

B.Sc. (Hons.) Horticulture
[4-Year, 8- Semester]

CHOICE BASED CREDIT SYSTEM (CBCS)

Effective from Academic Year, 2021-2022

**(In accordance to the 5th Dean Committee of ICAR curriculum for
undergraduate programme in Horticulture)**

H.N.B. GARHWAL UNIVERSITY
(A Central University)
Srinagar – Garhwal
Uttarakhand

DEPARTMENT OF HORTICULTURE
H.N.B. Garhwal University, Srinagar (Garhwal), Uttarakhand, India-246 174
Course Curriculum for B. Sc. (Hons.) Horticulture, 2021-22 under CBCS Course offered

Course no.	Paper Title	Total marks	Theory marks		Credits
			Internal	External	
Semester I					
Core					
SOA/HC/UG 01 T	Fundamentals of Soil Science	100	30	70	2
SOA/HC/UG 01 P	Fundamentals of Soil Science	100	30	70	1
SOA/HC/UG 02 T	Elementary Plant Biochemistry	100	30	70	2
SOA/HC/UG 02 P	Elementary Plant Biochemistry	100	30	70	1
SOA/HC/UG 03 T	Medicinal and Aromatic Plants	100	30	70	2
SOA/HC/UG 03 P	Medicinal and Aromatic Plants	100	30	70	1
SOA/HC/UG 04 T	Fundamentals of Extension Education	100	30	70	2
SOA/HC/UG 04 P	Fundamentals of Extension Education	100	30	70	1
Ability Enhancement Compulsory Course (AECC)					
SOA/HA/ECC/UG 01 T	Communication Skills and Personality Development	100	30	70	1
SOA/HA/ECC/UG 01 P	Communication Skills and Personality Development	100	30	70	1
Elective					
Student has to earn 6 credits from the electives. Student can choose any elective from same department or other department of School of Agriculture & Allied Sciences.					
SOA/HE/UG 01 T	Economics and Marketing	100	30	70	2
SOA/HE/UG 02 T	Elementary Plant Biotechnology	100	30	70	1
SOA/HE/UG 02 P	Elementary Plant Biotechnology	100	30	70	1
SOA/HE/UG 03 T	Fundamentals of Horticulture	100	30	70	1
SOA/HE/UG 03 P	Fundamentals of Horticulture	100	30	70	1
SOA/HE/UG 04 T	Information and Communication Technology	100	30	70	1
SOA/HE/UG 04 P	Information and Communication Technology	100	30	70	1
Total Credit to earn in the semester I					
Core	AECC	SEC	Elective	Total	
12	2	-	6	20	

Theory and practical are linked to each other.

In Theory, One credit = 1 hr

In practical, One credit= 3 hrs

T- Theory

P-Practical

Course no.	Paper Title	Total marks	Theory marks		Credits
			Internal	External	
Semester II					
Core					
SOA/HC/UG 05 T	Introductory Crop Physiology	100	30	70	2
SOA/HC/UG 05 P	Introductory Crop Physiology	100	30	70	1
SOA/HC/UG 06 T	Principles of Genetics and Cytogenetics	100	30	70	2
SOA/HC/UG 06 P	Principles of Genetics and Cytogenetics	100	30	70	1
SOA/HC/UG 07 T	Fundamentals of Plant Pathology	100	30	70	1
SOA/HC/UG 07 P	Fundamentals of Plant Pathology	100	30	70	1
SOA/HC/UG 08 T	Elementary Statistics and Computer Application	100	30	70	2
SOA/HC/UG 08 P	Elementary Statistics and Computer Application	100	30	70	1
SOA/HC/UG 09 T	Soil Fertility and Nutrient Management	100	30	70	1
SOA/HC/UG 09 P	Soil Fertility and Nutrient Management	100	30	70	1
Ability Enhancement Compulsory Course (AECC)					
SOA/HAECC/UG 02 T	Environmental Science and Disaster Management	100	30	70	1
SOA/HAECC/UG 02 P	Environmental Science and Disaster Management	100	30	70	1
Elective					
Student has to earn 6 credits from the electives. Student can choose any elective from same department or other department of School of Agriculture & Allied Sciences.					
SOA/HE/UG 05 T	Introductory Microbiology	100	30	70	1
SOA/HE/UG 05 P	Introductory Microbiology	100	30	70	1
SOA/HE/UG 06 T	Apiculture, Sericulture and Lac culture	100	30	70	1
SOA/HE/UG 06 P	Apiculture, Sericulture and Lac culture	100	30	70	1
SOA/HE/UG 07 T	Agrometeorology	100	30	70	1
SOA/HE/UG 07 P	Agrometeorology	100	30	70	1
SOA/HE/UG 08 T	Introductory Agroforestry	100	30	70	1
SOA/HE/UG 08 P	Introductory Agroforestry	100	30	70	1
Total Credit to earn in the semester II					
Core	AECC	SEC	Elective	Total	
13	2	-	6	21	

Theory and practical are linked to each other.

In Theory, One credit = 1 hr

In practical, One credit= 3 hrs

T- Theory

P-Practical

Course no.	Paper Title	Total marks	Theory marks		Credits
			Internal	External	
Semester III					
Core					
SOA/HC/UG 10 T	Tropical and Subtropical Fruits	100	30	70	2
SOA/HC/UG 10 P	Tropical and Subtropical Fruits	100	30	70	1
SOA/HC/UG 11 T	Weed Management in Horticultural Crops	100	30	70	1
SOA/HC/UG 11 P	Weed Management in Horticultural Crops	100	30	70	1
SOA/HC/UG 12 T	Tropical and Subtropical Vegetables crops	100	30	70	2
SOA/HC/UG 12 P	Tropical and Subtropical Vegetables crops	100	30	70	1
SOA/HC/UG 13 T	Orchard and Estate Management	100	30	70	1
SOA/HC/UG 13 P	Orchard and Estate Management	100	30	70	1
SOA/HC/UG 14 T	Principles of Plant Breeding	100	30	70	2
SOA/HC/UG 14 P	Principles of Plant Breeding	100	30	70	1
Skill Enhancement Compulsory Course (SEC)					
SOA/HSEC/UG 01 T	Propagation and Nursery Management	100	30	70	1
SOA/HSEC/UG 01 P	Propagation and Nursery Management	100	30	70	1
Elective					
Student has to earn 6 credits from the electives. Student can choose any elective from same department or other department of School of Agriculture & Allied Sciences.					
SOA/HE/UG 09 T	Fundamentals of Entomology	100	30	70	1
SOA/HE/UG 09 P	Fundamentals of Entomology	100	30	70	1
SOA/HE/UG 10 T	Introduction to Major Field Crops	100	30	70	1
SOA/HE/UG 10 P	Introduction to Major Field Crops	100	30	70	1
SOA/HE/UG 11 T	Water Management in Horticultural Crops	100	30	70	1
SOA/HE/UG 11 P	Water Management in Horticultural Crops	100	30	70	1
Total Credit to earn in the semester III					
Core	AECC	SEC	Elective	Total	
13	-	2	6	21	

Theory and practical are linked to each other.

In Theory, One credit = 1 hr

In practical, One credit= 3 hrs

T- Theory
P-Practical

Course no.	Paper Title	Total marks	Theory marks		Credits
			Internal	External	
Semester IV					
Core					
SOA/HC/UG 15 T	Spices and Condiments	100	30	70	1
SOA/HC/UG 15 P	Spices and Condiments	100	30	70	1
SOA/HC/UG 16 T	Temperate Fruit Crops	100	30	70	2
SOA/HC/UG 16 P	Temperate Fruit Crops	100	30	70	1
SOA/HC/UG 17 T	Ornamental Horticulture	100	30	70	2
SOA/HC/UG 17 P	Ornamental Horticulture	100	30	70	1
SOA/HC/UG 18 T	Breeding of Fruits and Plantation Crops	100	30	70	1
SOA/HC/UG 18 P	Breeding of Fruits and Plantation Crops	100	30	70	1
SOA/HC/UG 19 T	Plantation Crops	100	30	70	2
SOA/HC/UG 19 P	Plantation Crops	100	30	70	1
Skill Enhancement Compulsory Course (SEC)					
SOA/HSEC/UG 02 T	Organic Farming	100	30	70	1
SOA/HSEC/UG 02 P	Organic Farming	100	30	70	1
Elective					
Student has to earn 6 credits from the electives. Student can choose any elective from same department or other department of School of Agriculture & Allied Sciences.					
SOA/HE/UG 12 T	Nematode pests of horticultural crops and their Management	100	30	70	1
SOA/HE/UG 12 P	Nematode pests of horticultural crops and their Management	100	30	70	1
SOA/HE/UG 13 T	Growth and Development of Horticultural Crops	100	30	70	1
SOA/HE/UG 13 P	Growth and Development of Horticultural Crops	100	30	70	1
SOA/HE/UG 14 T	Dry land Horticulture	100	30	70	1
SOA/HE/UG 14 P	Dry land Horticulture	100	30	70	1
Total Credit to earn in the semester IV					
Core	AECC	SEC	Elective	Total	
13	-	2	6	21	

Theory and practical are linked to each other.

In Theory, One credit = 1 hr

In practical, One credit= 3 hrs

T- Theory
P-Practical

Course no.	Paper Title	Total marks	Theory marks		Credits
			Internal	External	
Semester V					
Core					
SOA/HC/UG 20 T	Temperate Vegetables	100	30	70	2
SOA/HC/UG 20 P	Temperate Vegetables	100	30	70	1
SOA/HC/UG 21 T	Principles of Landscape Architecture	100	30	70	1
SOA/HC/UG 21 P	Principles of Landscape Architecture	100	30	70	1
SOA/HC/UG 22 T	Farm Power and Machinery	100	30	70	1
SOA/HC/UG 22 P	Farm Power and Machinery	100	30	70	1
SOA/HC/UG 23 T	Diseases of Fruit, Plantation, Medicinal and Aromatic Crops	100	30	70	2
SOA/HC/UG 23 P	Diseases of Fruit, Plantation, Medicinal and Aromatic Crops	100	30	70	1
SOA/HC/UG 24 T	Insect Pests of Fruit, Plantation, Medicinal & Aromatic Crops	100	30	70	2
SOA/HC/UG 24 P	Insect Pests of Fruit, Plantation, Medicinal & Aromatic Crops	100	30	70	1
Skill Enhancement Compulsory Course (SEC)					
SOA/HSEC/UG 03 T	Entrepreneurship Development and Business Management	100	30	70	1
SOA/HSEC/UG 03 P	Entrepreneurship Development and Business Management	100	30	70	1
Elective					
Student has to earn 6 credits from the electives. Student can choose any elective from same department or other department of School of Agriculture & Allied Sciences.					
SOA/HE/UG 15 T	Soil, Water and Plant Analysis	100	30	70	1
SOA/HE/UG 15 P	Soil, Water and Plant Analysis	100	30	70	1
SOA/HE/UG 16 T	Mushroom Culture	100	30	70	1
SOA/HE/UG 16 P	Mushroom Culture	100	30	70	1
SOA/HE/UG 17 T	Fundamentals of Food Technology	100	30	70	1
SOA/HE/UG 17 P	Fundamentals of Food Technology	100	30	70	1
Total Credit to earn in the semester V					
Core	AECC	SEC	Elective	Total	
13	-	2	6	21	

Theory and practical are linked to each other.

In Theory, One credit = 1 hr

In practical, One credit= 3 hrs

T- Theory

P-Practical

Course no.	Paper Title	Total marks	Theory marks		Credits
			Internal	External	
Semester VI					
Core					
SOA/HC/UG 25 T	Potato and Tuber crops	100	30	70	1
SOA/HC/UG 25 P	Potato and Tuber crops	100	30	70	1
SOA/HC/UG 26 T	Breeding of Vegetable, Tuber and Spice Crops	100	30	70	2
SOA/HC/UG 26 P	Breeding of Vegetable, Tuber and Spice Crops	100	30	70	1
SOA/HC/UG 27 T	Post harvest Management of Horticultural Crops	100	30	70	2
SOA/HC/UG 27 P	Post harvest Management of Horticultural Crops	100	30	70	1
SOA/HC/UG 28 T	Seed production of Vegetable, tuber and Spice Crops	100	30	70	2
SOA/HC/UG 28 P	Seed production of Vegetable, tuber and Spice Crops	100	30	70	1
SOA/HC/UG 29 T	Insect Pests of Vegetable, Ornamental and Spice Crops	100	30	70	2
SOA/HC/UG 29 P	Insect Pests of Vegetable, Ornamental and Spice Crops	100	30	70	1
Skill Enhancement Compulsory Course (SEC)					
SOA/HSEC/UG 04 T	Commercial Floriculture	100	30	70	1
SOA/HSEC/UG 04 P	Commercial Floriculture	100	30	70	1
Elective					
Student has to earn 6 credits from the electives. Student can choose any elective from same department or other department of School of Agriculture & Allied Sciences.					
SOA/HE/UG 18 T	Breeding and Seed Production of Ornamental Plants	100	30	70	1
SOA/HE/UG 18 P	Breeding and Seed Production of Ornamental Plants	100	30	70	1
SOA/HE/UG 19 T	Diseases of Vegetable, Ornamentals and Spice Crops	100	30	70	1
SOA/HE/UG 19 P	Diseases of Vegetable, Ornamentals and Spice Crops	100	30	70	1
SOA/HE/UG 20 T	Precision Farming and Protected Cultivation	100	30	70	1
SOA/HE/UG 20 P	Precision Farming and Protected Cultivation	100	30	70	1
Total Credit to earn in the semester VI					
Core	AECC	SEC	Elective	Total	
14	-	2	6	22	

Theory and practical are linked to each other.

In Theory, One credit = 1 hr

In practical, One credit= 3 hrs

Course no.	Paper Title	Total marks	Theory marks		Credits
			Internal	External	
Semester VII					
Core					
SOA/HC/UG 30 T	Processing of Horticultural Crops	100	30	70	2
SOA/HC/UG 30 P	Processing of Horticultural Crops	100	30	70	1
SOA/HC/UG 31 T	STUDENT READY: Experimental Learning programme Commercial Horticulture I. Project preparation and Report writing	100	30	70	6
SOA/HC/UG 32 T	STUDENT READY: Experimental Learning programme Processing of Fruits and Vegetables for Value Addition I. Project preparation and Report writing	100	30	70	6
Skill Enhancement Compulsory Course (SEC)					
SOA/HSEC/UG 05 T	Horti-Business Management	100	30	70	2
Elective					
Student has to earn 6 credits from the electives. Student can choose any elective from same department or other department of School of Agriculture & Allied Sciences.					
SOA/HE/UG 21 P	STUDENT READY: Experimental Learning programme Commercial Horticulture II. Presentation and discussion.	100	30	70	3
SOA/HE/UG 22 P	STUDENT READY: Experimental Learning programme Processing of Fruits and Vegetables for Value Addition II. Presentation and discussion.	100	30	70	3
Total Credit to earn in the semester VII					
Core	AECC	SEC	Elective	Total	
15	-	2	6	23	

Theory and practical are linked to each other.

In Theory, One credit = 1 hr

In practical, One credit= 3 hrs

Course no.	Paper Title	Total marks	Theory marks		Credits
			Internal	External	
Semester VIII					
Core					
SOA/HC/UG 33 T	Rural Horticultural Work Experience (RHWE) I. Project preparation	100	30	70	4
SOA/HC/UG 34 P	Rural Horticultural Work Experience (RHWE) II. Placement in Industries	100	30	70	4
SOA/HC/UG 35 P	Rural Horticultural Work Experience (RHWE) III. Placement in Villages	100	30	70	6
SOA/HC/UG 36 T	Rural Horticultural Work Experience (RHWE) IV. Report writing, presentation and discussion (Placement in Industries & Villages)	100	30	70	6
Total Credit to earn in the semester VIII					
Core	AECC	SEC	Elective	Total	
20	-	-	-	20	

Theory and practical are linked to each other.

In Theory, One credit = 1 hr

In practical, One credit= 3 hrs

T- Theory

P- Practical

RHWE Programme schedule

S.N.		Duration
1.	Orientation Programme	2 weeks
2.	Village stay	12 weeks
3.	All India Study Tour	3 weeks
4.	Placement Programme	4 weeks
5.	Report writing & Final Examination	3 weeks
	Total	24 Weeks

Summary of credits:

Semester	Core	AECC	SEC	Elective	TOTAL
I	12	2	-	6	20
II	13	2	-	6	21
III	13	-	2	6	21
IV	13	-	2	6	21
V	13	-	2	6	21
VI	14	-	2	6	22
VII	15	-	2	6	23
VIII	20	-	-	-	20
TOTAL	113	4	10	42	169

Note: Practicals in affiliated colleges/ institute shall be conducted by the university appointed examiner.

SEMESTER-I

Course No.	Course Title	Credits
SOA/HC/UG 01	Fundamental of Soil Science	3(2+1)

SOA/HC/UG 01 T: Fundamental of Soil Science (2)

Composition of earth's crust, soil as a natural body – major components. Eluviations and alleviations formation of various soils. 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), AD – practical problems. Pore space – definition, factors affecting capillary and non-capillary porosity, soil colour – definition, its significance, colour variable, value hue and chroma. Munsell colour chart, factors influencing, parent material, soil moisture, organic matter, soil structure, definition, classification, clay prism like structure, factors influencing genesis of soil structure, soil 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 – classification – aerial photography – satellite of soil features – their interpretation; soil orders; land capability classification; soil of different ecosystems and their properties, Rock & Minerals classification, Pedogenic process. Objectives of soil science research institute in India (NBSS&LUP, ISSS, LTFE & NSSTL). Management of Soil Crusting, Soil Compaction and Soil Compression. Soil Biology benefits and harmful effects. Methods and objective of soil survey, Remote sensing application in soil and plant Studies, Soil degradation.

SOA/HC/UG 01 P: Fundamental of Soil Science (1)

Collection and preparation of soil samples, estimation of moisture, EC, pH and bulk density. Textural analysis of soil by Robinson's pipette method. Description of soil profile in the field. Quantification 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 pore space of soil. 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.

Suggested Reading:

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

- ❖ Brady, N. C. and Well, R.R. 2014. Nature and Properties of Soils. Pearson Education Inc., New Delhi.
- ❖ Das, D. K. 2011. Introductory Soil Science (3rd Edition), Kalyani Publisher, Ludhiana (India).
- ❖ Das, D. K. 2015. Introductory Soil Science. Kalyani Publishers, Ludhiana.
- ❖ Foth, H. D. 1991. Fundamentals of Soil Science (8th Edition), John Wiley & Sons, New Delhi.
- ❖ Ghildyal, B. P. and Tripathi, R. P. 1987. Soil Physics. Acad. Press. New York.
- ❖ Gupta, P. K. 2009. Soil, Plant, Water and Fertilizer Analysis (2nd Edition), AGROBIOS, Jodhpur (India).
- ❖ Indian Society of Soil Science. 2002. Fundamentals of Soil Science. IARI, New Delhi.
- ❖ Jackson, M. L. 2012. Soil Chemical Analysis: Advanced Course. Scientific Publisher
- ❖ Jaiswal, P. C. 2006. Soil, Plant and Water Analysis (2nd Edition), Kalyani Publishers, Ludhiana.
- ❖ Khan, T. O. 2013. Forest Soils: Properties and Management. Springer International Publishing, Switzerland.
- ❖ Kolay, A. K. 1983. Basic concepts of Soil Science. Wiley Eastern Ltd., New Delhi
- ❖ Pritchett and Fisher, R. F. 1987. Properties and Management of Forest Soils. John Wiley, New York.
- ❖ Sehgal, J. A. 2005. Textbook of Pedology Concepts and Applications. Kalyani Publishers, New Delhi.

Course No.	Course Title	Credits
SOA/HC/UG 02	Elementary Plant Biochemistry	3(2+1)

SOA/HC/UG 02 T: Elementary Plant Biochemistry (2)

Carbohydrates: Occurrence, classification and structure, physical and chemical properties of carbohydrates, isomerism, optical activity, reducing property, reaction with acids and alkalis, ozone formation. Lipids: Classification, important fatty acids and triglycerides, essential fatty acids. Physical and chemical control of oils, their rancidity, phospholipids, types and importance. Plant pigments – structure and function of chlorophyll and carotenoids, sterols, basic structure, role of brassino sterols in plants. Proteins: Classification, function and solubility, amino acids – classification and structure, essential amino acids, properties of amino acids, colour reactions, amphoteric nature and isomerism; structure of proteins – primary, secondary tertiary and quaternary properties 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, bioenergetics of glucose and fatty acids, structure and function of nucleic acid replication, transcription and translation.

SOA/HC/UG 02 P: Elementary Plant Biochemistry (1)

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.

Suggested Reading:

- ❖ Bose, B. and Hemantaranjan, A. 2008. Developments in Physiology Biochemistry & Molecular Biology of Plants (Vol. 2). New India Publications.
- ❖ Buchanan, B. B., Gruissem, W. and Jones, R. L. 2002. Biochemistry and Molecular Biology of Plants (2nd Edition). Blackwell Publications, UK.
- ❖ Fatima, N. A. D., Narayanan, L.M., Meyyan, R.P., Nallasingam, K. and Kumar, S.P. 2014. Biochemistry. Saras Publications.
- ❖ Lehninger, Nelson, D. L. and Michael, M. C. 2004. Principles of Biochemistry. Freeman Publishers.
- ❖ Rameshwar, A. 2006. Practical Biochemistry (3rd Edt.). Kalyani Publishers, New Delhi.
- ❖ Sadashiv, S. and Manickam, A. 1996. Biochemical Methods for Agricultural Sciences. New Age International Publishers, New Delhi.
- ❖ Voet, D. and Voet J. G. 2004. Biochemistry (4th Edt.). Wiley & Sons Publishers, USA.
- ❖ Voet, D. and Voet, J. G. 2004. Biochemistry (3rd Edt.). Wiley & Sons Publishers, USA.

Course No.	Course Title	Credits
SOA/HC/UG	Medicinal and Aromatic Plants	3(2+1)

SOA/HC/UG 03 T: Medicinal and Aromatic Plants (2)

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, Rauwolfia, 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.

SOA/HC/UG 03 P: Medicinal and Aromatic Plants (1)

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.

Suggested Reading:

- ❖ Atal, E. K. and Kapur, B. 1982. Cultivation and Utilization of Medicinal and Aromatic plants. CSIR, New Delhi.
- ❖ Chadha, K. L. 2001. Hand Book of Horticulture. Directorate of Information and Publications of Agriculture, ICAR, Pusa, New Delhi.

- ❖ Dastur, J. F. 1982. Medicinal plants of India Pakistan. Taraprevala Soms and Co-private Ltd, Bombay.
- ❖ Farooqui, A.A. and Sreeramu, B. S. 2001. Cultivation of Medicinal and Aromatic Plants. United Press Limited.
- ❖ Jain, S. K. 1968. Medicinal Plants. National Book Trust New Delhi, Oxford & IBH, New Delhi.
- ❖ Kumar, N. J. B. M., Khaddar, M.A., Swamy, R.P. and Irulappan, I. 1997. Introduction to Spices, Plantation Crops Medicinal and Aromatic Plants. Oxford & IBH, New Delhi.

Course No.	Course Title	Credits
SOA/HC/UG 04	Fundamentals of Extension Education	3(2+1)

SOA/HC/UG 04 T: Fundamentals of Extension Education (2)

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. 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.

SOA/HC/UG 04 P: Fundamentals of Extension Education (1)

Visits to study structure, functions, linkages and extension programmes of ICFRE institutes/voluntary organizations/Mahila Mandal, Village Panchayat, State Dept. of Horticulture /All India Radio (AIR). 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 & 35 mm slide projector transparencies. 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.

Suggested Reading:

- ❖ Ban, A.W.V.D. and Hawkins, H. S. 1996. Agricultural Extension. Wiley–Blackwell.
- ❖ Dahama, O. P. and Bhatnagar, O.P. 1998. Education and Communication for Development. Oxford and IBH publishing Co. Pvt. Ltd., New Delhi.
- ❖ Jaliha, K. A. and Veerabhadraiah, V. 2007. Fundamentals of Extension Education and Management in Extension. Concept Publishing Company, New Delhi.
- ❖ Mondal, S. and Ray, G. L. 2012. Text Book on Rural Development, Entrepreneurship and Communication Skills. Kalyani Publications.
- ❖ Muthaiah, M. P. and Arunachalam, R. 2003. Agricultural Extension. Himalaya Publishing House, Mumbai.

- ❖ Rathore, O. S., Dhakar, S.D. and Chauhan, M.S. 2012. Handbook of Extension Education. Agrotech Publishing Academy, Udaipur.
- ❖ Ray, G. L. 1991. Extension Communication and Management (1st Edition). Kalyani Publishers, Ludhiana.
- ❖ Reddy, A. A. 2001. Extension Education. Sree Lakshmi Press, Bapatla.
- ❖ Soundari, M. H. 2001. Indian Agriculture and Information and Communication technology (ICT). New Century Publications.
- ❖ Supe, S. V. 2013. A Text Book of Extension Education (2nd Edition). Agrotech Publishing Academy, Udaipur.

Course No.:	Course Title	Credits
SOA/HAECC/UG 01	Communication Skills and Personality Development	2(1+1)

SOA/HAECC/UG 01 T: Communication Skills and Personality Development (1)

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, impromptu presentation, public speaking; Group discussion. Organizing seminars and conferences.

SOA/HAECC/UG 01 P: Communication Skills and Personality Development (1)

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.

Suggested Reading:

- ❖ Balasubramanian, T. 1989. A Text book of Phonetics for Indian Students. Orient Longman, New Delhi.
- ❖ Balasubramanyam, M. 1985. Business Communication. Vani Educational Books, New Delhi.
- ❖ Bharati, T., Hariprasad, M. and Prakasam, V. 2009. Personality Development and Communicative English. Neelkamal Publications Pvt. Ltd, New Delhi.
- ❖ Carnegie, D. 2012. How to Win Friends and Influence People in the Digital Age. Simon & Schuster.
- ❖ Covey, S.R. 1989. The Seven Habits of Highly Successful People. Free Press.
- ❖ Krishna, M. and Banerjee, M. 1990. Developing Communication Skills. Macmillan India Ltd. New Delhi.
- ❖ Krishnaswamy, N and Sriraman, T. 1995. Current English for Colleges. Macmillan India Ltd. Madras.
- ❖ Murphy, R. 2012. English Grammar in Use (4th Edt.). Cambridge University Press.
- ❖ Narayanaswamy, V. R. 1979. Strengthen Your Writing. Orient Longman, New Delhi.
- ❖ Naterop, Jean, B. and Revell, R. 1997. Telephoning in English. Cambridge University Press, Cambridge.

- ❖ Sharma, R.C. and Mohan, K. 1978. Business Correspondence. Tata Mc Graw Hill Publishing Company, New Delhi.
- ❖ Spitzberg, B., Barge, K. and Morreale, S.P. 2006. Human Communication: Motivation, Knowledge & Skills. Wadsworth.
- ❖ Verma, K.C. 2013. The Art of Communication. Kalpaz.
- ❖ Wren and Martin, S. 2017. High School English Grammar and Composition. Chand and Company Ltd., New Delhi.
- ❖ Wren and Martin, S. 2019. Key to High School English Grammar and Composition. Chand and Company Ltd., New Delhi.

Course No.	Course Title	Credits
SOA/HE/UG 01	Economics and Marketing	2(1+1)

SOA/HE/UG 01 T: Economics and Marketing (2)

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

Suggested Reading

- ❖ Acharya, S.S. and Agarwal, N. L. 2005. Agricultural Marketing in India. Oxford and IBH Publishing Co. Pvt. Ltd
- ❖ Ahuja, H.L. 2019. Advanced Economic Theory: Micro Economic Analysis. S. Chand and Company Limited.
- ❖ Aswathappa, K. 2008. International Business. Tata McGraw-Hill Education, New Delhi
- ❖ C. N. Sontakki. Marketing Management. Kalyani Publishers, New Delhi.
- ❖ Chandra, P. 1984. Projects: Preparation, Appraisal & Implementation. McGraw Hill Inc.
- ❖ Chandra, P. 2009. Projects. Tata McGraw-Hill Publication, New Delhi.
- ❖ Chandra, P. 2019. Projects: Planning, Analysis, Selection, Financing, Implementation, and Review. Tata McGraw-Hill Publishing Company Ltd.
- ❖ Cherunilam, F. 2010. International Business: Text and Cases (5th Edt.) PHI Learning, New Delhi.

- ❖ Daniels, J.J., Radebaugh, L.H. and Sullivan, D.P. 2015. International Business (15th Edt.). Pearson Education
- ❖ 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.
- ❖ Gopalakrishnan, P. and Moorthy, V.E.R. 2014. Textbook of Project Management. Laxmi Publications.
- ❖ Gupta, R. D. & Lekhi, R. K. 1982. Elementary Economic Theory. Kalyani Publishers.
- ❖ Jhingan, M. L. 2012. Macro Economic Theory. Vrinda publishers, New Delhi.
- ❖ Kerzner, H. 2013. Project Management: A System Approach to Planning, Scheduling, and Controlling. CBS Publishers & Distributors.
- ❖ Mukherjee, S. 2002. Modern Economic Theory. New Age International.
- ❖ Nicholas, J.M. 2001. Project Management for Business and Technology: Principles and Practices. Pearson Prentice Hall.
- ❖ Philip, K. and Armstrong, G. 2010. Principles of Marketing. Prentice-Hall.
- ❖ Reddy, S.S., Ram, R.P., Sastry, N.T.V. and Devi, B. I. 2010. Agricultural Economics. Oxford & IBH Publishing Co. Private Limited, New Delhi
- ❖ Stanton, W. J. 1984. Fundamentals of Marketing. Tata McGraw-Hill Publication, New Delhi.

Course No.	Course Title	Credits
SOA/HE/UG 02	Elementary Plant Biotechnology	2(1+1)

SOA/HE/UG 02 T: Elementary Plant Biotechnology (1)

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

SOA/HE/UG 02 P: Elementary Plant Biotechnology (1)

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

transfer techniques, indirect methods; Demonstration of Confirmation of Genetic transformation; Demonstration of gel-electrophoresis techniques. Green synthesis of nano particles and their size characterization.

Suggested Reading:

- ❖ Bilgrami, K. S. and Pandey, A. K.1992. Introduction to Biotechnology. CBS Pub. New Delhi
- ❖ Chahal, G. S. and Gosal, S. S. 2003. Principles and Procedures of Plant Approaches Breeding Biotechnological and Conventional. Narosa Publishing House, New Delhi.
- ❖ Gautam, V.K. 2005. Agricultural Biotechnology. Sublime Publications
- ❖ Gupta, P. K. 1994. Elements of Biotechnology. Rastogi Pub. Meerut.
- ❖ Gupta, P. K. 2015. Elements of Biotechnology (2nd Edt.). Rastogi and Co., Meerut.
- ❖ Purohit, S. S. 2004. A Laboratory Manual of Plant Biotechnology (2nd Edt.). Agribios, India.
- ❖ Razdan, M. K. 2014. Introduction to Plant Tissue Culture (2nd Edt.). Science Publishers, Inc. USA.
- ❖ Singh, B. D. 2004. Biotechnology Expanding Horizons (2nd Edt.). Kalyani Publishers, New Delhi.
- ❖ Singh, B. D. 2012. Plant Biotechnology. Kalyani publishers, Ludhiana.
- ❖ Thomar, R. S., Parakhia, M. V., Patel, S. V. and Golakia, B. A. 2010. Molecular Markers and Plant Biotechnology. New Publishers, New Delhi.

Course No.	Course Title	Credits
SOA/HE/UG 03	Fundamentals of Horticulture	2(1+1)

SOA/HE/UG 03 T: Fundamentals of Horticulture (1)

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. Type of fruits - morphology. Rejuvenation of old orchards, top working, frame working, principles of organic farming, market chain management.

SOA/HE/UG 03 P: Fundamentals of Horticulture (1)

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

Suggested Reading:

- ❖ Chadha, K. L. 2002. Hand book of Horticulture. ICAR, New Delhi
- ❖ Denisen, E. L. 1957. Principles of Horticulture. Macmillan Publishing Co., New York.
- ❖ Edmond, J. B., Sen, T. L., Andrews, F. S. and Halfacre, R. G. 1963. Fundamentals of Horticulture. Tata Mc Graw Hill Publishing Co., New Delhi.
- ❖ Hooker. J.R., 1957. Fundamentals of Fruit Production. Mac Graw Hill Book Co., New York.
- ❖ Kumar, N. 1990. Introduction to Horticulture. Rajyalakshmi Publications, Nagarcoil, Tamilnadu
- ❖ Misra, K.K. and Kumar, R. 2014. Fundamentals of Horticulture. Biotech Books.
- ❖ Peter, K. V. 2009. Basics Horticulture. New India Publishing Agency
- ❖ Prasad, S. and Kumar, U. 2010. A Handbook of Fruit Production. Agrobios (India).
- ❖ Prasad, S. and Kumar, U. 2019. Principles of Horticulture (2nd Edt.). Agrobios (India).
- ❖ Salunkhe, D. K. and Kadam, S. S. 2013. A handbook of Fruit Science and Technology. CRC Press.
- ❖ Singh, J. 2002. Basic Horticulture. Kalyani Publishers, Hyderabad.
- ❖ Singh, J. 2011. Basic Horticulture. Kalyani Publications, New Delhi.
- ❖ Singh, N. P. 2005. Basic Concepts of Fruit Science (1st Edt.). IBDC Publishers.

Course No.	Course Title	Credits
SOA/HE/UG 04	Information and Communication Technology	2(1+1)

SOA/HE/UG 04 T: Information and Communication Technology (1)

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

SOA/HE/UG 04 P: Information and Communication Technology (1)

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 fisheries 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.

Suggested Readings

- ❖ Bal, H. P. 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. and Adabala, N. 2015. Fundamentals of Computers. PHI.
- ❖ Singh, G., Singh, R. and Saluja, K. K. 2003. Fundamentals of Computer Programming and Information Technology. Kalyani Publishers.

SEMESTER-II

Course No.	Course Title	Credits
SOA/HC/UG 05	Introductory Crop Physiology	3(2+1)

SOA/HC/UG 05 T: Introductory Crop Physiology (2)

Water Relations in Plants: Role of water in plant metabolism, osmosis inhibition, diffusion, water potential and its components, measurement of water potential in plants, absorption of water, mechanism of absorption and ascent of sap. Stomata: Structure, distribution, classification, mechanism of opening and closing of stomata. Osmotic pressure, guttation, stem bleeding; transpiration methods and mechanism and factors affecting transpiration. Drought: Different types of stresses; water, heat and cold tolerance; mechanism of tolerance. Plant Nutrition: Essentiality, mechanism of absorption and its role in plant metabolism. Biological Nitrogen Fixation Photosynthesis, structure and function of chloroplast, dark and light reactions, cyclic and non-cyclic electron transfer, CO₂ fixation – C₃, C₄ and CAM metabolism, advantages of C₄ pathway. Photorespiration and its implications, factors affecting photosynthesis. Mode of herbicide action, Secondary metabolites and plant defense.

SOA/HC/UG 05 P: Introductory Crop Physiology (1)

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, root initiation in cuttings.

Suggested Reading:

- ❖ Arteca, R. N. 2004. Plant Growth Substances. CBS. New Delhi.
- ❖ Basra, A. S. 2004. Plant Growth Regulators in Agriculture & Horticulture. HAWARTH press. New York.
- ❖ Delvin, R. M. 1986. Plant Physiology. CBS. Delhi.
- ❖ Durna, E. E. 2014. Principles of Horticultural Physiology. CABI, UK.
- ❖ Jacobs, W. P. 1979. Plant Hormones and Plant Development. Cambridge Univ. London.
- ❖ Noggle, G.R and Fritz, T.G.1944. Introductory Plant Physiology. Prentice Hall India Pvt. Ltd., New Delhi.
- ❖ Pandey, S.N. and Sinha, B.K. 2005. Plant Physiology. Vikas Publication House Pvt. Ltd.
- ❖ Salisbulry. 2007. *Plant Physiology*. CBS. New Delhi.
- ❖ Salisbury, F.B. and Rose, C.W. 2017. Plant Physiology. CBS publishers and Distributors, Delhi.
- ❖ Taiz, L. 2010. Plant Physiology. SINAUR. USA.
- ❖ Taiz, L. and Zeiger, E. 2010. Plant Physiology (5th Edition). Sinauer Associates, Inc.
- ❖ Zeiger. 2003. Plant Physiology. PANIMA. New Delhi.

Course No.	Course Title	Credits
SOA/HC/UG 06	Principles of Genetics and Cytogenetics	3(2+1)

SOA/HC/UG 06 T: Principles of Genetics and Cytogenetics (2)

Historical background of genetics, theories and hypothesis. Physical basis of heredity, cell reproduction, mitosis, meiosis and its significance. Gametogenesis and syngamy in plants. Mendelian genetics–Mendel’s principles of heredity, deviation from Mendelian inheritance, pleiotropy, threshold characters, co-dominance, penetrance and expressivity. Chromosome theory of inheritance, gene interaction. Modification of monohybrid and dihybrid ratios. 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.

SOA/HC/UG 06 P: Principles of Genetics and Cytogenetics (1)

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 F2 data and construction of linkage maps. Genetic variation in pea.

Suggested Reading:

- ❖ Acquaah, G. Principles of Plant Genetics and Breeding. Wiley-Blackwell
- ❖ B.D. Singh. 2012. Fundamental of Genetics. Kalyani. India
- ❖ Farook, S.A., Khan, I.A. and Nizam, J. 1989. Recent Advances in Genetics & Cytogenetics (I Ed.). Premier Publishing House, Hyderabad.
- ❖ Gardner, E. J., Simmons, M.J. and Snustard, D.P. 1991. Principles of Genetics (8th Edn). John Wiley & Sons, New York.
- ❖ Griffiths, A.J., Miller, J.H., Suzuki, D.T., Lewontin, R.C. and Gelbart. 2000. An introduction to Genetic Analysis (5th Edt.).W. H. Freeman & Company, New York.
- ❖ Gupta, P.K. 1985.Cytology, Genetics and Cytogenetics. Rastogi Publication, India.
- ❖ Jahier, J. 1986. Techniques of Plant Cytogenetics. Oxford & IBH Publishing Co Pvt. Ltd., New Delhi
- ❖ Khanna, V. K. 2005. Genetics–Numerical Problems. Kalyani Publishers, New Delhi.
- ❖ Lewin, B. 2020. Genes (II edn). Reverte, S.A. Editor.
- ❖ Loewy, A.G. and Siekevitz, P. 1970. Cell Structure & Function (2nd Edt.). Oxford & IBH Publishing Co. Pvt. Ltd, New Delhi.
- ❖ Rothwell, N.V. 1988. Understanding Genetics (4th Edt.). Oxford University Press, Oxford.
- ❖ Schieif, R. 1986. Genetics & Molecular Biology. The Benjamin/Cummings publishing Co, Inc, California.
- ❖ Shukla, R.M. 2001. Cell Biology. Dominant publishers, New Delhi.
- ❖ Singh, B. D. 2009. Fundamentals of Genetics (4th Edt.). Kalyani Publishers, New Delhi
- ❖ Singh, P. 2014. Elements of Genetics. Kalyani publishers, New Delhi.
- ❖ Sinnott, E.W., Dunn, Lc. & Dobzhansky, T. 2006. Principles of Genetics (5th Edt.) Tata McGraw-Hill Publishing Co. Ltd., New Delhi.
- ❖ Srivastava, S. & Tyagi, R. 1997. Selected Problems in Genetics (Vol.1-3). Anmol Publications Pvt. Ltd., New Delhi

- ❖ Stansfield, W.D. 1969. Theory and Problems of Genetics (Schaum's Outline Series). McGraw-Hill Inc.
- ❖ Stent, G.S. and Calendar, R. 1986. Molecular Genetics: Introductory Narrative (2nd Edt.). CBS Publishers, New Delhi
- ❖ Strickberger, M.W. 1976. Genetics. Macmillan Publishing Company, New York.
- ❖ Swanson, C.P. and Webster, P.L. 1985. The Cell (5th Edt.). Prentice Hall of India Pvt. Ltd, New Delhi
- ❖ Swanson, C.P., Merz, T. and Young, J.1973. Cytogenetics (2nd Edt.). Prentice Hall of India Pvt. Ltd. New Delhi.

Course No.	Course Title	Credits
SOA/HC/UG 07	Fundamentals of Plant Pathology	2(1+1)

SOA/HC/UG 07 T: Fundamentals of Plant Pathology (1)

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 nematocides.

SOA/HC/UG 07 P: Fundamentals of Plant Pathology (1)

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.

Suggested Readings:

- ❖ Agrios, G. N. 2006. Plant Pathology. Elsevier Academic press, London.
- ❖ Alexopoulos, C. J., Mims, C. W. and Blackwell, M. 1996. Introduction to Mycology Wiley Eastern Ltd., New York.
- ❖ Dhingra, O.D. and Sinclair, J.B. 1993. Basic Plant Pathology Methods. CBS, Publishers & Distributors, New Delhi.
- ❖ Mandahar, C. L. 1987. Introduction to Plant Viruses. Chand and Co. Pvt. Ltd., New Delhi.
- ❖ Mehrotra, R. S. and Agarwal, A. 2017. Fundamental of Plant Pathology. Mc Graw Hill Education.
- ❖ Mehrotra, R. S. and Aneja, K. R. 1990. . An Introduction to Mycology. New Age International (P) Ltd., New Delhi.
- ❖ Ravichandra, N. G. 2013. Fundamentals of Plant Pathology. PHI Hall of India, New Delhi.
- ❖ Sambamurthy, A.V.S.S. 2006. A textbook of Plant Pathology. I K International Publishing House.
- ❖ Singh, R. S. 1982. Plant Pathogens: The Fungi. Oxford and IBH Publishing Co., New Delhi.

- ❖ Singh, R. S. 1989. Plant Pathogens: The Prokaryotes .Oxford and IBH Publishing Co., New Delhi.
- ❖ Singh, R. S. 2017. Introduction to Principles of Plant Pathology. Oxford and IBH Publishing.

Course No.	Course Title	Credits
SOA/HC/UG 08	Elementary Statistics and Computer Application	3(2+1)

SOA/HC/UG 08 T: Elementary Statistics and Computer Application (2)

Introduction to statistics, limitations of statistics. Basic concepts: Variable statistics, types and sources of data, classification and tabulation of data, construction of frequency distribution, tables, graphic representation of data, simple, multiple component and percentage, bar diagram, pie diagram, histogram, frequency polygon and frequency curve average and measures of location, mean, mode, median, 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: Basic concept, additive and multiplicative laws. Theoretical distributions, binominal, poisson 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: 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, guard rows.

Computer application: Introduction to computers and personal computers, basic concepts, operating system, DOS and 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 programming languages, BASIC language, concepts, basic and programming techniques, MS Office, Win Word, Excel, Power point, introduction to multi-media and its application. Visual basic-concepts, basic and programming techniques, introduction to internet.

SOA/HC/UG 08 P: Elementary Statistics and Computer Application (1)

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 for row and grouped data, percentiles, quadrille, and median for row and grouped data, coefficient of variation, ‘t’ test for independent, will equal and unequal variants, paired ‘t’ test, chi-square test for contingency tables and theoretical ratios, correlation and linear regression. Studies on computer components – Basic language, visual basic, programming techniques, MS Office, Excel, power point.

Suggested Reading:

- ❖ Bandari, V. B. 2012. Fundamentals of Information Technology. Pearson Education, New Delhi.
- ❖ Gupta, S. C. and Kapoor, V. K. 2014. Fundamentals of Mathematical Statistics. Sultan Chand and Sons, New Delhi

- ❖ Gupta, V. 2002. Comdex Computer Kit. Dream Tech Press, New Delhi.
- ❖ ITL ESL, 2011. Fundamentals of Computers. Pearson Education, New Delhi.
- ❖ Nageswara, R.G. 2007. Statistics for Agricultural Sciences. B.S. Publications, Hyderabad.
- ❖ Parmar, A., Mathur, N., Deepti P. U. and Prasanna, V. B. 2000. Working with WINDOWS: A Handson Tutorials. Tata Mc Graw Hill Publishing Co., New Delhi.
- ❖ Rangaswamy, R. 1995. A Text Book of Agricultural Statistics. New Age International Publishing Limited, Hyderabad.

Course No.	Course Title	Credits
SOA/HC/UG 09	Soil Fertility and Nutrient Management	2(1+1)

SOA/HC/UG 09 T: Soil Fertility and Nutrient Management (1)

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

SOA/HC/UG 09 P: Soil Fertility and Nutrient Management (2)

Analysis of soil for organic matter, available N,P,K and Micronutrients and interpretations. Gypsum requirement of saline and alkali soils. Lime requirement of acid soils. Estimation of organic carbon content in soil. Determination of Boron and chlorine content In soil. Determination of Calcium, Magnesium and Sulphur in soil. Sampling of organic manure and fertilizer for chemical analysis. Physical properties of organic manure and fertilizers. Total nitrogen in urea and farmyard manure. Estimation of ammonical nitrogen and nitrate nitrogen in ammonical fertilizer. Estimation of water soluble P₂O₅, Ca and S in SSP, Lime and Gypsum. Estimation of Potassium in MOP/SOP and Zinc in zinc sulphate. Visiting of fertilizer testing laboratory.

Suggested Reading:

- ❖ Basak, R. K. 2000. Fertilizers A Text book. Kalyani Publishers, New Delhi.
- ❖ Bear, F. E. 1964. Chemistry of the Soil. Oxford and IBH Publishing Co., New Delhi.
- ❖ Binkley, D. and R. Fisher, 2012. Ecology and Management of Forest Soils (4th Edition). John Wiley & Sons Singapore Pvt. Ltd., Singapore
- ❖ Brady, N. C. and Weil, R. R. 2010. Elements of the Nature and Properties of Soils (3rd Edition.). Pearson Education, New Delhi
- ❖ Chopra, S. C. and Kanwar, J. S. 1976. Analytical Agricultural Chemistry. Kalyani Publishers, Ludhiana.
- ❖ Das, D.K. 2011. Introductory Soil Science (3rd Edition). Kalyani Publisher, Ludhiana (India).

- ❖ Gupta, P. K. 2009. Soil, Plant, Water and Fertilizer Analysis (2nd Edition), AGROBIOS, Jodhpur (India).
- ❖ Havlin, J.L., Tisdale, S.L., Nelson, W.L. and Beaton, J.D. 2014. Soil Fertility and Fertilizers: An Introduction to Nutrient Management (8th Edt.). PHI Learning Pvt. Ltd., Delhi.
- ❖ Indian Society of Soil Science, 2002. Fundamentals of Soil Science. Indian Society of Soil Science, IARI, New Delhi.
- ❖ Jackson, M. L. 2012. Soil Chemical Analysis: Advanced Course. Scientific Publisher
- ❖ Jaiswal, P. C. 2006. Soil, Plant and Water Analysis (2nd Edition). Kalyani Publishers, Ludhiana.
- ❖ Jones, J. B. 2012. Plant Nutrition and Soil Fertility Manual (2nd Edition). CRC Press, USA.
- ❖ Kanwar, J. S. 1976. Soil Fertility: Theory and Practice. ICAR, New Delhi.
- ❖ Khan, T. O. 2013. Forest Soils: Properties and Management. Springer International Publishing, Switzerland
- ❖ Mengel, K. and Kirkby, E.A. 2001. Principles of Plant Nutrition (5th Edition). Springer Netherlands.
- ❖ Nene, Y. L. and Thapliyal, P.N, 1991. Fungicides in Plant Disease Control. Oxford and IBH Publishing company, New Delhi.
- ❖ Pritchett. and Fisher, R.F. 1987. Properties and Management of Forest Soils. John Wiley, New York.
- ❖ Reddy, M. V. 2001. Management of Tropical Plantation Forests and Their Soil Litter System-Litter, Biota and Soil Nutrient Dynamics. Science Publishers, U. S.
- ❖ Richards, L.A. 1968. Diagnosis and Improvement of Saline and Alkaline Soils. Oxford & IBH Publishing Co. New Delhi.
- ❖ Seetharamaan, S., Biswas, B.C., Maheswari, S. and Yadav, D. S. 1986. Hand Book on Fertilizers Technology. The Fertilizers Association of India, New Delhi
- ❖ Seetharaman, S., Biswas, B. C., Yadav, D. S. and Matheswaru, S. U. 1996. Hand Bookon Fertilizers. Oxford and IBH Publishing Company, New Delhi.
- ❖ Sree, R.U.S. 1991. Chemistry of Insecticides. Oxford and IBH Publishing and Fungicides Company, New Delhi.
- ❖ Tandon, H. L. S. 1994. Fertilizers Guide. Fertilizers Development Consultation Organization, New Delhi.
- ❖ 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
- ❖ Yawalkar, K. S., Agarwal, J. P. and Bokde, S. 1992. Manures and Fertilizers. Agri-Horticultural Publishing House, Nagpur.

Course No.	Course Title	Credits
SOA/HAECC/UG 02	Environmental Studies and Disaster Management	2(1+1)

SOA/HAECC/UG 02 T: Environmental Studies and Disaster Management (1)

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. Case studies. f) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification. Role of an individual in conservation of natural resources. 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.

SOA/HAECC/UG 02 P: Environmental Studies and Disaster Management (1)

Field work: Visit to a local area to document environmental assets river/forest/grassland/hill/mountain, visit to a local polluted site; Urban/Rural/Industrial/Agricultural, study of common plants, insects, birds and study of simple ecosystems-pond, river, hill slopes, etc. 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.

Suggested Reading:

- ❖ Aswathanarayana, U. 1999. Soil Resources and the Environment. Oxford and IBH publishing Co., New Delhi.
- ❖ Bharucha, E. 2005. Textbook of Environmental Studies for Under Graduate Courses. UGC, University Press, Hyderabad.
- ❖ Botkin, D.B. and Keller, E.A. 2011. Environmental Science. Wiley Publisher.
- ❖ Chary, M. and Reddy, J. 2004. Principles of Environmental Studies. BB Publishers, Hyderabad.
- ❖ Cunningham, P.W. and Cunningham, A.M. 2011. Principles of Environmental Science (Inquiry and applications). Tata McGraw-Hill Publishing Company Limited, New Delhi.
- ❖ Deshwal, S. and Deshwal, A. 2013. A Basic Course in Environmental Science. Dhanpat Rai & Co.
- ❖ Diwan, P. and Diwan, P. 1998. Environmental Management Law and Administration. Variety Books International, New Delhi.
- ❖ Gupta, P.K. 2004. Methods in Environmental Analysis-Water, Soil and Air. Agro Bios, Jodhpur.
- ❖ Krishnamurthy, K.V. 2018. An Advanced Textbook on Biodiversity: Principles and Practice. Oxford and IBH Publishing.
- ❖ Misra, D. D. 2008. Fundamental Concepts in Environmental Studies. S. Chand Publishing.
- ❖ Nandini, N., Suneetha, N. and Tandon, S. 2019. Environmental Studies. Sapna Book House.
- ❖ Weart, S. R. 2008. The Discovery of Global Warming. Harvard University Press.
- ❖ Wright, R.T. and Nebel, B.J. 2016. Environmental science: Toward a Sustainable Future. Pearson Education.

Course No.	Course Title	Credits
SOA/HE/UG 05	Introductory Microbiology	2(1+1)

SOA/HE/UG 05 T: Introductory Microbiology (1)

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, dyes 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.

SOA/HE/UG 05 P: Introductory Microbiology (1)

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 plates, turbid metric estimation of microbial growth, mushroom culture- Spawn production, Culture and production techniques, harvesting, packing and storage.

Suggested Reading:

- ❖ Alchano, E. 2002. Introduction to Microbiology. Jones and Bartlett Hearing.
- ❖ Heritage, J., Evans, E. G. V. R. and Killington, A. 2008. Introductory Microbiology. Cambridge University Press.
- ❖ Madigan, M. T. and Martinko, J.M. 2014. Brock Biology of Microorganisms (14th Edn.). Pearson Education.
- ❖ Madigan, M., Martinkoj, M. and Parker. 2003. Biology of Microorganisms. Prentice Hall of India Pvt. Ltd., New Delhi.
- ❖ Pelczar, J.R., Chan, M. J. E. C. S. and Krieg, N. R. 1996. Microbiology. Mc Graw Hill Publishers, Newyork.
- ❖ Pelczer, M. J. 1998. Microbiology (5th Edn.). Tata Mc. Grow Hill Education Pvt. Ltd.
- ❖ Prescott, L. M., Harley, J. P. and Klein, D.A. 2002. Microbiology. Mc Graw Hill Publishers, New York.
- ❖ Singh, R. P. 2007. General Microbiology. Kalyani Publishers.
- ❖ Stainer, R, 1987. General Microbiology. Palgrave Macmillan.

Course No.:	Course Title	Credits
SOA/HE/UG 06	Apiculture, Sericulture and Lac culture	2(1+1)

SOA/HE/UG 06 T: Apiculture, Sericulture and Lac culture (1)

Introduction to beneficial insects. Importance and History of apiculture. Species of honey bees, Rock bee, Little bee, 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, 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 /chawki rearing and old age rearing of silkworms. Feeding, spacing, environmental conditions and sanitation. Cocoon characters colour, shape, hardness 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.

SOA/HE/UG 06 P: Apiculture, Sericulture and Lac culture (1)

Honey bee colony, different bee hives and apiculture equipment. Summer and Winter management 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 rainfed conditions. 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 equipments for 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.

Suggested Reading:

- ❖ David, B.V. and Ramamurthy, V. V. 2012. Elements of Economic Entomology (7th Edt.). Namrutha Publications, Chennai.
- ❖ DeBach, P. and Rosen, D. 1991. Biological Control by Natural Enemies. Cambridge University Press.
- ❖ Ganga, G. and Sulochana, C. J. 1997. An introduction to Sericulture (2nd Edn.). Oxford & IBH publishing Co. Pvt. Ltd., New Delhi.
- ❖ Glover, P. M. 1937. Lac cultivation in India. Indian Lac Research Institute, Ranchi.
- ❖ Jolly, M. S. 1987. Appropriate Sericulture Techniques. International Centre for Training and Research in Tropical Sericulture, Mysore.
- ❖ Krishnaswamy, S. 1978. Sericulture Manual: Silkworm Rearing. FAO Agrl. Services Bulletin, Rome.
- ❖ Mishra, R. C. and Gar, R. 2002. Prospective in Indian Apiculture. Agrobios, Jodhpur.
- ❖ Narasaiah, M. L. 2013. Problems and Prospects of Sericulture. Discovery publishing House Pvt. Ltd.
- ❖ Singh, D and Singh, D. P. 2006. A Handbook of Beekeeping. Agrobios (India).
- ❖ Singh, S. 1975. Bee Keeping in India. ICAR, New Delhi.
- ❖ Singh, T. 2015. Principles and Techniques of Silkworm Seed Production, Discovery publishing House Pvt. Ltd.
- ❖ Srivastava, K.P. 1993. A Text Book of Applied Entomology (Vol. I & II). Kalyani Publishers, Ludhiyana
- ❖ Sunita, N. D., Guled, M. B., Mulla, S.R. and Jagginavar. 2003. Beekeeping. UAS Dharwad

Course No.	Course Title	Credits
SOA/HE/UG 07	Agro-meteorology and Climate Change	2(1+1)

SOA/HE/UG 07 T: Agro-meteorology and Climate Change (1)

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 CO₂ concentration. Measurement of short-term effects and mechanisms underlying the

observed responses in C₃ and C₄ species. plant development affected by growth in elevated CO₂. Physiology of rising CO₂ on nitrogen use and soil fertility, its implication for production. Methodology for studying effect of CO₂. 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.

SOA/HE/UG 07 P: Agro-meteorology and Climate Change (1)

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 rain gauges, Measurement of wind speed and direction and atmospheric humidity, Recording of evaporation. Synoptic charts and weather reports, symbols, *etc.*

Suggested Reading:

- ❖ Lenka, D. 2006. Climate, Weather and Crops in India. Kalyani Publishers, New Delhi.
- ❖ Mavi, H. S. 1985. Introduction to Agrometeorology. Oxford & IBH Publishing Co., New Delhi.
- ❖ Mavi, H. S. 1994. Introduction to Agrometeorology. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
- ❖ Mavi, H. S. and Tupper, G. J. 2005. Agrometeorology: Principles and Applications of Climate Studies in Agriculture. International Book Publishing Co., Lucknow.
- ❖ Nanjappa, H. V. and Ramachandrapa, B. K. 2007. Manual on Practical Agricultural Meteorology. Agrobios India, Jodhpur.
- ❖ Pattersen, S. 1958. Introduction to Meteorology. McGraw Hill Book Co. Inc., New York.
- ❖ Rao, G. S. L. H. V. P. 2008. Agricultural Meteorology. Prentice Hall of India Pvt. Ltd., New Delhi.
- ❖ Reddy, S. R. 1999. Principles of Agronomy. Kalyani Publishers, New Delhi.
- ❖ Reddy, T. Y. and Reddi, G. H. S. 2010. Principles of Agronomy. Kalyani Publishers, New Delhi.
- ❖ Srivastava, K. and Tyagi, P. K. 2011. Practical Agricultural Meteorology. New Delhi Publishing Agency, New Delhi.
- ❖ Tailor, J.T. 1967. Agricultural Climatology. Pergman Press Ltd., Headington Hill Hall, Oxford, England.
- ❖ Trewarthe, T. G. 1968. An Introduction to Climate. McGraw Hill Book Co. Inc., New York.

Course No.	Course Title	Credits
SOA/HE/UG 08	Introductory Agroforestry	2(1+1)

SOA/HE/UG 08 T: Introductory Agroforestry (1)

Agroforestry – definition, objectives and potential. Distinction between agroforestry and social forestry. Status of Indian forests and role in India farming systems. Agroforestry system, sub-system and practice: agri-silviculture, silvipastoral, horti-silviculture, hortisilvipastoral, shifting cultivation, taungya, home gardens, alley cropping, intercropping, wind breaks, shelterbelts and energy plantations. Planning for agroforestry – constraints, diagnosis and design methodology, 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*, *Quercus* spp. and bamboo, tamarind, neem etc.). Neem *Azadirachta indica*, Tamarind (*Tamarindus indica*) and melia dubia as per local prevalence.

SOA/HE/UG 08 P: Introductory Agroforestry (1)

Identification and seeds and seedlings of multipurpose tree species. Nursery practices for poplar, *Grewia optiva*, *Morus alba*, *Acacia catechu*, *Dalbergia sissoo*, robinia, leucaena 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.

Suggested Readings:

- ❖ Chaturvedi, A. N. and Khanna, L. S. 1982. Forest Menstruation. International Book Distributors, Dehradun.
- ❖ Chundawat, B.S. and Gautam, S. K. 1996. A Textbook of Agroforestry. Oxford and IBH Publishing company Pvt. Ltd.
- ❖ Dadhwal, K.S., Panwar, P. and Kaushal, R. 2014. Practical Manual on Agroforestry. Jaya Publishing House, Delhi.
- ❖ Dwivedi, P. 1992. Agroforestry: Principles and Practices. Oxford and IBH Publishing Company.
- ❖ Jha, L.K. 2015. Advances in Agroforestry. APH Publishing Corporation, New Delhi.
- ❖ Linford, J. 2007. A Concise Guide to Trees. Parragon Books Service Limited, Parragon.
- ❖ Luna, R. K. 1989. Plantation Forestry in India. International Book Distributors, Dehradun.
- ❖ Nair, P.K.R. 1993. An Introduction to Agroforestry. Springer International Edition.
- ❖ Negi, S. S. 2006. Forest Tree Seed. Prashant Gahlotat Valley Printers and Publishers, Dehradun.
- ❖ Negi, S. S. 2007. Agroforestry Hand Book. International Book Distributer, New Delhi.
- ❖ Panwar, P. and Puri, S. 2007. Agroforestry: Systems and Practices. New India Publishing Agency, New Delhi.
- ❖ Pathak, P.S. and Newaj, R. 2010. Agroforestry: Potentials and Opportunities. Agrobios, Jodhpur
- ❖ Patra, K. 2013. Agroforestry: Principles and Practices. New India Publishing Agency.
- ❖ Satish, L. 2006. Biodiesel and Jatropha Plantations. AGROBIOS, Jodhpur.

- ❖ Tejawani, K. G. 1994. Agroforestry in India. Oxford & IBH, Publishing Co. Pvt. Ltd., New Delhi
- ❖ Umrani, R. and Jain, C.K. 2010. Agroforestry: Systems and Practices. ABD Publishers, New Delhi.

SEMESTER-III

Course No.	Course Title	Credits
SOA/HC/UG 10	Tropical and Subtropical Fruits	3(2+1)

SOA/HC/UG 10 T: Tropical and Subtropical Fruits (2)

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

SOA/HC/UG 10 P: Tropical and Subtropical Fruits (1)

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

Suggested Reading:

- ❖ Bose, T. K., Mitra, S. K. and Sanyal, D. 2002. Tropical and Sub-Tropical (Vol-I). Naya Udyog, Kolkata.
- ❖ Chadda, K. L. 2009. Advanced in Horticulture. Malhotra Publishing House, New Delhi.
- ❖ Chadha, K. L. 2001. Hand Book of Horticulture. ICAR, New Delhi.
- ❖ Chattopadhyay, T. K. 1997. Text Book on Pomology. Kalyani Publishers, New Delhi.
- ❖ Chundawat, B. S. 1990. Arid Fruit Culture. Oxford and IBH, New Delhi.
- ❖ Davies, F.S. and Albrigo, L. G. 2001. Citrus. Cab International.
- ❖ Dhillon, W. S. 2013. Fruit Production in India. Narendra Publishing House, New Delhi.

- ❖ Ladaniya, M. S. 2013. Citrus Fruits. Elsevier, India Post Ltd.
- ❖ Litz, R. E. 2009. The Mango (2nd Edt.). CABI Publishing, Willingford, U.K.
- ❖ Radha, T. and Mathew, L. 2007. Fruit Crops. New India Publishing Agency.
- ❖ Rajput, C.B.S. and Srihari, B.R. 1985. Citriculture. Kalyani Publishers, New Delhi.
- ❖ Singh, H. P. and Mustafa, M. M. 2009. Banana: New Innovations. Westville Publishing House, New Delhi.
- ❖ Singh, S.P. 2004. Commercial Fruits. Kalyani Publishers, New Delhi.
- ❖ Symmonds, 1996. Banana (2nd Edt.). Longman, London.

Course No.	Course Title	Credits
SOA/HC/UG 11	Weed Management in Horticultural Crops	2(1+1)

SOA/HC/UG 11 T: Weed Management in Horticultural Crops (1)

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

SOA/HC/UG 11 P: Weed Management in Horticultural Crops (1)

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.

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. 2012. 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. 2013. 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 A. 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.

Course No.	Course Title	Credits
SOA/HC/UG 12	Tropical and Subtropical Vegetables crops	3(2+1)

SOA/HC/UG 12 T: Tropical and Subtropical Vegetables crops (2)

Area, production, economic importance and export potential of tropical and sub-tropical vegetable crops. Description of varieties and hybrid, climate and soil requirements, seed rate, preparation of field, nursery practices; transplanting of vegetable crops and planting for directly sown/transplanted vegetable crops. Spacing, planting systems, water and weed management; nutrient management and deficiencies, use of chemicals and growth regulators. Cropping systems, harvest, yield, post-harvest handling, economics and marketing of tropical and subtropical vegetable crops such as tomato, brinjal, chillies, capsicum, okra, amaranthus, cluster beans, cowpea, lab-lab, snap bean, cucurbits, moringa, curry leaf, portulaca, basella, sorrel and roselle.

SOA/HC/UG 12 P: Tropical and Subtropical Vegetables crops (1)

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

Suggested Reading:

- ❖ Bose, T. K. 2002. Vegetable Crops. Nayaprakash. Kolkata.
- ❖ Bose, T.K. and Som, M.G. 1986. Vegetables Crops in India. Naya Prokash.
- ❖ Bose, T.K., Kabir, J., Maity, T.K., Parthasarathy, V.A. and Som, M.G. 2003. Vegetables Crops (Vols. I to III). Naya Udyog.
- ❖ Bose, T.K., Som, M.G. and Kabir, J. 2002. Vegetables Crops in India. Naya Prokash.
- ❖ Chadha, K. L. 1993. Advances in Horticulture. Malhotra Publishing House, New Delhi
- ❖ Choudhary, B. R. 2009. A Textbook on Production Technology of Vegetables. Kalyani Publishers. Ludhiana.
- ❖ Choudhury, B. 1990. Vegetables (8th ed.). National Book Trust, New Delhi.
- ❖ Dhaliwal, M. S. 2008. Handbook of Vegetable Crops. Kalyani Publishers. Ludhiana.
- ❖ Fageria, M.S., Choudhary, B.R. and Dhaka, R.S. 2000. Vegetable Crops: Production Technology (Vol. II). Kalyani Publishers.
- ❖ Hazra, P. 2006. Vegetable Science. Kalyani Publishers. Ludhiana.
- ❖ Hazra, P. 2011. Modern Technology in Vegetable Production. New India Publishing Agency. New Delhi.
- ❖ Kamath, K. V. 2007. Vegetable Crop Production. Oxford Book Company. Jaipur.
- ❖ Krishnan, T. R. G. 2007. Vegetable Crops. New India Publishing Agency. New Delhi.
- ❖ Nath, P. 1994. Vegetables for the Tropical Regions. ICAR New Delhi.

- ❖ Nath, P., Velayudhan, S. and Singh, D.P. 1987. Vegetables for the Tropical region. ICAR, New Delhi.
- ❖ Rana, M. K. 2008. Olericulture in India. Kalyani Publishers. Ludhiana.
- ❖ Shankar, U. 2008. Vegetable Pest Management Guide for Farmers. International Book Distribution Co. Publication. Lucknow.
- ❖ Shanmugavelu, K. G., 1989. Production Technology of Vegetable Crops. Oxford & IBH Publishing Co. Pvt. Ltd, New Delhi.
- ❖ Sharma, P. 2007. Vegetables: Disease Diagnosis and Bio-management. Avishkar Publishers. Jaipur.
- ❖ Singh, D.K. 2007. Modern Vegetable Varieties and Production. IBN Publishers, Technology International Book Distributing Co, Lucknow.
- ❖ Singh, U. 2008. Indian Vegetables. Anmol Publications. Pvt. Ltd .New Delhi.
- ❖ Thamburaj, S. 2014. Textbook of Vegetable, Tuber Crops and Spices. ICAR, New Delhi.
- ❖ Yawalkar, K. S. 2008. Vegetable Crops in India. Agri-Horticultural Pub. House. Nagpur. 2004.

Course No.	Course Title	Credits
SOA/HC/UG 13	Orchard and Estate Management	2(1+1)

SOA/HC/UG 13 T: Orchard and Estate Management (1)

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

SOA/HC/UG 13 P: Orchard and Estate Management (1)

Layout of different systems of orchard 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.

Suggested Reading:

- ❖ Dhillon, W.S. and Bhatt. 2011. Fruit Tree Physiology. Narendra Publishing House, New Delhi.
- ❖ Kumar, 1990. Introduction to Horticulture Crops. Rajyalakshmi Publications, Nagercoil, Tamilnadu.
- ❖ Kumar, T. P., Suma, B., Bhaskar, J. and Satheson, K. N. 2008. Management of Horticultural Crops. New India Publishing Agency, New Delhi.
- ❖ Mazumdar, B .C. 2004. Orchard Irrigation and Soil Management Practices. Daya Publishing Agency, New Delhi.
- ❖ Mazumdar, B.C. 2004. Principles and Methods of Orchard Establishment. Daya Publishing House, New Delhi.

- ❖ 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.

Course No.	Course Title	Credits
SOA/HC/UG 14	Principles of Plant Breeding	3(2+1)

SOA/HC/UG 14 T: Principles of Plant Breeding (2)

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.

SOA/HC/UG 14 P: Principles of Plant Breeding (1)

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

Suggested Reading:

- ❖ Allard, R. W. 1960. Principles of Plant Breeding. John Wiley & Sons, New York.
- ❖ B. D. Singh. 2013. Plant Breeding: Principles and Methods. Kalyani Publishers, Ludhiana.
- ❖ Chahal, G. S. and Gosal, S.S. 2002. Principles and Procedures of Plant Breeding. Narosa Publishing House, New Delhi.
- ❖ Chaudhary, R. C. 1994. Introduction to Plant Breeding. Oxford and IBH Publishing Company.
- ❖ Chopra, V. L. 2012. Plant Breeding: Theory and Practice. Oxford & IBH Publishing CO. Pvt. Ltd., New Delhi.
- ❖ Falconer, D. S. 1989. Introduction to Quantitative Genetics. Longman Scientific & Technical, Longman Group, UK, Ltd., England.
- ❖ Fehr, W.R. 1998. Principles of Cultivar Development: Theory and Technique (Vol. 1). Macmillan Publishing Company, New York.
- ❖ Hayes, H.K. and Garber, R.J. 1927. Breeding Crop Plants. McGraw Hill Publications, New York.
- ❖ Kallo, G. 1998. Vegetable Breeding (Vol. I to IV). CRC Press. Florida.

- ❖ Mather, K. and Jinks, J.L. 1976. Introduction to Biometrical Genetics. Chapman and Hall, London
- ❖ Poehlman, J.M. and Borthakar, D. 1995. Breeding Asian Field Crops. Oxford & IBH Publishing Co., New Delhi.
- ❖ Sharma, J. R. 1994. Principles and Practices of Plant Breeding. Tata McGraw Publishing Company Ltd., New Delhi.
- ❖ Singh, B. D. And Bansal, P. 2018. Fundamental of Plant Breeding. Kalyani Publisher, India.
- ❖ Singh, P. 2014. Essentials of Plant Breeding. Kalyani Publishers.
- ❖ Singh, R. K. and Chaudhary, B. D. 2013. Biometrical Methods in Quantitative Genetic Analysis. Kalyani Publishers, Ludhiana.

Course No.	Course Title	Credits
SOA/HSEC/UG 01	Propagation and Nursery Management	2(1+1)

SOA/HSEC/UG 01 T: Propagation and Nursery Management (1)

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

SOA/HSEC/UG 01 P: Propagation and Nursery Management (1)

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

Suggested Reading:

- ❖ Adriance, F. R. and Brison, G. W. 2010. Propagation of Horticultural Plants. Agrobios (India).
- ❖ Bose, T. K., Mitra, S. K., Sadhu, M. K., Das, P. and Sanyal, D. 2005. Propagation of Tropical & Subtropical Horticultural Crops (Vo. 1 3rd Revised Edition). Naya Udyog, Kolkata.
- ❖ Chadha, K. L. 2002. Hand Book of Horticulture. ICAR, New Delhi.
- ❖ Chundawat, B.S. 1990. Arid Fruit Culture. Oxford and IBH, New Delhi.
- ❖ Ganner, R. J. and Choudhri, S. A. 1972. Propagation of Tropical Fruit Trees. Oxford and IBN publishing Co., New Delhi.
- ❖ Hartman, H. T. and Kester, D.E. 1976. Plant Propagation Principles and practices. Prentice Hall of India Pvt. Ltd., Bombay.
- ❖ Hartmann, H. T., Kester, D. E., Davies, F. T. and Geneve, R. 2010. Plant Propagation-Principles and Practices (8th Edition). Pearson.
- ❖ Mukherjee, S. K. and Majumdar, P. K. 1973. Propagation of Fruit Crops. ICAR, New Delhi.
- ❖ Rajan, S. and Markose, B. L. 2007. Propagation of Horticultural Crops: Horticulture Science Series (Vol.6.). New India Publishing Agency, New Delhi.
- ❖ Sadhu, M. K. 1996. Plant Propagation. New Age International Publishers, New Delhi.
- ❖ Sarma, R. R. 2002. Propagation of Horticultural Crops. Kalyani Publishers, New Delhi.
- ❖ Symmonds, 1996. Banana (2nd edition). Longman, London.

Course No.	Course Title	Credits
SOA/HE/UG 09	Fundamentals of Entomology	2(1+1)

SOA/HE/UG 09 T: Fundamentals of Entomology (1)

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 genitalia. 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 insects upto orders, sub-order and families of economic importance and their distinguished characters. Plant mites – morphological features, important families with examples.

SOA/HE/UG 09 P: Fundamentals of Entomology (1)

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.

Suggested Reading:

- ❖ Awasthi, V. B. 1997. Introduction to General and Applied Entomology. Scientific Publishers, Jodhpur.
- ❖ Borror, D. J., Horn, C. A. T. and Johnson, N.F. 1987. An Introduction to the Study of Insects (6th Edition). Harcourt Brace College Publishers, New York.

- ❖ Chapman, R. F. 1981. The Insects: Structure and Function. Edward Arnold (Publishers) Ltd, London.
- ❖ Devasahayam, H. L. 2011. Practical Manual of Entomology (Insect and Non-insect Pests. New India Publishing Agency.
- ❖ Gullan, P. J. and Cranston, P.S. 2001. The Insects: An Outline of Entomology (2th Edition). Chapman & Hall, Madras.
- ❖ Mani, M.S. 1968. General Entomology. Oxford and IBH Publishing Co. Pvt Ltd., New Delhi.
- ❖ Nation, J. L. 2015. Insect Physiology and Biochemistry. CRC Press.
- ❖ Nayar, K.K., Ananthkrishnan, T.N. and David, B.V. 1976. General and Applied Entomology. Tata McGraw Hill Publishing Company Limited, New Delhi.
- ❖ Pant, N.C. and Ghai, S. 1981. Insect Physiology and Anatomy. ICAR, New Delhi.
- ❖ Pedigo, L.P. 1999. Entomology and Pest Management (3rd Edition). Prentice Hall, New Jersey, USA.
- ❖ Richards, O.W. and Davies, R.G. 1977. General Textbook of Entomology (Vol.1&2). Chapman and Hall Publication, London.
- ❖ Romoser, W.S. 1988. The Science of Entomology, McMillan, New York.
- ❖ Saxena, S.C. 1992. Biology of Insects. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
- ❖ Snodgrass, R.E. 2001. Principles of Insect Morphology. CBS Publishers and Distributors, New Delhi.
- ❖ Srivastava, P.D. and Singh, R.P. 1997. An Introduction to Entomology. Concept Publishing Company, New Delhi.
- ❖ Tembhare, D.B. 1997. Modern Entomology. Himalaya Publishing House, Mumbai.

Course No.	Course Title	Credits
SOA/HE/UG 10	Introduction to Major Field Crops	2(1+1)

SOA/HE/UG 10 T: Introduction to Major Field Crops (1)

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.

SOA/HE/UG 10 P: Introduction to Major Field Crops (1)

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

Suggested Reading:

- ❖ Bose, M. S. C. and Balakrishnan, V. 2001. Forage Production Technologies. South Asian Publishers, New Delhi.
- ❖ Gurarajan, B., Balasubramanian, R. and Swaminathan, V. 2008. Recent Strategies on Crop Production. Kalyani Publishers, New Delhi.
- ❖ Prasad, R. 2002. Text Book of Field Crops Production, ICAR, New Delhi.
- ❖ Prasad, R. 2017. Textbook of Field Crops Production: Commercial Crops (Vol. II). ICAR Publication.
- ❖ Prasad, R. 2017. Textbook of Field Crops Production: Food grain Crops (Vol. I). ICAR Publication.
- ❖ Reddy, S. R. 2009. Agronomy of Field Crops. Kalyani Publishers, New Delhi.
- ❖ Reddy, S.R. 2004. Agronomy of Field Crops, Kalyani Publishers, Ludhiana.

- ❖ Singh, C. 1983. Modern Techniques of Raising Field Crops. Oxford & IBH, Publishing Co., New Delhi.
- ❖ Singh, C. 1997. Modern Techniques of Raising Field Crops. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
- ❖ Singh, S. S. 2005. Crop Management. Kalyani Publishers, New Delhi.

Course No.	Course Title	Credits
SOA/HE/UG 11	Water Management in Horticultural Crops	2(1+1)

SOA/HE/UG 11 T: Water Management in Horticultural Crops (1)

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

SOA/HE/UG 11 P: Water Management in Horticultural Crops (1)

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

Suggested Reading:

- ❖ Carr, M. K. V. and Fereres, E. 2012. Advances in Irrigation Agronomy. Cambridge University Press.
- ❖ Michael, A. M. 2015. Irrigation Theory and Practices. Vikas Publishing House Pvt., Ltd.
- ❖ Mujmdar, D. K. 2004. Irrigation Water Management: Principles and Practices. Prentice Hall of India Pvt. Ltd.
- ❖ Patil, S.V. & Rajakumar, G. R. 2016. Water Management in Agriculture and Horticultural Crops. Satish Serial Publishing House, Delhi.
- ❖ Rao, Y.P. and Bhaskar, S.R. 2008. Irrigation Technology. Theory and practice. Agrotech Publishing Academy, Udaipur.

SEMESTER-IV

Course No.	Course Title	Credits
SOA/HC/UG 15	Spices and Condiments	2(1+1)

SOA/HC/UG 15 T: Spices and Condiments (1)

History, scope and importance, area and production, uses, export potential and role in national economy. Classification, soil and climate, propagation-seed, vegetative and micro propagation 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, pepper, ginger, turmeric, clove, nutmeg, cinnamon, all spice, curry leaf, coriander, fenugreek, fennel, cumin, dill, celery, bishops weed, saffron, vanilla, thyme and rosemary.

SOA/HC/UG 15 P: Spices and Condiments (1)

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.

Suggested Reading:

- ❖ Kumar, N. J. B. M., Khaddar, M. A., Swamy, R. P. and Irulappan, I. 1997. Introduction to Spices, Plantation Crops and Aromatic Crops. Oxford & IBH, New Delhi.
- ❖ Pruthi, J. S. 1980. Spices and Condiments. Academic Press, New York.
- ❖ Pruthi, J. S. 1993. Major Spices of India: Crop Management Postharvest Technology. ICAR, New Delhi.
- ❖ Pruthi, J. S. 2001. Minor Spices and Condiments: Crop Management Post Harvest Technology. ICAR, New Delhi.
- ❖ Purseglove, J. W., Brown, E. G., Green, C. L. and Robbins, S. R. J. 1981. Spices (Vol. I & II). Longman Group Ltd.
- ❖ Shanmugavelu, K. G. and Rao, M. 1977. Spices and Plantation Crops. Madras Popular Book Depot.
- ❖ Shanmugavelu, K.G., Kumar, N. and Peter, K.V. 2005. Production Technology of Spices and Plantation Crops. Agrosis, Jodhpur.

Course No.	Course Title	Credits
SOA/HC/UG 16	Temperate Fruit Crops	3(2+1)

SOA/HC/UG 16 T: Temperate Fruit Crops (2)

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, apricot, plum, cherry, persimmon, strawberry, kiwi, Queens land nut (Mecademia nut), almond,

walnut, pecan nut, hazel nut and chest nut. Re-plant problem, rejuvenation and special production problems like pre-mature leaf fall, physiological disorders, important insect – pests and diseases and their control measures. Special production problems like alternate bearing problem and their remedies.

SOA/HC/UG 16 P: Temperate Fruit Crops (1)

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.

Suggested Reading:

- ❖ Banday, F. A. and Sharma, M. K. 2010. Advances in Temperate Fruit Production. Kalyani Publishers, Ludhiana.
- ❖ Chadha, T. R. 2001. Text Book of Temperate Fruits. Indian Council of Agricultural Research, New Delhi.
- ❖ Chattopadhyay, T. K. 2000. A Text Book on Pomology: Temperate Fruits (Vol. IV). Kalyani Publishers, Hyderabad.
- ❖ Chattopadhyay, T. K. 2009. A Textbook on Pomology: IV Devoted to Temperate fruits. Kalyani Publishers, Ludhiana.
- ❖ Das, B. C. and Das, S. N. Cultivation of Minor Fruits. Kalyani Publishers, Ludhiana.
- ❖ Dhillon, W. S. 2013. Fruit Production in India. Narendra Publishing House, New Delhi.
- ❖ Jackson, D. and Laone, N. E. 1999. Subtropical and Temperate Fruit Production. CABI, Publications.
- ❖ Misra, K. K. 2014. Textbook of Advanced Pomology. Biotech Books, New Delhi.
- ❖ Mitra, S. K., Rathore, D.S. and Bose, T. K. 1992. Temperate Fruit Crops. Horticulture and Allied Publishers, Calcutta.
- ❖ Pal, J.S. 2010. Fruit Growing. Kalyani Publishers, Ludhiana.

Course No.	Course Title	Credits
SOA/HC/UG 17	Ornamental Horticulture	3(2+1)

SOA/HC/UG 17 T: Ornamental Horticulture (2)

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

SOA/HC/UG 17 P: Ornamental Horticulture (1)

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

Suggested Reading:

- ❖ Arora, J. S. 2006. Introductory Ornamental Horticulture. Kalyani Publishers, Ludhiana.
- ❖ Bird, R. 2002. Flowering Trees and Shrubs. Star Standard Industries Pvt. Ltd.
- ❖ Bose, T. K. and Mukherjee, D. 2004. Gardening in India. Oxford & IBH Publishers.
- ❖ Chadha, K.L. and Chaudhary, B. 1986. Ornamental Horticulture in India. Publication and Information Division. ICAR, New Delhi.
- ❖ Chowdhury, B. and Jana, B.L. 2014. Flowering Garden Trees. Pointer Publishers, Jaipur, India.
- ❖ Chowdhury, B. D., Bose, T.K. and Sharma, S.P. 1991. Tropical Garden Plants in Colour. Horticulture and Allied Publishers, Kolkata.
- ❖ Peter, K.V. 2009. Ornamental Plants. New India Publishing Agency, New Delhi.
- ❖ Randhawa, G. S. and Mukhopadhyay, A. 2004. Floriculture in India. Allied Publishers Pvt. Ltd., New Delhi.

Course No.	Course Title	Credits
SOA/HC/UG 18	Breeding of Fruits and Plantation Crops	2(1+1)

SOA/HC/UG 18 T: Breeding of Fruits and Plantation Crops (1)

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

SOA/HC/UG 18 P: Breeding of Fruits and Plantation Crops (1)

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

Suggested Reading:

- ❖ Kumar, N. 1997. Breeding of Horticultural Crops: Principles and Practices. New India Publishing Agency, New Delhi.
- ❖ Nijar. 1985. Fruit Breeding in India, Oxford & IBH Publishing Co. New Delhi.
- ❖ Shukla, A. K. 2004. Fruit Breeding Approaches and Achievements. International Book Distributing Co. New Delhi.
- ❖ Singh, B.D. 1983. Plant Breeding Principles and Methods. Kalyani Publishers, New Delhi.

Course No.	Course Title	Credits
SOA/HC/UG 19	Plantation Crops	3(2+1)

SOA/HC/UG 19 T: Plantation Crops (2)

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 micropropagation, 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, topworking, 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.

SOA/HC/UG 19 P: Plantation Crops (1)

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.

Suggested Reading:

- ❖ Kumar, N.J.B. M., Khaddar, M. A., Ranga, S. P. and Irrulappan, I. 1997. *Introduction to Spices, Plantation Crops and Aromatic Plants*. Oxford & IBH, New Delhi.
- ❖ Nair, 1979. *Cashew*. CPCRI, Kerala.
- ❖ Ranganadhan, V. 1979. *Hand Book of Tea Cultivation*. UPASI Tea Research Station, Cinchona.
- ❖ Thampan, P.K. 1981. *Hand Book of Coconut Palm*. Oxford IBH, New Delhi.
- ❖ Thompson, P.K. 1980. *Coconut*. Oxford & IBH Publishing Co. Ltd., New Delhi.
- ❖ Wood, G.A.R. 1975. *Cacao*. Longmen, London.

Course No.	Course Title	Credits
SOA/HSEC/UG 02	Organic Farming	2(1+1)

SOA/HSEC/UG 02 T: Organic Farming (1)

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 processors, marketing, exports.

SOA/HSEC/UG 02 P: Organic Farming (1)

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

Suggested Reading:

- ❖ Dahama, A. K. 2007. Organic Farming for Sustainable Agriculture. Agrobios (India), Jodhpur.
- ❖ Palaniappan, S.P. and Annadurai, K. 2010. Organic Farming: Theory and Practice. Scientific Publishers. Jodhpur.
- ❖ Purshit, S.S. 2006. Trends in Organic Farming in India. Agros Bios (India), Jodhpur.
- ❖ Sathe, T. V. 2004. Vermiculture and Organic Farming. Days Publishing House, New Delhi.
- ❖ Sharma, A. K. 2011. Handbook of Organic Farming. Agrobios (India), Jodhpur.
- ❖ Thampan, P. K. 1995. Organic Agriculture. Peckay Tree Crops Development Foundation, Cochin, Kerala.
- ❖ Thapa, U. and Tripathy, P. 2006. Organic Farming in India: Problems and Prospects. Agrotech Publishing Agency, Udaipur.
- ❖ Veeresh, G.K. 2006. Organic Farming. Foundation Books. New Delhi.

Course No.	Course Title	Credits
SOA/HE/UG 12	Nematode Pests of Horticultural Crops and their Management	2(1+1)

SOA/HE/UG 12 T: Nematode Pests of Horticultural Crops and their Management (1)

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

SOA/HE/UG 12 P: Nematode Pests of Horticultural Crops and their Management (1)

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.

Suggested Reading:

- ❖ Butani, D.K. 1984. Insects and Fruits. Periodical Expert Book Agency, New Delhi.
- ❖ David, B. V. R. 2001. Elements of Economic Entomology. Popular Book Depot, Chennai.
- ❖ Jonathan, E. I., Cannayane, I., Devrajan, K., Kumar, S. and Ramakrishan, S. Agricultural Nematology. TNAU, Coimbatore.
- ❖ Metcalf, R.L and Luckman, W.H. 1982. Introduction to Insect Pest Management. Wiley Inter Science Publishing, New York.
- ❖ Nair, M.R.G.K. 1975. Insects and Mites of Crops in India. ICAR, New Delhi.
- ❖ Swaroop, G. and Gupta, D. 1986. Plant Parasitic Nematodes of India: Problems and Progress. ICAR, New Delhi.
- ❖ Upadhyay, K. D. and Dwivedi, K. 1997. A Textbook of Plant Nematology. Amman Publishing House, Meerut.

Course No.	Course Title	Credits
SOA/HE/UG 13	Growth and Development of Horticultural Crops	2(1+1)

SOA/HE/UG 13 T: Growth and Development of Horticultural Crops (1)

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

SOA/HE/UG 13 P: Growth and Development of Horticultural Crops (1)

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

Suggested Reading:

- ❖ Arteca, R. N. 2004. Plant Growth Substances. CBS. New Delhi.
- ❖ Basra, A. 2000. Plant Growth Regulators in Agriculture and Horticulture: Their role & Commercial Uses. CRC Press.
- ❖ Basra, A. S. 2004. Plant Growth Regulators in Agriculture & Horticulture. HAWARTH press. New York.
- ❖ Bleasdale, J.K.A. 1973. Plant Physiology in Relation to Horticulture. Macmillan International Higher Education.
- ❖ Delvin, R. M. 1986. Plant Physiology. CBS. Delhi.
- ❖ Durna, E. E. 2014. Principles of Horticultural Physiology. CABI, UK.
- ❖ Jacobs, W. P. 1979. Plant Hormones and Plant Development. Cambridge Univ. London.
- ❖ Noggle, G.R and Fritz, T.G. 1944. Introductory Plant Physiology. Prentice Hall.
- ❖ Pandey, S.N. and Sinha, B.K. 2005. Plant Physiology. Vikas Publication House Pvt Ltd.
- ❖ Rajendran, C., Ramamoorthy, K. and Hepziba, S. J. 2009. Nutritional and Physiological Disorders in Crop Plants. Scientific Publishers.
- ❖ Salisbulry. 2007. Plant Physiology. CBS. New Delhi.
- ❖ Taiz, L. 2010. Plant Physiology. SINAUR. USA.
- ❖ Taiz, L. and Zeiger, E. Plant Physiology (5th Edition). Sinauer Associates, Inc.
- ❖ Zeiger. 2003. Plant Physiology. PANIMA. New Delhi.

Course No.	Course Title	Credits
SOA/HE/UG 14	Dry land Horticulture	2(1+1)

SOA/HE/UG 14 T: Dry Land Horticulture (1)

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

SOA/HE/UG 14 P: Dry Land Horticulture (1)

Study of rainfall patterns. Contour bunding/trenching, micro catchments, soil erosion and its control. Study of evapo-transpiration, 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.

Suggested reading:

- ❖ Chundawat, B. S. 1990. Arid Fruit Culture. Oxford and IBH, New Delhi.
- ❖ Hiwale, S. 2015. Sustainable Horticulture in Semiarid Dry Lands. Springer India.
- ❖ Jatav, M. K., Saroj, P. L. and Sharma, B. D. 2019. Dryland Horticulture. New India Publishing Agency.
- ❖ Korwar, G. R. 1988. Dryland Horticulture. Central Research Institute for Dryland Agriculture.
- ❖ Kumar, T. P., Suma, B., Bhaskar, J. and Sathesan, K. N. 2008. Management of Horticultural Crops. New India Publishing Agency.
- ❖ Sivamurugan, A. P. and Kumar, R. A. 2008. Dryland Horticulture. Kalyani Publishers.
- ❖ Sontakke, M.B. 2016. Production and Management of Fruit Crops in Arid / Dry Lands. Agrotech Publishing Academy.
- ❖ Taroj, P. L., Vashishtha, B. B. and Dhandar, D. G. 2004. Advances in Arid Horticulture. Internal Book Distributing Co., Lucknow.

SEMESTER-V

Course No.	Course Title	Credits
SOA/HC/UG 20	Temperate Vegetables	3(2+1)

SOA/HC/UG 20 T: Temperate Vegetables (2)

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, knolkhol, 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.

SOA/HC/UG 20 P: Temperate Vegetables (1)

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.

Suggested Reading:

- ❖ Bose, T. K. 2002. Vegetable Crops. Naya Prakash, Kolkata
- ❖ Choudhary, B. R. 2009. A Textbook on Production Technology of Vegetables. Kalyani Publishers. Ludhiana.
- ❖ Dhaliwal, M. S. 2008. Handbook of Vegetable Crops. Kalyani Publishers, Ludhiana.
- ❖ Hazra, P. 2006. Vegetable Science. Kalyani Publishers, Ludhiana.
- ❖ Hazra, P. 2011. Modern Technology in Vegetable Production. New India Publishing Agency, New Delhi.
- ❖ Kamath, K. V. 2007. Vegetable Crop Production. Oxford Book Company, Jaipur.
- ❖ Krishnan, T. R. G. 2007. Vegetable Crops. New India Publishing Agency, New Delhi.
- ❖ Rana, M. K. 2008. Olericulture in India. Kalyani Publishers, Ludhiana.
- ❖ Thamburaj, S. 2014. Textbook of Vegetable, Tuber Crops and Spices. ICAR, New Delhi.
- ❖ Umashankar, S. 2008. Indian Vegetables. Anmol Publications. Pvt.Ltd .New Delhi.
- ❖ Yawalkar, K. S. 2004. Vegetable Crops in India. Agri-Horticultural Pub. House. Nagpur.

Course No.	Course Title	Credits
SOA/HC/UG 21	Principles of Landscape Architecture	2(1+1)

SOA/HC/UG 21 T: Principles of Landscape Architecture (1)

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, objectives, Planning and designing of home gardens, colonies, country planning, urban landscape, Development of institutional gardens, planning and planting of avenues, beautifying schools, railway lines, railway stations, factories, bus stands, airports corporate buildings, dams, hydro electric stations, river banks, play grounds, Gardens for places of religious importance viz. temples, churches, mosques, tombs etc, Importance, features and establishment of English garden , Japanese gardens , Mughal, gardens, French and Persian garden, Italian gardens, Hindu gardens and Buddhist gardens, Xeriscaping, definition, principles and practice.

SOA/HC/UG 21 P: Principles of Landscape Architecture (1)

Study of garden equipments. Study of Graphic language, Use of drawing equipments, graphic

symbols and notations in landscaping designing, 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, traffic islands, schools and colleges, public buildings, factories, railway stations, air ports, temples, churches, play grounds, corporate buildings/ malls. Designing and planting of avenues for state and National highways, Design and establishment of Japanese, English and Mughal gardens. Visit to public, institutional and botanical gardens.

Suggested Reading:

- ❖ Arora, J. S. 2006. Introductory Ornamental Horticulture. Kalyani Publishers, Ludhiana.
- ❖ Bose, T. K., Malti, R.G., Dhua, R.S. and Das, P. 2004. Floriculture and Landscaping. Nayaprakash, Calcutta.
- ❖ De, L.C. 2013. Nursery and Landscaping. Pointer Publishers, Jaipur, India.
- ❖ Grewal, H. S. and Singh, P. 2014. Landscape Designing and Ornamental Plants. Kalyani Publisher.
- ❖ Randhawa, G.S. and Mukhopadhyay, A. 2004. Floriculture in India. Allied Publishers Pvt. Ltd., New Delhi.
- ❖ Roy, R. K. 2013. Fundamentals of Garden Designing. New India Publishing Agency, Pitampura, New Delhi.
- ❖ Srivastava, R. 2014. Fundamentals of Garden Designing. Agrotech Press, New Delhi.
- ❖ Tiwari, A. K. 2012. Fundamentals of Ornamental Horticulture and Landscape Gardening. New India Publishing Agency.

Course No.	Course Title	Credits
SOA/HC/UG 22	Farm Power and Machinery	2(1+1)

SOA/HC/UG 22 T: Farm Power and Machinery (1)

Basic concepts of various forms of energy, unit and dimensions of force, energy and power, calculations with realistic examples. IC Engines: Basic principles of operation of compression, ignition and spark ignition engines, two stroke and four stroke engines, cooling and lubrication system, power transmission system, broad understanding of performance and efficiency, 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. Grafting, pruning and training tools and equipment. Inter-culture equipment: sweep. Junior hoe, weeders, long handle weeders. Crop harvesting equipments: potato diggers, fruit pluckers, tapioca puller and hoists.

SOA/HC/UG 22 P: Farm Power and Machinery (1)

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, calculation of dilution ratio and operation.

Suggested Reading:

- ❖ Field, H.L. and Roth, L.O. 1992. Introduction to Agricultural Engineering: Problem Solving Approaches (2nd Edt.). CBS Publishers & Distributors Pvt. Ltd.
- ❖ Ghoshal, M. K. and Das, D. K. 2008. Farm Power, Kalyani Publishers.
- ❖ Jain, S C. 2003. Farm Machinery: An Approach. Standard Publishers and Distributors, New Delhi.
- ❖ Kepner, R.A., Roy, B. And Barger, B.L. 1978. Principles of Farm Machinery. CBS Publisher and Distributors, Delhi.
- ❖ Klenin, N.I., Popov, I.F. and Sakun, V.A. 1985. Agricultural Machines. Amerind Publishing Co. Pvt. Ltd., New Delhi.
- ❖ Michal, A.M. and Ojha, T.P. 1993. Principles of Agricultural Engineering (Vol. I). Jain Brothers, New Delhi.
- ❖ Nakra, C.P.1986. Farm Machinery and Equipment. Dhanpat Raiand Sons, New Delhi.
- ❖ Ojha, T. P. and Michael, A.M. 2005. Principles of Agricultural Engineering (Vol. 1). Jain Brothers.
- ❖ Pandey, M.M. 2012. Handbook of Agricultural Engineering. ICAR Publication
- ❖ Sahay, J. 1992. Elements of Agricultural Engineering. Agro Book Agency, Patna.
- ❖ Singh, S. 2007. Farm Machinery Principles and Applications. ICAR Publications.
- ❖ Singh, S. and Verma. 2009. Farm Machinery Maintenance & Management. ICAR Publication.

Course No.	Course Title	Credits
SOA/HC/UG 23	Diseases of Fruit, Plantation, Medicinal and Aromatic Crops	3(2+1)

SOA/HC/UG 23 T: Diseases of Fruit, Plantation, Medicinal and Aromatic Crops (2)

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, *Solanum khasianum* and Tephrosia. Important post-harvest diseases of fruit, plantation and medicinal and aromatic crops and their management.

SOA/HC/UG 23 P: Diseases of Fruit, Plantation, Medicinal and Aromatic Crops (1)

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, plantation, medicinal and aromatic crops.

Suggested Reading:

- ❖ Arjunan, G., Karthikeyan, G., Dinakaran, T. Raghuchander, T. 1999. Diseases of Horticultural Crops. Dept. of Plant Pathology, TNAU, Coimbatore
- ❖ Chadha, K.L. 2002. Hand Book of Horticulture. ICAR, New Delhi.
- ❖ Godara, S.L., Kapoor, B.B.S. and Rathore, B.S. 2010. Disease Management of Spice Crops. Madhu Publications.
- ❖ Henry, L. D. C. and Devasahayam, H. L. 2011. Crop Diseases: Identification, Treatment and Management. New India publishing. Agency.

- ❖ Kulkarni, S. and Hedge, Y.R. 2002. Diseases of Plantation Crops and Their Management. Agrotech Publication Academy.
- ❖ Kulkarni, S. and Hedge, Y.R. 2002. Diseases of Plantation Crops and Their Management Agrotech Publication Academy.
- ❖ Pathak, V.N. 1980. Diseases of Fruit Crops. Oxford IBH Publishing Co. Pvt. Ltd., New Delhi.
- ❖ Ranga, S. G. 1988. Diseases of Crop Plants in India. Prentice Hall of India Pvt. Ltd., New Delhi.
- ❖ Saha, L.R. 2002. Hand Book of Plant Diseases. Kalyani Publishers, New Delhi.
- ❖ Singh, R.S. 1996. Plant Diseases. Oxford IBH Publishing Co. Pvt. Ltd., New Delhi.
- ❖ Singh, R.S. 2018. Plant Diseases. Oxford and IBH Publishing Co. Pvt. Ltd.
- ❖ Snowdon, A. L. 1992. Post Harvest Diseases and Disorders of Fruits and Vegetables. CRC Press.
- ❖ Steferud, A. 2005. Diseases of Plantation Crops. Daya Books.
- ❖ Verma, L.R. and Sharma, R.C. 1999. Diseases of horticultural Crops. Indus Publishers.
- ❖ Verma, L.R. and Sharma, R.C. 1999. Diseases of Horticultural Crops. Indus Publishers, New Delhi.

Course No.	Course Title	Credits
SOA/HC/UG 24	Insect Pests of Fruit, Plantation, Medicinal & Aromatic Crops	3(2+1)

SOA/HC/UG 24 T: Insect Pests of Fruit, Plantation, Medicinal & Aromatic Crops (2)

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, Solanum khasianum and. 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).

SOA/HC/UG 24 P: Insect Pests of Fruit, Plantation, Medicinal & Aromatic Crops (1)

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.

Suggested Reading:

- ❖ Alford, D.V. 2017. Pest of Fruit Crops. Taylor & Francis Group.
- ❖ Atwal, A. S. and Dhaliwal, G.S. 2015. Agricultural Pests of South Asia and Their Management. Kalyani Publishers.
- ❖ Ayyar, T.V.R. 1963. Hand Book of Entomology for South India. Govt. Press Madras.
- ❖ 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.
- ❖ Fryer, J.C.F. 2008. Insect Pest of Fruit Crops. Daya Books.

- ❖ Ghosh, S.P., Srivastav, K. P. and Ahawat, Y. S. 1999. Pest Management in Citrus. Studium Press.
- ❖ Metcalf, R. L. and Luckman, W.H. 1982. Introduction to Insect Pest Management. Wiley Inter Science Publishing, New York.
- ❖ Nair, M. R. G. K. 1995. Insect and Mites of Crops in India, ICAR, New Delhi.
- ❖ Rachna, G. and Kumari, B. 2013. Pest Management and Residual Analysis in Horticultural Crop. New India Publishing Agency.
- ❖ Ranjit, P. 2012. Entomological Techniques in Horticultural Crops, New India Publishing Agency.
- ❖ Ranjith, A.M. 2013. Identification and Management of Horticultural Pest. New India Publishing Agency.
- ❖ Reddy, P. P. 2010. Plant Protection in Horticulture (Vol. 1, 2 & 3). Scientific Publishers, Jodhpur.
- ❖ Sharma, R. 2014. Identification and Management of Horticulture Pest. ABD Publisher.
- ❖ Slingerland, M. V. and Crosby, C. R. 2002. Manual of Fruit Insects. Biotech Books, India.

Course No.	Course Title	Credits
SOA/HSEC/UG 03	Entrepreneurship Development and Business Management	2(1+1)

SOA/HSEC/UG 03 T: Entrepreneurship Development and Business Management (1)

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.

SOA/HSEC/UG 03 P: Entrepreneurship Development and Business Management (1)

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, precis 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, dyadic 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.

Suggested Reading:

- ❖ Barry, P. J., Hopkins, J. A. and Baker, C. B. 2000. Financial Management in Agriculture (6th Edt.). IL Interstate Publishers.
- ❖ Benjamin, M. D. P. 1985. Investment Projects in Agriculture: Principles and Case Studies. Longman Group Limited. Essex. UK.
- ❖ Chole, R. and Deshmukh, P.R. 2013. Entrepreneurship Development and Communication Skills. Scientific Publishers, Jodhpur.
- ❖ Gittiner, J P. 1982. Economic Analysis of Agricultural Projects. The John Hopkins University Press Baltimore, USA.
- ❖ Kotler, P. and Armstrong, G. 2010. Principles of Marketing. Pearson.
- ❖ Kumar, S. A., Poornima, S.C., Abhraham, M. K. and Jayashree, K. 2008. Entrepreneurship Development. New Age International Publishers.
- ❖ Mondal, S. and Ray, G. L. 2012. Text Book on Rural Development, Entrepreneurship and Communication Skills. Kalyani Publications.
- ❖ Pandey, U. K. 1990. Introduction to Agricultural Finance. Kalyani Publishers.
- ❖ Singh, A.K. 2009. Entrepreneurship Development and Management. Lakshmi Publications Ltd.
- ❖ Somani, L. L. 2009. Extension Education and Communication, Agrotech, Publishing Academy, Udaipur.

Course No.	Course Title	Credits
SOA/HE/UG 15	Soil, Water and Plant Analysis	2(1+1)

SOA/HE/UG 15 T: Soil, Water and Plant Analysis (1)

Methods of soil 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. Saline, alkali, acid, waterlogged and sandy soils, their appraisal and management. Chemical and mineral composition of horticultural crops. Leaf analysis standards, index tissue, interpretation of leaf analysis values Quality of irrigation water. Radio tracer technology application in plant nutrient studies. Rapid tissue tests for soil and plant. Management of poor quality irrigation water in crop management. Soil and Water pollution.

SOA/HE/UG 15 P: Soil, Water and Plant Analysis (1)

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.

Suggested Reading:

- ❖ Chopra, S.C. and Kanwar, J. S. 1976. Analytical Agricultural Chemistry, Kalyani Publishers, Ludhiana.

- ❖ Durai, M. V. 2014. Handbook of Soil, Plant, Water, Fertilizers and Manure Analysis. New India Publishing Agency.
- ❖ Gupta, P. K. 2013. Soil, Plant, Water and Fertilizer Analysis. Agrobios, India.
- ❖ Jackson, M. L. 1967. Soil Chemical Analysis. Oxford and IBH Publishing Co., New Delhi.
- ❖ Jaiswal, P.C. 2006. Soil, Plant and Water Analysis (2nd Edition). Kalyani Publishers, Ludhiana.
- ❖ Mushtaq, A. W. 2014. Soil, Plant and Water Analysis Manual. Agrotech Publishing Company, Udaipur.
- ❖ Piper, C. S. 2014. Soil and Plant Analysis. Scientific Publishers India.
- ❖ Richards, L. A, 1968. Diagnosis and Improvement of Saline and Alkaline Soils. Oxford and IBH publishing Co. New Delhi.
- ❖ Sehgal, J. A. 2005. Textbook of Pedology Concepts and Applications. Kalyani Publishers, New Delhi.
- ❖ Tandon, H.L.S. 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.

Course No.	Course Title	Credits
SOA/HE/UG 16	Mushroom Culture	2(1+1)

SOA/HE/UG 16 T: Mushroom Culture (1)

Introduction to mushrooms fungi – nutritional value, edible and poisonous types, edible mushrooms, *Pleurotus*, *Volvariella* and *Agaricus*, medicinal value of mushrooms, genetic improvement of mushroom, preparation of culture, mother spawn production, multiplication of spawn, cultivation techniques, harvesting, packing and storage; problems in cultivation – diseases, pest and nematodes – weed moulds and their management strategies. Economics of cultivation, post harvest technologies.

SOA/HE/UG 16 P: Mushroom Culture (1)

Equipment and sterilization techniques for culture media, isolation of mother culture, and span preparation and maintenance of mushroom beds of oyster mushroom, *Volvariella* and *Agaricus*. Processing and preservations of mushrooms, economics of spawn and mushroom production and mushroom recipes.

Suggested Reading:

- ❖ Biswas, S., Datta, M. and Ngachan, S. V. 2011. Mushrooms: A Manual for Cultivation. PHI Learning Pvt. Ltd.
- ❖ Chang, S.T. and Philip, G. M. 2004. Mushrooms Cultivation, Nutritional Value, Medicinal Effect and Environmental Impact (2nd Edt.). CRC Press LLC.
- ❖ Diego, C. Z. and Gimenez, A. P. 2017. Edible and Medicinal Mushrooms: Technology and Applications. John Wiley & Sons Ltd.
- ❖ Marimuthu, T., Krishnamoorthy, A.S., Sivaprakasam, K. and Jayarajan. R. 1991. Oyster Mushrooms. Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore.
- ❖ Neeta, B. 1984. Handbook on Mushrooms. Oxford and IBH Publishing Co., New Delhi.

- ❖ Singh, B.H. 1983. Mushroom Growing in India. Starling Publishers Private Limited, New Delhi.
- ❖ Singh, R. and Singh, U.C. 2011. Modern Mushroom Cultivation. Agrobios (India), Jodhpur.
- ❖ Singh, R.P. and Chaube, H.S. 1995. Mushroom Production Technologies. G.B. Pant University of Agriculture and Technology, Pantnagar.
- ❖ Stamets, P. and Chilton, J.S. 1983. The Mushroom Cultivator. Agarikon Press Box 2233, Olympia, Washington, 98507.
- ❖ Suman, B.C. and Sharma, V.P. 2013. Mushroom Cultivation in India. Daya Publishing House.
- ❖ Tewari, P. and Kapoor, S.C. 1988. Mushroom Cultivation, Mittal Publications, Delhi.
- ❖ Verma, D. and Chauhan, A. 2017. A Handbook of Mushroom Production in India. LAP LAMBERT Academic Publishing.

Course No.	Course Title	Credits
SOA/HE/UG 17	Fundamentals of Food Technology	2(1+1)

SOA/HE/UG 17 T: Fundamentals of Food Technology (1)

Food and its function, physico-chemical properties of foods, food preparation techniques, nutrition, relation of nutrition of good health. Characteristics of well and malnourished population. Energy, definition, determination of energy requirements, food energy, total energy needs of the body. 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, assessment of nutritional status of the population.

SOA/HE/UG 17 P: Fundamentals of Food Technology (1)

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 proteins and fats of foods. Planning diet for various age groups.

Suggested Reading:

- ❖ Anita, T. 1996. Food and Nutrition. Oxford.
- ❖ Bettelheim and March. 1984. Introduction to General, Organic & Biochemistry. Harcourt Brace college Publishers.
- ❖ Devendra, K. B. and Priyanka, T. 2006. An Introduction to Food Science and technology and Quality Management. Kalyani Publishers.
- ❖ George, I. S. and Dennis, D. L. 1994. Chemistry for the Health Science. MacMillan.
- ❖ Manoranjan, K. and Sangita, S. 1996. Food Preservation and Processing. Kalyani Publishers.
- ❖ Masferton and Hurley. 1989. Chemistry Principles and Reactions. Saunders Golden Sunburst.
- ❖ Monoranjam, K. and Sangita, S. 2008. Food Preservation and Processing. Kalyani Publishers.
- ❖ Passmore, R. and Eastwood, M. A. 1986. Human Nutrition & Dietetics. ELBS.
- ❖ Shankunthala, M. 1972. Foods-Facts, Principles & Procedure. The Eastern Press, Bengaluru.

- ❖ Srilakshmi. 2005. Dietetics. New age International.
- ❖ Srilakshmi. 2010. Food Science. New age International.
- ❖ Swaminathan, M. 1985. Essential of Food and Nutrition (Vol. II). BAPPCO, Bangalore.
- ❖ Swaminathan, M. 1985. Food and Nutrition (Vol. I & II). BAPPCO, Bangalore.

SEMESTER-VI

Course No.	Course Title	Credits
SOA/HC/UG 25	Potato and Tuber crops	2(1+1)

SOA/HC/UG 25 T: Potato and Tuber crops (1)

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.

SOA/HC/UG 25 P: Potato and Tuber crops (1)

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.

Suggested Reading:

- ❖ Bose, T.K. 2002. Vegetable Crops. Nayaprakash, Kolkata
- ❖ Choudhary, B.R. 2009. A Textbook on Production Technology of Vegetables. Kalyani Publishers, Ludhiana.
- ❖ Dhaliwal, M.S. 2008. Handbook of Vegetable Crops. Kalyani Publishers, Ludhiana.
- ❖ Hazra, P. 2011. Modern Technology in Vegetable Production. New India Publishing Agency, New Delhi.
- ❖ Kamath, K.V. 2007. Vegetable Crop Production. Oxford Book Company, Jaipur
- ❖ Krishnan, T.R.G. 2007. Vegetable Crops. New India Publishing Agency, New Delhi.
- ❖ Thamburaj, S. 2014. Textbook of Vegetable, Tuber Crops and Spices. ICAR, New Delhi.

Course No.	Course Title	Credits
SOA/HC/UG 26	Breeding of Vegetable, Tuber and Spice Crops	3(2+1)

SOA/HC/UG 26 T: Breeding of Vegetable, Tuber and Spice Crops (2)

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, Bhendi, Capsicum, Chilli, Cucurbits, Cabbage, Cauliflower, Tuber crops, Potato, Carrot, Radish, Spice crops (Ginger, Turmeric).Breeding procedures for development of hybrids/varieties in various crops. Genetic basis of adoptability and stability.

SOA/HC/UG 26 P: Breeding of Vegetable, Tuber and Spice Crops (1)

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.

Suggested Reading:

- ❖ Dhaliwal, M.S. 2009. Vegetable Seed Production & Hybrid Technology. Kalyani Publishers, Ludhiana.
- ❖ Dhaliwal, M.S. 2012. Techniques of Developing Hybrids in Vegetable Crops. Agrobios. Jodhpur.
- ❖ Kallo, G, 1998. Vegetable Breeding (Vol.I to IV). CRC Press. Florida. 1988.
- ❖ Ram, H. H. 2013. Vegetable Breeding: Principle and Practices. Kalyani Publishers. Ludhiana.
- ❖ Singh, H.P. 2009. Vegetable Varieties of India. Studium Press (India) Pvt Ltd. New Delhi.
- ❖ Singh, P.K. 2005. Hybrid Vegetable Development. CRC Press. Florida.
- ❖ Swaroop, V. 2014. Vegetable Science & Technology in India. Kalyani Publishers. Ludhiana.

Course No.	Course Title	Credits
SOA/HC/UG 27	Postharvest Management of Horticultural Crops	3(2+1)

SOA/HC/UG 27 T: Postharvest Management of Horticultural Crops (2)

Importance of post-harvest technology in horticultural crops. Maturity indices, harvesting, handling, grading of fruits, vegetables, cut flowers, plantation crops, medicinal and aromatic plants. Pre-harvest factors affecting quality, factors responsible for deterioration of horticultural produce, physiological and bio-chemical changes, hardening and delaying ripening process. Post-harvest treatments of horticultural crops. Quality parameters and specification. Structure of fruits, vegetables and cut flowers related to physiological changes after harvest. Methods of storage for local market and export. Pre-harvest treatment and precooling, pre-storage treatments. Different systems of storage, packaging methods and types of packages, recent advances in packaging. Types of containers and cushioning materials, vacuum packaging, cold storage, poly shrink packaging, grape guard packing treatments. Modes of transport.

SOA/HC/UG 27 P: Postharvest Management of Horticultural Crops (1)

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, physical and chemical methods. Packaging studies in fruits, vegetables, plantation crops and cut flowers by using different packaging materials, methods

of storage, post-harvest disorders in horticultural produce. Identification of storage pests and diseases in spices. Visit to markets, packaging houses and cold storage units.

Suggested Reading:

- ❖ Battacharjee, S. K. and De, L. C. 2005. Post Harvest Technology of Flowers and Ornamentals Plants. Ponteer Publisher, Jaipur, India.
- ❖ Chadha, K. L. and Kalloo, G. 1993. Advances in Horticulture (Vol. 4 to 10). MPH, New Delhi.
- ❖ Fellows, P. J. 1998. Food Processing Technology: Principles and Practices. Ellis Horwood.
- ❖ Hulme, A.C. 1970. Food Science & Technology: A Series of Monograph. The Biochemistry of Fruits and their Products (Vol.-1). Academic Press London & New York.
- ❖ Jacob, J. P. 2008. A Handbook on Post Harvest Management of Fruits and Vegetables. Daya Publishing House, Delhi.
- ❖ Kitinoja, L. and Kader, A. A. 2003. Small-Scale Postharvest Handling practice: A Manual for Horticulture crops (4th edt.). US Davis, PHT Research and information Center.
- ❖ Kitinoja, L. and Kader, A. A. 2003. Small-Scale Postharvest Handling Practice: A Manual for Horticulture Crops (4 edt). US Davis, PHT Research and information Center.
- ❖ Mitra, S. K. 1997. Post Harvest Physiology and Storage of Tropical and Sub-tropical Fruits. CAB International.
- ❖ Pruthi, J. S. 2001. Minor Spices and Condiments: Crop Managements and Post Harvest Technology. ICAR, New Delhi.
- ❖ Ranganna, S. 2017. Handbook of Analysis and Quality Control for Fruit and Vegetable Products (2nd Edt.). McGraw Hill Education.
- ❖ Saraswathy, S. 2008. Post Harvest Management of Horticultural Crops. Agribios (India).
- ❖ Shanmugavelu, K. G., Kumar, N. and Peter K.V. 2002. Production Technology of Spices and Plantation Crops. Agrobios (India).
- ❖ Sharma, N. and Mashkoo, A. M. 1998. Post Harvest Diseases of HorticulturalPerishables. International Book Distributing Co., Lucknow.
- ❖ Srivastava, R.P. and Sanjeev, K. 2017. Fruit and Vegetable Preservation: Principles and Practices. CBS Publishers & Distributors.
- ❖ Stanley, J. K. 1998. Post Harvest Physiology of Perishable Plant Products. CBS, New Delhi.
- ❖ Thomposon, A. K. 1996. Post harvest Technology of Fruits and Vegetables. Blackwell Science.
- ❖ Verma, L. R. and Joshi, V. K. 2000. Post Harvest Technology of Fruits and Vegetables (Vol. I & II). Indus Publishing Co., New Delhi.
- ❖ Wiils, M. G. and Graham, J. 2007. Post Harvest: An Introduction to the Physiology and Handling of Fruits, Vegetables and ornamentals. Cab International.

Course No.	Course Title	Credits
SOA/HC/UG 28	Seed production of Vegetable, tuber and Spice Crops	3(2+1)

SOA/HC/UG 28 T: Seed production of Vegetable, tuber and Spice Crops (2)

Introduction and history of seed industry in India. Definition of seed, classes-types of seed. Differences between grain and seed. Importance and scope of vegetable seed production in

India. 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.

SOA/HC/UG 28 P: Seed production of Vegetable, tuber and Spice Crops (1)

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.

Suggested Reading:

- ❖ Agarwal, P. K. 2010. Techniques in Seed Science and Technology. South Asian Publishers, New Delhi.
- ❖ Agrawal, R. L. 1999. Seed Technology. Oxford and IBH Publicity Company, New Delhi.
- ❖ Copeland, L.O. 1999. Principles of Seed Science and Technology. Springer Publications.
- ❖ Fageria, M. S. 2011. Vegetable Crops: Breeding and Seed Production. Kalyani Publishers, Ludhiana.
- ❖ Geetharani, P. 2007. Seed Technology in Horticultural Crops. NPH Publications. Jodhpur.
- ❖ Hazra, P. and Som, M.G. 2009. Vegetable Seed Production and Hybrid Technology. Kalyani, Publishers, Ludhiana.
- ❖ Kulkarni, G.N. 2002. Principles of Seed Technology. Kalyani Publishers, Ludhiana.
- ❖ Nema, N.P. 1988. Principles of seed certification and Testing. Allied Publications.
- ❖ Singh, A. P. 2003. Vegetable Seed Production Principles. Kalyani Publishers, Ludhiana.
- ❖ Singh, S.P. 2001. Seed Production in Commercial Vegetables. Agrotech Publishing Academy, Udaipur.
- ❖ Vanangamudi, K. 2010. Vegetable Hybrid Seed Production and Management. Agrobios, Jodhpur.

Course No.	Course Title	Credits
SOA/HC/UG 29	Insect Pests of Vegetable, Ornamental and Spice Crops	3(2+1)

SOA/HC/UG 29 T: Insect Pests of Vegetable, Ornamental and Spice Crops (2)

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, bioecology, injury and integrated management. Insecticidal residue problems in vegetables and ornamental crops, tolerance limits etc.

SOA/HC/UG 29 P: Insect Pests of Vegetable, Ornamental and Spice Crops (1)

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.

Suggested reading:

- ❖ Atwal, A.S. and Dhaliwal, G.S. 2015. Agricultural Pests of South Asia and Their Management. Kalyani Publishers.
- ❖ Ayyar, T.V.R. 1963. Handbook of Entomology for South India. Govt. Press Madras.
- ❖ David, B. V. and Kumarswami, T. 1982. Elements of Economic Entomology. Popular Book Department, Madras.
- ❖ Nair, M. R. G. K. 1995. Insect and Mites of Crops in India. ICAR, New Delhi.
- ❖ Rachna, G. and Kumari, B. 2013. Pest Management and Residual Analysis in Horticultural Crop. New India Publishing Agency.
- ❖ 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.
- ❖ Sathe, T. V. 2012. Pests of Ornamental Plants. Daya Publishing House.
- ❖ Sharma, R. 2014. Identification and Management of Horticulture Pest. ABD Publisher.
- ❖ Srivastava, P. and Dharmo, K. B. 1998. Pest Management in Vegetables (Part 1). Researcho Book Centre,
- ❖ Srivastava, P. and Dharmo, K. B. 1998. Pest management in Vegetables (Part-2). Researcho Book Centre.

Course No.	Course Title	Credits
SOA/HSEC/UG 04	Commercial Floriculture	2(1+1)

SOA/HSEC/UG 04 T: Commercial Floriculture (1)

Scope and importance of commercial floriculture in India, production techniques of commercial flower crops like rose, marigold, chrysanthemum, orchid, carnation, gladiolus, jasmine, crossandra, anthurium, dahlia, tuberose, bird of paradise, china aster and gerbera for domestic and export market, production techniques of flowers and foliage filler materials growing of flowers under protected environments such as glass house, plastic house etc., postharvest technology of cut flowers in respect of commercial flower crops, dehydration technique for drying of flowers, production techniques for bulbous.

SOA/HSEC/UG 04 P: Commercial Floriculture (1)

Identification of commercially important floricultural crops. Propagation practices in chrysanthemum, 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.

Suggested Reading:

- ❖ Arora, J.S. 2006. Introductory Ornamental Horticulture. Kalyani Publishers, Ludhiana.
- ❖ Bhattacharjee, S. K. and De, L.C. 2003. Advanced Commercial Floriculture. Aavishkar Publishers, Distributors, Jaipur, India.

- ❖ Bose, T. K., Yadav, L. P., Patil, P., Das, P. and Sarthy, V. A. P. 2003. Commercial Flowers. Naya Udyog, Kolkata.
- ❖ Choudhary, D. and Mehta, A. 2010. Flower Crops Cultivation and Management. Oxford Book Company, Jaipur, India.
- ❖ Randhawa, G.S. and Mukhopadhyay, A. 2004. Floriculture in India. Allied Publishers Pvt. Ltd.
- ❖ Sheela, V. L. 2008. Flower for Trade. New India Publishing Agency, New Delhi.
- ❖ Singh, A. K. 2006. Flower Crops, Cultivation and Management. New India Publishing Agency, Pitamura, New Delhi.

Course No.	Course Title	Credits
SOA/HE/UG 18	Breeding and Seed Production of Flower and Ornamental Plants	2(1+1)

SOA/HE/UG 18 T: Breeding and Seed Production of Flower and Ornamental Plants (1)

History of improvements of ornamental plants, Centre of origin of flower crops 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*, Bouganvillea, Zinnia, Cosmos, Dianthus, Snapdragon, Pansy, crossandra, marigold, geranium, antirrhinum, china aster, orchids, anthurium, carnation, hibiscus etc. Breeding for disease resistance. Development of promising cultivars of important ornamentals and flower crops. Role of heterosis and its exploitation, production of F1 hybrids and utilization of male sterility, production of open pollinated seed. Harvesting processing and storage of seeds, seed certification.

SOA/HE/UG 18 P: Breeding and Seed Production of Flower and Ornamental Plants (1)

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 seeds. Practice in seed production methods.

Suggested Reading:

- ❖ Agarwal, P.K. 1994. Principles of Seed Technology. ICAR Publication, New Delhi
- ❖ Agarwal, R.L. 1996. Seed Technology. Oxford & IBH Publishers, New Delhi
- ❖ Bhattacharjee, S.K. and De, L.C. 2003. Advanced Commercial Floriculture. Aavishkar Publishers, Distributors, Jaipur, India.
- ❖ Bose, T.K., Yadav, L.P., Patil, P., Das, P. and Sarthy, V.A. P. 2003. Commercial Flowers. Naya Udyog, Kolkata.
- ❖ Callaway, D.J. and Callaway, M.B. 2000. Breeding Ornamental Plants. Timber Press
- ❖ Harding, J., Singh, F. and Mol, J.N. 1991. Genetics and Breeding of Ornamental Species. Springer Publishers.
- ❖ Pal, B.P. 1966. The Rose in India. Directorate of Knowledge Management in Agriculture, ICAR, New Delhi.
- ❖ Singh, B.D. 1983. Breeding Principles and Methods. Kalyani Publishers, New Delhi.
- ❖ Vainstein. 2002. Breeding for Ornamental: Classical and Molecular Approaches. Springer Publishers.

Course No.	Course Title	Credits
SOA/HE/UG 19	Diseases of Vegetable, Ornamentals and Spice Crops	2(1+1)

SOA/HE/UG 19 T: Diseases of Vegetable, Ornamentals and Spice Crops (1)

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, ginger, potato, turmeric, pepper, cumin, cardamom, nutmeg, coriander, clove, cinnamon, jasmine, rose, crossandra, tuberose, gerebera, anthurium, geranium. Important post-harvest diseases of vegetables and ornamental crops and their management.

SOA/HE/UG 19 P: Diseases of Vegetable, Ornamentals and Spice Crops (1)

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.

Suggested Reading:

- ❖ Godara, S.L., Kapoor, B.B.S. and Rathore, B.S. 2010. Disease Management of Spice Crops. Madhu Publications.
- ❖ Henry, L. D. C. and Devasahayam, H. L. 2011. Crop Diseases: Identification, Treatment and Management. New India Publishing Agency.
- ❖ Kulkarni, S. and Hedge, Y. R. 2009. Diseases of Plantation crops and their management. Agrotech Publication Academy.
- ❖ Ranga, S.G. 1988. Diseases of Crop Plants in India. Prentice Hall of India Pvt. Ltd., New Delhi.
- ❖ Singh, R.S 1996. Plant Diseases. Oxford IBH Publishing Co. Pvt. Ltd., New Delhi
- ❖ Singh, R.S. 1994. Diseases of Vegetable Crops. Oxford IBH Publishing Co. Pvt. Ltd., New Delhi.
- ❖ Sohi, H.S. 1992. Diseases of Ornamental Plants in India. ICAR, New Delhi

Course No.	Course Title	Credits
SOA/HE/UG 20	Precision Farming and Protected Cultivation	2(1+1)

SOA/HE/UG 20 T: Precision Farming and Protected Cultivation (1)

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.

SOA/HE/UG 20 P: Precision Farming and Protected Cultivation (1)

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.

Suggested Reading:

- ❖ Aldrich, R.A. and Bartok, J.W. 1994. Green House Engineering. NRAES, Riley, Robb Hall. Cornell University, Ithaca, New York.
- ❖ Castilla, N. 2012. Greenhouse Technology and Management (2nd Edt.). CABI.
- ❖ Kumar, T. P., Suma, B., Bhaskar, J. and Satheson, K. N. 2008. Management of Horticultural Crops. New India Publishing Agency, New Delhi.
- ❖ Nelson, P. V. 1991. Green House Operation and Management. Bali Publ.
- ❖ Parvatha, R. P. 2003. Protected Cultivation. Springer Publications. USA.
- ❖ Parvatha, R. P. 2011. Sustainable Crop Protection Under Protected Cultivation. Springer Publications. USA.
- ❖ Prasad, S. 2005. Greenhouse Management for Horticultural Crops. Agrobios. Jodhpur.
- ❖ Singh, B. 2006. Protected Cultivation of Vegetable Crops. Kalyani Publishers, Ludhiana.
- ❖ Singh, B. 2014. Advances in Protected Cultivation. New India Publishing Agency. New Delhi.
- ❖ Singh, J. 2015. Precision Farming in Horticulture. New India Publishing Agency. New Delhi.
- ❖ Singh, J., Jain, S. K., Dashora, L. K. and Cundawat, B. S. 2013. Precision Farming in Horticulture. New India Publishing Agency, New Delhi.

SEMESTER-VII

Course No.	Course Title	Credits
SOA/HC/UG 30	Processing of Horticultural Crops	3(2+1)

SOA/HC/UG 30 T: Processing of Horticultural Crops (2)

Importance and scope of fruit and vegetable preservation industry in India, food pipe line, losses in post-harvest operations, unit operations in food processing. Principles and guidelines for the location of processing units. Principles and methods of preservation by heat - pasteurization, canning, bottling. Methods of preparation of juices, squashes, syrups, cordials and fermented beverages. Jam, jelly and marmalade. Preservation by sugar and chemicals, candies, crystallized fruits, preserves chemical preservatives, preservation with salt and vinegar, pickling, chutneys and sauces, tomato and mushrooms, freezing preservation. Processing of plantation crops, products, spoilage in processed foods, quality control of processed products, Govt. policy on import and export of processed fruits. Food laws.

SOA/HC/UG 30 P: Processing of Horticultural Crops (1)

Equipments used in food processing units. Physico-chemical analysis of fruits and vegetables. Canning of fruits and vegetables, preparation of squash, RTS, cordial, syrup, jam, jelly, marmalade, candies, preserves, chutneys, sauces, pickles (hot and sweet). Dehydration of fruits and vegetables–tomato product dehydration, refrigeration and freezing, cut out analysis of processed foods. Processing of plantation crops. Visit to processing units.

Suggested Reading:

- ❖ Chadha, K. L. and Kalloo, G.1993. Advances in Horticulture (Vol. 4 to 10). MPH, New Delhi.
- ❖ Dauthy and Mircea, E.1995. Fruit and Vegetables Processing. International Book Distribution Co, Lucknow.
- ❖ Dauthy, M. E. 1995. Fruits and Vegetables Processing: FAO Bulletin 119. International Book Distributing Co., Lucknow.
- ❖ FAO- Training Manual No.17/2. 2007. Prevention of Post Harvest Food Losses: Fruits, Vegetables and Root crops. Daya Publishing House, Delhi.
- ❖ Fellows, P. J. 1998. Food Processing Technology: Principles and Practices. Ellis Horwood.
- ❖ Manoranjan, K and Sangita, S. 1996. Food Preservation & Processing. Kalyani Publishers, India.
- ❖ Morris, T. N. 2006. Principles of Fruit Preservation. Biotech Books, Delhi.
- ❖ Salunkhe, D.K., Bolin, H. R. and Reddy, N. R. 1991. Storage, Processing and Nutritional Quality of Fruits and Vegetables (2nd Edition). CRC Press.
- ❖ Sharma, N. and Mashkoo, A. M. 1998. Post Harvest Disease of Horticultural Perishable. International Book Distributing Co., Lucknow
- ❖ Siddappa, G. S., Girdhari Lal and Tandon, G. L. 1998. Preservation of Fruits and Vegetables. ICAR, New Delhi
- ❖ Srivastava, R. P. and Kumar, S. 2002. Fruits and Vegetable Preservation: Principles and Practice. International Book Distributing Co., Lucknow.
- ❖ Srivastava, R. P. And Sanjeev K.1998. Fruit and Vegetable Preservation Principles Practice. International Book Distributing Co., Lucknow.
- ❖ Verma, L. R. and Joshi, V. K. 2000. Post Harvest Technology of Fruits and Vegetables (Vol. I & II). Indus Publishing Co., New Delhi.
- ❖ Vijay, K. 2001. Text Book of Food Sciences and Technology. ICAR, New Delhi.

Course No.	Course Title	Credits
SOA/HC/UG 31	STUDENT READY: Experimental Learning programme Commercial Horticulture	6(6+0)

SOA/HC/UG 31 T: STUDENT READY: Experimental Learning programme

Commercial Horticulture (6)

Project preparation and Report Writing

1. Nursery production of fruit crops: Raising of rootstocks, grafting and budding of rootstocks, management of grafted plants, cost of production, plant certification, packaging and marketing, quality control.
2. Nursery production of ornamentals: Production of plantlets, production of potted plants, management and maintenance, sale, marketing and cost of production.
3. Protected cultivation of vegetables and flowers: Nursery raising/procurement and transplanting, management and maintenance of the crop, postharvest handling, quality control, marketing and cost of production
4. Report writing, presentation and discussion.

Course No.	Course Title	Credits
SOA/HC/UG 32	STUDENT READY: Experimental Learning programme Processing of Fruits and Vegetables for Value Addition	6(6+0)

SOA/HC/UG 32 T: STUDENT READY: Experimental Learning programme

Processing of Fruits and Vegetables for Value Addition (6)

Project preparation and Report Writing

1. Planning and execution of a market survey
2. Preparation of processing schedule
3. Preparation of project module based on market information
4. Calculation of capital costs, source of finance, assessment of working capital requirements and other financial aspects
5. Identification of sources for procurement of raw material
6. Production and quality analysis of fruits and vegetables products at commercial scale
7. Packaging, labelling, pricing and marketing of product
8. Working out economics
9. Report writing, presentation and discussion

Course No.	Course Title	Credits
SOA/HSEC/UG 05	Horti- Business Management	2(2+0)

SOA/HSEC/UG 05 T: Horti- Business Management (2)

Farm management - definition, nature, characteristics and scope. Farm management 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- equi-marginal 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 evaluation measures.

Suggested Reading

- ❖ Dewett, K. K. and Navalur, M. H. 2006. Modern Economic Theory. S. Chand & Sons, New Delhi.

- ❖ Heady, E.O. and Herald, R. J. 1954. Farm Management Economics. Prentice Hall, New Delhi.
- ❖ Johl, S. S. and Kapur, J. R. 2006. Fundamentals of Farm Business Management. Kalyani Publishers, New Delhi.
- ❖ Koontz, H. 2010. Essential of Management. Tata McGraw-Hill Education Private Limited, New Delhi.
- ❖ Prasad, L. M. 2001. Principles and Practices of Management (9th Ed.) S. Chand & Sons, New Delhi.
- ❖ Rao, P. S. 2018. Human Resource Management. Himalaya Publications.
- ❖ Singh, K. and Kahlon, A. S. 1992. Economics of Farm Management in India. Theory and Practice. Allied Publishers, New Delhi.
- ❖ Thomas, P. C. and Maurice, S.C. 2004. Managerial Economics (9th Ed.). Kalyani Publishers.

Course No.	Course Title	Credits
SOA/HE/UG 21	STUDENT READY: Experimental Learning programme Commercial Horticulture	3(0+3)

**SOA/HE/UG 21 P: STUDENT READY: Experimental Learning programme
Commercial Horticulture (3)**

II. Presentation of report and discussion.

Course No.	Course Title	Credits
SOA/HE/UG 22	STUDENT READY: Experimental Learning programme Processing of Fruits and Vegetables for Value Addition	3(0+3)

**SOA/HE/UG 22 P: STUDENT READY: Experimental Learning programme
Processing of Fruits and Vegetables for Value Addition (3)**

II. Presentation of report and discussion.

SEMESTER-VIII

Rural Horticultural Work Experience 20 (4+4+6+6)

In this whole semester, students will be working with horticulture farmers/horticulture based industries in collaboration with developmental departments, extension functionaries, input suppliers, marketing and procurement functionaries, processing industries.

Horticultural work experience will be evaluated by the department committee on the basis of

SOA/HC/UG 33 T: I. Project preparation (4)

SOA/HC/UG 34 P: II. Placement in Industries (4)

SOA/HC/UG 35 P: III. Placement in Villages (6)

SOA/HC/UG 36 T: Project report writing, Presentation and Discussion (Placement in Industries & Villages) (6)