepper. Export Promotion Council, institutions and research centers in R&D. Crops: Cardamom, black pepper, betel vine ginger, turmeric, clove, nutmeg, cinnamon, all spice, curry leaf, coriander, fenugreek, fennel, cumin, dill, celery, bishops weed, nigella, saffron, vanilla, thyme and rosemary.

Practical

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

Lecture Schedule: Theory

S.No.	Topics	Tentative Date
1	History, scope and importance, Present status, area and production, uses, export potential and role in national economy of spice crops.	
2	Classification of spices and condiments.	
3	Role of Spice Board and Pepper. Export Promotion Council, institutions and research centers in R&D.	
4	Cultivation of cardamom.	
5	Cultivation of black pepper.	
6	Cultivation of betel vine.	
7	Cultivation of ginger.	
8	Cultivation ofturmeric.	
9	Cultivation of clove.	
10	Cultivation of cinnamon.	
11	Cultivation of, all spice.	
12	Cultivation of curry leaf.	
13	Cultivation of coriander	
14	Cultivation of fenugreek.	
15	Cultivation of fennel.	
16	Cultivation ofcumin.	
17	Cultivation of dill.	
18	Cultivation of celery.	
19	Cultivation ofbishops weed.	
20	Cultivation of nigella.	

21	Cultivation of saffron.	
22	Cultivation ofvanilla.	
23	Cultivation of thyme.	
24	Cultivation ofrosemary.	

S.No.	Topics	Tentative Date
1	Study of Identification of spices and condiments.	
2	Study of propagation of spices and condiments.	
3	Study of sowing of spice crops.	
4	Study of seed treatment of spice crops.	
5	Study of intercultural operation of spice crops.	
6	Study of manuring of spice crops.	
7	Study of use of weedicides in spice crops.	
8	Study of harvesting and maturity indices of spice crops.	
9	Study of curing and processing of spice crops.	
10	Hoeing and eartheing in spices crops	
11	Training and pruning in spices crops	
12	Study of extraction of essential oils and oleoresins of spice crops.	
13	Visit of commercial plantations in local and regional areas.	

Suggested Reading:

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FLS- 221 Ornamental Horticulture 3(2+1)

Theory:

History and scope of ornamental horticulture, definitions and aesthetic values. Floriculture industry- importance, area and production, industrial importance of ornamental plants and flowers. Importance, classification, design values and general cultivation aspects for ornamental plants *viz*. annuals, biennales, herbaceous perennials, grasses and bulbous ornamentals, shrubs, climbers, trees, indoor plants, palms and cycads, ferns and sellagenellas, cacti and succulents. Importance and design values of garden features/components *viz.* hedge, edge, borders, flower beds, bridges, drives, paths, fences, garden walls, gates, carpet bed, arbour, patio, decking, retaining walls, shade garden, sunken garden, roof garden, terrace garden, pebble garden, rockery, pools, waterfalls, fountains, bog garden, avenue planting and children garden. Lawn- establishment and maintenance. Importance of garden adornments *viz.* floral clock, bird bath, statues, sculptures, lanterns, water basins, garden benches, etc. Importance of flower arrangement; Ikebana- types, suitable flowers and foliages. Uses of vertical garden, bottle garden and terrarium. Bonsai- styles, culture and maintenance.

Practical:

Identification and description of annuals, biennials, herbaceous perennials, climbers, shrubs, trees, indoor plants, ferns and sellagenellas, palms and cycads and cacti and succulents. Planning and designing of garden features *viz.* lawn, hedge and edge, rockery, water garden, carpet bedding and shade garden. Study and creation of terrarium and vertical garden. Study and practice of different types of flower arrangements, preparation of floral bouquets, preparation of floral rangoli, veni, etc. Bonsai practicing and training. Visit to nurseries and floricultural units.

Lecture Schedule: Theory

S.No.	Topics	Tentative date
1.	History and scope of ornamental horticulture, definitions and aesthetic values	
2.	Floriculture industry: importance, area and production, industrial importance of ornamental plants and flowers	
3.	Importance and classification, design values and general cultivation aspects of ornamental plants: annuals and biennials	
4.	Ornamental plants: herbaceous perennials and bulbous ornamentals	
5.	Ornamental plants: grasses, ferns and sellagenellas	
6.	Ornamental plants: shrubs	
7.	Ornamental plants: climbers, palms and cycads	
8.	Ornamental plants: trees	
9.	Importance and classification, design values and general cultivation aspects of indoor ornamental plants	
10.	Ornamental plants: cacti and succulents	
11.	Importance and design values of garden features/components: garden walls, fences and gates	

12.	Garden features: drives and paths and steps	
13.	Garden features: hedges and edges	
14.	Garden features: borders and flower beds	
15.	Garden components: arches, pergola and arbour	
16.	Garden features: patio, decking, living wall and retaining wall	
17.	Garden features: carpet bedding, paved garden and shade garden	
18.	Garden features: pebble garden, rockery and pools	
19.	Garden features: roof garden and terrace garden	
20.	Garden features: waterfalls and fountains	
21.	Garden features: sunken garden, bog garden,	
22.	Garden features: children corner, avenue planting, etc.	
23.	Importance of garden adornments: garden seats, garden lights, sundials, bird baths and floral clocks	
24.	Garden adornments: ornamental stones, lanterns, statues,water basin, etc.	
25.	Lawn: establishment and maintenance	
26.	Flower arrangement: importance and types	
27.	Ikebana: types, suitable flowers and foliages	
28.	Uses of vertical garden, bottle garden and terrarium	
29.	Bonsai: definition, classification and different styles	
30.	Bonsai: culture and maintenance	

Lecture Schedule: Practicals

S.No.	Topics	Tentative Dates
1	Identification and description of annuals, herbaceous perennials, creepers & climbers, foliage & flowering shrubs, trees, palms, ferns, ornamental grasses and cacti & succulents	
2	Planning and designing of garden features: lawn and edge	
3	Planning and designing of garden features: hedge	
4	Planning and designing of garden features: herbaceous border	
5	Planning and designing of garden features: rockery and water garden	
6	Planning and designing of garden features: carpet bedding	
7	Planning and designing of garden features: shade garden	
8	Study and creation of terrarium	
9	Study and creation of vertical garden	
10	Study and practice of Ikebana flower arrangement	
11	Practice in preparation of floral bouquet	
12	Practice in preparation of floral rangoli	
13	Practice in preparation of floral garland/veni	
14	Practice in bonsai making	
15	Visit to nurseries and floricultural units	

PPR-221 Insect Pests of Fruit, Plantation, Medicinal and Aromatic Crops 3(2+1)

Theory

General – economic classification of insects; Bio-ecology and insect-pest management with reference to fruit, plantation, medicinal and aromatic crops; pest surveillance. Distribution, host range, bio-ecology, injury, integrated management of important insect pests affecting tropical, sub-tropical and temperate fruits, plantation, medicinal and aromatic crops like coconut, areca nut, oil palm, cashew, cacao, tea, coffee, cinchona, rubber, betel vine senna, neem, belladonna, pyrethrum, costus, crotalaria, datura, dioscorea, mint, opium, *Solanumkhasianum* and **Aonla**. Storage insects – distribution, host range, bio-ecology, injury, integrated management of important insect pests attacking stored fruits, plantation, medicinal and aromatic crops and their processed products. Insecticide residue problems in fruit, plantation, medicinal and aromatic crops and their maximum residue limits (MRLs).

Practical

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

Lecture Schedule: Theory

S. No.	Topics	Tentative Dates
1	General — economic classification of insects; ecology and pest surveillance with reference to fruit, plantation, medicinal and aromatic crops	
2	IPM :Definition and concept : Definition and terminology of entomological words and causes for insect assuming pests status	
3	Polyphagous pests and their management of fruit, plantation, medicinal and aromatic crops	
4	Distribution, host range, bio-ecology, injury, integrated management of insect-pest of Banana	
5	Distribution, host range, bio-ecology, injury, integrated man agement of insect-pest of Grape	
6	Distribution, host range, bio-ecology, injury, integrated management of insect-pest of Citrus	
7	Distribution, host range, bio-ecology, injury, integrated management of insect-pest of Mango	
8	Distribution, host range, bio-ecology, injury, integrated management of insect-pest of Guava	
9	Distribution, host range, bio-ecology, injury, integrated management of insect-pest of Sapota& papaya	
10	Distribution, host range, bio-ecology, injury, integrated management of insect-pest of jack fruit & pineapple	
11	Distribution, host range, bio-ecology, injury, integrated management of insect-pest of pomegranate and ber	
12	Distribution, host range, bio-ecology, injury, integrated management of insect-pest of apple	
13	Distribution, host range, bio-ecology, injury, integrated management of insect-pest of pear, peach & plum	

14	Distribution, host range, bio-ecology, injury, integrated management of insect-pest of almond & walnut	
15	Distribution, host range, bio-ecology, injury, integrated management of insect-pest of strawberry	
16	Distribution, host range, bio-ecology, injury, integrated management of insect-pest of areca nut	
17	Distribution, host range, bio-ecology, injury, integrated management of insect-pest of coconut & oil palm	
18	Distribution, host range, bio-ecology, injury, integrated management of insect-pest of tea	
19	Distribution, host range, bio-ecology, injury, integrated management of insect-pest of coffee & cocoa	
20	Distribution, host range, bio-ecology, injury, integrated management of insect-pest of cashew rubber	
21	Distribution, host range, bio-ecology, injury, integrated management of insect-pest of betel vine &senna	
22	Distribution, host range, bio-ecology, injury, integrated management of insect-pest of neem and**Aonla**	
23	Distribution, host range, bio-ecology, injury, integrated management of insect-pest of belladonna & hemp,	
24	Distribution, host range, bio-ecology, injury, integrated management of insect-pest of camphor & pyrethrum	
25	Distribution, host range, bio-ecology, injury, integrated management of insect-pest of crotalaria &costus	
26	Distribution, host range, bio-ecology, injury, integrated management of insect-pest of dioscorea&datura	
27	Distribution, host range, bio-ecology, injury, integrated management of insect-pest of mint & opium	
28	Distribution, host range, bio-ecology, injury, integrated management of insect-pest of Solanumkhasianum and Tephrosia	
29	Distribution, host range, bio-ecology, injury, management of important insect pests attacking stored product of fruit and plantation crops	
30	Distribution, host range, bio-ecology, injury, management of important insect pests attacking stored product of medicinal and aromatic crops	
31	Find out tolerance limits of insecticide in fruit crops	
32	Find out tolerance limits limit of insecticide in plantation, medicinal and aromatic crops	

Lecture Schedule: Practicals

S. No.	Topics	Tentative Dates
1	Collection, Identification and preservation of important insect-pests of fruit crops	
2	Collection, Identification and preservation of important insect-pests of Plantation crops	
3	Collection, Identification and preservation of important insect-pests medicinal & aromatic crops	
4	Collection & study of damage symptoms caused by insect-pests of fruit crop & plantation crops	
5	Collection & study of damage symptoms caused by insect-pests of medicinal & aromatic crops	
6	Study of important predators & parasites of important insect-pests of fruit crops	
7	Study of important predators & parasites of important insect-pests of plantation crops	
8	Study of life cycle of important insect-pests of fruit crops	
9	Study of life cycle of important insect-pests of plantation crops	
10	Study of life cycle of important insect-pests of medicinal and aromatic crops	
11	Study of damage caused by stored product insect-pests of fruit, plantation, medicinal and aromatic crops	
12	Calculation of spray formulations of insecticides solution	
13	Calculation of Dust formulations of insecticides	
14	Study of spraying and dusting Equipments	

Suggested Reading:

Atwal. A. S. Agricultural pests of south Asia and their management

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David B V and Kumarswami, T, 1982. Elements of Economic Entomology. Popular Book Department, Madras, 536p.

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Fryer. Insect pest of fruit crops

Mark Vernon Slingerlands and C. R. Crosby. Manual of fruit insects

Metcalf, R.L and Luckman,W.H.1982. Introduction to Insect pest management. Wiley Inter Science Publishing, New York

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PPR-222 Diseases of Fruit, Plantation, Medicinal and Aromatic Crops 3(2+1)

Theory

Etiology, symptoms, mode of spread, epidemiology and integrated management of the diseases of fruits, plantation, medicinal and aromatic crops *viz* mango, banana, grape, citrus, guava, sapota, papaya, jack fruit, pineapple, pomegranate, ber, apple, pear, peach, plum, almond, walnut, strawberry, areca nut, coconut, oil palm, coffee, tea, cocoa, cashew, rubber, betel vine senna, neem, hemp, belladonna, pyrethrum, camphor, costus, crotalaria, datura, dioscorea, mint, opium, *Solanumkhasianum*, Tephrosia,**aonla and bael**. Important post-harvest diseases of fruit, plantation and medicinal and aromatic crops and their management.

Practical

Observations of disease symptoms, identification of casual organisms and host parasite relationship of important diseases. Examination of scrapings and cultures of important pathogens of fruits

Lecture Schedule: Theory

S. No.	Topics	Tentative Date
1	Etiology, symptoms, mode of spread, epidemiology and integrated management of diseases in fruits, plantation, medicinal and aromatic plants	
2	Diseases of Mango	
3	Diseases of Citrus	
4	Diseases of Grape	
5	Diseases of Banana	
6	Diseases of Guava	
7	Diseases of Sapota	
8	Diseases of papaya	
9	Diseases of Jack fruit	
10	Diseases of pineapple	
11	Diseases of pomegranate	
12	Diseases of ber, **Aonla and bael**	
13	Diseases of apple	
14	Diseases of pear and peach	
15	Diseases of plum	
16	Diseases of almond and walnut	
17	Diseases of strawberry	
18	Diseases of areca nut	
19	Diseases of coconut and oil palm	
20	Diseases of tea and coffee	
21	Diseases of cocoa	
22	Diseases of cashew	
23	Diseases of rubber	
24	Diseases of betel vine and senna	
25	Diseases of neem	
26	Diseases of belladonna and hemp	

27	Diseases of camphor and pyrethrum	
28	Diseases of crotalaria and costus	
29	Diseases of dioscorea and datura	
30	Diseases of mint and opium	
31	Diseases of Solanumkhasianum and Tephrosia	
32	Important post—harvest diseases of fruit, plantation and medicinal and aromatic plants and their management	

Lecture Schedule: Practicals

S. No.	Topics	Tentative Date
1	Diseases caused by *Pythium* and *Phytophthora*infruits, plantation, medicinal and aromatic plants	
2	Diseases of fruits, plantation, medicinal and plants caused by downy and Powdery mildew fungi	
3	Rust and scab disease of fruits, plantation, medicinal and aromatic plants	
4	Diseases of fruits, plantation, medicinal and aromatic plants caused by *Botryodiplodia*/*Botryotis* / *Capnodium*	
5	Diseases of fruits, plantation, medicinal and aromatic plants caused by *Cercospora*and *Mycosphaerella*	
6	Diseases of fruits, plantation, medicinal and aromatic plants caused by *Colletotrichum*	
7	Diseases of fruits, plantation, medicinal and aromatic plants caused by *Fusarium*	
8	Diseases of fruits, plantation, medicinal and aromatic plants caused by *Phoma* and *Phomopsis*	
9	Diseases caused by *Rhizoctonia* infruits, plantation, medicinal and aromatic plants	
10	Diseases of fruit, plantation, medicinal and aromatic plants caused by *Pestalotiopsis*	
11	Diseases of fruit, plantation, medicinal and aromatic plants caused by *Alternaria, Armillaria*, and *Pellicularia*	
12	Diseases of fruits, plantation, medicinal and aromatic plants caused by Algae, Nematode and Flowering parasite	
13	Diseases of fruits, plantation, medicinal and aromatic plants caused by Bacteria	
14	Diseases of fruits, plantation, medicinal and aromatic plants caused by Virus, Viroids, Phytoplasma	
15	Fruit disease controlled by Fungicide	
16	Post-harvest diseases of infruits, plantation, medicinal and aromatic plants	

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Tripathi D.P. (2009) Crop Diseases, Kalyani Publisher, New Delhi pp 480

Verma L.R. and R.C. Sharma. *Diseases of horticultural Crops*-, Indus Publishers

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

Theory

Methods of soil, **water** and plant sampling and processing for analysis. Characterization of hydraulic mobility – diffusion and mass flow. Renewal of gases in soil and their abundance. Methods of estimation of oxygen diffusion rate and redox potential. Use of radio tracer techniques in soil fertility evaluation. Soil micro-organisms and their importance. Chemical and mineral composition of horticultural crops. Leaf analysis standards, index tissue, interpretation of leaf analysis values.Rapid tissue tests for soil and plant. Quality of irrigation water. Soil and Water pollution. Management of poor quality irrigation water in crop management.

Practical

Introduction to analytical chemistry, Collection and preparation of soil, water and plant samples for analysis. Determination of pH, electrical conductivity, sodium adsorption ratio and exchangeable sodium percentage of soils. Estimation of available macro and micronutrient elements in soils and their contents in plants. Irrigation water quality analysis. Determination of pH and EC in irrigation water samples, Determination of Carbonates and bicarbonates in soil and irrigation water, Determination of Calcium and Magnesium in soil and irrigation water. Determination of N, P, K, Ca, Mg, Sand micronutrients in plant samples. Determination of Sodium, Potassium, Chlorine and Boron in irrigation water.

Lecture Schedule: Theory

S.No.	Topics	Tentative Dates
1	Methods of soil sampling and processing for analysis.	
2	Methods of **water** sampling and processing for analysis.	
3	Methods of plant sampling and processing for analysis.	
4	Characterization of hydraulic mobility – diffusion and mass flow.	
5	Renewal of gases in soil and their abundance.	
6	Methods of estimation of oxygen diffusion rate and redox potential.	
7	Use of radio tracer techniques in soil fertility evaluation.	
8	Soil micro-organisms and their importance.	
9	Chemical and mineral composition of horticultural crops.	
10	Leaf analysis standards, index tissue,	
11	interpretation of leaf analysis values.	
12	Rapid tissue tests for soil and plant.	
13	Quality of irrigation water.	
14	Soil and Water pollution.	
15	Management of poor quality irrigation water in crop management.	

Lecture Schedule: Practicals

S.No.	Topics	Tentative Dates
1	Introduction to analytical chemistry,	
2	Collection and preparation of soil and water samples for analysis	
3	Collection and preparation of plant samples for analysis.	
4	Determination of pH, electrical conductivity of soils.	
5	Determination of sodium adsorption ratio and exchangeable sodium percentage of soils.	
6	Estimation of available macro and micronutrient elements in soils	
7	Estimation of available macro and micronutrient elements in plants.	
8	Irrigation water quality analysis. Determination of pH and EC in irrigation water samples,	
9	Determination of Carbonates and bicarbonates in soil and irrigation water,	
10	Determination of Calcium and Magnesium in soil and irrigation water.	
11	Determination of N, P, K, Ca, Mg, Sand micronutrients in plant samples.	
12	Determination of Sodium, Potassium, Chlorine and Boron in irrigation water.	

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

Yawalkar, K. S. Agarwal, J. P. and Bokde, S., 1977. *Manures and Fertilizers*. Agri-Horticultural Publishing House, Nagpur.

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NRM-222 Farm Power and Machinery 2(1+1)

Theory

Basic concepts of various forms of energy, unit and dimensions of force energy and power, calculations with realistic examples. IC Engines: Basic principles **and** operation of compression, ignition and spark ignition engines, two stroke and four stroke engines, cooling and lubrication system, power transmission system of tractors, power tillers and their types and uses. Electric motors: types, construction and performance comparison. Tillage: objectives, method of ploughing. Primary tillage implements: construction and function of indigenous ploughs, improved indigenous ploughs, mould board ploughs, disc and rotary ploughs. Secondary tillage implements: construction and function of tillers, harrows, levelers, ridgers and bund formers. Sowing and transplanting equipment: seed drills, potato planters, seedling transplanter. Inter-culture equipment: sweep. Junior hoe, weeders, long handle weeders. Crop harvesting equipments: potato diggers, fruit pluckers, tapioca puller and hoists.

Practical

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

Lecture Schedule: Theory

Lecture Schedule: Theory

Lecture Nos.	Topics	Tentative Dates
1	Explanation of whole course content in brief	
2	Basic concepts of various forms of energy, unit and dimensions of force, energy and power	
3	Basic principles of operation of compression ignition and spark ignition engines,	
4	Basic principles of operation of two stroke and four stroke engines	
5	Measurement of drawbar power	
6	calculations with realistic solved examples	
7	Cooling system	
8	lubrication system	
9	power transmission system,	
10	Fuel supply system	
11	performance and efficiency, tractors, power tillers and their types and uses	
12	Electric motors: types, construction and performance comparison.	
13	Tillage: objectives, method of ploughing. Primary tillage implements: construction and function	
14	Secondary tillage implements: construction and function	
15	Sowing and transplanting equipment	
16	Grafting, pruning and training tools and equipment	
17	Inter-culture equipment, Crop harvesting equipments	

PRACTICALS

1	Calculations with realistic unsolved examples based on force, energy and farm power	
2	Gupta & Mahindra Agency visit for showing the components of dismantled engines & motors and different systems in tractor	
3	Showing the components of primary and secondary tillage implements on college farm	
4	Tractor driving,	
5	Hitching, adjustments and operations of primary tillage equipments with tractor	
6	Hitching, adjustments and operations of secondar y tillage equipments with tractor	
7	Spraying equipment, calibration and operation.	
8	Plant protection equipment, calculation of dilution ratio and operation.	
9	Calculations with realistic unsolved examples based on draft, side draft, area coverage by primary tillage equipments	
10	Calculations with realistic unsolved examples based on draft, side draft, area coverage by Secondary tillage equipments	
11	Calibration of seed cum fertilizer seed drill on farm	
12	Showing a video of assembling different parts of a tractor	

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FRS-311 Orchard and Estate Management 2(1+1)

Theory

Orchard and estate management, importance, objectives, merits and demerits, clean cultivation and use of herbicides, sod culture, sod mulch, inorganic and organic mulches. Tropical, sub-tropical and temperate horticultural systems, competitive and complimentary effect of root and shoot systems. Biological efficiency of cropping systems in horticulture, systems of irrigation. Soil management in relation to nutrient and water uptake and their effect on soil environment, moisture, organisms and soil properties. Causes and remedies of unfruitfulness. Rejuvenation of old orchards, top working, frame working, Integrated nutrient and pest management. Training and pruning of fruit plants. Crop model and crop regulation in relation to fruit orchard. Climate aberrations and mitigation measures of Horticultural crops.

Practical

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

Lecture Schedule: Theory

S.No.	Topics	Tentative Dates
1	Orchard and estate management, importance, objectives, merits and demerits,	
2	clean cultivation and use of herbicides	
3	sod culture, sod mulch, inorganic and organic mulches.	
4	Tropical, sub-tropical and temperate horticultural systems,	
5	Competitive and complimentary effect of root and shoot systems.	
6	Biological efficiency of cropping systems in horticulture	
7	systems of irrigation	
8	Soil management in relation to nutrient and water uptake	
9	Effect of soil management on soil environment moisture, organisms and soil properties	
10	Rejuvenation of old orchards, top working, frame working	
11	Integrated nutrient management	
12	Integrated pest management	
13	Training and pruning of fruit plants	
14	Crop model and crop regulation in relation to fruit orchard	
15	Climate aberrations and mitigation measures of Horticultural crops.	
16	Causes of unfruitfulness	
17	Remedies of unfruitfulness	

Lecture Schedule: Practicals

S.No.	Topics	Tentative Dates
1	Layout of different systems of orchard and estate	
2	Orchard soil management	
3	Clean cropping in orchards	
4	Inter cropping in orchards	
5	Cover cropping in orchards	
6	Mixed cropping	
7	Filler planting and its importance	
8	Use of mulch materials	
9	Organic and inorganic mulching	
10	Importance of moisture conservation	
11	Method of moisture conservation techniques	
12	weed and its importance	
13	weed control methods	
14	Layout of surface irrigation systems	
15	Layout of drip irrigation systems	

Suggested Reading:

Kumar, 1990. *Introduction to Horticulture crops*. Rajyalakshmi Publications, Nagercoil, Tamilnadu.

Palaniappan, S.P. and Sivaraman, K. 1996. *Cropping systems in the Tropics*. New age International (P) Ltd., Publishers, New Delhi.

Shanmugavelu, K.G.1989. *Production Technology of Fruit Crops*. Oxford & IBH Publishing Co. Pvt.Ltd., New Delhi.

W. S. Dhillon and Bhatt. 2011. *Fruit Tree Physiology*. Narendra Publishing House, New Delhi.

B .C. Mazumdar. 2004. *Principles and Methods of Orchard Establishment*. Daya Publishing House, New Delhi.

T. Pradeep Kumar, B. Suma, Jyothi Bhaskar and K.N.Satheson. 2008. *Management of Horticultural Crops*. New India Publishing Agency, New Delhi.

B .C. Mazumdar. 2004. *Orchard Irrigation and Soil Management Practices* Daya Publishing Agency, New Delhi. Daya Publishing Agency, New Delhi.

FRS-312 Weed Management in Horticultural Crops 2 (1+1)

Theroy

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

Practical

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

Lecture Schedule: Theory

S.No.	Topics	Tentative Dates
1	Weeds: Introduction, harmful and beneficial effects	
2	Weeds: Introduction, harmful and beneficial effects	
3	Classification of weeds	
4	Weeds: Introduction, harmful and beneficial effects Classification of weeds	
5	Propagation and dissemination of weeds	
6	Propagation and dissemination of weeds	
7	Weed biology and ecology, crop weed association	
8	Weed biology and ecology, crop weed association	
9	Crop weed competition and allelopathy	
10	Concepts of weed prevention, control and eradication	
11	Methods of weed control: physical, cultural, chemical and biological methods	
12	Methods of weed control: physical, cultural, chemical and biological methods	
13	Methods of weed control: physical, cultural, chemical and biological methods	
14	Methods of weed control: physical, cultural, chemical and biological methods	
15	Integrated weed management	
16	Integrated weed management	
17	Herbicides: advantages and limitation of herbicide usage in India	
18	Herbicides: advantages and limitation of herbicide usage in India	
19	Herbicide classification, formulations,	

20	Herbicide classification, formulations,	
21	Methods of application of herbicides	
22	Introduction to Adjuvants and their use in herbicides	
23	Introduction to Adjuvants and their use in herbicides	
24	Introduction to selectivity of herbicides; Compatibility of herbicides with other agro chemicals	
25	Introduction to selectivity of herbicides; Compatibility of herbicides with other agro chemicals	
26	Weed management in major horticultural crops	
27	Weed management in major horticultural crops	
28	Shift of weed flora in cropping systems	
29	Shift of weed flora in cropping systems	
30	Aquatic and problematic weeds and their control	
31	Aquatic and problematic weeds and their control	
32	Revision	

Lecture Schedule: Practicals

S.No.	Topics	Tentative Dates
1	Identification of weeds	
2	Survey of weeds in orchards and other habitats	
3	Preparation of herbarium of weeds	
4	Calculations on weed control efficiency and weed index	
5	Herbicide label information	
6	Computation of herbicide doses	
7	Study of herbicide application equipment and calibration	
8	Demonstration of methods of herbicide application	
9	Preparation of list of commonly available herbicides	
10	Study of phytotoxicity symptoms of herbicides in different crops	
11	Biology of nut sedge	
12	Biology of bermuda grass	
13	Biology of parthenium	
14	Biology of parthenium	
15	Economics of weed control practices; Tours and visits of problem areas	
16	Economics of weed control practices; Tours and visits of problem areas	

Suggested reading:

Crafts, A.S. and Robbins, W.W. 1973. *Weed Control*. Tata McGraw-Hill Publishing Co. Ltd., New Delhi.

Gupta, O.P. 1984. *Scientific Weed Management*. Today and Tomorrow Printers and Publishers, New Delhi.

Gupta, O.P. 2015. *Modern Weed Management*. Agro Bios (India), Jodhpur.

Naidu, V.S.G.R., *Handbook of Weed Identification*. Directorate of Weed Research, Jabalpur.

Rajagopal, A., Aravindan, R. and Shanmugavelu, K.G., 2015. *Weed management of Horticultural Crops.* Agrobios (India), Jodhpur.

Ramamoorthy, K. and Subbian, P., *Predominant Weed flora in hill –ecosystems*. Agrobios (India), Jodhpur.

Rao, V.S. 2000. *Principles of Weed Science*. Oxford & IBH Publishing Co., New Delhi.

Subramanian, S., Mohammed Ali, A. and Jayakumar, R. 1991. *All About Weed Control*. Kalyani Publishers, Ludhiana.

Tadulingam, C. and Venkatnarayana, D. 1955. *A Handbook of Some South Indian Weeds.* Government Press, Madras.

Thakur, C. 1977. *Weed Science*. Metropolitan Book Co. Pvt. Ltd., New Delhi.

VEG-311 Potato and Tuber Crops 2 (1+1)

Theroy

Origin, area, production, economic importance and export potential of potato and tropical, sub-tropical and temperate tuber crops; description of varieties and hybrids. Climate and soil requirement, season; seed rate; preparation of field; planting practices; spacing; water, nutrient and weed management; nutrient deficiencies. Use of chemicals and growth regulators; cropping systems. Harvesting practices, yield; economic of cultivation. Post- harvest handling and storage, field and seed standards, marketing. Crops to be covered – potato, sweet potato, arrow root, cassava, colocasia, xanthosoma, amorphophallus, dioscorea, Jerusalem artichoke, horse radish and other under exploited tuber crops.

Practical

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

Lecture Schedule: Theory

S.No.	Topics	Tentative Dates
1	Cultivation practices of potato.	
2	Cultivation practices of sweet potato.	
3	Cultivation practices of arrow root.	
4	Cultivation practices of cassava.	
5	Cultivation practices of colocasia.	
6	Cultivation practices of xanthosoma.	
7	Cultivation practices of amorphophallus.	
8	Cultivation practices of dioscorea.	
9	Cultivation practices of Jerusalem artichoke.	
10	Cultivation practices ofhorse radish.	
11	Cultivation practices ofchinese potato	
12	Cultivation practices ofother under exploited tuber crops.	

Lecture Schedule: Practicals

S.No.	Topics	Tentative Dates
1	Study of identification and description of potato and tropical, sub-tropical and temperate tuber crops.	
2	Study of field preparation and sowing/planting of tuber crops.	
3	Study of fertilizers application of tuber crops.	
4	Study of herbicides and its application in tuber crops.	
5	Preparation ofgrowth regulators and its application in tuber crops.	
6	Study of propagation methods of tuber crops.	

7	Study of identification of nutrient deficiencies and physiological disorders of tuber crops.	
8	Study of harvest indices and maturity standards of tuber crops.	
9	Study of post-harvest handling and storage, marketing of tuber crops.	
10	Workout the cost of cultivation of tuber crops.	
11-12	Study of project preparation of commercial cultivation.	

Suggested reading:

S. Thamburaj. 2014. *Text book of vegetable, tuber crops and Spices*. ICAR, New Delhi.

B.R.Choudhary 2009.*AText book on production technology of vegetables*. Kalyani Publishers. Ludhiana.

T.K.Bose. 2002.*Vegetable Crops*. Nayaprakash. Kolkata

P.Hazra. 2011. *Modern Technology in Vegetable Production*. New India Publishing Agency. New Delhi.

T.R.Gopal Krishnan, 2007. *Vegetable Crops*. New India Publishing Agency. New Delhi.

K.V.Kamath. 2007.*Vegetable Crop Production*. Oxford Book Company. Jaipur

M.S.Dhaliwal, 2008.*Handbook of Vegetable Crops*. Kalyani Publishers. Ludhiana

Singh, Umashankar, 2008. Indian Vegetables. Anmol Publications. Pvt.Ltd .New Delhi.

K S Yawalkar, 2004.*Vegetable crops in India*. Agri-Horticultural Pub. House. Nagpur.

M.K.Rana, 2008.*Olericulture in India*. Kalyani Publishers. Ludhiana

P.Hazra. 2006.*Vegetable science*. Kalyani Publishers .Ludhiana

Pratibha Sharma,2007.*Vegetables : Disease Diagnosis and Biomanagement*. Avishkar Publishers. Jaipur

Uma Shankar. 2008. *Vegetable Pest Management Guide for Farmers*. International Book Distribution Co. Publication. Lucknow.

Nath Prem. 1994.*Vegetables for the Tropical Regions*. ICAR New Delhi

K.L.Chadha. 1993.*Advances in Horticulture*. Malhotra publishing house. New Delhi

Shanmugavelu, K.G. 1989. Production technology of vegetable crops. Oxford and IBH publishing Co. Pvt. Ltd, New Delhi.

Bose, T.K. 2003. Vegetable Crops. Naya udyog publishers, Kolkata. 2002. Naya Prakash, Calcutta.

Prem Singh Arya, 1999. Vegetable Seed Production Principles. Kalyani Publishers, New Delhi.

Choudhery, B., 1990. Vegetables. 8th edition. National Book Trust, New Delhi.

Vincent Lebot, 2008.*Tropical roots and tuber crops*. CAVI.

J.E. Bradashaw, 2010. Root and tuber crops. Springer Publications.

FLS-311 Medicinal and Aromatic Crops 3(2+1)

Theroy

History, scope, opportunities and constraints in the cultivation and maintenance of medicinal and aromatic plants in India. 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. Medicinal Plants: *Withania*, periwinkle, Rauvolfia, Dioscorea, Isabgol, opium poppy *Ammi majus*, Belladonna, Cinchona, Pyrethrum and other species relevant to local conditions. Aromatic Plants: Citronella grass, khus grass, flag (baje), lavender, geranium, patchouli, bursera, menthe, musk, occimum and other species relevant to the local conditions. Marketing.

Practical

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

Lecture Schedule: Theory

S.No.	Topics	Tentative Date
1	History of medicinal & Aromatic plants in India	
2	Scope of medicinal & Aromatic plants in India	
3	Opportunities and constraints in the cultivation and maintenance of medicinal & aromatic plants in India	
4	Classification of medicinal and aromatic plants	
5	Production technology of *Withania*	
6	Production technology of periwinkle	
7	Production technology of Rauvolfia	
8	Production technology of Dioscorea	
9	Production technology of opium poppy	
10	Production technology of *Ammi majus*	
11	Production technology of Belladonna	
12	Production technology of Cinchona	
13	Production technology of Pyrethrum	
14	Production technology of Isabgol,	
15	Production technology of Lemon grass	
16	Production technology of khus grass	
17	Production technology of flag (wach)	
18	Production technology of lavender	
19	Production technology of geranium	

20	Production technology of patchouli	
21	Production technology of bursera	
22	Production technology of mentha	
23	Production technology of occimum	
24	Production technology of musk	
25	Production technology of Aloe	
26	Production technology of Santalum	
27	Study of chemical composition of a few important medicinal and aromatic plants	
28	Storage techniques of essential oils	
29	Extraction method of essential oils	
30	Use and economics of drugs and essential oils of medicinal and aromatic plants	

Lecture Schedule: Practicals

S.No.	Topics	Tentative Date
1	Identification of medicinal & aromatic plants	
2	Collection of medicinal & aromatic plants from college campus	
3	Collection of medicinal & aromatic plants from natural habitats	
4	Preparation of nursery bed and raising of medicinal plants by seeds	
	Preparation of nursery bed and raising of aromatic plants by seeds	
5	Preparation of nursery bed and raising of medicinal plants by cuttings	
	Preparation of nursery bed and raising of aromatic plants by cuttings	
6	Preparation of nursery bed a nd raising of medicinal plants by vegetative means	
7	Preparation of nursery bed and raising of aromatic plants by vegetative means	
8	Harvesting, drying grading and storage of medicinal plants	
9	Harvesting drying grading and storage of aromatic plants	
10	Visit to nearby medicinal & aromatic plantation area/Ayurvedic pharmecies	
11	Visit to nearby medicinal & aromatic nursery	
12	Visit to nearby Ayurvedic pharmacies	

Suggested Reading:

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

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

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

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

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

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

PHT- 311 Postharvest Management Of Horticultural Crops 3(2+1)

Theory:

Importance & scope of post-harvest management of horticultural crops in India. Maturity indices, harvesting, pre cooling, sorting and grading of fruit, vegetables, cut flowers, medicinal and aromatic plants. Pre-harvest factors affecting quality. Factors responsible for deterioration of horticultural produce. Physiological and bio-chemical changes during ripening. Hastening and delaying ripening process. Pre and Post harvest treatments of Horticultural crop viz. pre harvest sprays, curing, degreening, pre cooling, waxing, fumigation, irradiations, VHT, etc. Quality parameters and specification. Structure of fruits, vegetables and cut flowers related to physiological changes after harvest. Different systems of storage including cold storage, CA & MA storage, low cost cooling structures, etc. Packaging, pre packaging treatments, types of packages, types of cushioning materials, vacuum packaging, , poly shrink packaging, grape guard packing . Transportation of fresh horticultural produce to local and export market.

Practical:

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

Lecture Schedule: Theory

S.No.	Topics	Tentative Date
1.	Present scenario of distribution system of perishables in India, losses during supply chain	
2.	Importance of strong post-harvest infrastructure of horticultural crops in India	
3.	Scope for development of post-harvest management infrastructure of horticultural crops in India	
4.	Maturity, optimum stage of maturity for different fruits and vegetable crops	
5.	General maturity indices of fruits and vegetables: Computational, physical, chemical and physiological methods	
6.	Harvest indices of fruits like mango, banana, papaya, pineapple, apple, sapota, guava, citrus, grapes, etc.	
7.	Harvest indices of vegetables like tomato, brinjal, beans, melons, etc.	
8.	Pre-harvest factors affecting quality of fruits and vegetables	
9.	Changes during fruit growth	
10.	Physiology of transpiration	
11.	Physiology of respiration	
12.	Physiology and biochemistry of fruit ripening	
13.	Ethylene evolution	
14.	Delaying ripening	
15.	Artificial ripening of fruits	
16.	factors responsible for deterioration of horticultural produce	

17.	Harvesting: methods and tools, Pre-cooling: methods and objectives	
18.	Sorting and grading of fruits and vegetables	
19.	pre- treatments like curing, waxing, etc.	
20.	Pre & post-harvest treatments of horticultural crops	
21.	Quality parameters and specification. Structure of fruits, vegetables and cut flowers related to physiological changes after harvest	
22.	Cold storage: construction and mechanical refrigeration	
23.	CA storage	
24.	MA storage	
25.	Zero energy cool chamber: principle and construction	
26.	Packaging : quality of ideal packaging material	
27.	Pre- packaging treatments: grape guard etc.	
28.	Types of packages, pelletization,	
29.	Cushioning material	
30.	vacuum packaging, poly shrink packaging	
31.	Transportation of fresh horticultural produce	

Lecture Schedule: Practicals

S.No.	Topics	Tentative Date
1.	Analyzing maturity stages of fruits: use of refractometer	
2.	Analyzing maturity stages of fruits: use of tenderometer	
3.	Maturity determination by specific gravity	
4.	Maturity determination by starch test	
5.	Estimation of PLW	
6.	Effect of packaging and temperature on PLW of fruits and vegetables	
7.	Practice of harvesting of horticultural produce	
8.	Practice of manual grading of horticultural produce	
9.	Practice of packaging in fruits/ vegetables/ flowers	
10.	To become familiar with working of cold room	
11.	Construction of ZECC	
12.	To become acquint with post-harvest disorders in horticultural produce	
13.	Identification of storage pests and diseases in spices	
14.	Visit to markets, packaging houses and cold storage units	

Suggested Readings:

1. Jain, S.K. and Dashora, L.K. 2012. *Practical Manual on Post harvest handling of horticultural produce.* CH&F, Jhalawar p.
2. Pantastico. B. 1975. *Post Harvest Physiology, Handling and Utilization of Tropical and Subtropical Fruits and Vegetables,* AVI Publishing Company, Inc.
3. S. K. Mitra. Post Harvest Physiology and storage of tropical and subtropical fruits, CABI Publishing.
4. Saraswathy,S., Preethi,T.L., Balasubramanyan, S., Suresh, J., Revathy, N. and Natarajan, S. 2008. *Post Harvest Management of Horticultural Crops,* Agribios (India), Jodhpur.
5. Thompson, A.K. *Post Harvest Technology of fruits and vegetables*, Blackwell Science.

   Wills, R.B.H., McGlasson, W.B., Graham, D., Lee, T.H. and Hall, E.G. 1996. *Post Harvest: An Introduction to the Physiology and Handling of Fruits and vegetables,* CBS Publishers and Distributors, New Delhi.

PPR-311 Insect Pests of Vegetable, Ornamental and Spice Crops 3(2+1)

Theory

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

Practical

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

Lecture Schedule: Theory

S. No.	Topics	Tentative Dates
1	General — economic classification of insects; ecology and pest surveillance with reference to vegetable, ornamental and spice crops	
2	IPM : Definition and concept	
3	Definition and terminology of entomological words and causes for insect assuming pests status	
4	Polyphagous pests and their management of vegetable, ornamental and spice crops	
5	Distribution, host range, bio-ecology, injury, integrated management of insect- pest of tomato	
6	Distribution, host range, bio-ecology, injury, integrated management of insect-pest of brinjal	
7	Distribution, host range, bio-ecology, injury, integrated managem ent of insect-pest of okra	
8	Distribution, host range, bio-ecology, injury, integrated management of insect-pest of cucurbits	
9	Distribution, host range, bio-ecology, injury, integrated management of insect-pest of cole crops	
10	Distribution, host range, bio-ecology, injury, integrated management of insect-pest of potato	
11	Distribution, host range, bio-ecology, injury, integrated management of insect-pest of sweet potato	
12	Distribution, host range, bio-ecology, injury, integrated managemen t of insect-pest of onion and garlic	
13	Distribution, host range, bio-ecology, injury, integrated management of insect-pest of pea	
14	Distribution, host range, bio-ecology, injury, integrated management of insect-pest of cardamom and Large cardamom	

15	Distribution, host range, bio-ecology, injury, integrated management of insect-pest of chilli and black paper	
16	Distribution, host range, bio-ecology, injury, integrated management of insect-pest of black paper	
17	Distribution, host range, bio-ecology, injury, integrated management of insect-pest of turmeric and ginger	
18	Distribution, host range, bio-ecology, injury, integrated management of insect-pest of coriander and cumin	
19	Distribution, host range, bio-ecology, injury, integrated manage ment of insect-pest of fennel and fenugreek	
20	Distribution, host range, bio-ecology, injury, integrated management of insect-pest of clove	
21	Distribution, host range, bio-ecology, injury, integrated management of insect-pest of rose	
22	Distribution, host range, bio-ecology, injury, integrated management of insect-pest of tuberose	
23	Distribution, host range, bio-ecology, injury, integrated management of insect-pest of jasmine	
24	Distribution, host range, bio-ecology, injury, integrated manag ement of insect-pest of marigold and hollyhock	
25	Distribution, host range, bio-ecology, injury, integrated management of insect-pest of chrysanthemum	
26	Distribution, host range, bio-ecology, injury, integrated management of insect-pest of lily	
27	Distribution, host range, bio-ecology, injury, integrated management of insect-pest of carnation	
28	Distribution, host range, bio-ecology, injury, integrated management of insect-pest of gladiolus	
29	Distribution, host range, bio-ecology, injury, man agement of important insect pests attacking stored product of vegetable crops	
30	Distribution, host range, bio-ecology, injury, management of important insect pests attacking stored product of ornamental and spice crops	
31	Find out tolerance limits of insecticide in vegetable crops	
32	Find out tolerance limits limit of insecticide in ornamental crops	
33	Find out tolerance limits limit of insecticide in spice crops	

Lecture Schedule: Practicals

S. No.	Topics	Tentative Dates
1	Collection, Identification and preservation of important insect-pests of vegetable crops	
2	Collection, Identification and preservation of important insect-pests of ornamental crops	
3	Collection, Identification and preservation of important insect-pests spice crops	
4	Collection & study of damage symptoms caused by insect-pests of vegetable crops	

5	Collection & study of damage symptoms caused by insect-pests of ornamental and spice crops	
6	Study of important predators & parasites of important insect-pests of vegetable crops	
7	Study of important predators & parasites of important insect-pests of ornamental & spice crops	
8	Study of life cycle of important insect-pests of vegetable crops	
9	Study of life cycle of important insect-pests of ornamental crops	
10	Study of life cycle of important insect-pests of crops spice	
11	Study of damage caused by stored product insect-pests of vegetable, ornamental & spice crops	
12	Calculation of spray formulations of insecticides solution	
13	Calculation of Dust formulations of insecticides	
14	Study of spraying and dusting Equipment's	

Suggested reading:

Atwal. A. S. Agricultural pests of south Asia and their management

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

Butani, D.K. 1984.Insects and Fruits. Periodical Expert Book Agency, New Delhi.

Butani, D.K. 1984.Insects and Fruits. Periodical Expert Book Agency, New Delhi

David B V and Kumarswami, T, 1982. Elements of Economic Entomology. Popular Book Department, Madras, 536p.

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

Emmanuel, N, A. Sujatha, T.S.K. K. KiranPatro, MLN Reddy, B. Srinivasulu, TSSK SammuelPatro. Text Book on Integrated Pest Management of Horticultural Crops Astral International Publishers, New Delhi.

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

Srivastava, K.P. A Text Book on Applied Entomology Vol. I&II. , Kalyani Publishers, Ludhiyana

Metcalf,R.LandLuckman,W.H.1982.

IntroductiontoInsectpestmanagement.WileyInterSciencePublishing,NewYork

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

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

Rachna and Bennakumari. Pest management and residual analysis in horticultural crop

Ramnivas Sharma. Identification and management of horticulture pest.

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

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

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PPR-312 Diseases of Vegetable, Ornamental and Spice Crops 3(2+1)

Theory

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

Practical

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.

Lecture Schedule: Theory

S. No.	Topics	Tentative Dates
1	Nursery diseases of tomato and other vegetables	
2	Fungal diseases of tomato	
3	Bacterial and viral diseases of tomato	
4	Diseases of brinjal	
5	Bell pepper and chillies	
6	Diseases of bhindi/ladyfinger/okra	
7	Fungal diseases of cabbage, cauliflower, radish and knol-khol-I	
8	Fungal diseases of cabbage, cauliflower, radish and knol-khol-II	
9	Bacterial and viral diseases of cabbage, cauliflower, radish and knol-khol	
10	Diseases of pea	
11	Diseases of beans	
12	Diseases of beetroot	
13	Diseases of onion and garlic	
14	Diseases of **cucurbits**	
15	Diseases of ginger and turmeric	
16	Diseases of potato - I	
17	Diseases of potato - II	
18	Diseases of carrot and sweet potato	
19	Disease of yam and colocassia	
20	Diseases of cumin and fennel	
21	Diseases of pepper	
22	Diseases of small cardamom	
23	Diseases of large cardamom and nutmeg	
24	Diseases of coriander	

25	Diseases of clove, cinnamon and fenugreek	
26	Diseases of rose	
27	Diseases of Dahelia and marigold	
28	Diseases of crossandra and jasmine	
29	Diseases of tuberose	
30	Diseases of geranium	
31	Diseases of chrysanthemum	
32	Post-harvest diseases of vegetables, ornamentals and spice crops	

Lecture Schedule: Practicals

S. No.	Topics	Tentative Dates
1	Diseases caused by *Pythium* spp.	
2	Diseases caused by *Phytophthora* spp.	
3	Diseases caused by downy mildew and white rust fungi	
4	Diseases caused by powdery mildew fungi	
5	Diseases caused by *Alternaria* spp.	
6	Leaf spot diseases caused by *septoria/ phaeoisariopsis/ cercospora/ phomopsis* spp.	
7	Diseases caused by rust fungi	
8	Diseases caused by rust fungi in ornamentals	
9	Diseases caused by *Fusarium*spp	
10	Diseases caused by sclerotia forming fungi	
11	Diseases caused by *Colletotrichum*spp	
12	To perform gram's staining	
13	Diseases caused by bacteria	
14	Symptoms of plant virus diseases	
15	Fungicides and their application	
16	Post-harvest diseases	

Suggested Reading:

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

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

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

Rangaswamy, G. and A. Mahadevan. 2008. Diseases of Crop Plants in India (4th Edition). PHI Learning Private Limited, New Delhi. 536 p.

Saha, L.R. (2008) Hand Book of Plant Diseases. Kalyani Publisher, New Delhi pp 457

Singh, R.S. (1994). Diseases of Vegetable Crops, Oxfords and IBH Publishing co. Pvt. Ltd. New Delhi pp 362

Mehrotra, R.S. and A. Agarwal. Plant Pathology (2nd Edition). Tata McGraw-Hill Publishing Company Limited, New Delhi. 846 p.

Mishra, A. Bohra, A. and Mishra A. (2005). Plant Pathology: Disease and Management. AGROBIOS India pp 766

Mukerji, K.G. 2004 Fruit and Vegetable Diseases. Kluwer Academic Publisher Dordrecht pp554

Thind, T.S. (2005). Diseases of Fruits and Vegetables and Their Management. Kalyani Publisher, New Delhi pp 474

Tripathi D.P. (2009) Crop Diseases, Kalyani Publisher, New Delhi pp 480

NRM-311 Introduction to Major Field Crops 2(1+1)

Theroy

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

Practical

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

Lecture Schedule: Theory

S.No.	Topics	Tentative Dates
1.	Classification and distribution of field crops	
2.	Classification and distribution of field crops	
3.	Definitions and concept of multiple cropping	
4.	Definitions and concept of mixed cropping	
5.	Definitions and concept of intercropping	
6.	Definitions and concept of relay cropping	
7.	Definitions and concept of alley cropping	
8.	Cultural practices for raising major cereals	
9.	Cultural practices for raising major cereals	
10.	Cultural practices for raising major cereals	
11.	Cultural practices for raising pulses	
12.	Cultural practices for raising oil seeds	
13.	Green manuring and crop rotation	

Lecture Schedule: Practicals

S.No.	Topics	Tentative Dates
1.	Identification of crop plants,.	
2.	Identification of seeds	
3.	Identification of weeds	
4.	Preparation of cropping scheme	
5.	Preparation of cropping scheme	
6.	Application of herbicides in field crops	

Suggested Reading:

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

Chidda Singh.1997. Modern techniques of raising field crops. Oxford and IBH

Publishing Co. Pvt. Ltd., New Delhi.

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

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

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

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

UAS, Bangalore. 2011. Package of Practice. UAS, Bangalore.

Chidda Singh 1983. Modern Techniques of raising Field crops.Oxford & IBH, Publishing Co., New Delhi

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

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

Subhash Chandra Bose, M. and Balakrishnan, V. 2001. Forage Production South

Asian Publishers, New Delhi.

NRM-312 Introductory Agro-forestry 2(1+1)

Theory

Agroforestry – definition, objectives and potential. Distinction between agroforestry and social forestry. Status of Indian forests and role in Indian farming systems. Agroforestry system, sub-system and practice: agri-silviculture, silvipastoral, horti-silviculture, horti-silvipastoral, shifting cultivation, taungya, home gardens, alley cropping, intercropping, wind breaks, shelterbelts and energy plantations. Planning for agroforestry – constraints, diagnosis and design methodology, and selection of tree crop species for agro-forestry. Agroforestry projects – national, overseas, MPTS – their management practices, economics of cultivation – nursery and planting (*Acacia catechu*, *Dalbergia sissoo*, Tectona, Populus, Morus, Grewia, Eucalyptus, *Moringa olefera, Murraya koengii* , Quercus spp. and bamboo, tamarind, neem etc.

Practical

Identification and seeds and seedlings of multipurpose tree species. Nursery practices for, *Acacia catechu*, *Dalbergia sissoo*, leucaena, *Ailanthus excelsa, Pongamia pinnata, Acacia nilotica, khejri, tamarind, neem bamboo* etc. Visit to agro-forestry fields to study the compatibility of MPTS with agricultural crops: silvipastoral, alley cropping, horti-silviculture, agro-silvipasture, fuel and fodder blocks. Visit to social forestry plantations – railway line plantations, canal plantations, roadside plantations, industrial plantations and shelterbelts. Rapid assessment of farmers needs for green manure, fodder, fuel wood in selected villages. Economics and marketing of products raised in agro-forestry systems

Lecture Schedule: Theory

S.No.	Topics	Tentative Dates
1.	Agroforestry – definition, objectives and potential	
2.	Distinction between agroforestry and social forestry	
3.	Status of Indian forests and role in Indian farming systems	
4.	Agroforestry system, sub-system and practice: Agri-silviculture and Silvipastoral	
5.	Agroforestry system, sub-system and practice: Horti-silviculture and Horti-silvipastoral	
6.	Agroforestry system, sub-system and practice: Shifting cultivation and Taungya	
7.	Agroforestry system, sub-system and practice: Home gardens and Alley cropping	
8.	Agroforestry system, sub-system and practice: Intercropping and wind breaks,	
9.	Agroforestry system, sub-system and practice: shelterbelts and energy plantations	
10.	Planning for agroforestry – constraints, diagnosis and design methodology, and selection of tree crop species for agro-forestry	
11.	Agroforestry projects – national and overseas	
12.	MPTS – their management practices,economics of cultivation – nursery and planting of *Acacia catechu*, *Dalbergia sissoo* and Tectona,	
13.	MPTS – their management practices,economics of cultivation – nursery and planting ofPopulus, Morus and Grewia	

14.	MPTS – their management practices,economics of cultivation – nursery and planting of Eucalyptus, Moringa olefera and Murraya koengii	
15.	MPTS – their management practices,economics of cultivation – nursery and plantingof , Quercus spp., bamboo, tamarind and neem.	

Lecture Schedule: Practicals

S.No.	Topics	Tentative Dates
1.	Identification and seeds and seedlings of multipurpose tree species	
2.	Nursery practices for, Acacia catechu and Dalbergia sissoo	
3.	Nursery practices for, leucaena andAilanthus excelsa	
4.	Nursery practices for Pongamia pinnata and Acacia nilotica	
5.	Nursery practices for khejri andtamarind	
6.	Nursery practices forneem and bamboo	
7.	Visit to agro -forestry fields to study the compatibility of MPTS with agricultural crops: silvipastoral and alley cropping	
8.	Visit to agro -forestry fields to study the compatibility of MPTS with agricultural crops: horti-silviculture	
9.	Visit to agro -forestry fields to study the compatibility of MPTS with agricultural crops: Agro-silvipasture	
10.	Visit to agro -forestry fields to study the compatibility of MPTS with agricultural crops: fuel and fodder blocks	
11.	Visit to social forestry plantations – railway line plantations and canal plantations	
12.	Visit to social forestry plantations –roadside plantations, industrial plantations and shelterbelts.	
13.	Rapid assessment of farmers needs for green manure, fodder, fuel wood in selected villages	
14.	Rapid assessment of farmers needs for green manure, fodder, fuel wood in selected villages	
15.	Economics and marketing of products raised in agro -forestry systems	

Suggested readings:

1. **Buck LE, Lassoie, Fernandes ECM 1999, Agro Forestry In Sustainable Agri. Systems, CRC Press.**
2. **Nair PKR and Latt 1998, Directions in Tropical Agroforestry Research, Kluwer.**
3. **Nair PKR, Rai MR and Buck LE. 2004 New Vistas in Agroforestry, Kluwer.**

NRM-313 Agro-meteorology and Climate Change 2(1+1)

Theory

Agricultural Meteorology- Introduction, definition of meteorology, scope and practical utility of Agricultural meteorology. Composition and structure of atmosphere and definition of weather and climate, aspects involved in weather and climate, atmospheric temperature, soil temperature, solar radiation, atmospheric pressure, atmospheric humidity, evaporation and transpiration, monsoons, rainfall, clouds, drought, weather disasters and their management atmospheric pollution and role of meteorology. Basics of weather forecasting. Climate change-causes. Global warming-causes and remote sensing. Effect of climate change on horticulture Past and future changes in greenhouse gases within the atmosphere. Sources and sinks for greenhouse gases. Atmospheric chemistry. Plants sense and respond to changes in CO_2 concentration. Measurement of short-term effects and mechanisms underlying the observed responses in C_3 and C_4 species. Plant development affected by growth in elevated CO_2. Physiology of rising CO_2 on nitrogen use and soil fertility, its implication for production. Methodology for studying effect of CO_2. Change in secondary metabolites and pest disease reaction of plants. The mechanisms of ozone and UV damage and tolerance in plants. Increased temperature and plants in tropical/sub-tropical climates- effect on growing season, timing of flowering, duration of fruit development and impacts on crop yields and potential species ranges, interaction of temperature with other abiotic/biotic stress. Mitigation strategies and prospects for genetic manipulation of crops to maximize production in the future atmosphere. Modifying Rubisco, acclimation, metabolism of oxidizing radicals, and sink capacity as potential strategies.

Practical

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

Lecture Schedule: Theory

S.No.	Topics	Tentative Dates
1.	Agricultural Meteorology- Introduction, definition of meteorology, scope and practical utility of Agricultural meteorology	
2.	Composition and structure of atmosphere and definition of weather and climate, aspects involved in weather and climate, atmospheric temperatureand their management atmospheric pollution and role of meteorology	
3.	aspects involved in soil temperature, solar radiationatmospheric pressure and their management atmospheric pollution and role of meteorology	
4.	Aspects involved in, atmospheric humidity, evaporation and transpiration, monsoons, rainfalland their management atmospheric pollution and role of meteorology	
5.	Aspects involved in clouds, drought, weather disasters and their management atmospheric pollution and role of meteorology	
6.	Basics of weather fore casting. Climate change-causes. Global warming-causes and remote sensing	
7.	Effect of climate change on horticulture Past and future changes in greenhouse gases within the atmosphere	
8.	Sources and sinks for greenhouse gases. Atmospheric chemistry.	
9.	Plants sense and respond to changes in CO_2 concentration. Measurement of short-term effects and mechanisms underlying the observed responses in C_3 and C_4 species.	
10.	Plant development affected by growth in elevated CO_2.Physiology of rising CO_2 on nitrogen use and soil fertility, its implication for production.	
11.	Methodology for studying effect of CO_2. Change in secondary metabolites and pest disease reaction of plants.The mechanisms of ozone and UV damage and tolerance in plants.	
12.	Increased temperature an d plants in tropical/sub -tropical climates - effect on growing season, timing of flowering, duration of fruit development	
13.	Increased temperature and plants in tropical/sub -tropical climates - impacts on crop yields and potential species ranges, interactio n of temperature with other abiotic/biotic stress	
14.	Mitigation strategies and prospects for genetic manipulation of crops to maximize production in the future atmosphere.	
15.	Modifying Rubisco, acclimation, metabolism of oxidizing radicals, and sink capacity as potential strategies.	

Lecture Schedule: Practicals

S.No.	Topics	Tentative Dates
1.	Site selection for Agromet observatory;	
2.	Measurement of temperature; Measurement of rainfall	
3.	Measurement of evaporation (atmospheric/soil),	
4.	Recording of evaporation	
5.	Synoptic charts andweather reports, symbols, etc.	
6.	Measurement of atmospheric pressure;	
7.	Measurement of sunshine duration and solar radiation;	
8.	Measurement of wind direction and speed and relative humidity;	
9.	Study of weather forecasting and synoptic charts	
10.	Visit to Meteorological observatory,	
11.	Visit to IMD meteorological observatory -Lay out plan of standard meteorological observatory.	
12.	Recording of air and soil temperature	
13.	Measurement of radiation and components	
14.	Measurement of rainfall-different types of raingauges	
15.	Measurement of wind speed and direction and atmospheric humidity,	

Suggested readings:

1. Ghadekar, S.R. (2001) Metrology. Agromet Publisher, Nagpur-10 (M.s)

2. Mavi H.S. (2003) Introduction to Agrometorology, India Book House Ltd. New Delhi

3. Our Weather, By P. Menon

FRS-321 Dryland Horticulture 2 (1+1)

Theory

Definition, importance and limitation of dryland horticulture, present status and future scope. Constraints encountered in drylands. Agro-climatic features in rain shadow areas, scarse water resources, high temperature, soil erosion, run-off losses, etc.

Techniques and management of dry land horticulture. watershed development, soil and water conservation methods-terraces, contour bunds, etc. Methods of control and impounding of run-off water-farm ponds, trenches, macro catch pits, etc., *in-situ* water harvesting methods, micro catchment, different types of tree basins etc. Methods of reducing evapotranspiration, use of shelter belts, mulches, antitranspirants, growth regulators, etc.

water use efficiency-need based, economic and conjunctive use of water, micro systems of irrigation etc.Selection of plants having drought resistance. Special techniques, planting and after care-use of seedling races, rootstocks, *in-situ* grafting, deep pitting/planting, canopy management etc.

Characters and special adaptation of crops: ber, aonla, annona, jamun, wood apple, bael, pomegranate, carissa, date palm, phalsa, fig, west Indian cherry and tamarind.

Practical

Study of rainfall patterns. Contour bunding/trenching, micro catchments, soil erosion and its control. Study of evapotranspiration, mulches and micro irrigation systems. Special techniques of planting and aftercare in dry lands. Study of morphological and anatomical features of drought tolerant fruit crops.

Lecture Schedule: Theory

S.No.	Topics	Tentative Dates
1.	Definition, importance and limitation of dryland horticulture, present status and future scope.	
2.	Present status and future scope of dryland horticulture .Constraints encountered in drylands	
3.	Agro-climatic features in rain shadow areas and scarse water resources	
4.	Agro-climatic features in ,high temperature, soil e rosion, run -off losses, etc	
5.	Techniques and mana gement of dry land horticulture, watershed development	
6.	Soil and water conservation methods-terraces, contour bunds, etc.	
7.	Methods of control and impounding of run -off water -farm ponds, trenches, macro catch pits, etc.	
8.	*in-situ* water harvesting methods, micro catchment, different types of tree basins etc.	
9.	Methods of reducing evapotranspiration, use of shelter belts, mulches, antitranspirants, growth regulators, etc	
10.	water use efficiency -need base d, economic and conjunctive use of water, micro systems of irrigation etc	
11.	Selection of plants having drought resistance.	
12.	Special techniques, planting and after care -use of seedling races, rootstocks, *in-situ* grafting, deep pitting/planting, canopy management etc.	

13.	Characters and special adaptation of crops: ber, aonla, annona, and jamun	
14.	Characters and special adaptation of crops: wood apple , bael pomegranate, Carissa and date palm	
15.	Characters and special adaptation of crops:phalsa, fig, west Indian cherry and tamarind	

Lecture Schedule: Practicals

S.No.	Topics	Tentative Dates
1.	Study of rainfall patterns	
2.	Contour bunding/trenching	
3.	micro catchments	
4.	soil erosion and its control	
5.	Study of evapotranspiration	
6.	Study of mulches	
7.	Study of micro irrigation systems.	
8.	Special techniques of planting and aftercare in dry lands	
9.	Study of morphological features of drought tolerant fruit crops	
10.	Study of morphological features of drought tolerant fruit crops	
11.	Study of anatomical features of drought tolerant fruit crops	
12.	Study of anatomical features of drought tolerant fruit crops	

Suggested reading:

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

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

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

J V S Murthy (1998) Watershed Management, New Age International, New Delhi

Singh, R.P. (2016) Sustainable Development of Dryland Agriculture in India, Scientific Publishers, Jodhpur

VEG-321 Breeding of Vegetable, Tuber and Spice Crops 3(2+1)

Theory

Breeding objectives and important concepts of breeding self pollinated, cross pollinated and vegetatively propagated crops. Plant genetic resources, their conservation and utilization in crop improvement. Breeding for insect resistance, breeding for disease resistance, breeding for abiotic resistance, male sterility and incompatibility and their utilization in development of hybrids. Origin, distribution of species, wild relatives and forms of vegetable crops Tomato, Brinjal, Okra, Chilli, Cucurbits, Cabbage, Cauliflower, Tuber crops (Potato, Sweet potato, Cassava), Carrot, Radish, Spice crops (Ginger, Turmeric, Coriander, Fenugreek), bulb (onion & garlic), legume (pea and French bean). Breeding procedures for development of hybrids/varieties in various crops. Genetic basis of adoptability and stability.

Practical

Floral biology and pollination mechanism in self and cross pollinated vegetables, tuber crops and spices. Working out phenotypic and genotypic heritability, genetic advance. GCA, SCA, combining ability, heterosis, heterobeltosis, standard heterosis, GxE interactions (stability analysis) Preparation and uses of chemical and physical mutagens. Polyploidy breeding and chromosomal studies. Techniques of F1 hybrid seed production. Maintenance of breeding records.

Lecture Schedule: Theory

S.No.	Topics	Tentative Dates
1.	Breeding objectives and important concepts of breeding self pollinated, cross pollinated and vegetatively propagated crops…	
2.	…Continue…	
3.	…Continue…	
4.	…Continue…	
5.	…Continue.	
6.	Plant genetic resources, their conservation and utilization in crop improvement.	
7.	Breeding for insect resistance, breeding for disease resistance, breeding for abiotic resistance…	
8.	…Continue.	
9.	Male sterility and incompatibility and their utilization in development of hybrids.	
10.	Breeding procedures for development of hybrids/varieties in various crops	
11.	Genetic basis of adoptability and stability	
12.	Origin, distribution of species, wild relatives and forms, crop improvement of following vegetable crops : Solanaceous crops (Tomato, Brinjal, Chilli)…	
13.	…Continue…	
14.	…Continue.	
15.	Okra	
16.	Cucurbits…	
17.	…Continue…	

18.	…Continue.	
19.	Cole crops (Cabbage, Cauliflower)…	
20.	…Continue.	
21.	Tuber crops (Potato, Sweet potato, Cassava)…	
22.	…Continue…	
23.	…Continue.	
24.	Root crops (Carrot, Radish)…	
25.	…Continue.	
26.	Spice crops (Ginger, Turmeric, Coriander, Fenugreek)…	
27.	…Continue…	
28.	…Continue.	
29.	Bulb crops (Onion & Garlic)…	
30.	…Continue.	
31.	Legumes (Pea and French bean)…	
32.	…Continue.	

Lecture Schedule: Practicals

S.No.	Topics	Tentative Dates
1.	Floral biology and pollination m echanism in self pollinated vegetables (Tomato & Brinjal, Pea, Beans, okra)	
2.	Floral biology and pollination mechanism in self pollinated vegetables (Tomato & Brinjal, Pea, Beans, okra)	
3.	Floral biology and pollination mechanism in cross pollinated vegetables (Cauliflower, radish, onion, bottlegourd, muskmelon, cucumber)	
4.	Floral biology and pollination mechanism in cross pollinated vegetables (Cauliflower, radish, onion, bottlegourd, muskmelon, cucumber)	
5.	Floral biology and pollination mechanism in tu ber crops and spices (Potato, coriander, Fenugreek)	
6.	Floral biology and pollination mechanism in tuber crops and spices (Potato, coriander, Fenugreek)	
7.	Working out phenotypic and genotypic heritability, genetic advance	
8.	Working out phenotypic and genotypic heritability, genetic advance	
9.	Combining ability (GCA, SCA)	
10.	Heterosis (Heterobeltosis & standard heterosis)	
11.	GxE interactions (stability analysis)	
12.	Preparation and uses of chemical and physical mutagens	
13.	Polyploidy breeding and chromosomal studies	
14.	Polyploidy breeding and chromosomal studies	
15.	Techniques of F1 hybrid seed production	
16.	Maintenance of breeding records	

Suggested Reading:

Hari Hara Ram, 2013.***Vegetable Breeding: Principle and Practices*.** Kalyani Publishers. Ludhiana.

Vishnu Swaroop, 2014. *Vegetable Science &Technology in India*. Kalyani Publishers. Ludhiana.

Kallo.G, 1998. *Vegetable Breeding (Vol.I to IV).* CRC Press. Florida. 1988.

H.P. Singh, 2009.*Vegetable Varieties of India*. Studium Press (India) Pvt Ltd. New Delhi.

M.S. Dhaliwal.2012**.** Techniques of Developing Hybrids in Vegetable Crops**.**Agrobios. Jodhpur.

P.K.Singh, 2005. *Hybrid Vegetable Development*. CRC Press. Florida.

M.S.Dhaliwal, 2009. *Vegetable Seed Production & Hybrid Technology*. Kalyani Publishers. Ludhiana.

Fageria, M.S., 2011. *Vegetable Crops- Breeding and Seed Production*. Kalyani Publishers, Ludhiana

VEG-322 Seed Production of Vegetable, Tuber and Spice Crops 3(2+1)

Theory

Introduction and history of seed industry in India. Importance and scope of vegetable seed production in India. Definition of seed, classes-types of seed. Differences between grain and seed. Principles of vegetable seed production. Role of temperature, humidity and light in vegetable seed production, land requirements, climate, season, planting time, nursery management, seed rate, rouging, seed extraction and storage of cole crops, root vegetables, solanaceous vegetables, cucurbits, okra, leafy vegetables, bulb crops, leguminous vegetables and exotic vegetables. Seed germination and purity analysis. Field and seed standards. Seed drying and extraction. Seed legislation.

Practical

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

Lecture Schedule: Theory

S.No.	Topics	Tentative Dates
1	Introduction and history of seed industry in India.	
2	Importance and scope of vegetable seed production in India.	
3	Definition of seed, classes-types of seed. Differences between grain and seed.	
4	Principles of vegetable seed production.	
5	Role of temperature, humidity and light in vegetable seed production,	
6	Land requirements, climate, season, planting time, nursery management, seed rate, rouging, seed extraction and storage of cole crops…	
7	…Continue…	
8	…Continue…	
9	…Continue…	
10	Land requirements, climate, season, planting time, nursery management, seed rate, rouging, seed extraction and storage of rootvegetables…	
11	…Continue.	

12	Land requirements, climate, season, planting time, nursery management, seed rate, rouging, seed extraction and storage of solanaceous vegetables…	
13	…Continue…	
14	…Continue.	
15	Land requirements, climate, season, planting time, nursery management, seed rate, rouging, seed extraction and storage of bulb crops…	
16	…Continue.	
17	Land requi rements, climate, season, planting time, nursery management, seed rate, rouging, seed extraction and storage of cucurbits…	
18	…Continue.	
19	Land requirements, climate, season, planting time, nursery management, seed rate, rouging, seed extraction and storage of okra.	
20	Land requirements, climate, season, planting time, nursery management, seed rate, rouging, seed extraction and storage of leafy vegetables…	
21	…Continue.	
22	Land requirements, climate, season, planting time, nursery management, seed rate, rouging, seed extraction and storage of leguminous vegetables…	
23	…Continue.	
24	Land requirements, climate, season, planting time, nursery management, seed rate, rouging, seed extraction and storage of exotic vegetables.	
25	Seed germination and purity analysis.	
26	…Continue…	
27	Field and seed standards.	
28	Seed drying and extraction.	
29	Seed legislation.	

Lecture Schedule: Practicals

S.No.	Topics	Tentative Dates
1	Study of seed structure, colour size, shape and texture.	
2	Field inspection of seed crops.	
3	Practices in rouging.	
4	Harvesting and seed extraction	
5	Germination and purity analysis.	
6	Methods of seed production and seed certification in cole crops.	
7	Methods of seed production and seed certification in Root and bulb crops.	
8	Methods of seed production and seed certification in solanaceous vegetables.	
9	Methods of seed production and seed certification in cucurbits.	
10	Methods of seed production and seed certification in okra.	
11	Methods of seed production and seed certification in leafy vegetables.	
12	Methods of seed production and seed certification in leguminous vegetables.	
13	Methods of seed production and seed certification in exotic vegetables.	
14	Study of Seed processing machines.	
15	Visit to seed production units.	

Suggested Reading:

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FLS- 321 Breeding and Seed Production of Flower and Ornamental Plants 3(2+1)

Theory:

History of improvements of ornamental plants. Centres of origin of flower and ornamental crops. Objectives and techniques in ornamental plant breeding. Introduction, selection, hybridization, mutation and biotechnological technique for improvement of ornamental and flower crops *viz*., Rose, Jasmine, Chrysanthemum, Tuberose, Gerbera, Gladiolus, Dahlia, Heliconia, Lilium, Gaillardia, Petunia, Hibiscus, Bougainvillea, Zinnia, Cosmos, Dianthus, Snapdragon, Pansy, Marigold, Antirrhinum, China aster, **Amaryllis, Zephyranthes, Spider lily and Balsam**. Breeding for disease resistance. Development of promising cultivars of important flower and ornamental crops. Role of heterosis and its exploitation. Production of F_1 hybrids and utilization of male sterility. Production of open pollinated seed. Harvesting, processing and storage of seed. Seed certification.

Practical:

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

Lecture Schedule: Theory

S.No.	Topics	Tentative date
1.	History of improvement of ornamental plants	
2.	Centres of origin of flower and ornamental crops	
3.	Objectives of ornamental plant breeding	
4.	Techniques in ornamental plant breeding: introduction	
5.	Technique: selection- mass and progeny	
6.	Technique: pureline selection	
7.	Technique: clonal selection	
8.	Technique: pedigree selection	
9.	Technique: backcross selection	
10.	Technique: bulk and SSD method	
11.	Technique: hybridization- types and procedure	
12.	Technique: mutation breeding	
13.	Technique: polyploid breeding	
14.	Technique: biotechnological techniques	
15.	Breeding for disease resistance- pathogenity; vertical & horizontal resistance	
16.	Breeding for disease resistance- methods	
17.	Techniques for improvement of rose and development of promising cultivars	
18.	Techniques for improvement of chrysanthemum and development of promising cultivars	

19.	Techniques for improvement of gladiolus and development of promising cultivars	
20.	Techniques for improvement of dahlia and development of promising cultivars	
21.	Techniques for improvement of orchids and development of promising cultivars	
22.	Techniques for improvement of jasmines and development of promising cultivars	
23.	Techniques for improvement of tuberose and development of promising cultivars	
24.	Techniques for improvement of gerbera, lilium, heliconia, amaryllis, zephyranthes and spider lilyand development of promising cultivars	
25.	Techniques for improvement of marigold, petunia, China aster, zinnia, cosmos, dianthus, snapdragon, pansy and antirrhinumand development of promising cultivars	
26.	Techniques for improvement of bougainvillea and hibiscus and development of promising cultivars	
27.	Heterosis- its role and exploitation in ornamentals	
28.	Production of F_1 hybrids and utilization of male sterility in ornamentals	
29.	Production of open pollinated seed	
30.	Harvesting, processing and storage of flower seeds	
31.	Seed certification	

Lecture Schedule: Practicals

S.No.	Topics	Tentative Dates
1	Acquaintance with tools and equipments used in plant breeding	
2	Study of pollen viability	
3	Study of floral biology and pollination in chrysanthemum	
4	Study of floral biology and pollination in gladiolus	
5	Study of floral biology and pollination in rose	
6	Study of floral biology and pollination in marigold	
7	Techniques of inducing polyploidy	
8	Techniques of inducing mutations	
9	Practice in production of hybrid seed	
10	Practice in production of pure seed	
11	Harvesting and conditioning of flower seed	
12	Testing of seed viability	
13	Determination of seed moisture content	
14	Numerical problem on seed quality testing	
15	Numerical problem on inheritance of characters	
16	Practice in seed production method- open pollinated seed	

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PHT-321 PROCESSING OF HORTICULTURAL CROPS 3(1+2)

Theory:

Importance and scope of fruit and vegetable preservation industry in India. Food pipe line, unit operations in food processing. General principles of preservation of fruits and vegetables.

Preservation by heat, pasteurization and sterilization , canning and bottling of fruits and vegetables. Unit operations in canning, containers and equipments used.

Preservation by chemical preservatives, Preparation and preservation of unfermented beverages viz. juices, RTS, nectar, squashes, syrups, cordials and fermented beverages viz. wine, champagne etc.

Preservation by sugar, Jam, jelly and marmalade, preserves, candies, crystallized fruits etc.

Preservation with salt, spices, oil and vinegar, pickling, chutneys and tomato products. Preservation by Freezing, Drying & dehydration of fruits & vegetables, spoilage in processed foods, quality control of processed products, Govt. policy on import and export of processed fruits. Food laws. Principles and guidelines for the establishment of processing units.

Practical:

Equipment and containers/ packaging material used in food processing. Canning of fruits and vegetables, preparation of juice, squash, RTS, cordial, syrup, jam, jelly, marmalade, candies, preserves, chutneys, sauces, pickles. Tomato products, dehydration and freezing, Visit to processing units. Quality control of processed products.

Lecture Schedule: Theory

S.No.	Topics	Tentative Date
1.	Importance and scope of fruit and vegetable preservation industry in India	
2.	Food pipe line, losses in post-harvest operations	
3.	Unit operations in food processing	
4.	Principles and guidelines for the establishment of processing units	
5.	Principles and methods of preservation	
6.	Preservation by heat	
7.	Canning process	
8.	Juice extractions and its clarification	
9.	Methods of preservation of fruit juice and Preparation of fruit beverages such as RTS, cordial squash etc.	
10.	Role of sugar and pectin in processed products, preparation of jam, jelly, marmalades, preserve, candy, crystallized fruit.	
11.	Preservation by chemical preservatives	
12.	preservation with salt and vinegar, pickling, chutneys and sauces	
13.	Processed products of tomato.	
14.	freezing preservation.	
15.	Drying & dehydration of fruits & vegetables	
16.	spoilage in processed foods	
17.	quality control of processed products, Govt. policy on import and export of processed fruits. Food laws.	

Lecture Schedule: Practicals

S.No.	Topics	Tentative Date
1.	To become acquint with processing machines and equipments in the processing unit.	
2.	Estimation of TSS of fruits/ vegetables	
3.	Estimation of acidity of fruits/ vegetables	
4.	Estimation of ascorbic acid content of fruits/ vegetables	
5.	Extraction of juice/ pulp from seasonal fruit and its preservation.	
6.	Calculation of ingredients for processed products	
7.	Preparation of orange squash	
8.	Preparation of lime squash	
9.	Preparation of guava based RTS	
10.	Preparation of lime juice cordial	
11.	Preparation of apple jam	
12.	Preparation of papaya jam	
13.	Preparation of guava jelly	
14.	Preparation of aonla candies	
15.	Preparation of tomato chutneys	
16.	Preparation of fermented pickles of radish	
17.	Preparation of garlic pickle in vinegar	
18.	Preservation of onions in vinegar	
19.	Solar drying of leafy vegetables (methi)	
20.	Freezing of peas	
21.	Preparation of tomato ketchup	
22.	Preparation of salsa sauce of bell paper/ capsicum	
23.	Preparation of aonla jam	
24.	Preparation of grape wine	
25.	Osmotic dehydartion of grapes	
26.	Visit to processing units	

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2. Kalia, Manoranjan and Sood, Sangita.*Food Preservation and Processing*, Kalyani Publishers, Ludhiana.
3. Lal, Girdhari Siddappaa, G.S. and Tandon, G.L.*Preservation of fruits & vegetables,* ICAR, New Delhi.
4. Srivastava, R.P. and Sanjeev Kumar.*Fruit & Vegetable Preservation: Principles and Practices, 3rd Edition,* International Book Distributing Co., Lucknow.

PPR-321 Apiculture, Sericulture and Lac culture 2(1+1)

Theory

Introduction to beneficial insects. Importance and History of apiculture. Species of honey bees, Rock bee, Littlebee, Indian bee, European bee, Italian bee and Dammar bee, lifecycle and caste determination. Bee colony maintenance, bee colony activities, starting of new colony, location site, transferring colony, replacement of queen, combining colonies, swarm prevention, colony management in different seasons, Equipment for apiary, types of bee hives and their description. Bee pasturage. Honey extraction, honey composition and value, bee wax and tissues.. Importance, History and development in India of sericulture, silkworms kinds and their hosts, systematic position, distribution, lifecycles in brief, Silk glands. Mulberry silkworm-morphological features, races, rearing house and equipments, disinfection and hygiene. Grainage acid treatment, packing and transportation of eggs, Incubation, black boxing, hatching of eggs. Silkworm rearing young age /chawkirearing and old age rearing of silkworms. Feeding, spacing, environmental conditions and sanitation. Cocoon characters colour, shape, hardiness and shell ratio. Defective cocoons and stifling of cocoons. Uses of silk and by-products. Economics of silk production. Moriculture-Mulberry varieties, package of practices, Pests and diseases and their management. Lac growing areas in India, Lac insects, biology, behaviour, lac cultivation, food plants, pruning, inoculation, cropping, kinds of lac. Enemies of lac-insects.

Practical

Honey bee colony, different bee hives and apiculture equipment. Summer and Wintermanagement of colony. Honey extraction and bottling. Study of pests and diseases of honeybees. Establishment of mulberry garden. Preparation of mulberry cuttings, planting methods under irrigated and rainfedconditions. Maintenance of mulberry garden-pruning, fertilization, irrigation and leaf harvest. Mulberry pests and diseases and their management and nutritional disorders. Study of different kinds of silkworms and mulberry silkworm morphology, silk glands. Sericulture equipmentsfor silkworm rearing. Mulberry silkworm rearing room requirements. Rearing of silkworms-chalky rearing. Rearing of silkworms late age silkworm rearing and study of mountages. Study of silkworm pests and their management. Study of silkworm diseases and its management. Lac insects-biology, behaviour, lac cultivation, food plants, pruning, inoculation, cropping, kinds of lac. Enemies of lac insects.

Lecture Schedule: Theory

S. No.	Topics	Tentative Dates
1	Introduction, Importance and history of apiculture	
2	Study of honeybee life cycle and different species of honeybee Indian as well exotic	
3	Management of honeybee colonies in different seasons, artificial feeding etc. and colony division, combine and migration of colonies and replacement of queen	
4	Equipment for apiary establishment types of bee hives and their description, precautions during handling and inspection of colony in apiary andBee pasturage.	
5	Types of bee hives, , procedure of honey extraction and precautions during extraction	
6	Study of honey composition and value of other products of bee hive/colony	

7	Importance, History and development of sericulturein India	
8	Silkworms kinds and their hosts, systematic position, distribution, lifecycles in brief, Silk glands	
9	Mulberry silkworm-morphological features, races, rearing house and equipments, disinfection and hygiene	
10	Grainage aci d treatment, packing an d transportation of eggs, Incubation, black boxing, hatching of eggs	
11	Silkworm rearing young age /chawk irearingandold age rearing of silkworms. Feeding, spacing, environmental conditions and sanitation. Cocoon characters colou r, shape, hardiness and shell ratioand defective cocoons and stifling of cocoons.	
12	Uses of silk and by-products. Economics of silk production. Moriculture-Mulberry varieties, package of practices	
13	Silkworm pests and diseases and their management	
14	Lac growing areas in India and Lac insectsbiology, behavior and Lac cultivation	
15	Lac insect food plants, pruning, inoculation, cropping, kinds of lac	
16	Enemies of lac insects	

Lecture Schedule: Practicals

S. No.	Topics	Tentative Dates
1.	Study of colony organization and life cycle of different species of honey bees	
2.	Morphology, anatomy and social behaviour of honey bee	
3.	Study of Beekeeping equipment and Handling of bee colony and maintenance of apiary recordand types of bee hive	
4.	Seasonal management of honey bee colonies: summer and winter	
5.	Queen rearing and Economics of beekeeping	
6.	Familiarization with enemies of honey bees and their control	
7.	Honey extraction, processing and bottling	
8.	Study of different kinds of silkworms and mulberry silkworm morphology, silk glands	
9.	Establishment of mulberry garden. Preparation of mulberry cuttings, planting methods under irrigated and rainfedconditions	
10.	Study of Sericultur e equipmentsfor silkworm rearing. Mulberr y silkworm rearing room requirements	
11.	Study of rearin g of silkworms-chalky rearing, rearin g of silkworms late age silkworm rearing and study of mount ages	
12.	Study of mulberr y pests and diseases and their management and nutritional disorder	
13.	Study of Lac insects-biology and behaviour	
14.	Study of lac cultivation, food plants, pruning, inoculation, cropping	
15.	Study of types of lac	
16.	Enemies of lac insects	

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

PPR-322 Nematode Pests of Horticultural Crops and their Management 2(1+1)

Theory

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

Practical

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

Lecture Schedule: Theory

S. No.	Topics	Tentative Dates
1	History and Development of Nematology	
2	Economic Importance of Plant Parasitic Nematodes	
3	General Characters of Plant Parasitic Nematodes	
4	General Morphology (I)	
5	General Morphology (II)	
6	General Morphology (III)	
7	Biology of Plant Parasitic Nematodes	
8	Symptomatology	
9	Nematode Pests of Vegetable Crops and their Management (I)	
10	Nematode Pests of Vegetable Crops and their Management (II)	
11	Nematode Pests of Tuber Crops and their Management	
12	Nematode Pests of Fruit Crops and their Management (I)	
13	Nematode Pests of Fruit Crops and their Management (II)	
14	Nematode Pests of Ornamental plants and their Management	
15	Nematode Pests of Spice and Plantation Crops and their Management	
16	Role of Nematodes in Plant Disease Complexes	
17	Integrated nematode management	

Lecture Schedule: Practicals

S. No.	Topics	Tentative Dates
1	Survey and surveillance	
2	Collection of Soil and Root Samples	
3	Extraction of Nematodes from Soil Samples	
4	Extraction of Nematode from Plant Material	
5	Handling and Use of Microscopes	
6	Counting and Picking of Nematodes	
7	Preparation of Fixatives and their Recipes/Compositions	
8	Preparation of Temporary and Permanent Mounts	
9	Morphology of a Typical Plant Parasitic Nematode	
10	To Study the Symptoms Produced by Nematodes	
11	Collection and Preservation of Nematode infested plant specimens - Fruit crops	
12	Collection and Preservation of Nematode infested plant specimens Vegetable crops	
13	Collection and Preservation of Nematode infested plant specimens – Flower crops	
14	Nematicides and their Application	

Suggested Reading:

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Reddy, P.P. 2007 Integrated Nematode Management in Horticultural Crops. Scientific Publisher, Jodhpur pp300

Reddy, P.P. 2008 Disease of Horticultural Crops: Nematode Problem and their Management. Scientific Publisher, Jodhpur pp379.

Wallia, R.K. And Bajaj, H.K. (2013) Text Book on Introductory Plant Nematology. ICAR, New Delhi pp227.

BAS-321 Horti-Business Management 2 (2+0)

Theroy

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

Lecture Schedule: Theory

S.No.	Topics	Tentative Dates
1.	Farm management - definition, nature, characteristics, scope, principles and	
2.	Decision making, production function, technical relationships, cost concepts, curves and functions – factors, product,	
3.	Relationship – factors relationship, product relationship, optimum conditions,	
4.	Principles of opportunity cost of equi-marginal returns and	
5.	Comparative advantages, time value of money, economic of scale, returns to scale,	
6.	Cost of cultivation and production, break even analysis,	
7.	Decision making under risk and uncertainty.	
8.	Farming systems and types.	
9.	Planning – meaning, steps and methods of planning,	
10.	Types of plan, characteristics of effective plans.	
11.	Organizations – forms of business organizations,	
12.	Organizational principles, division of labour.	
13.	Unity of command, scalar pattern, job des ign, span of control responsibility,	
14.	Power authority and accountability.	
15.	Direction – guiding, leading, motivating, supervising,	
16.	Coordination – meaning, types and	
17.	Methods of controlling – evaluation, control systems and devices.	
18.	Budgeting as a tool for planning and control.	

19.	Record keeping as a tool of control.	
20.	Functional areas of management – operations management – physical facilities, implementing the plan,	
21.	Scheduling the work,	
22.	Controlling production in terms of quantity and quality.	
23.	Materials management – types of inventories, inventory costs,	
24.	Managing the inventories,	
25.	Economic order quantity (EOQ).	
26.	Personnel management – recruitment, selection and training, job specialization.	
27.	Marketing management – definitions, planning the marketing programmes, marketing mix and four p's.	
28.	Financial management – financial statements and ratios, capital budgeting.	
29.	Project management – project preparation and evaluation measures.	

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

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

Theroy

Entrepreneurship Development: Assessing overall business environment in the Indian economy. Overview of Indian social, political and economic systems and their implications for decision making by individual entrepreneurs. Globalization and the emerging business / entrepreneurial environment. Concept of entrepreneurship; entrepreneurial and managerial characteristics; managing an enterprise; motivation and entrepreneurship development; importance of planning, monitoring, evaluation and follow up; managing competition; entrepreneurship development programs; SWOT analysis, Generation, incubation and commercialization of ideas and innovations. 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. Venture capital. Contract farming and joint ventures, public-private partnerships. Supply chain management and total quality management. Overview of horti inputs industry. Characteristics of Indian horticultural processing and export industry. Social Responsibility of Business. Communication Skills: meaning and process of communication, verbal and non-verbal communication; listening and note taking, writing skills, oral presentation skills developing organizational and managerial skills, problem solving skills. field diary and lab record; indexing, footnote and bibliographic procedures.

Practical

Listening and note taking, writing skills, oral presentation skills; field diary and lab record; indexing, footnote and bibliographic procedures. Reading and comprehension of general and technical articles, précis writing, summarizing, abstracting; Conducting market survey to the demand for product, preparing advertisements for popularization of product, news writing, preparing project proposals, individual, group presentation, features of oral presentation, presentation, evaluation of presentation and evaluation of sheet, dyanamic communication-face to face conversation, telephone conversation, rate of speech and clarity of voice, speaking and listening politeness, telephone etiquettes, organising general and group meeting, salient features of participation in seminars and conferences, conducting and participating in mock interviews.

Lecture Schedule: Theory

S.No.	Topics	Tentative Dates
1.	Assessing overall business environment in the Indian economy.	
2.	Overview of Indian social, political and economic systems and their implications for decision making by individual entrepreneurs.	
3.	Globalization and the emerging business / entrepreneuri al environment.	
4.	Concept of entrepreneurship; entrepreneurial and managerial characteristics;	
5.	Managing an enterprise; motivation and entrepreneurship development;	
6.	Importance of planning, monitoring, evaluation and follow up;	
7.	Managing competition; entrepreneurship development programs;	
8.	SWOT analysis, generation, incubation and commercialization of ideas and innovations.	
9.	Government schemes and incentives for promotion of entrepreneurship.	
10.	Government policy on small and medium enterprises (smes) / ssis.	
11.	Export and import policies relevant to horticulture sector.	

12.	Venture capital. Contract farming and joint ventures, public -private partnerships.	
13.	Supply chain management and total quality management.	
14.	Overview of horti inputs industry.	
15.	Characteristics of Indian horticultural processing and export industry. Social responsibility of business.	
16.	Meaning and process of communication,	
17.	Verbal and non-verbal communication;	
18.	Listening and note taking, writing skills, oral presentation skills developing organizational and	
19.	Managerial skills, problem solving skills.	
20.	Field diary and lab record; indexing, footnote and bibliographic procedures.	

Lecture Schedule: Practicals

S.No.	Topics	Tentative Dates
1.	Listening and note taking, writing skills, oral presentation skills;	
2.	Field diary and lab record; indexing, footnote and bibliographic procedures.	
3.	Reading and comprehension of general and technical articles, précis writing, summarizing, abstracting;	
4.	Conducting market survey to the demand for product,	
5.	Preparing advertisements for popularization of product,	
6.	News writing, preparing project proposals,	
7.	Individual, group presentation, features of oral presentation,	
8.	Evaluation of presentation and evaluation of sheet,	
9.	Dyanamic communication -face to face conversation, telephone conversation,	
10.	Rate of speech and clarity of voice, speaking and listening politeness,	
11.	Telephone etiquettes, organising general and group meeting,	
12.	Salient features of participation in seminars and conferences,	
13.	Conducting and participating in mock interviews.	

Suggested Reading:

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

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

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

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

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

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

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

Somani, L. L., *Extension Education and Communication*, Agrotech, Publishing Academy, Udaipur.

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

S. Anil Kumar, S.C Poornima, M.K. Abhraham and K. Jayashree, 2008; Entrepreneurship Development. New Age International Publishers

NRM-321 Organic Farming 2 (1+1)

Theory

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

Practical

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

Lecture Schedule: Theory

S.No.	Topics	Tentative Dates
1.	Introduction, Definitions, Concept, Principles & scope of organic farming	
2.	Ill effect of green revolution, advantages & disadvantages of OF	
3.	Relevance of organic farming in present context	
4.	Organic production requirements-for nutrient management	
5.	Biological intensive nutrient management-organic manures	
6.	Vermicomposting, Vermiwash	
7.	Green manuring, Recycling of organic residues, Soil improvement through amendments	
8.	Biofertilizers	
9.	Composting –methods, its advantages & disadvantages	
10.	Integrated diseases and pest management	
11.	Use of biocontrol agents-Biopesticides pheromones, Trap crops, bird perches	
12.	Weed management	
13.	Quality considerations, certification,	
14.	Labeling and accreditation procedures	
15.	Marketing & exports of organic products	

Lecture Schedule: Practicals

S.No.	Topics	Tentative Dates
1.	Raising of vegetable crops organically through nutrient, diseases and pest management…	
2.	…Continue…	
3.	…Continue…	
4.	…Continue…	
5.	…Continue…	
6.	…Continue…	
7.	…Continue	
8.	Estimation of organic matter content in soil sample	
9.	Vermicomposting	
10.	Vermiwash Preparation	
11.	Use of Vermiwash in nursery and fruit orchards	
12.	Vegetable and ornamental nursery raising…	
13.	…Continue…	
14.	…Continue.	
15.	Macro quality analysis, grading, packaging, post harvest management	

Suggested Readings:

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

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

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

U.Thapa and P. Tripathy. 2006. *Organic farming in India- Problems and Prospects*. Agrotech publishing agency, Udaipur.

G.K.Veeresh. 2006. *Organic farming*. Foundation Books. New Delhi.

Purshit,S.S.2006.*TrendsinOrganicFarminginIndia*. AgrosBios(INDIA), Jodhpur.

Thampan,P. K.1995.*OrganicAgriculture*. PeckaytreeCropsDevelopmentFoundation, Cochin,Kerala.

Sathe,T.V.2004.*VermicultureandOrganicFarming*. DaysPublishingHouse,NewDelhi.