COLLEGE OF HORTICULTURE

Course Curriculum

B.Sc. (Hons.) Horticulture Programme

(As per Fifth Deans' Committee recommendation report of ICAR)

2020 - 2021

Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut (UP)

Patron

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MESSAGE

Horticulture has been the mainstay of rural economy since ages. The tremendous research and development base has made our country the second largest producer of fruits and vegetables in the world. Horticulture crops covering 30.4 % of the total area contribute 30 % to the agricultural GDP. Thereby besides green, white, blue and yellow revolution in different fields, we have yet another revolution to come as Golden revolution. Fruit and vegetables have emerged as an important sector with high potential in our country. They play a vital role in the economy of nation and provide the nutritional security to our people. Floriculture has emerged as most lucrative business and is fast emerging as a major venture on the world scene due to much higher return than other crops. Medicinal and aromatic plants and spices have been used for a long time for their medicinal properties.

In the farming system of western Uttar Pradesh, horticulture occupies an important position and therefore it has great relevance in improving the overall economy of the zone. The very specific agro climatic condition of the region offers tremendous potential for the development of horticulture. The total area of horticultural crops occupied in 4 divisions of western Uttar Pradesh (Meerut, Saharanpur, Bareilly and Moradabad) is 606815 ha. of the total area, fruits are cultivated in 328733 ha, vegetables in 264282 ha, spice in 6096 ha, and flower crops occupy 7704 ha areas. The university which came into existence on 20 October 2000 has responsibility for agricultural education, research and extension in 4 commissionaires comprising of 18 districts of western Uttar Pradesh. The university has made considerable progress in education, research and extension programmes in the field of crop husbandry, horticulture, plant protection, biotechnology and animal science relevant to peculiar condition of western zone of UP. Considering the role of horticulture in the national economy and need for generation of income and employment opportunity in the region, the Government of Uttar Pradesh has approved the college of horticulture in the university in 2018-19. The establishment of college of horticulture is significant because no sole programme of education in the field of horticulture is at present running in any organization of western UP. By establishing the college in the region, the horticultural education, research and training will be imparted in the very heart of the region which is basically called a green belt of western Uttar Pradesh. The college will also generate knowledge on frontier areas like value addition, market intelligence, biotechnology, sustainability and cluster approach for marketing network etc. It is hoped that horticultural education, research and training to the people will go a long way in meeting the requirement of education and trained personnel.

During the academic year 2019-20, the undergraduate programme in horticulture will commence in the college of Horticulture of university. I appreciate the faculty of Horticulture for preparing the detailed course curriculum and syllabus of B.Sc. (Hons.) Horticulture degree programme as per 5th Dean Committee recommendation in a short period of time. The syllabus contains the details of catalogue description, department & semester- wise distribution of courses and course outlines of each course of B.Sc. (Hons.) Horticulture degree programme. I am sure this edition of syllabus will be of immense use to both the teachers and the students.

(R.K. Mittal)

CONTENTS

Executive Summary

The State of Agriculture Education Quality human resource, the main driver of comprehensive development, is the greatest treasure of a nation. India's national agricultural education and research system - the agricultural universities and ICAR institutes, through creating desired trained human ware, ushered in the Rainbow Revolution, led by the Green Revolution launched in the 1960s.

The agrarian progress during the past few years has, however, slackened and serious asymmetries exist in science-led growth of agriculture, farmers' income and food and nutrition securities, these asymmetries are exacerbated due to the volatilities in climate change and markets, and the declining land, water and biodiversity resources.

The not so satisfactory state of India's food and agriculture system and agrarian economy could partly be attributed to the decline in quality of agricultural education, viz erosion of basic sciences from agricultural curricula, extensive inbreeding, serious skill gaps, and poor employability of agriculture graduates. Thus, bridging these gaps in the availability of quality human resources must be a high national priority.

The Indian Council of Agricultural Research (ICAR), an autonomous organization under the Department of Agricultural Research and Education (DARE), Ministry of Agriculture and Farmers Welfare, Government of India is one of the largest national agricultural research and education system in the world. With 103 ICAR Institutes and 73 agricultural universities spread across the country, the ICAR, the apex body for coordinating, guiding and managing research and education in agriculture in the entire country, must address the asymmetries.

The Education Division of the Council, towards addressing the veritable asymmetries, undertakes planning, development, coordination and quality assurance in higher agricultural education in the country and, thus, strives for maintaining and upgrading quality and relevance of higher agricultural education thought partnership and efforts of the components of the ICAR-Agricultural Universities (AUS) System comprising 61 State Agricultural Universities (SAUS), 5 Deemed to be Universities (DUS), 3 Central Agricultural Universities (CAUS) and 4 Central Universities (CU) with Agriculture Faculty.

Quality assurance in higher agricultural education in the country has been pursued through policy support, accreditation, framing of minimum standards for higher agricultural education, academic regulation, personnel policies, review of course curricula and delivery systems, development support for creating/strengthening infrastructure and facilities, improvement of faculty competence and admission of students thought All India competitions. As foremost step for quality improvement in education, the ICAR has periodically been appointing Deans' Committees for revision of course curricula. In the series, Fifth Deans Committee was constituted and given terms of reference (TORs) considering contemporary challenges for employability of passing out graduates and to adopt a holistic approach for quality assurance and effective governance in agricultural education.

A comprehensive consultation process adopting a bottom up approach w undertaken for curricula development to ensure nation-wide acceptance of the Committee's Report and its ownership by all stakeholders. Inputs from different stakeholders of agricultural education were obtained at different levels. The Committee first deliberated on the skills which graduates must possess and then worked out backward to design course curricula. The Committee identified Conveners/Co-conveners and gave them the responsibility to have inputs from all the Deans of all the colleges of their disciplines based on the suggestions received from their faculty after holding meetings at University/College level. The suggestions received for all the disciplines were reviewed by the Committee. The Committee has endeavoured to make sure that the Report represents a national consensus in respect of its terms of reference and various issues that were flagged to it. In particular, the course curricula have been restructured to underpin relevant practical skills, entrepreneurial aptitude, self-employment, leadership qualities and confidence among graduates, attracting and retaining youth in agriculture, which among other things, will be helpful in implementing the new initiatives of the government, viz., Make-in-India, Start-up-India, Skill India etc. During this "Decade of Innovations in India", importance of cost effective, location specific and affordable innovations along the value chain and of new extension systems have been highlighted in the revised curricula. Further, the Committee has also considered the international dimension of agricultural education in context of technological, socio-economic, environmental, and livelihood security, and sought to achieve global level academic excellence and relevance. The updated curricula thus provide academic legitimacy to the new and emerging issues of food and agricultural system and contextualize the new pursuits.

Student READY programme

Student READY programme was launched by the Hon'ble Prime Minister of India on 25th July 2015.

Introduction

The term **READY** refers to "**Rural Entrepreneurship Awareness Development Yojana**". To reorient graduates of agriculture and allied subjects for ensuring and assuring employability and develop entrepreneurs for emerging knowledge intensive agriculture, the component envisages the introduction of the program in all the Agricultural Universities as an essential prerequisite for the award of degree to ensure hands on experience and practical training. **Component of the programme**: It is proposed to include the following components in Student READY programme,

i. Experiential Learning/Hands on Training
ii. Skill Development Training
iii. Rural Agriculture Work Experience
iv. In Plant Training/ Industrial Attachment
v. Students Projects

In some disciplines where some components, say, Experiential Learning, are not possible at graduate level, the students will be given Hands on Training and/or Skill Development Training, but it should be (out of these 5 components) implemented for the complete year.

All the above-mentioned components are interactive and are conceptualized for building skills in project development and execution, decision-making, individual and team coordination, approach to problem solving, accounting, quality control, marketing and resolving conflicts, etc. with end to end approach. Salient features of each component are summarised below:

- Experiential Learning helps the student to develop competence, capability, capacity building, acquiring skills, expertise, and confidence to start their own enterprise and turn job creators instead of job seekers. This embraces the earning while learning concept. Experiential Learning is a major step forward for high quality professional competence, practical work experience in real life situation to graduates, production-oriented courses, production to consumption project working, facilitates producing job providers rather than job seekers and inculcates entrepreneurial orientation.
- Rural Agriculture Work Experience also enables the students to gain rural experience giving them confidence and enhancing on-farm problem solving abilities in real life situations especially in contact with farmers, growers, and other stakeholders.

- In-plant Training for a short period of time in relevant industry helps gain the knowledge and experience of the work culture. In-plant Training by reputed organizations either MNCs or organised sectors provide an exposure to the students as well as helps develop their career in high industrial requirements.
- Skill Development component includes use of Agriculture Systems & devices for enhancing functional skill. It is expected that basic infrastructure Experiential Learning Unit available in universities may help in boosting livelihood-ensuring opportunities.
- Student Project is essential for students interested in higher education: Through this component, they will know how to identify research problems, create experimental set up and to write report etc.

All the components as per suitability of course i.e. Experiential Learning and Development Training, Rural Agriculture Work Experience (RAW Internship/In-Plant Training and Student Projects are included in the final year of study for 2 semesters, to provide entrepreneurial skills, confidence an hands on experience. There are 20 credits for Experiential Learning/Skill Development Training (24 weeks), 10 credits for RAWE (10 weeks programme and 10 Credits for Industry Attachment/Student Project (10 weeks attachment to industry).

Some of the important components of Student READY programme are given as follows:

1. Experiential Learning (EL)

a) Concept

The word 'experiential' essentially means that learning and development are achieved through personally determined experience and involvement, rather than on received teaching or training, typically in group, by observation, study of theory or hypothesis, and bring in innovation or some other transfer of skills or knowledge. Experiential learning is a business curriculum-related endeavour which is interactive.

EL is for building (or reinforcing) skills in project development and execution, decision-making, individual and team coordination, approach to problem solving, accounting, marketing and resolving conflicts, etc. The programme has end to end approach. Carefully calibrated activities move participants to explore and discover their own potential. Both activities and facilitation play a critical role in enhancing team performance.

b) Objectives

EL provides the students an excellent opportunity to develop analytical and entrepreneurial skills, and knowledge through meaningful hands on experience,

confidence in their ability to design and execute project work. The main objectives of EL are:

- ❖ To promote professional skills and knowledge through meaningful hands on experience
- ❖ To build confidence and to work in project mode.
- ❖ To acquire enterprise management capabilities.

c) Duration

The experiential learning programme will be offered for 180 days (one semester period in the final year. As the programme is enterprise oriented, students and faculty are expected to attend the activities of the enterprise even on institutional holidays with total commitment, and without any time limit or restriction of working hours for ELP. The Experiential Learning Programme shall be run for full year by making two groups and rotating activities of the final year in two groups

d) Attendance

The minimum attendance required for this programme is 85%. The attendance of a student will be maintained at the EL unit. The attendance shall be communicated to the Chief Executive Officer (Associate Dean) by the Manager of the EL unit every week. The students will be eligible for the final evaluation of EL only when the attendance requirement is met with. Any student in the event of recording shortage of attendance has to re-register the EL when offered next by paying the assigned fee.

e) Students Eligibility

To get the eligibility for registering for the EL programme, the students should have completed all the courses successfully. No student should be allowed to take up the EL programme with backlog/repeat courses. The assignment/allotment of the EL programme shall be based on merit of the student at the end of 5th semester. A separate certificate should be issued to the students after successful completion of EL course. Allotment of EL programmes amongst students to different modules should be done strictly based on merit at the end of fifth semester.

II. Rural Agricultural Work Experience

The Rural Agricultural Work Experience (RAWE) helps the students primarily to understand the rural situations, status of agricultural technologies adopted by the farmers to prioritize the farmers' problems and to develop skills & attitude of working with farm families for overall development in rural area. The timings for RAWE can be flexible for specific regions to coincide with the main cropping season.

2. Objectives

1. To provide an opportunity to the students to understand the rural setting in relation to agriculture and allied activities.
2. To make the students familiar with socio-economic conditions of the farmers and their problems.
3. To impart diagnostic and remedial knowledge to the students relevant to real field situations through practical training.
4. To develop communication skills in students using extension teaching methods in transfer of technology.
5. To develop confidence and competence to solve agricultural problems.
6. To acquaint students with on-going extension and rural development programmes.

III. In Plant Training (IPT)

Technology and globalization are ushering an era of unprecedented change. The need and pressure for change and innovation is immense. To enrich practical knowledge of the students, In-plant Training shall be mandatory in the last semester for a period of up to 10 weeks. In this training, students will have to study a problem in industrial perspective and submit the reports to the university. Such In-plant Trainings will provide an industrial exposure to the students as well as to develop their career in the high-tech industrial requirements. In-plant Training is meant to correlate theory and actual practices in the industries. It is expected that sense of running an industry may be articulated in right way through this type of industrial attachment mode.

Objectives

- To expose the students to industrial environment, which cannot be simulated in the university.
- To familiarize the students with various materials, machines, processes products and their applications along with relevant aspects of shop management.
- To make the students understand the psychology of the workers and approach to problems along with the practices followed at factory.
- To make the students understand the scope, functions and job responsibility-ties in various departments of an organization.
- Exposure to various aspects of entrepreneurship during the programme period.

The students will be required to submit report on various aspects and will be issued certificates upon successful completion of the student READY components.

Fifth Dean's Committee, after deliberations with the Conveners/Co-conveners and Subject Matter Specialists recommends the discipline-wise Student READY programmes as follows:

HORTICULTURE

Student READY Program will be taken up during VII and VIll semesters and will have the following components:

Semester - VII

Student READY

Rural horticulture work Experience (RHWE) & Placement in Industries. This problem will be taken up during the VII semester for duration of 24 weeks and will be allowed 0+20 credit hours. The program will include orientation, village attachment in the University/KVK or a research station.

Semester - VIII

Student READY

Experiential learning (Professional package) will be for the duration of 20 weeks and will carry a waitage of 0+20 credit hours. Students can select any two modules from the following under

STUDENTS READY- Experiential learning programme depending on the facilities available at the college:

- Commercial horticulture
- Protected cultivation of high value horticulture crops
- Processing of fruit and vegetables for value addition
- Floriculture and landscape architecture
- Bio-inputs: bio-fertilizers and bio-pesticides
- Mass multiplications of plant and modules through tissue culture
- Mushroom culture
- Bee keeping

Examination and evaluation system

Fifth Dean's committee deliberated on the examination and evaluation being followed by different universities. The Committee recommends uniform Grading system to be followed with uniform OGPA requirements for award of degrees at all levels and uniform conversion formulae to be follow declaration of I, II and III divisions, distinctions etc. Declaration of division in the degree certificate to be made compulsory by all universities:

1. Examination

- External theory (50%)

- Internal Theory + Practical (50%)

➢ **Courses with Theory and Practical**

Mid-term Exam (30%) + Assignment (5%) in practical oriented courses + Practical (15%)

➢ **Courses with only Theory**

Mid-term Exam (40%) + Assignment (10%)

➢ **Courses with only Practical:**

(100%) Internal

- Paper to be set by external: HOD shall ensure the coverage of syllabus. If needed moderation can be done.
- Evaluation to be done internally by the faculty other than the Course Instructor. Syllabus of the concerned course shall be sent to the external examiner, who shall prepare the question papers. For practical, it is recommended that examination shall be conducted by course instructor(s) and one teacher nominated by HOD.

2. Evaluation

Degree	**Percentage of marks obtained**	**Conversion into points**
All	**100**	**10 points**
	90 to <100	**9 to <10**
	80 to <90	8 to <9
	70 to <80	7 to <8
	60 to <70	6 to <7
	50 to <60	5 to <6
	<50 (Fail)	<5
	Ex. 80.76	8.076
	43.60	44.360
	72.50 (but shortage in attendance)	Fail (1point)

OGPA	**Division**
5.000 - 5.999	Pass
6.000 - 6.999	2nd division
7.000 - 7.999	1st division
8.000 and above	1st division with distinction

GPA = Total points scored / Total credits (for 1 semester)

CGPA = Σ Total points scored / Course credits

OGPA = Σ Total points scored (after excluding failure points)/ Course credits % of Marks = OGPA X 100/10

COLLEGE OF HORTICULTURE

Discipline-wise Courses

(As per Fifth Dean's Committee recommendation report)

B.Sc. (Hons.) Horticulture

4	HPP-214	Nematode Pests of Horticultural Crops and their Management	2 (1+1)	52
5	HPP-221	Insect Pests of Fruit, Plantation, Medicinal and Aromatic Crops	3 (2+1)	52
6	HPP-311	Diseases of Vegetable, Ornamental and Spice Crops	3 (2+1)	53
7	HPP-321	Insect Pests of Vegetable, Ornamental and Spice Crops	3 (2+1)	53
Natural Resource Management				
1	HNM-111	Fundamentals of Soil Science	2 (1+1)	56
2	HNM-121	Environmental Studies and Disaster Management	3 (2+1)	57
3	HNM-122	Water Management in Horticultural Crops	2 (1+1)	59
4	HNM-123	Soil Fertility and Nutrient Management	2 (1+1)	60
5	HNM-221	Farm Power and Machinery	2 (1+1)	62
6	HNM-222	Soil, Water and Plant Analysis	2 (1+1)	62
7	HNM-311	Organic Farming	3 (2+1)	63
8	HNM-312	Introduction to Major Field Crops	2 (1+1)	64
9	HNM-313	Agro-meteorology and Climate Change	2 (1+1)	65
Basic Sciences				
1	HBS-111	Introductory Crop Physiology	2 (1+1)	67
2	HBS-112	Introductory Microbiology	2 (1+1)	68
3	HBS-113	Elementary Statistics and Computer Application	3 (2+1)	69
4	HBS-114	Principles of Plant Breeding	3 (2+1)	70
5	HBS-121	Principles of Genetics and Cytogenetics	3 (2+1)	71
6	HBS-115	Elementary Plant Biochemistry	2 (1+1)	72
7	HBS-211	Elementary Plant Biotechnology	2 (1+1)	73
Social Sciences				
1	HSS-111	Economics and Marketing	3 (2+1)	75
2	HSS-112	Communication Skills and Personality Development	2 (1+1)	76
3	HSS-121	Information and Communication Technology	2 (1+1)	77
4	HSS-323	Fundamentals of Extension Education	2 (1+1)	78
5	HSS-321	Horti-Business Management	2 (1+1)	79
6	HSS-322	Entrepreneurship Development and Business Management	2 (1+1)	80
7	NSO-121	Physical and Health Education (NC)	1 (0+1)	81
8	NSO-114/ NSO-115	NSS/NCC(NC)	1 (0+1)	82

STUDENT READY:

Professional Packages Hands on Training /Experimental Learning Module: Final year B.Sc. (Hort.) students can select two modules under STUDENT READY Experiential Learning programme depending on the facilities available at the college.

1. Commercial Horticulture
2. Protected cultivation of high value Horticulture crops
3. Processing of fruits and vegetables for value addition
4. Floriculture and landscape architecture
5. Bio-inputs: Bio-fertilizers and bio-pesticides
6. Mass multiplication of plant and molecules through tissue culture
7. Mushroom culture

8. Bee keeping

Batch of student can select two modules under STUDENT READY- Experiential Learning Programme depending on the facilities available at the college.

II. Rural Horticultural Work Experience Programme (0+20)

i. STUDENT READY - Placement in Industries (0+10)

ii. STUDENT READY- Placement in Villages (0+10)

Semester wise courses

Semester- I				
SL	**Course No**	**Title of the Course**	**Credit Hrs**	**Page No**
1	HFS-111	Fundamentals of Horticulture	3 (2+1)	20
2	HFL-111	Principles of Landscape Architecture	2 (1+1)	44
3	HBS-111	Introductory Crop Physiology	2 (1+1)	67
4	HNM-111	Fundamental of Soil Science	2 (1+1)	56
5	HBS-115	Elementary Plant Biochemistry	2 (1+1)	72
6	HBS-114	Principles of Plant Breeding	3 (2+1)	70
7	HSS-112	Communication Skills and Personality Development	2 (1+1)	76
8	HBS-112	Introductory Microbiology	2 (1+1)	68
9	HBS-113	Elementary Statistics and Computer Application	3 (2+1)	69
10	HSS-111	Economics and Marketing	3 (2+1)	75
11	NS0-114 / NSO-115	National Service Scheme/National Cadet Corp	1 (0+1) (NC)*	82
		Total	**25 (14+11)**	
Semester- II				
SL	**Course No**	**Title of the Course**	**Credit Hrs**	
1	HFS-121	Tropical and Subtropical Fruits	3 (2+1)	21
2	HVS-121	Tropical and Subtropical Vegetables	3 (2+1)	32
3	HBS-121	Principles of Genetics and Cytogenetics	3 (2+1)	71
4	HNM-121	Environmental Studies and Disaster Management	3 (2+1)	57
5	HFS-124	Growth and Development of Horticultural Crops	2 (1+1)	23
6	HSS-121	Information and communication technology	2 (1+1)	77
7	HNM-122	Water Management in Horticultural Crops	2 (1+1)	59
8	HNM-123	Soil Fertility and Nutrient Management	2 (1+1)	60
9	HFS-123	Plant Propagation and Nursery Management	2 (1+1)	22
10	NSO-121	Physical and Health Education	1 (0+1) (NC)*	81
		Total	**23 (13+10)**	
Semester- III				
SL	**Course No**	**Title of the Course**	**Credit Hrs**	
1	HPP-211	Fundamentals of Entomology	3 (2+1)	49
2	HVS-211	Temperate Vegetable Crops	2 (1+1)	33
3	HPT-211	Fundamentals of Food Technology	2 (1+1)	40
4	HFS-211	Temperate Fruit Crops	2 (1+1)	24

5	HFL-211	Commercial Floriculture	3 (2+1)	45
6	HBS-211	Elementary Plant Biotechnology	2 (1+1)	73
7	HPP-212	Diseases of fruit, Plantation, Medicinal and Aromatic Crops	3 (2+1)	50
8	HFS-212	Weed Management in Horticultural Crops	2 (1+1)	25
9	HPP-213	Fundamentals of Plant Pathology	3 (2+1)	51
10	HPP-214	Nematode pests of horticultural crops and their Management	2 (1+1)	52
11	NSO-114/ NSO-115	NSS/NCC(NC)	1 (0+1)	82
Total			**25 (14+11)**	
Semester- IV				
SL	**Course No**	**Title of the Course**	**Credit Hrs**	
1	HFL-221	Ornamental Horticulture	2 (1+1)	45
2	HVS-221	Spices and Condiments	3 (2+1)	34
3	HFS-221	Plantation Crops	3 (2+1)	26
4	HNM-221	Farm Power and Machinery	2 (1+1)	62
5	HNM-222	Soil, Water and Plant Analysis	2 (1+1)	62
6	HFS-222	Breeding of Fruit and Plantation Crops	3 (2+1)	26
7	HPP-221	Insect Pests of Fruit, Plantation, Medicinal & Aromatic Crops	3 (2+1)	52
8	HVS-222	Precision Farming and Protected Cultivation	3 (2+1)	35
9	HFS-223	Dry land Horticulture	2 (1+1)	27
Total			**23 (14+9)**	
Semester- V				
SL	**Course No**	**Title of the Course**	**Credit Hrs**	
1	HNM-311	Organic Farming	3 (2+1)	63
2	HFL-311	Medicinal and Aromatic crops	3 (2+1)	46
3	HFS-311	Introductory Agroforestry	2 (1+1)	28
4	HVS-311	Breeding of Vegetable, Tuber and Spice Crops	3 (2+1)	36
5	HPP-311	Diseases of Vegetables, Ornamentals and Spice Crops	3 (2+1)	53
6	HFS-312	Orchard and Estate Management	2 (1+1)	29
7	HVS-312	Potato and tuber crops	2 (1+1)	37
8	HNM-312	Introduction to Major Field Crops	2 (1+1)	64
9	HNM-313	Agro-meteorology and Climate Change	2 (1+1)	65
Total			**22 (13+9)**	
Semester- VI				
SL	**Course No**	**Title of the Course**	**Credit Hrs**	
1	HPP-321	Insect Pests of Vegetable, Ornamental and Spice Crops	3 (2+1)	53
2	HPT-321	Postharvest Management of Horticultural Crops	3 (2+1)	41
3	HVS-321	Seed production of Vegetable, Tuber and Spice Crops	3 (2+1)	38
4	HFL-321	Breeding and Seed Production of Flower and Ornamental Plants	3 (2+1)	47
5	HPT-322	Processing of Horticultural Crops	3 (2+1)	42
6	HSS-321	Horti-Business Management	2 (1+1)	79
7	HSS-322	Entrepreneurship Development and Business	2 (1+1)	80

		Management		
8	HFS-322	Apiculture, Sericulture and Lac culture	2 (1+1)	30
9	HSS-323	Fundamentals of Extension Education	2 (1+1)	78
Total			**23 (14+9)**	
Semester- VII				
SL	**Course No**	**Title of the Course**	**Credit Hrs**	
Rural Horticultural Work Experience Programme				
1	RHWE	STUDENT READY - Placement in Industries	0+10	82
		STUDENT READY- Placement in Villages	0+10	82
Total			**20 (0+20)**	
Semester- VIII				
SL	**Course No**	**Title of the Course**	**Credit Hrs**	
STUDENT READY: Experimental Learning programme				
1	HELP-421/HHC-221	Commercial Horticulture		82
2	HELP-422/HHP-421	Protective Cultivation of High Value Horticulture Crops		83
3	HELP-423/ HHP-421	Processing of Fruits and Vegetables for Value Addition		83
4	HELP-423 / HFF-421	Floriculture and Landscape Architecture	New Module	83
5	HELP-444/AB-421	Bio-inputs: Bio-fertilizers and Bio-pesticides	New Module	83
6	HELP-426/HM-421	Mass Multiplication of Plant and Molecules through Tissue Culture	New Module	84
7	HELP427/APH-421	Mushroom Culture	New Module	84
8	HELP-428/AEB-421	Bee Keeping	New Module	84
Total			**20 (0+20)**	

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

Department Wise Syllabus of B.Sc. (Hons.) Horticulture

I. FRUIT SCIENCE

1. (HFS-111) Fundamentals of Horticulture 3(2+1)

Theory

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

Practical

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

Suggested Reading:

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

❖ Jitendra Singh, 2011. Basic Horticulture. Kalyani Publications, New Delhi.

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

Theory

Horticultural classification of fruits including genome classification, Horticultural zones of India, detailed study of area, production and export potential, varieties, climate and soil requirements, propagation techniques, planting density and systems, after care, training and pruning. Management of water, nutrient and weeds, special horticultural techniques including plant growth regulators, their solution preparation and use in commercial orchards, Physiological disorders, 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.

Practical

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

Suggested Reading:

❖ H.P. Singh and M.M. Mustafa, 2009. Banana-new innovations. Westville Publishing House, New Delhi.
❖ M.S. Ladaniya, 2013. Citrus Fruits. Elsevier, India post Ltd.
❖ Bose, T.K., Mitra, S.K. and Sanyal, D., 2002. Tropical and Sub-Tropical Vol-l. Nayaudyog-Kolkata
❖ Rajput, CBS and Srihari babu, R., 1985. Citriculture. Kalyani Publishers, New Delhi.
❖ Chundawat, B.S., 1990. Arid fruit culture. Oxford and IBH, New Delhi.
❖ Chadha, K.L. (ICAR) 2002, 2001. Hand book of Horticulture. ICAR, New Delhi.
❖ Symmonds, 1996. Banana. || Edn. Longman, London.
❖ Radha T and Mathew L., 2007. Fruit crops. New India Publishing Agency.
❖ W S Dhillon, 2013. Fruit Production in India. Narendra Publishing House, New Delhi
❖ T.K. Chattopadhyay, 1997. Text book on Pomology. Kalyani Publishers, New Delhi.
❖ R.E. Litz, 2009. The Mango 2nd Edn. CABI Publishing, Willing ford.
❖ K.L. Chadha, 2009. Advanced in Horticulture. Malhotra Publishing New Delhi.

❖ S.P. Singh, 2004. Commercial fruits. Kalyani Publishers, New Delhi.

3. (HFS-123) Plant Propagation and Nursery Management 2(1+1)

Theory

Propagation: Need and potentialities for plant multiplication, sexual and asexual methods of propagation, advantages and disadvantages, Seed dormancy types of dormancy (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, soma clonal variation hardening of plants in nurseries, Nursery registration act, Insect/pest/disease control in nursery, Cost of establishment of propagation structures.

Practical

Media for propagation of plants in nursery beds, potting and repotting, Preparation of nursery beds and sowing of seeds, Raising of rootstock, Seed treatments for breaking dormancy and inducing vigorous seedling growth, Preparation of plant material for potting. Hardening plants in the nursery. Practicing different types of cuttings, layering, grafting and buddings including opacity and grafting, top grafting and bridge grafting etc. Use of mist chamber in propagation and hardening of plants, Preparation of plant growth regulators, Tissue cultured plants. Maintenance of implements for nursery. Cost of polyhouse and their maintenance. Nutrient and plant protection applications during nursery

Suggested Reading:

❖ Hudson T. Hartmann, Dale E. Kester, Fred T. Davies, Jr. and Roma Geneve. Plant Propagation- Principles and Practices (7th Edition Learning Private Limited, New Delhi-110001
❖ T.K. Bose, S.K. Mitra, M.K. Sadhu, P. Das and D. Sanyal. Propagation Tropical & Subtropical Horticultural Crops, Volume 1(3rd Revised edition). Naya Udyog, 206, Bidhan Sarani, Kolkata 700006.
❖ Guy W. Adriance and Feed R. Brison. Propagation of Horticultural Plants Axis Books (India).
❖ S. Rajan and B. L. Markose (series editor Prof. K.V. Peter). Propagation of Horticultural Crops- Horticulture Science Series Vol.6. New India Publishing Agency, Pitam Pura, New Delhi-110088.
❖ Hartman, H.T and Kester, D.E.1976.Plant Propagation Principles and practices. Prentice hall of India Pvt. Ltd., Bombay.

- Sadhu, M.K.1996. Plant Propagation. New age International Publishers New Delhi. Mukherjee, S.K. and Majumdar, P.K.1973. Propagation of fruit crops. ICAR, New Delhi.
- Ganner, R.J. and Choudhri, S.A. 1972. Propagation of Tropical fruit trees. Oxford and IBN publishing Co., New Delhi.
- Sarma, R.R. 2002. Propagation of Horticultural Crops. Kalyani Publishers, (Principles and practices) New Delhi.
- Symmonds, 1996. Banana. IInd edition Longman, London.
- Chundawat, B.S. 1990. Arid fruit culture. Oxford and IBH, New Delhi.
- Chadha, K.L. (ICAR) 2002, 2001. Hand book of Horticulture. ICAR, New Delhi.

4. HFS-124 Growth and Development of Horticultural Crops 2(1+1)

Theory

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

Practical

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

Suggested readings:

- Salisbury, F.B. and C.W. Ross. 1992. Plant physiology (Fourth edition). Wadworth publishing Co., California, USA.
- Taiz, L. and Zeiger, E.2003. Plant physiology (Third edition). Signature Associates, Inc., Publishers, Massachusettes, USA.
- Zeiger. 2003 Plant physiology. PANIMA, New Delhi.
- Edward E. Durna. 2014. Principles of Horticultural Physiology. CABI, UK.

- Delvin, R.M. 1986. Plant Physiology. CBS. Delhi.
- Richard, N. Arteca. 2004. Plant Growth Substances. CBS. New Delhi.
- Jacobs, W. P. 1979. Plant Hormones and Plant Development. Cambridge Univ. London.
- Basra, A. S. 2004. Plant Growth Regulators in Agriculture & Horticulture. HAWARTH press. New York.
- Lincoln Taiz and Eduards Zeiger (5th Edition). Plant physiology
- Noggle G.R and Fritz T. G. Introductory Plant Physiology
- Pandey and Sinha. Plant Physiology
- JKA Bleasdale, Plant Physiology in relation to Horticulture
- Amarjeet Basara, Plant Growth Regulator in Agriculture and Horticulture: Their role in Commercial uses

5. (HFS-211) Temperate Fruit Crops 2(1+1)

Theory

Classification of temperate fruits, detailed study of areas, production, varieties, climate and soil requirements, propagation, planting density, crop systems, after care training and pruning, self-incompatibility and 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.

Practical

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

Suggested Reading:

- Chattopadhyay T.K. 2009. A text book on Pomology-IV Devoted to Temperate fruits. Kalyani Publishers.B-1/292, Rajinder Nagar, Ludhiana 141008
- Banday F.A. and Sharma M.K. 2010. Advances in Temperate Fruit Production. Kalyani Publishers.B-1/292, Rajinder Nagar, Ludhiana 141008.
- Kaushal Kumar Misra 2014. Text book of Advanced Pomology. Biotech Books.4762-63, Ansari Road, Darya Ganj, New delhi-11002.
- Das B.C and Das S.N. Cultivation of Minor Fruits. Kalyani Publishers. B 1/292, Rajinder Nagar, Ludhiana-141008.
- Pal J.S. 2010. Fruit Growing. 2010. Kalyani Publishers. B-1/292, Rajinder Nagar, Ludhiana-141008.
- Mitra S.K, Rathore D.S. and Bose T.K. 1992. Temperate Fruit Crops Horticulture and Allied Publishers, Calcutta.
- Chattopadhya, T.K. 2000. A Text Book on Pomology (Temperate Fruits) Vol. IV Kalyani Publishers, Hyderabad

- Chadha, T.R. 2001. Text Book of Temperate Fruits. Indian Council on Agricultural Research, New Delhi.
- W S Dhillon. 2013. Fruit Production in India. Narendra Publishing House. New Delhi.

6. (HFS-212) Weed Management in Horticultural Crops 2(1+1)

Theory

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

Practical

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

Suggested reading:

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

7. (HFS-221) Plantation Crops 3(2+1)

Theory

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

Practical

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

Suggested Reading:

- Kumar, N.J.B. M. Md. Abdul Khaddar, Ranga Swamy, P. and Irrulappan, I. 1997. Introduction to spices, Plantation crops and Aromatic plants. Oxford & IBH, New Delhi.
- Thampan, P.K. 1981. Hand Book of Coconut Palm. Oxford IBH, New Delhi.
- Nair 1979. Cashew. CPCRI, Kerala y Wood, GAR, 1975. Cacao. Longmen, London
- Ranganadhan, V. 1979. Hand Book of Tea Cultivation. UPASI Tea Research Station, Cinchona.
- Thompson, P.K. 1980. Coconut. Oxford & IBH Publishing Co. Ltd., New Delhi.

8. (HFS-222) Breeding of Fruit and Plantation Crops 3 (2+1)

Theory

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

Practical

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

Suggested Reading:

- Nijar 1985.Fruit breeding in India, Oxford & IBH Publishing Co. New Delhi
- Anil Kumar Shukla 2004. Fruit breeding approaches & Achievements. International Book Distributing Co. New Delhi.
- Kumar, N. 1997. Breeding of Horticultural Crops, Principles and Practices. New India Publishing Agency, New Delhi.
- Singh, B.D. 1983. Plant Breeding Principles and methods. Kalyani Publishers, New Delhi.

9. (HFS-223) Dryland Horticulture 2(1+1)

Theory

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, scares 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 evapo-transpiration, use of shelter belts, mulches, anti-transpirants, 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.

Practical

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.
- P.L. Saroj, B.B. Vashishtha, D.G. Dhandar. 2004. Advances in Arid Horticulture. Internal Book Distributing Co., Lucknow.
- T. Pradeep Kumar, B. Suma, Jyothi Bhaskar and K.N. Sathesan. 2008. Management of Horticultural Crops. New India Publishing Agency.

10 HFS-311 Introductory Agroforestry 2(1+1)

Theory:

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, horti-silvipastoral, 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 crops species for agroforestry, Agroforestry project-national, overseas, MPTS their management practices, Economics of cultivation-nursery and planting (Acacia catechu, Delbergia sissoo, Tectona, Populus, Grewia, Eucalyptus, Quercus spp., bamboo, Tamarindus and Neem, etc.)

Practical:

Identification of seeds and seedlings of multipurpose tree species. Nursery practices for Populus deltoides, Grewia optiva, Morus alba, Acacia catechu, Delbergia sissoo, Robinia, Leucaena etc, Visit to agroforestry fields to study the compatibility of MPTS with agriculture crops: silvi-pasture, alley cropping, horti-silviculture, agro-silvipature fuel and fodder block. Visit to social forestry plantations- railway line plantations.

Suggested Readings:

- K. Patra, 2013. Agroforestry –Principles and Practices. New India publishing agency.
- P. Dwivedi, 1992. Agroforestry –Principles and Practices. Oxford and IBH Publishing company.
- Dadhwal et al., 2014. Practical Manual on Agroforestry. Jaya publishing house, Delhi.
- L.K. Jha, 2015. Advances in Agroforestry. APH Publishing corporation, New Delhi.
- Linford, Jenny, 2007. A concise guide to Trees. Parragon books service limited, Parragon.
- Negi, S.S., 2007. Agroforestry Hand book. International book distributer, New Delhi.
- P.S. Pathak and Ram Newaj, 2010. Agroforestry –Potentials and Opportunities. Agrobios, Jodhpur
- Pankaj Panwar & Sunil Puri, 2007. Agroforestry: Systems & Practices. New India publishing agency, New Delhi.
- Ramesh Umrani and C.K. Jain, 2010. Agroforestry –Systems & Practices. ABD Publishers, New Delhi.
- Ramachandran Nair, P.K.1993. An Introduction to Agroforestry. First reprint in India–2008. Springer International Edition
- Tejawani, K.G.1994. Agroforestry in India. Oxford & IBH, Publishing Co. Pvt. Ltd., New Delhi
- Luna, R.K. 1989. Plantation forestry in India. International Book Distributors, Dehradun.
- LedaSatish.2006. Biodiesel and Jatropha Plantations. AGROBIOS, Jodhpur.

- Chaturvedi, A.N. and Khanna, L.S.1982. Forest Menstruation. Reprinted in 2006. International Book Distributors, Dehradun
- Negi, S.S.2006. Forest Tree Seed. Prashant Gahlotat Valley printers and publishers, Dehradun.
- Chundawat and S K Gautam.1996. A text book of Agroforestry. Oxford and IBH Publishing company Pvt. Ltd.

11. (HFS-312) Orchard and Estate Management 2(1+1)

Theory

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.

Practical

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

Suggested Reading:

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

12. HFS-322 Apiculture, Sericulture and Lac culture 2 (1+1)

Theory:

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, hardiness and shell ratio, Defective cocoons and stifling of cocoons, Uses of silk and by-products, Economics of silk production, Moriculture-Mulberry varieties, package of practices, Pests and diseases and their management. Lac growing areas in India, Lac insects, biology, behaviour, lac cultivation, food plants, pruning, inoculation, cropping, kinds of lac. Enemies of lac-insects.

Practical:

Honey bee colony, different bee hives and apiculture equipment. Summer and 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:

- Singh, S., 1975. Bee keeping in India –ICAR, New Delhi., 214p.
- Sunita, N.D, Guled , M.B, Mulla S.R and Jagginavar,2003, Beekeeping, UAS Dharwad.
- Mishra, R.C. and Rajesh Gar. 2002. Prospective in Indian Apiculture. Agrobios, Jodhpur.
- Singh, D and Singh, D.P. 2006. A hand book of Beekeeping, Agrobios (India).

- Paul De Bach and Devid Rosen 1991. Biological control by natural enemies. Cambridge University Press; 2 edition (27 June 1991)
- YA Shinde and BR Patel. Sericulture in India
- Tribhuwan Singh. Principles and Techniques of Silkworm Seed Production, Discovery publishing House Pvt. Ltd
- M.L. Narasaiah. Problems and Prospects of Sericulture. Discovery publishing House Pvt. Ltd.
- Ganga, G. and Sulochana Chetty, J. 1997. An introduction to Sericulture (2nd Edn.). Oxford & IBH publishing Co. Pvt. Ltd., New Delhi.
- Krishnaswamy, S. (Ed). 1978. Sericulture Manual -Silkworm Rearing. FAO Agrl. Services bulletin, Rome.
- Singh, S. 1975. Bee keeping in India. ICAR, 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.
- K.P. Srivastava. A Text Book on Applied Entomology Vol. I&II. , Kalyani Publishers, Ludhiana.
- B.R. David and V.V. Ramamurthy. Elements of Economic Entomology, 7th Edition. Namrutha Publications, Chennai.

ll VEGETABLE SCIENCE

1. (HVS-121) Tropical and sub-tropical Vegetable Crops 3(2+1)

Theory

Area, production economic importance and export potential of Tropical and sub-tropical vegetable crops. Description of varieties and hybrid climate and soil requirements, seed rate, preparation of field nursery Practices, transplanting of vegetable crops and planting for directly sown/transplanted vegetable crops. Spacing, planting systems, water and Weed Management, nutrient management and deficiencies, use of chemicals and Growth regulators. Cropping systems, harvest, yield, post-harvest handling, economics and marketing of tropical and 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.

Practical

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

Suggested Reading:

- S. Thamburaj 2014. Text book of vegetable, tuber crops and Spices. ICAR, New Delhi
- B.R. Choudhary, 2009. A Text book on production technology of vegetables. Kalyani Publishers. Ludhiana.
- T.K. Bose, 2002. Vegetable Crops. Nayaprakash. Kolkata
- P. Hazra, 2011. Modern Technology in Vegetable Production. New India Publishing Agency. New Delhi.
- T.R. Gopal Krishnan, 2007. Vegetable Crops. New India Publishing Agency, New Delhi.
- K.V. Kamath, 2007. Vegetable Crop Production. Oxford Book Company, Jaipur
- M.S. Dhaliwal, 2008. Handbook of Vegetable Crops. Kalyani Publishers, Ludhiana
- Singh, Umashankar, 2008. Indian Vegetables. Anmol Publications. Pvt- Ltd. New Delhi.
- K S Yawalkar, 2008. Vegetable crops in India. Agri-Horticultural Pub. House. Nagpur. 2004
- M.K. Rana, 2008. Olericulture in India. Kalyani Publishers, Ludhiana
- P. Hazra 2006, Vegetable science. Kalyani Publishers, Ludhiana

- Partibha Sharma 2007. Vegetables: Disease Diagnosis and Bio Management Avishkar Publishers. Jaipur
- Uma Shankar 2008. Vegetable Pest Management Guide for Farmers. International Book Distribution Co. Publication, Lucknow.
- Nath Prem 1994. Vegetables for the Tropical Regions. ICAR New Delhi
- KL Chadha 1993. Advances in Horticulture. Malhotra publishing house. New Delhi.
- Shanmugavelu, K.G., 1989. Production Technology of Vegetable Crops. Oxford &IBH Publishing Co. Pvt. Ltd, New Delhi.
- Choudhury, B. (ICAR). 1990. Vegetables. 8th edition, National Book Trust, New Delhi.
- Singh, D.K., 2007. Modern Vegetable varieties and production. IBN publishers, Technology International Book Distributing Co, Lucknow.
- Premnath, Sundari Velayudhan and Singh, D.P., 1987. Vegetables for the tropical region. ICAR, New Delhi.

2. (HVS-211) Temperate Vegetable Crops 2(1+1)

Theory

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.

Practical

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

Suggested Reading:

- S. Thamburaj. 2014. Text book of vegetable, tuber crops and Spices. ICAR, New Delhi.
- B.R. Choudhary 2009. A Text book on production technology of vegetables. Kalyani Publishers. Ludhiana.
- T.K. Bose. 2002. Vegetable Crops. Nayaprakash. Kolkata
- P. Hazra. 2011. Modern Technology in Vegetable Production. New India Publishing Agency. New Delhi.
- T.R. Gopal Krishnan, 2007. Vegetable Crops. New India Publishing Agency. New Delhi
- K.V. Kamath. 2007. Vegetable Crop Production. Oxford Book Company. Jaipur
- M.S. Dhaliwal, 2008. Handbook of Vegetable Crops. Kalyani Publishers. Ludhiana
- Singh, Umashankar, 2008. Indian Vegetables. Anmol Publications. Pvt. Ltd New Delhi.

- KS Yawalkar, 2004. Vegetable crops in India. Agri-Horticultural Pub. House. Nagpur.
- M.K. Rana, 2008. Olericulture in India. Kalyani Publishers. Ludhiana
- P. Hazra. 2006.Vegetable science. Kalyani Publishers. Ludhiana
- Pratibha Sharma, 2007. Vegetables: Disease Diagnosis and Bio management. Avishkar Publishers. Jaipur
- Uma Shankar. 2008. Vegetable Pest Management Guide for Farmers. International Book Distribution Co. Publication. Lucknow.
- Nath Prem. 1994.Vegetables for the Tropical Regions. ICAR New Delhi
- K.L. Chadha. 1993. Advances in Horticulture. Malhotra publishing house. New Delhi
- Shanmugavelu, K.G. 1989. Production technology of vegetable crops. Oxford and IBH publishing Co. Pvt. Ltd, New Delhi.
- Bose, T.K. 2003. Vegetable Crops. Nayaudyog publishers, Kolkata. 2002. Naya Prakash, Calcutta.
- Prem Singh Arya, 1999. Vegetable Seed Production Principles. Kalyani Publishers, New Delhi
- Choudhery, B., 1990. Vegetables. 8th edition. National Book Trust, New Delhi

3. (HVS-221) Spices and Condiments 3(2+1)

Theory

History, scope and importance, Present Status, area and production, uses, export potential and role in national economy. Classification, soil and climate, propagation-seed, vegetative and 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 centres in R&D. Crops: Cardamom, pepper, betel vine ginger, turmeric, clove, nutmeg, cinnamon, all spices, curry leaf, coriander, fenugreek, fennel, cumin, dill, celery, bishops weed, saffron, vanilla, thyme and rosemary.

Practical

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

Suggested Reading:

- Shanmugavelu, K.G. Kumar, N and Peter, K.V., 2005. Production technology of spices and plantation crops. Agrosis, Jodhpur
- Shanmugavelu, K.G. and Madhava Rao, 1977. Spices and Plantation -Crops. Madras Popular Book Depot.
- Kumar, N. J.B. M. Md. Abdul khaddar, Ranga Swamy, P. and Irulanan 1997. Introduction to Spices, Plantation Crops, and aromatic 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 Post harvest Technology. ICAR, New Delhi.
- Pruthi, J.S., 2001. Minor Spices and Condiments-Crop Management pour Harvest Technology. ICAR, New Delhi.
- Purseglove, Brown, E.G. Green, G.Z. Robbins, S.R.J. London, Longman 1981. Spices Vol. l& II.

4. (HVS-222) Precision Farming & Protected Cultivation 3 (2+1)

Theory

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

Practical

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

Suggested Reading:

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

5. **(HVS-311) Breeding of Vegetable, Tuber and Spice Crops 3 (2+1)**

Theory

Breeding objectives and important concepts of breeding self-pollinated, cross pollinated and vegetative propagated crops. Plant genetic resources, their conservation and utilization in crop improvement. Breeding for insect resistance, breeding for disease resistance, breeding for abiotic and biotic 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.

Practical

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

Suggested Reading:

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

6. (HVS-312) Potato and Tuber Crops 2(1+1)

Theory

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

Practical

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

Suggested Reading:

- S. Thamburaj. 2014. Text book of vegetable, tuber crops, ICAR New Delhi.
- B.R. Choudhary 2009. A Text book on production techno vegetables. Kalyani Publishers. Ludhiana.
- T.K. Bose. 2002. Vegetable Crops. Nayaprakash. Kolkata
- P. Hazra. 2011. Modern Technology in Vegetable Production. New Publishing Agency. New Delhi.
- T.R. Gopal Krishnan, 2007. Vegetable Crops. New India Publishing Agency. New Delhi.

- K.V. Kamath. 2007. Vegetable Crop Production. Oxford Book Company, Jaipur
- M.S. Dhaliwal, 2008. Handbook of Vegetable Crops. Kalyani Publishers Ludhiana
- Singh, Umashankar, 2008. Indian Vegetables. Anmol Publications Pvt. Ltd. New Delhi.
- K S Yawalkar, 2004.Vegetable crops in India. Agri-Horticultural Pub. House. Nagpur.
- M.K. Rana, 2008. Olericulture in India. Kalyani Publishers. Ludhiana
- P. Hazra. 2006. Vegetable science. Kalyani Publishers. Ludhiana
- Pratibha Sharma, 2007. Vegetables: Disease Diagnosis and Bio management. Avishkar Publishers. Jaipur
- Uma Shankar. 2008. Vegetable Pest Management Guide for Farmers. International Book Distribution Co. Publication. Lucknow.
- Nath Prem. 1994.Vegetables for the Tropical Regions. ICAR New Delhi
- K.L. Chadha. 1993. Advances in Horticulture. Malhotra publishing house. New Delhi
- Shanmugavelu, K.G. 1989. Production technology of vegetable crops. Oxford and IBH publishing Co. Pvt. Ltd, New Delhi.
- Bose, T.K. 2003. Vegetable Crops. Nayaudyog publishers, Kolkata. 2004. Naya Prakash, Calcutta.
- Prem Singh Arya, 1999. Vegetable Seed Production Principles. Kalyani Publishers, New Delhi.
- Choudhery, B., 1990. Vegetables. 8th edition. National Book Trust, New Delhi.
- Vincent Lebot, 2008.Tropical roots and tuber crops. CAVI.

7. **(HVS-321) Seed Production of Vegetable, Tuber and Spice Crops 3(2+1)**

Theory

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.

Practical

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

Suggested Reading:

- G.N. Kulkarni, 2002. Principles of Seed Technology. Kalyani Publishers, Ludhiana.

- L.O. Copeland, 1999. Principles of Seed Science and Technology. Springer Publications.
- N.P. Nema, 1988.Principles of seed certification and Testing. Allied Publications.
- P. Hazra and M.G. Som, 2009. Vegetable seed production and Hybrid Technology. Kalyani Publishers, Ludhiana.
- 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.
- Arya, Prem Singh. 2003. Vegetable seed Production Principles. Kalyani Publishers Ludhiana.
- Fageria, M. S. 2011. Vegetable Crops- Breeding and Seed Production. Kalyani Publishers. Ludhiana.
- Geetharani, P. 2007. Seed Technology in Horticultural Crops. NPH Publications. Jodhpur.
- Singh, S.P. 2001. Seed Production in Commercial Vegetables. Agro Publishing Academy, Udaipur.
- Vanangamudi, K. 2010. Vegetable Hybrid Seed Production Management. Agrobios. Jodhpur.
- Singh, Prabhakar. 2015. Seed Production Technology of vegetable. Daya Publishing House. New Delhi.
- Raymond A.T., 2000. Vegetable Seed Production. Oxford University Press, USA
- Prem Singh Arya, 2003. Vegetable breeding, production and seed production. Kalyani publishers, New Delhi.
- Rattan Lal Agarwal, 1995. Seed technology. Oxford & IBH, New Delhi
- Singh, S.P. 2001. 1st edition, Seed production of commercial vegetables Agrotech Publishing, Udaipur
- Vanangamudi, K. 2006. Natarajan, P. Srimathi, N. Natarajan, T. Saravanan, M. Bhaskaran, A. Bharathi, P. Nateshan, K. Malarkodi. Advances in Seed Science. Agrobios (India), Jodhpur.
- Nemgal Singh, P.K. Singh, Y.K. Singh and Virendra Kumar, 2006. Vegetable Seed Production Technology. International book distributing co., Lucknow.
- Khare, D. and Bhole, M.S. 2000. Seed Technology. Scientific Publishers (India) Jodhpur.

III Post Harvest Technology

1. (HPT-211) Fundamentals of Food Technology 2(1+1)

Theory

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.

Practical

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:

- Dr. Swaminathan, M.1985. Food and Nutrition Vol., I & II. BAPPCO, Bangalore.
- Dr. Swaminathan, M. 1985. Essential of Food and Nutrition Vol. II. BAPPCO, Bangalore.
- Manoranjan, K. and Sangita, S. 1996. Food Preservation and Processing. Kalyani Publishers 978-81-272-4262-6.
- Srilakshmi. 2010. Food Science. New age International 978-81-224-27240.
- Srilakshmi. 2005. Dietetics. New age International 978-81-224-1611-4.
- Shankunthala, M. 1972. Foods-Facts, Principles & Procedure. The Eastern Press, Bengaluru.
- Passmore, R. and Eastwood, M. A. 1986. Human Nutrition & Dietetics. ELBS 0443039194.
- Anita, T. 1996. Food and Nutrition. Oxford 0198327668.
- Devendra, K. B. and Priyanka, T. 2006. An Introduction to Food Science and technology and Quality Management. Kalyani Publishers 81-272 2521-5.
- Monoranjam, K. and Sangita, S. 2008. Food Preservation and Processing, Kalyani Publishers 978-81-272-4262-6.

- George, L. S. and Dennis, D. L. 1994. Chemistry for the Health Sc MacMillan 0-02405161-6.
- Masferton and Hurley. 1989. Chemistry Principles and Reaction Saunders Golden Sunburst 0-03-005889-9.
- Bettelheim and March. 1984. Introduction to General, Organic Biochemistry. Harcourt Brace college Puplishers 0030202175 Sound College Puplishing.
- Gopalan, G., Ramasastri, B.V. and Balasubramnian C. 1989. Nutritive value of the Indian Foods. National Institute Nutrition, ICMR, Hyderabad
- http://www.fao.org/infoods/
- Swaminathan, M. 1988. Hand book of Food Science & Experimental Foods. Bappco publishers, Bangalore
- Manay, S.N, Shadaksharaswamy, M.1998. Food-facts & Principles New Age International Publishers, New Delhi
- Srilakshmi, B. 1995. Food Science. New Age International Publishers, New Delhi.

2. (HPT-321) Postharvest Management of Horticultural Crops 3(2+1)

Theory

Importance of Postharvest Technology in horticultural crops. Maturity indices harvesting, handling, grading of fruits, vegetables, cut flowers, plantation crops, spices, 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. Postharvest treatments of horticultural crops. Quality parameters and specifications. 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 pre-cooling, 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.

Practical

Practice in judging the maturity of various horticultural produce, determination of physiological loss in weight and quality. Grading of horticultural produce, post-harvest treatment of horticultural crops, physical and chemical methods. Packaging studies in fruits, vegetables, plantation crops, spices 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, packing houses and cold storage units.

Suggested Reading:

- Verma, L. R. and Joshi, V. K. 2000. Post-Harvest Technology of Fruits and Vegetables. Vol. I & II. Indus Publishing Co., New Delhi

- Wiils, McGlasson and Graham, J. 2007. Post-Harvest- An Introduction to the Physiology and Handling of Fruits, Vegetables and ornamentals. Cab International
- Stanley, J. K. 1998. Post-Harvest Physiology of Perishable Plant Products. CBS, New Delhi
- Neetu Sharma and Mashkoor Alam, M. 1998. Post-Harvest Diseases of Horticultural Perishables, International Book Distributing Co., Lucknow.
- Chadha, K. L and Kalloo, G. 1993. Advances in Horticulture. Vol. 4 to 10. MPH, New Delhi,
- 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.
- Mitra, S. K. 1997. Post-Harvest Physiology and Storage of Tropical and Sub-tropical Fruits. CAB International.
- Fellows, P. J. 1998. Food Processing Technology - principles and Practices. Ellis Horwood.
- Thomposon, A. K. 1996. Post-harvest Technology of Fruits and Vegetables, Blackwell Science.
- Battacharjee, S. K. and De, L. C. 2005. Post-Harvest Technology of Flowers and Ornamentals Plants. Ponteer Publisher, Jaipur, India.
- Pruthi, J. S. 2001. Minor Spices and Condiments - Crop Managements and Post-Harvest Technology. ICAR, New Delhi.
- Shanmugavelu, K. G., Kumar, N. and Peter K.V. 2002. Production Technology of Spices and Plantation Crops. Agrobios (India).
- Saraswathy, S, et al. 2008. Post-harvest Management of Horticultural Crops. Agribios (India).S1-7754-322-9.
- 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.
- Jacob John, P. 2008. A Handbook on Post Harvest management of Fruits and vegetables. Daya Publishing House, Delhi-1081-7035-532-X
- http://www.postharvest.com.au
- http://www.fao.org/infoods/index en.stm
- www.postharvest.ucdavis.edu

3. (HPT-322) Processing of Horticultural Crops 3(1+2)

Theory

Importance and scope of fruit and vegetable preservation industry in India, food pipeline, 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 and bottling. Methods of preparation of juices, squashes, syrups, cordials and fermented beverages. Jam, jelly and marmalade. Preservation by sugar and chemicals candles, crystallized fruits, preserves chemical pro preservation with salt and

vinegar, pickling, chutneys and sauces, to mushrooms, freezing preservation processing of plantation crops, spoilage in processed foods, quality control of processed products, Govt. Policy on import and export of processed fruits. Food laws.

Practical

Equipment's used in food processing units. Physico-chemical analysis of fruits and vegetables. Canning of fruits and vegetables, preparation of squash. cordial, syrup. jam, jelly, marmalade, candies, preserves, chutneys, souse pickles (hot and sweet). Dehydration of fruits and vegetables - tomato products, dehydration, refrigeration and freezing, cut out analysis of process foods. Processing of plantation crops. Visit to processing units.

Suggested Reading:

- Verma, L. Rand Joshi, V. K. 2000. Post-Harvest Technology of Fruits and Vegetables. Vol. I & II. Indus Publishing Co., New Delhi,
- Dauthy, M. E. 1995. Fruits and Vegetables Processing- FAO Bulletin 119 International Book Distributing Co., Lucknow,
- Srivastava, R. P. & Sanjeev Kumar. 2002. Fruits and vegetable Preservation - Principles and Practice. International Book Distributing Co., Lucknow.
- Salunkhe, D.K., Bolin, H. R. and Reddy, N. R. 1991. Storage, Processing and Nutritional Quality of Fruits and Vegetables, 2nd Edition. Vol. II. CRC Press y 0849356245
- Neetu Sharma and Mashkoor Alam, M. 1998. Post-Harvest Disease of Horticultural Perishable. International Book Distributing Co., Lucknow
- 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.
- Manoranjan, K and Sangita, S. 1996. Food Preservation & Processing, Kalyani Publishers, India,
- Vijay, K. 2001. Text Book of Food Sciences and Technology. ICAR, New Delhi.
- Siddappaa, G. S., Girdhari Lal and Tandon, G.L. 1998. Preservation of Fruits and Vegetables. ICAR, New Delhi
- FAO - Training Manual No.17/2. 2007. Prevention of post-harvest food losses: Fruits, Vegetables and Root crops. Daya Publishing House, Delhi.
- Morris, T. N. 2006. Principles of Fruit Preservation. Biotech Books, Delhi. 81-7622-116-3.
- http://www.postharvest.com.au
- http://www.fao.org/infoods/index en.stm
- Srivastava, R. P. and Sanjeev K. 1998. Fruit and vegetable preservation principles and practice. International Book Distributing Co., Lucknow.

- Girdharilal, Siddappa, G. S. and Tandon, G. L.1998. Preservation of fruit and vegetables. ICAR, New Delhi.
- Dauthy and Mircea, E.1995. Fruit and vegetables processing. International Book Distribution Co, Lucknow.
- Kays and Stanely, J. 1998. Post harvest physiology of perishable plant products. CBS Publishers, Distributors, New Delhi

IV. Floriculture and Landscape Architecture

1. (HFL-111) Principles of Landscape Architecture 2(1 +1)

Theory

Historical Importance of Indian gardens, Gardens of ancient world, Definitions, Famous gardens of India and abroad, formal, informal, free style and wild gardens, basic themes of gardens viz. circular, rectangular and diagonal themes, Steps in preparation of garden design. Use of Auto CAD and Arch CAD in designing gardens. Factors affecting landscape design viz. initial approach, view, human choice, simplicity, topography etc., Principles of Landscape gardens viz. Axis, rhythm, balance, time and light, space, texture, form, mass effect, focal point, mobility, emphasis, unity and harmony etc. Elements of landscape gardens viz. tangible and intangible elements. Bio-aesthetic planning, definition, 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, air ports corporate buildings, hydro-electric stations, river banks, play grounds, Gardens for places religious importance viz. temples, churches, mosques, tombs etc, Important 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.

Practical

Study of garden equipments, Study of Graphic language, Use of drawing equipment's, 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:

- A.K. Tiwari and R. Kumar. 2012. Fundamentals of ornamental horticulture and landscape gardening. New India.
- H.S. Grewal and Parminder Singh. 2014. Landscape designing and ornamental plants
- R.K. Roy. 2013. Fundamentals of Garden designing. New India publishing agency, Pitampura, New Delhi
- Rajesh Srivastava. 2014. Fundamentals of Garden designing. Agrotech press, Jaipur, New Delhi.
- L.C. De. Nursery and landscaping.2013. Pointer publishers, Jaipur India.
- Bose, T.K. Malti, R.G. Dhua, R.S. & Das, P. 2004. Floriculture and Landscaping Nayaprakash, Calcutta.
- Arora, J.S. 2006. Introductory Ornamental Horticulture. Kalyani publishers, Ludhiana.
- Randhawa, G.S. and Amitabha Mukhopadhyay 2004. Floriculture in India. Allied Publishers Pvt. Ltd., New Delhi.

2. (HFL-211) Commercial Floriculture 3(2+1)

Theory

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.

Practical

Identification of commercially important floricultural crops. Pro practices in chrysanthemum, sowing of seeds and raising of seed annuals. Propagation by cutting, layering, budding and grafting, Training and pruning of roses. Use of chemicals and other compounds for prolong Vase life of cut flowers. Drying and preservation of flowers, arrangement practices.

Suggested Reading:

- A.K.Singh 2006. Flower crops, cultivation and management. New publishing agency, Pitampura, New Delhi.
- T.K. Bose, LP. Yadav, P. Patil, P. Das and VA Partha Sarthy.2003. Commercial flowers. Nayaudyog, 206, Bidhan Sarani, Kolkata-700006
- S.K. Bhattacharjee and L.C. De. 2003. Advanced Commercial Floriculture Aavishkar Publishers, Distributors, Jaipur (Rajasthan) India.
- Dewasish Choudhary and Amal Mehta. 2010. Flower crops cultivation and management. Oxford book company Jaipur, India.
- Randhawa, G.S. Amitabh Mukhopadhyay, 2004. Floriculture in India, Allied Publishers

- Arora, J.S. 2006. Introductory Ornamental Horticulture. Kalyani Publishers, Ludhiana - 141 008.
- Prof. Bhattacharjee, S.K. Advanced Commercial Floriculture. Aavishkar Publishers Distributors, Jaipur - 320 003
- Prof. V.L. Sheela, 2008. Flower for trade. New India Publishing Agency, Pitampura, New Delhi-110088

3 (HFL-221) Ornamental Horticulture 2(1+1)

Theory

History, definitions, scope of ornamental horticulture, aesthetic values, floriculture industry, Importance, area and production, industrial importance of ornamental plants and flowers. Importance, classification, design values and general cultivation aspects for ornamental plants viz. Annuals, biennales herbaceous perennials, grasses and bulbous ornamentals. shrubs, climbers, trees, indoor plants, palms and cycads, ferns and sellagenellas, cacti and succulents, 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.

Practical

Identification and description of annuals, biennials, herbaceous perennials, climbers, shrubs, trees, indoor plants, ferns and sellagenellas, Palms and cycads and Cactus 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 or floral bouquets, preparation of floral rangoli, veni etc., Study of Bonsai techniques, Bonsai practicing and training, Visit to nurseries and floriculture units.

Suggested Reading:

- Bose, Chowdhury and Sharma, 1991. Tropical Garden Plants in colour Horticulture and allied publishers, 3D Madhab Chatterjee street Kolkata
- K.V. Peter. 2009.Ornamental plants. New India publishing agency, Pitampura, New Delhi,
- Richard Bird, 2002. Flowering trees and shrubs, Printed in Singapore by Star Standard Industries pvt. Ltd.
- Bimaldas Chowdhury and Balai Lal Jana 2014. Flowering Garden trees. Pointer publishers, Jaipur, India,
- Arora, J.S. 2006. Introductory Ornamental Horticulture. Kalyani Publishers, Ludhiana

- Randhawa, G.S. Amitabha Mukhopadhyay, 2004. Floriculture in India. Allied Publishers Pvt. Ltd., New Delhi.
- Bose, T.K. Mukherjee, D. 2004. Gardening in India. Oxford & IBH Publishers.
- Chadha, K.L. and Chaudhary, B. 1986. Ornamental Horticulture in India. Publication and information division. ICAR, New Delhi.

4. (HFL-311) Medicinal and Aromatic Crops 3(2+1)

Theory

History, scope, opportunities and constraints in the cultivation and maintenance of medicinal and aromatic plants in India. Importance, origin, distribution, area, production, climatic and soil requirements, propagation and nursery techniques, planting and after care, cultural practices, training and pruning, nutritional and water requirements. Plant protection, harvesting and processing of under mentioned important medicinal and aromatic plants. Study of chemical composition of a few important medicinal and aromatic plants, extraction, use and economics of drugs and essential oils in medicinal and aromatic plants. Therapeutic and pharmaceutical uses of important species. Storage techniques of essential oils. Medicinal Plants: Withania, periwinkle, Rauvolfia, Dioscorea, Isabgol, opium poppy Ammi majus, Belladonna, Cinchona, Pyrethrum and other species relevant to local conditions. Aromatic Plants: Citronella grass, khus grass, flag (baje), lavender, Meranium patchouli, bursera, mentha, musk. ocimum and other species relevant to the local conditions and Marketing.

Practical

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

Suggested Reading:

- Chadha, K.L. ICAR, 2001. Hand Book of Horticulture. Directorate of Information and Publications of Agriculture, Pusa, New Delhi.
- Azhar Ali Farooqui and Sreeramu, B.S. 2001. Cultivation of medicinal and aromatic plants. United Press Limited.
- Atal, E.K. and Kapur, B. 1982. Cultivation and Utilization of Medicinal and Aromatic plants. CSIR, New Delhi.
- Kumar, N. J.B.M. Md. Abdul Khaddar, Ranga Swamy, P. and Irulappan, l. 1997. Introduction to Spices, Plantation Crops Medicinal and Aromatic Plants. Oxford & IBH, New Delhi.
- Jain, S.K. 1968. Medicinal Plants. National Book Trust New Delhi. Oxford & IBH, New Delhi,
- Dastur, J.F. 1982. Medicinal plants of India Pakistan Taraprevalasoms and co-private Ltd, Bombay.

5 (HFL-321) Breeding and Seed Production of Flower and Ornamental Crops 3(2+1)

Theory

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, 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.

Practical

Study of floral biology and pollination in important species a 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:

- B.P. Pal. The Rose in India. 1966. Directorate of Knowledge management in Agriculture, Indian council of Agriculture Research-New Delhi
- T.K. Bose, L.P. Yadav, P. Patil, P. Das and V.A. Parthasart Commercial flowers. Nayaudyog, 200 Sarani, Kolkata-700006
- S.K. Bhattacharjee and L.C. De. 2003. Advanced Commercial Floriculture, Aavishkar Publishers, Distributors, Jaipur (Rajasthan) India.
- D.J. Callaway and M.B. Callaway. 2000. Breeding Ornamental Timber Press
- J. Harding, F. Singh and J.N. Mol. 1991. Genetics and Breeding of Ornamental Species. Springer Publishers
- Vainstein. 2002. Breeding for Ornamental: Classical and Modren Approaches. Springer Publishers
- Singh, B.D. 1983. Breeding Principles and Methods. Kalyani Publisher New Delhi
- R.L. Agarwal. 1996. Seed Technology. Oxford & IBH Publishers. New Delhi
- P.K. Agarwal. 1994. Principles of Seed Technology. ICAR Publication, New Delhi

V. PLANT PROTECTION

1 (HPP-211) Fundamentals of Entomology 3 (2+1)

Theory

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

Practical

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

Suggested Reading:

- Awasthi, V.B. 1997. Introduction to general and applied entomology. Scientific Publishers, Jodhpur, 379 p.
- Borror, D. J., C.A. Triple Horn and N.F. Johnson. 1987. An introduction to the study of insects (VI Edition). Harcourt Brace College Publish York, 875p.
- Chapman, R.F. 1981. The Insects: Structure and function. Edware (Publishers) Ltd, London, 919p.
- Gullan, P.J. and Cranston, P.S. 2001. The insects. An outline of entomology, II edition, Chapman & Hall, Madras, 491p.
- Mani, M.S. 1968. General entomology. Oxford and IBH Publishing Ltd., New Delhi, 912p.
- Nayar, K.K., T.N. Ananthakrishnan and B.V. David. 1976. General applied entomology, Tata McGraw Hill Publishing Company Limited Delhi, 589p
- Richards, O.W. and R.G. Davies. 1977. General text books of entomology, Vol. 1 & 2, Chapman and Hall Publication, London, 1345p.
- Romoser, W.S. 1988. The Science of Entomology, McMillan, New York 449p
- Saxena, S.C. 1992. Biology of insects. Oxford and IBH Publishing Co. Put Ltd., New Delhi, 366p.
- Srivastava, P.D. and R.P. Singh. 1997. An introduction to entomology Concept Publishing Company, New Delhi, 269p.
- Tembhare, D.B. 1997. Modern Entomology. Himalaya Publishing House, Mumbai, 623p.
- Pedigo, L.P. 1999. Entomology and pest management. III Edition. Prentice Hall, New Jersey, USA, 691p.
- H. Lewin and Devasahayam. Practical manual of entomology insect and non-insect pests.
- Pant, N.C. and Ghai, S. 1981Insect physiology and anatomy, ICAR, New Delhi.
- Snodgrass, R.E. 2001. Principles of Insect Morphology.CBS Publishers and Distributors, New Delhi
- James, L, Nation. CRC Press, Insect Physiology and Biochemistry. Washington

2 (HPP-212) Diseases of Fruit, Plantation, Medicinal and Aromatic Crops 3 (2+1)

Theory

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

Practical

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

Suggested Reading:

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

3 (HPP-213) Fundamentals of Plant Pathology 3 (2+1)

Theory

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

Practical

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

Suggested Readings:

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

4 (HPP-214) Nematode Pests of Horticultural Crops and their Management 2(1+1)

Theory

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

Practical

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

Suggested Reading:

- Upadhyay, K.D and Dwivedi, K. 1997. A text book of plant nematology Aman publishing house, Meerut
- Vasanth Raju David, B. 2001. Elements of economic entomology. Popular book Depot, Chennai.
- Gopal Swaroop and Das Gupta 1986.ICAR, New Delhi, Plant Parasitic Nematodes of India Problems and Progress.
- Nair, M.R.G.K. 1975. Insects and Mites of Crops in India. ICAR, New Delhi y Metcalf,
- R.L and Luckman, W.H. 1982. Introduction to Insect pest management Wiley Inter Science Publishing, New York.
- Butani, D.K. 1984. Insects and Fruits. Periodical Expert Book Agency, New Delhi

❖ E.I. Jonathan, l. Cannayane, K. Devrajan, S. Kumar, S. Ramakrishan, Agricultural Nematology. TNAU, Coimbatore.

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

Theory

General - economic classification of insects; Bio-ecology and insect-pest management with reference to fruit, plantation, medicinal and aromatic crops; pest surveillance. Distribution, host range, bio-ecology, injury, integrated management of important insect pests affecting tropical, sub-tropical and temperate fruits, plantation, medicinal and aromatic crops like coconut, areca nut, oil palm, cashew, cacao, tea, coffee, cinchona, rubber, betel vine, senna, neem, belladonna, pyrethrum, costus, crotalaria, datura, dioscorea, mint, opium, Solanum khasianum. 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 (MRL).

Practical

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

Suggested Reading:

❖ Reddy, P. P., 2010, Plant Protection in Horticulture Vol. 1, 2 & 3, Scientific Publishers, Jodhpur.
❖ Ranjit, P., 2012, Entomological Techniques in Horticultural Crops, New India Publishing Agency.
❖ Nair MRG K, 1995, Insect and Mites of Crops in India, ICAR, New Delhi.
❖ Ayyar, T.V.R. 1963. Hand book of entomology for south India. Govt. press Madras, 516p.
❖ David B V and Kumarswami, T, 1982. Elements of Economic Entomology. Popular Book Department, Madras, 536p.
❖ David V. Alford. Pest of fruit crops.
❖ A.M. Ranjith. Identification and management of Horticultural pest.
❖ Rachna and Benna Kumari. Pest management and residual analysis in horticultural crop
❖ K. P. Srivastav and Y. S. Ahlawat. Pest management in citrus
❖ Ramnivas Sharma. Identification and management of horticulture pest.
❖ Fryer. Insect pest of fruit crops
❖ S. Atwal. Agricultural pests of South Asia and their management
❖ Mark Vernon Slingerland and C. R. Crosby. Manual of fruit insects
❖ Metcalf, R. Land Luckman, W.H. 1982. Introduction to Insect pest management. Wiley lnter Science Publishing, New York
❖ Butani, D.K.1984. Insects and Fruits. Periodical Expert Book Agency, New Delhi

6 (HPP-311) Diseases of Vegetable, Ornamental and Spice Crops 3(2+1)

Theory

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

Practical

Observations of symptoms, causal organisms and host parasitic relations important diseases, examination of cultures of important pathogen vegetables, ornamental and spice crops in field as well as in protected cultivation,

Suggested Reading:

- Srikant Kulkarni, Yashoda R. Hedge. Diseases of Plantation crops an. their management-, Agrotech publication Academy
- S.L. Godara, BBS Kapoor, B.S. Rathore. Disease management of spice crops-, Madhu Publications
- L. Darwin Christdhar Henry and H. Lewin Devasahayam Crop disease Identification, Treatment and Management. An Illustrated Handbook New India publishing Agency
- Singh, R. S. 1994. Diseases of Vegetable Crops. Oxford IBH Publishing Co. Pvt. Ltd., New Delhi
- Singh, R. S. 1996. Plant Diseases. Oxford IBH Publishing Co. Pvt. Ltd., New Delhi
- Sohi, H.S. 1992. Diseases of Ornamental plants in India. ICAR, New Delhi
- Ranga Swamy, G. 1988. Diseases of Crop Plants in India. Prentice Hall of India Pvt. Ltd., New Delhi.
- Saha, L.R. 2002. Hand Book of Plant Diseases. Kalyani Publishers
- Arjunan, G. Karthikeyan, G. Dinakaran, D. Raguchander, T. 1999. Diseases of Horticultural Crops. Dept. of Plant Pathology, Tamilnadu Agricultural University Coimbatore.

7 (HPP-321) Insect Pests of Vegetable, Ornamental and Spice Crops 3(2+1)

Theory

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

ornamental crops, their host range, bio-ecology, injury and integrated management. Insecticidal residue problems in vegetables and ornamental crops, tolerance limits etc.

Practical

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

Suggested reading:

- Reddy, P. P., 2010, Plant Protection in Horticulture Vol. 1, 2 & 3, Scientific Publishers, Jodhpur
- Ranjit, P., 2012, Entomological Techniques in Horticultural Crops, New India Publishing Agency.
- Nair MRG K, 1995, Insect and Mites of Crops in India, ICAR, New Delhi.
- Ayyar, T.V.R. 1963. Hand book of entomology for south India. Gov Madras, 516p.
- David B V and Kumarswami, T, 1982. Elements of Economic Entomology, Popular Book Department, Madras, 536p
- K.P. Srivastava, Dhamo K. Butani Pest management in vegetables - Pa 2. Research Book Centre, 1998
- Rachna and Benna Kumari. Pest management and residual analysis horticultural crop
- Ramnivas Sharma. Identification and management horticulture pest.
- T. V. Sathe. Pests of ornamental plants.
- S. Atwal. Agricultural pests of south Asia and their management
- Butani, D.K. 1984. Insects and Fruits. Periodical Expert Book Agency. New Delhi
- Metcalf, R.L. and Luckman, W.H. 1982. Introduction to Insect pest management. Wiley Inter Science Publishing, New York
- Dhalinal, G.S. and Ramesh Arora Integrated Pest Management Concept and Approaches. Kalyani Publishers, Ludhiana.
- K.P. Srivastava. A Text Book on Applied Entomology Vol. I&II., Kalyani Publishers, Ludhiyana
- Emmanuel, N, A. Sujatha, T.S.K. K. Kiran Patro, MLN Reddy, B. Srinivasulu, TSSK Sammuel Patro. Text Book on Integrated Pest Management of Horticultural Crops Astral International Publishers, New Delhi.

VI. NATURAL RESOURCE MANAGEMENT

1. (HNM-111) Fundamentals of Soil Science 2(1+1)

Theory

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 and chroma. Munsell colour chart, factors influencing, parent material, soil moisture, organic matter, soil structure, definition, classification, 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, lon 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 eco-systems and their properties, Rock and 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.

Practical

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:

- Brady Nyle C and Ray R Well, 2014. Nature and properties of soils. Pearson Education Inc., New Delhi.
- Indian Society of Soil Science, 2002. Fundamentals of Soil Science. IARI, New Delhi.
- Sehgal J. A., 2005. Textbook of Pedology Concepts and Applications. Kalyani Publishers, New Delhi.
- Dilip Kumar Das, 2015. Introductory Soil Science. Kalyani Publishers, Ludhiana.
- Biswas, T.D. and Mukharjee, S.K., 2015. Text Book of Soil science. Tata Mc Graw Hill Publishing Co. Ltd., New Delhi.
- Brady, N.C., 1995. The Nature and properties of Soils. Macmilan Publishing Co, New York.
- Ghildyal, B.P. and Tripathi, R.P., 1987. Soil Physics. Acad. Press, New York
- Kolay, A.K., 1983. Basic concepts of Soil Science. Wiley Eastern Ltd, New Delhi
- Brady, N. C. and Well, R. R., 2010. Elements of the Nature and Pro of Soils (3rd Edition), Pearson Education, New Delhi.
- Foth, H.D., 1991. Fundamentals of Soil Science (8th Edition), John Wil & Sons, New Delhi.
- Das, D.K., 2011. Introductory Soil Science (3rd Edition), Kalyani publisher Ludhiana (India).
- Khan, T. 0. 2013 Forest Soils: Properties and Management. Spring International Publishing, Switzerland
- Pritchett and Fisher RF, 1987. Properties and Management of Forest Soils. John Wiley, New York.

- Gupta, P.K. 2009. Soil, Plant, Water and Fertilizer Analysis (2nd Edition) AGROBIOS, Jodhpur (India).
- Jaiswal, P.C. 2006. Soil, Plant and Water Analysis (2nd Edition), Kalyani Publishers, Ludhiana.
- Jackson, M. L. 2012. Soil Chemical Analysis: Advanced Course, Scientific Publisher

2 (HNM-121) Environmental Studies and Disaster Management 3(2+1)

Theory

Multidisciplinary nature of environmental studies Definition, scope and importance. Natural Resources: Renewable and non-renewable resources. Natural resources and associated problems. a) Forest resources: Use and over exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people. b) Water resources: Use and over utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies. d) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. e) Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies. 1) 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 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. Field work: Visit to a local area to document environmental assets river/forest/grass/ and/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. 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, before Industrial waste water pollution, road accidents, rail accidents, air and space accidents, Disaster Management Effect to migrate natural disease national and global levels. International strategy for disaster reduction, Concept of disaster management, national disaster management framework, financial arrangements; role of NGOs, community-based organization media. Central, state, district and local administration; Armed forces in disaster response; Disaster response; Police and other organizations.

Practical

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

Suggested Reading:

- Nandini, N. Suneetha and Sucharitha Tandon. Environmental Studies
- Aswathanarayana, U. 1999. Soil resources and the environment. Oxford and IBH publishing Co., New Delhi. P. 173-195.
- D.D. Misra, Fundamental Concepts in Environmental Studies.
- Diwan, P. and P. Diwan. 1998. Environmental Management Law and Administration. Variety Books international, New Delhi.
- Krishnamurthy. An Advanced Textbook on Biodiversity.
- S. Deshwal A. Deshwal. A Basic Course in Environmental Science.
- Erach Bharucha 2005. Textbook of environmental studies for under graduate courses.UGC, University Press, Hyderabad.
- Manohara Chary and Jayaram Reddy 2004. Principles of Environmental studies BB publishers, Hyderabad.
- William, P. Cunning Ham and Mary Ann. Inquiry and applications Cunningham 2005. Principles of Environmental science. Tata MCG raw hill publishing company limited, New Delhi.
- Gupta, P.K. 2004 Methods in environmental analysis-water, soil and Air. Agro Bios (India). Jodhpur.
- Spencer R. Weart. The discovery of global warming. y Daniel B. Botkin, Edward A. Keller. Environmental Science.
- Richard T. Wright and Bernard J. Nebel Environmental science: toward a sustainable agriculture in field
- C. Brown. Pollution prevention and control.

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

Theory

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.

Practical

Measurements of irrigation water by using water measuring devices, use of common formula in irrigation practices, practicing of land levelling 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:

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

4 (HNM-123) Soil Fertility and Nutrient Management 2(1+1)

Theory

Introduction to soil fertility and productivity- factors affecting. Essential plant nutrient elements- functions, deficiency systems, transformations and availability. Acid, calcareous and salt affected soils - characteristics and management. Soil organic matter, Role of

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

Practical

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

Suggested Reading:

- Yawalkar KS, Agarwal JP and Bokde S, 1992. Manures and Fertilizers. Agri. Horticultural Publishing House, Nagpur.
- Tandon HLS, 1994. Fertilizers Guide. Fertilizers Development Consultation Organization, New Delhi.
- Seetharaman S, Biswas B C, Yadav D S and Matheswaru S. Usage 1996. Hand Book on Fertilizers. Oxford and IBH Publishing Company, New Delhi.
- The fertilizer Association of India, Fertilizer control order Shaheed Jit Singh marg, New Delhi, 1985.
- Ranjan Kumar Basak , 2000. Fertilizers A Text book. Kalyani publishers, New Delhi,
- British Crop Production Council, U.K., 1995. The Pesticide Manual, A - World Compendium.
- Sree Ramulu US, 1991. Chemistry of Insecticides. Oxford and IBH Publishing and Fungicides Company, New Delhi.
- Nene Y L and Thapliyal PN, 1991. Fungicides in plant disease control. Oxford and IBH Publishing company, New Delhi.
- Havlin et al. 2014. Soil Fertility and Fertilizers: An Introduction to Nutrient Management (8th Edition), PHI Learning Pvt. Ltd., Delhi.
- Binkley, D. and R. Fisher, 2012. Ecology and Management of Forest Soils (4th Edition), John Wiley & Sons Singapore Pvt. Ltd., Singapore
- Reddy M. V., 2001. Management of Tropical Plantation Forests and Their Soil Litter System- Litter, Biota and Soil Nutrient Dynamics, Science Publishers US
- Khan, T. O., 2013. Forest Soils: Properties and Management. Springer International Publishing, Switzerland

- Brady, N. C. and Weil, R. R., 2010. Elements of the Nature and Properties of Soils (3rd Edition.), Pearson Education, New Delhi
- Das, D.K., 2011. Introductory Soil Science (3rd Edition), Kalyani Publisher, Ludhiana (India).
- Indian Society of Soil Science, 2002. Fundamentals of Soil Science Society of Soil Science, IARI, New Delhi.
- Pritchett and Fisher RF, 1987. Properties and Management of Soils. John Wiley, New York.
- Gupta, P.K., 2009. Soil, Plant, Water and Fertilizer Analysis (2nd Edit AGROBIOS, Jodhpur (India).
- Jaiswal, P.C., 2006. Soil, Plant and Water Analysis (2nd Edition), Kalu Publishers, Ludhiana
- Jackson, M. L., 2012. Soil Chemical Analysis: Advanced Course, Scientific Publisher
- J. Benton Jones, Jr., 2012. Plant Nutrition and Soil Fertility Manual (Edition), CRC Press, USA.
- Mengel, et al., 2001. Principles of Plant Nutrition (5th Edition), Springer
- Bear, F.E.,1964. Chemistry of the Soil. Oxford and IBH Publishing Co New Delhi
- Richards, LA., 1968. Diagnosis and Improvement of Saline and Alkaline soils. Oxford& IBH Publishing Co. New Delhi (USDAH and Book No.60)
- Chopra, S. Chand Kanwar, J.S.,1976. Analytical Agricultural Chemistry, Kalyani Publishers, Ludhiana.
- Tisdale, S.L. Nelson, W.L.andBeaton,J.D.,1993. Soil Fertility and Fertilizers. Macmillan Publishing Company, New York
- Yawalkar, K.S. Agarwal, J.P. and Bokde, S.,1977. Manures and Fertilizers. Agri-Horticultural Publishing House, Nagpur
- Seetharamaan, S. Biswas, B.C. Maheswari, S. and Yadav, D.S., 1986. Hand Book on Fertilizers Technology. The Fertilizers Association of India, New Delhi

5 (HNM-221) Farm Power and Machinery 2(1+1)

Theory

Basic concepts of various forms of energy, unit and dimensions of for and power, calculations with realistic examples. IC Engines: Basic principles, operation of compression, ignition and spark ignition engines, two stroke four stroke engines, cooling and lubrication system, power trans system, broad understanding of performance and efficiency, tractors tillers and their types and uses. Electric motors: types, construction 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, leveler ridgers and bund formers. Sowing and transplanting equipment: seed drill potato planters, seedling transplanter. Grafting, pruning and training tools equipment. Inter-culture equipment: sweep. Junior hoe, weeders, long handi. weeders. Crop harvesting equipments: potato diggers, fruit pluckers, tapioca puller and hoists.

Practical

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

Suggested Reading:

- T. P. Ojha and A.M. Michael. 2005. Principles of Agricultural Engineering (Volume - 1), Jain Brothers
- Manoj Kumar Ghoshal and Dhirendra Kumar Das. 2008. Farm Power, Kalyani Publishers.
- Surendra Singh. 2007. Farm Machinery Principles and Applications. ICAR Publications
- Roth Field. 1992. Introduction to Agricultural Engineering - Problem Solving Approaches, 2nd. Edition. CBS publishers & distributors Pvt. Ltd.
- Surendra Singh & Verma. 2009. Farm Machinery Maintenance & Management. ICAR Publication.
- M.M. Pandey & Others. 2012. Handbook of Agricultural Engineering. ICAR publication
- Jagadishwar Sahay. 1992. Elements of Agricultural Engineering. Agro Book Agency, Patna.
- Michal AM and Ojha TP.1993.Voll. Principles of Agricultural Engineering. Jain Brothers, New Delhi.

6 (HNM-222) Soil, Water and Plant Analysis 2(1+1)

Theory

Methods of soil and plant sampling and processing for analysis. Characterization of hydraulic mobility - diffusion and mass flow. Renewal of ices 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

Practical

Introduction to analytical chemistry, Collection and preparation of soil, water and plant samples for analysis. Determination of pH, electrical conductivity, sodium adsorption ratio and exchangeable sodium percentage of soils. Estimation of available macro and micronutrient elements in soils and their contents in plants. Irrigation water quality analysis. Determination of pH and FC 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:

- H.L.S. Tandon. 2013, Methods of analysis of soil, plant, water and fertilizers. FDCO, New Delhi.
- Yawalkar, K.S. Agarwal, J.P. and Bokde, S., 1977. Manures and fertilizers. Agri Horticultural Publishing House, Nagpur.
- Sehgal J. A., 2005. Textbook of Pedology Concepts and Applications. Kalyani Publishers, New Delhi.
- Jaiswal, P.C., 2006. Soil, Plant and Water Analysis (2nd Edition), Kalyani Publishers, Ludhiana.
- Jackson M. L, 1967. Soil Chemical Analysis, Oxford and IBH Publishing Co., New Delhi.
- Richards L A, 1968. Diagnosis and Improvement of Saline and Alkaline Soils. Oxford and IBH publishing Co. New Delhi(USDA Hand Book No. 60)
- Chopra S.C. and Kanwar, J. S 1976. Analytical Agricultural Chemistry, Kalyani Publishers, Ludhiana.
- C. S. Piper. 2014, Soil and plant analysis, Scientific publishers India.
- Mushtaq A. Wan., 2014, Soil, plant and water analysis manual. Agrotech publishing company, Udaipur.
- P. K. Gupta., 2013, Soil, plant, water and fertilizer analysis. Agrobios, India.
- M. V. Durai., 2014, Hand book of Soil, plant, water, fertilizers and manure analysis. New India Publishing Agency.

7. (HNM-311) Organic Farming 3(2+1)

Theory

Introduction, concept. relevance in present context; Organic production requirements; Biological intensive nutrient management-organic mar vermicomposting, green manuring, recycling of organic residues, biofertilizers, Soil improvement and amendments; integrated diseases and management - use of biocontrol agents, biopesticides pheromones, traps bird perches; Weed management; Quality considerations, certification labelling and accreditation processors, marketing, exports.

Practical

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

Suggested Reading:

- A.K. Dahama. 2007. Organic farming for sustainable agriculture. Agrobios (India), Jodhpur.
- Arun. K. Sharma. 2011. Handbook of Organic farming. Agrobios (India) Jodhpur.

- S.P. Palaniappan and K. Annadurai. 2010. Organic farming - Theory and Practice, Scientific Publishers. Jodhpur.
- U. Thapa and P. Tripathy. 2006. Organic farming in India- Problems and Prospects. Agrotech publishing agency, Udaipur.
- G.K. Veeresh. 2006. Organic farming. Foundation Books. New Delhi.
- Purshit, S.S. 2006. Trends in Organic Farming in India. Agros Bios (INDIA), Jodhpur.
- Thampan, P. K. 1995. Organic Agriculture. Peckay tree Crops Development Foundation, Cochin, Kerala.

8 (HNM-312) Introduction to Major Field Crops 2 (1+1)

Theory

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

Practical

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

Suggested Reading:

- B. Gurarajan, R. Balasubramanian and V. Swaminathan. Recent Strategies on Crop Production. Kalyani Publishers, New Delhi.
- Chidda Singh. 1997. Modern techniques of raising field crops. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
- Rajendra Prasad. Textbook of Field Crops Production - Commercial Crops. Volume II ICAR Publication.
- Rajendra Prasad. Textbook of Field Crops Production - Fooder: Volume II ICAR Publication.
- S.R. Reddy. 2009. Agronomy of Field Crops. Kalyani Publishing Delhi.
- Subhash Chandra Bose. M. and Balakrishnan, V. 2001. Forage Pro South Asian Publishers, New Delhi.

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

Theory

Agricultural Meteorology- Introduction, definition of meteorology, scope and practical utility of Agricultural meteorology. Composition and structure of atmosphere and definition of weather and climate, aspects involved in weather and climate, atmospheric temperature,

soil temperature, solar radiation, atmospheric pressure, atmospheric humidity, evaporation and transpiration, monsoons, rainfall, clouds, drought, weather disasters and their management atmospheric pollution and role of meteorology. Basics of weather forecasting. Climate change-causes. Global warming-causes and remote sensing. Effect of climate change on horticulture Past and future changes in greenhouse gases in 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 response 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 one and UV damage and tolerance in plants, Increased temperature and plants in tropical/sub-tropical climates- effect on growing season, timing of flowering, duration of fruit development and impacts on crop yields and potential species ranges, interaction of temperature with other abiotic/biotic stress. Mitigation strategies and prospects for genetic manipulation of crops to maximize production in the future atmosphere. Modifying Rubisco, acclimation, metabolism of oxidizing radicals, and sink capacity as potential strategies.

Practical

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

Suggested Reading:

- K. Srivastava and P. K. Tyagi, 2011. Practical Agricultural Meteorology. New Delhi Publishing Agency, New Delhi.
- D. Lenka, 2006. Climate, Weather and Crops in India. Kalyani Publishers, New Delhi.
- G. S. L. H. V. Prasad Rao, 2008. Agricultural Meteorology. Prentice Hall of India Pvt. Ltd., New Delhi.
- H.S. Mavi and Graeme J. Tupper, 2005. Agrometeorology - Principles and applications of climate studies in agriculture. International Book Publishing Co., Lucknow.
- H.S. Mavi, 1994. Introduction to Agrometeorology. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
- H.V. Nanjappa and B.K. Ramachandrappa, 2007. Manual on Practical Agricultural Meteorology. Agrobios India. Jodhpur.

- S.R. Reddy, 1999. Principles of Agronomy. Kalyani Publishers, New Delhi.
- T. Yellamanda Reddy and G.H. Sankara Reddi, 2010. Principals of Agronomy. Kalyani Publishers, New Delhi.
- Pattersen, S.1958. Introduction to Meteorology. Mc. Graw Hill Inc., New York
- Tailor, J.1.1967. Agricultural Climatology. Pergman Press Ltd., Hess Hill Hall, Oxford, England
- Trewarthe, T.G. 1968. An Introduction to Climate. McGraw Hill Book Co. Inc., New York,

BASIC SCIENCE

1 (HBS-111) Introductory Crop Physiology 2(1+1)

Theory

Water Relations in Plants: Role of water in plant metabolism, osmosis inhibition, diffusion, water potential and its components, measurement water potential in plants, absorption of water, mechanism of absorption 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 Photosynthetic structure and function of chloroplast, dark and light reactions, cyclic and son cyclic electron transfer, CO, fixation - C3, CA and CA metabolism, advantages CA pathway. Photorespiration and its implications, factors affecting photosynthesis. Mode of herbicide action, Secondary metabolites and plant defence.

Practical

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

Suggested Reading:

- Salisbulry. 2007. Plant Physiology. CBS. New Delhi.
- Taiz, L. 2010. Plant Physiology. SINAUR. USA.
- Zeiger. 2003. Plant Physiology. PANIMA. New Delhi.
- Edward E. Durna. 2014. Principles of Horticultural Physiology. CABI, UK.
- Delvin, R.M. 1986. Plant Physiology. CBS. Delhi.
- Richard, N. Arteca. 2004. Plant Growth Substances. CBS. New Delhi.
- Jacobs, W. P. 1979. Plant Hormones and Plant Development. Cambridge Univ. London.
- Basra, A. S. 2004. Plant Growth Regulators in Agriculture & Horticulture. HAWARTH press. New York.
- Lincoln Taiz and Eduards Zeiger (5th Edition). Plant physiology
- Noggle G.R and Fritz T. G. Introductory Plant Physiology
- Pandey and Sinha. Plant Physiology
- Salisbury and Ross. Plant Physiology
- Carl fedtke. Biochemistry and Physiology of Herbicide Action
- Aswanipareek, S.K. Sopory, Hans Bohnert Govindjee. Abiotic stress adaptation in plants: Physiological, Molecular and Genomic foundation Horst Marschner, Mineral Nutrition of Higher plants

2 (HBS-112) Introductory Microbiology 2(1+1)

Theory

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.

Practical

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

Suggested Reading:

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

3 (HBS-113) Elementary Statistics and Computer Application 3(2+1)

Theory

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 sample, 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, poison and

normal distributions, sampling, basic concepts, sampling vs. complete enumeration parameter and statistic, sampling methods, simple random sampling and stratified random sampling. Tests of Significance: Basic concepts, tests for equality of means, and independent and paired t-tests, chi-square test for application of attributes and test for goodness of fit of Mendalian ratios. Correlation: Scatter diagram, correlation co-efficient and its properties, regression, fitting of simple linear regression, test of significance of correlation and regression coefficient. Experimental designs: 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, basis concepts, operating system, DOS and Windows, MS Word- Features of word processing, creating document and tables and printing of document, MS EXCE! Concept of electronic spreadsheet, creating, editing and saving of spreadsheet input statistical functions and formula bar, MS Power point- preparation, citation of slides and slide show. Introduction to programming languages, basic language, concepts, basic and programming techniques, MS Office, Word, Excel, Power point, introduction to multi-media and its application. Visual basic-concepts, basic and programming techniques, introduction to internet.

Practical

construction of frequency distribution table and its graphical representation, histogram, frequency polygon, frequency curve, bar chart, simple, multiple, component and percentage bar charts, pie chart, mean, mode 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:

- Gupta, S. C. and Kapoor, V. K. 2014. Fundamentals of Mathematical Statistics. Sultan chand and sons. New Delhi
- Nageswara Rao, G. 2007.Statistics for Agricultural Sciences. B.S. Publications, Hyderabad.
- Rangaswamy, R.1995. A Text Book of Agricultural Statistics. New Age International Publishing Limited, Hyderabad.
- Gupta, V., 2002. Comdex Computer kit. Dream Tech Press, New Delhi.

- 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.
- Bandari, V. B., 2012. Fundamentals of Information Technology. Pearson Education, New Delhi.
- Fundamentals of Computers. 2011. Pearson Education-ITL ESL, New Delhi

4 (HBS-114) Principles of Plant Breeding 3(2+1)

Theory

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

Practical

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

Suggested Reading:

- R.W. Allard. Principles of plant breeding. John Wiley & Sons, New York
- V.L. Chopra. Plant breeding: Theory and Practice. Oxford Publishing Co. Pvt. Ltd., New Delhi.
- Phundan Singh. Essentials of plant breeding. Kalyani Publishers
- J.R. Sharma. Principles and practices of plant breeding. Tata McGrew Publishing Company Ltd., New Delhi
- B.D. Singh. Plant breeding: principles and methods. Kalyani Publishers Ludhiana.
- R.C. Chaudhary. Plant Breeding
- Hays and Garber. Breeding crop plants. Mc Graw Hill Publications, New York
- G. Kallo. Breeding of vegetables. Panima publishers, New Delhi
- W.R. Fehr. Principles of cultivar development: theory and technique (Vol. 1). Macmillan Publishing Company, New York.

- D.S. Falconer. Introduction to quantitative genetics. Longman Scientific & Technical, Longman Group, UK, Ltd., England.
- R.K. Singh and B.D. Chaudhary. Biometrical methods in quantitative genetic analysis. Kalyani Publishers, Ludhiana.
- K. Mather and J.L Jinks. Introduction to Biometrical genetics. Chapman and Hall, London
- B D Singh. Fundamental of Plant breeding. Kalyani. India.
- Pundan Singh. Essentials of plant breeding. Kalyani. India
- G. S. Chahal and S.S. Gosal. 2002. Principles and Procedures of Plant Breeding. Narosa Publishing House, New Delhi.
- Poehlman, J.M. and Borthakar, D. 1995. Breeding Asian Field Crops. Oxford & IBH Publishing Co., New Delhi

5 (HBS-121) Principles of Genetics and Cytogenetics 3(2-1)

Theory

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

Practical

Study of fixatives and stains. Squash and smear techniques. Demonstrations of permanent slides and cell division, illustration in plant cells, pollen fertility and viability, determination of gametes, solving problems of monohybrid, dihybrid, and test cross ratios using chi-square test, gene interactions, estimation of linkages using three-point test cross from F2 data and construction of linkage maps. Genetic variation in pea.

Suggested Reading

- Gardner E J, Simmons MJ & Snustard D P. Principles of Genetics (VIII Edn). John Wiley & Sons, New York.
- Strickberger. Genetics. Macmillan Publishing Company, New York.
- William D. Stansfield. Theory and Problems of Genetics (3rd Ed). Schaum's Outline series - McGraw-Hill Inc.
- Benjamin Lewin. Genes (Il edn). John Wiley & Sons, New York.

- Phundan Singh. Elements of Genetics. Kalyani publishers, New Delhi.
- Swanson & Webster. The Cell (V edn). Prentice Hall of India Pvt. Ltd, New Delhi
- Norman, V. Rothwell. Understanding Genetics (IV Ed.). Oxford University Press, Oxford.
- Sinnut, Dunn & Dobzhansky. Principles of Genetics XIX reprint. Tata McGraw-Hill Publishing Co. Ltd., New Delhi.
- Griffiths, Miller, Suzuki Lewontin & Gelbart. An introduction to Genetic Analysis (V Ed.). W.H. Freeman & Company, New York
- Robert Schieif. Genetics & Molecular Biology (1986). The Benjamin/cummings publishing Co, Inc, California.
- Swanson, Merz & Young. Cytogenetics (Il ed.). Prentice Hall of India Pvt. Ltd. New Delhi.
- Joseph Jahier & INRA working group. Techniques of Plant Cytogenetics (1986). Oxford & IBH Publishing Co Pvt. Ltd., New Delhi
- Loewy & Siekevitz. Cell Structure & Function (Il Ed.). Oxford & IBH Publishing Co. Pvt. Ltd, New Delhi.
- Stent & Calendar. Molecular Genetics (II Ed.). CBS Publishers, New Delhi
- Singh B D. Fundamentals of Genetics. Kalyani Publishers, New Delhi
- Srivastava & Tyagi. Selected Problems in Genetics (Vol.1-3). Anmol Publications Pvt. Ltd., New Delhi
- Khanna VK. Genetics-Numerical Problems. Kalyani Publishers, New Delhi.
- Farook & Khan. Genetics & Cytogenetics (1 Ed.). Premier Publishing House, Hyderabad.
- Shukla. Cell Biology (2001). Dominant publishers, New Delhi
- George Acquaah. Principles of Plant Genetics and Breeding. Blackwell
- B.D. Singh. Fundamental of Genetics. Kalyani. India
- Gupta, P.K. 1985. Cytology, genetics and cytogenetics. Rastogi Publication, India.

6 (HBS-115) Elementary Plant Biochemistry 2(1+1)

Theory

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 and solubility amino acids - classification and structure amino acids, properties of amino acids, colour reactions, amphoteric and isomerism; structure of proteins-primary, secondary tertiary quaternary properties and reaction of proteins. Enzymes: Classification mechanism of action; factors affecting enzyme action, co-factors coenzymes. Vitamins and minerals as co-enzymes/ co-factors. Carbohydrates metabolism - glycolysis and TCA-cycle; metabolism of lipids, fatty a oxidation, biosynthesis of fatty acids, electron transport chain, bioenergetics glucose and fatty acids, structure and function of nucleic acid replication transcription and translation.

Practical

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

Suggested Reading:

- Lehninger, Nelson, D. L. and Michael, M. C. 2004. Principles of Biochemistry. Freeman Publishers
- Narayanan L M. Biochemistry. Saras Publications
- Bose. Developments in Physiology Biochemistry & Molecular Biology of Plants Vol.-1. New India Publications.
- Voet, D and Voet J. G. 2004. Biochemistry 4th Edn. Wiley & sons Publishers. USA.
- Sadashiv, S and Manickam, A. 1996. Biochemical methods for Agricultural sciences. New age International publishers, New Delhi.
- Voet, D. and Voet, J.G. 2004. (3rd edit). Biochemistry. John Wiley & Sons Incl.USA.
- Rameshwar, A. 2006. (3rd edit). Practical Biochemistry. Kalyani Publishers, New Delhi.
- Buchanan, B. B., Gruissem, W. and Jones, R. L. 2002. Biochemistry and molecular biology of plants. 2nd edition. Blackwell publications, UK.

(HBS-211) Elementary Plant Biotechnology 2(1+1)

Theory

Concepts of Plant Biotechnology: History of Plant Tissue Culture and Plant Genetic Engineering; Scope and importance in Crop Improvement: Totipotency and Morphogenesis, Nutritional requirements of in-vitro cultures; Techniques of In-vitro culture, Embryo culture affecting above in-vitro variation, Types. Re production technology Genet cloning - Direct and in vitro cultures, Micropropagation, Anther culture, Pollen culture, Ovule Embryo culture, Test tube fertilization, Endosperm culture, Factors affecting above in-vitro culture; Applications and Achievements; Somaclonal ion, Types, Reasons: Somatic embryogenesis and synthetic seed function technology; Protoplast isolation, Culture, Manipulation and Fusion; ducts of somatic hybrids and cybrids, Applications in crop improvement. genetic engineering; Restriction enzymes; Vectors for gene transfer - 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 OTL - Future aspects. MAS, and its application in crop improvement. Nanotechnology: Definition and scope, types of nano material and their synthesis, green synthesis. Tools and techniques

to characterize the nano particles. Nano biotechnological applications with examples, Nano toxicology and safety.

Practical

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

Suggested Reading:

- Singh, B D, 2004. Biotechnology Expanding Horizons 2nd Edn. Kalyani Publishers, New Delhi.
- Gupta, P.K., 2015. Elements of Biotechnology 2nd Edn. Rastogi and Co., Meerut.
- Razdan M K, 2014. Introduction to plant Tissue Culture 2nd Edn. Science Publishers, inc. USA.
- Gautam V K, 2005. Agricultural Biotechnology. Sublime Publications
- Thomar, R.S., Parakhia, M.V., Patel, S.V. and Golakia, B.A., 2010. Molecular markers and Plant Biotechnology, New Publishers, New Delhi.
- Purohit, S.S., 2004. A Laboratory Manual of Plant Biotechnology 2nd Edn. Agribios, India.
- Singh, B.D. 2012. Plant Biotechnology. Kalyani publishers, Ludhiana
- Bilgrami, K.S. and Pandey, A.K.1992. Introduction to Biotechnology. CBS Pub. New Delhi
- Gupta, P.K. 1994. Elements of Biotechnology. Rastogi Pub. Meerut.

VIII. SOCIAL SCIENCES

1. (HSS-111) Economics and Marketing 3(2+1)

Theory

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

Practical

Techno-economic parameters for preparation of projects. Preparation bankable projects for various agricultural products and its values products Identification of marketing channel- Calculation of Price Sore Identification of Market Structure - Visit to different Markets.

Suggested Reading

- HL Ahuja, S. Chand and Company Limited. Advanced Economic Theory. Micro Economic Analysis
- Chandra P. 1984. Projects: Preparation, Appraisal & Implementation McGraw Hill Inc
- Dewett KK and Chand, A. 1979. Modern Economic Theory. S. Chanda Co, New Delhi
- Dewett, K.K. and Varma, J.D. 1986. Elementary Economics. S.Chanda Co, New Delhi,
- Gupta RD & Lekhi RK. 1982. Elementary Economic Theory. Kalyani Publishers
- Kotler Philip and Armstrong. Principles of Marketing. Prentice-Hall
- Jhingan, M.L. 2012. Macro-Economic Theory. Vrinda publishers, New Delhi.
- SS Acharya and N L Agarwal. 2005. Agricultural Marketing in India Oxford and IBH Publishing Co. Pvt. Ltd
- Sampat Mukherjee 2002. Modern Economic Theory. New fee International.
- Subba Reddy, S., Raghu ram, P., Neelakanta Sastry T.V., Bhavani Devi L 2010, Agricultural Economics, Oxford & IBH Publishing Co Private Limited, New Delhi
- Willium J. Stanton. 1984. Fundamentals of Marketing. Tata McGraw-Hill Publication, New Delhi.
- CN. Sontakki. Marketing Management. Kalyani Publishers, New Delhi

- John Daniels, Lee Radebaugh, Brigham, Daniel Sullivan. International Business, 15th Ed., Pearson Education
- Aswathappa. International Business. Tata McGraw-Hill Education, New Delhi
- Fransis cherunilam. International Business: Text and Cases 5th Ed. PH Learning, New Delhi.
- Prasanna Chandra. Projects. Tata McGraw-Hill Publication, New Delhi
- John M. Nicholas. Project Management for Business and Technology Principles and Practices. Pearson Prentice Hall
- Harold Kerzner. Project Management - A System Approach to Planning, Scheduling, and Controlling. CBS Publishers & Distributors.
- Prasanna Chandra. Projects - Planning, Analysis, Selection, Financing, Implementation, and Review. Tata McGraw-Hill Publishing Company Ltd.
- P. Gopalakrishnan and V.E. Rama Moorthy. Textbook of Project Management. Macmillan.

2 (HSS-112) Communication Skills and Personality Development 2(1+1)

Theory

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.

Practical

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

Suggested Reading:

- Balasubramanian T. 1989. A Text book of Phonetics for Indian Students. Orient Longman, New Delhi.
- Balasubrmanyam M. 1985. Business Communication. Vani Educational Books, New Delhi.
- Naterop, Jean, B. and Rod Revell. 1997. Telephoning in English. Cambridge University Press, Cambridge.
- Mohan Krishna and Meera Banerjee. 1990. Developing Communication Skills. Macmillan India Ltd. New Delhi.
- Krishnaswamy, N and Sriraman, T. 1995. Current English for Colleges. Macmillan India Ltd. Madras.

- Narayanaswamy V R. 1979. Strengthen your writing. Orient Longman, New Delhi.
- Sharma R C and Krishna Mohan. 1978. Business Correspondence. Tata Mc Graw Hill publishing Company, New Delhi.
- Carnegie, Dale. 2012. How to Win Friends and Influence People in the Digital Age. Simon & Schuster.
- Covey Stephen R. 1989. The Seven Habits of Highly Successful Free Press.
- Spitzberg B, Barge K & Morreale, Sherwyn P. 2006 Communication: Motivation, Knowledge & Skills. Wadsworth.
- Verma, KC. 2013. The Art of Communication. Kalpaz.
- Dr. T. Bharati, Dr. M. Hariprasad and Pro. V. Prakasam, Personality Development and Communicative English. Neelkamal Publication Ltd, New Delhi.
- Wren and Martin, S. Key to High School English Grammar Composition- Chand and Company Ltd., New Delhi
- Wren and Martin, S. High School English Grammar and Compact. Chand and Company Ltd., New Delhi
- Raymond Murphy, English Grammar in Use. Cambridge University Press
- The Official Guide to the TOEFL Test-IV Edition, Educational Testi Services. Mc Graw Hill, New Delhi. Balasubramanyam,
- M.1985. Business communication. Vani Educational Books Ansari road, New Delhi.
- Krishna Mohan and Meera Banerjee1990. Developing Communication Skills Mac Millan India Ltd.

3 (HSS-121) Information and Communication Technology 2(1+1)

Theory

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 A.V 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.

Practical

Exercises on binary number system, algorithm and flow chart; MS Word; MS Excel; MS Power Point; Internet applications: Web Browsing, Creation and operation of Email account; Analysis of 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

- Gurvinder Singh, Rachhpal Singh & Saluja KK. 2003. Fundamentals of Computer Programming and Information Technology. Kalyani Publishers.
- Harshawardhan P. Bal. 2003. Perl Programming for Bioinformatics. Tata McGraw-Hill Education.
- Kumar A 2015. Computer Basics with Office Automation, IK International Publishing House Pvt Ltd.
- Rajaraman V & Adabala N. 2015. Fundamentals of Computers. PHI.

4 (HSS-323) Fundamentals of Extension Education 2(1+1)

Theory

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.

Practical

Visits to study structure, functions, linkages and extension programmes on 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:

- Adivi Reddy, A., 2001, Extension Education, Sree Lakshmi press, Bapatla.
- Dahama, O. P. and Bhatnagar, O.P., 1998, Education and Communication for Development, Oxford and IBH publishing Co. Pvt. Ltd., New Delhi.
- Jalihal, K. A. and Veerabhadraiah, V., 2007, Fundamentals of Extension Education and Management in Extension, Concept publishing company, New Delhi.

- Muthaiah Manoraharan, P. and Arunachalam, R., Agricultural Extension, Himalaya Publishing House (Mumbai).
- Sagar Mondal and Ray, G. L., Text Book on Rural Development, Entrepreneurship and Communication Skills, Kalyani Publications.
- Rathore, O. S. et al., 2012, Handbook of Extension Education, Agrotech Publishing Academy, Udaipur
- Ray, G. L., 1991 (1st Edition), Extension Communication and Management, Kalyani Publishers, Ludhiana (7th revised edition - 2010).
- Supe, S. V., 2013 (2nd Edition), A Text Book of Extension Education, Agrotech Publishing Academy, Udaipur.
- Van Den Ban, A. W. and Hawkins, H. S., Agricultural Extension, S. K. Jain for CBS Publishers & Distributors, New Delhi.
- M. Hilaris. Indian Agriculture and Information: Soundari, New century Publications, 2011and communication technology (ICT)

5 (HSS-321) Horti-Business Management 2(2+0)

Theory

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, economics 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 rations, capital budgeting. Project management - project preparation evaluation measures.

Suggested Reading

- Heady Earl O and Herald R. Jenson, 1954, Farm Management Economics. Prentice Hall, New Delhi
- S.S. Johl, J.R. Kapur, 2006, Fundamentals of Farm Business Management. Kalyani Publishers, New Delhi
- Karan Singh and Kahlon A. S. Economics of Farm Management in India. Theory and Practice. New Delhi. Allied

- L.M. Prasad. 2001. Principles and Practices of Management, 9th Ed. S. Chand & Sons, New Delhi.
- Koontz Harold. Principles of Management. Tata McGraw-Hill Education Private Limited, New Delhi.
- P.C. Thomas, Managerial Economics, 9th Ed. Kalyani Publishers.
- K.K. Dewett and M.H. Navalur. Modern Economic Theory. S. Chand & Sons, New Delhi.
- P. Subba Rao. Human Resource Management. Himalaya Publications.
- S.P. Jain. Financial Accounting. Kalyani Publications, Ludhiana.
- Shapiro E. Macroeconomic analysis. Galgotia Publications Delhi
- Barry P J, Hopkins J A and Baker C B. Financial Management in Agriculture, 6th ed. Danville, IL Interstate Publishers.
- Gittiner, J P., Economic analysis of agricultural projects. The John Hopkins University Press Baltimore, USA, 1982
- Benjamin Mc Donald P 1985. Investment Projects in Agriculture. Principles and Case studies. Longman Group Limited. Essex. UK
- Pandey UK 1990. An Introduction to Agricultural Finance. Kalyani Publishers New Delhi.

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

Theory

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 Venture capital. Contract farming and joint ventures, public partnerships. Supply chain management and total quality mar Overview of horticulture inputs industry. Characteristics of Indian horticulture processing and export industry, Social Responsibility of Communication Skills: meaning and process of communication, verbal communication; listening and note taking, writing skill presentation skills developing organizational and managerial skills, solving skills, field diary and lab record; indexing, footnote and biblio procedures.

Practical

Listening and note taking, writing skills, oral presentation skills; field diary lab record; indexing, footnote and bibliographic procedures. Reading comprehension of general and technical articles, précis writing, summary, abstracting; Conducting market survey to the demand for product, preparation of advertisements for popularization of product, news writing, preparing project proposals, individual, group presentation, features of oral 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:

- Benjamin MC Donald P. 1985, Investment Projects in Agriculture Principles and Case studies. Longman Group Limited. Essex. UK.
- Chole, R. R. et al., 2012, Entrepreneurship Development and Communication skills, Scientific publishers, Jodhpur.
- Gittiner, J P., 1982, Economic Analysis of Agricultural Projects, The John Hopkins University Press Baltimore, USA.
- Hopkins J A and Baker C B Danville, Financial Management in Agriculture, 6th edn Barry PJ, IL Interstate Publishers.
- Kotler Philip and Armstrong, Principles of Marketing. Prentice-Hall.
- Pandey U. K., An Introduction to Agricultural Finance.
- Sagar Mondal and G. L. Ray, Text Book on Rural Development, Entrepreneurship and Communication Skills, Kalyani Publications.
- Somani, L L., Extension Education and Communication, Agrotech, Publishing Academy, Udaipur.
- Dr. A.K. Singh, 2009.Entrepreneurship Development and Management Lakshmi Publications Ltd.,
- S. Anil Kumar, S.C Poornima, M.K. Abhraham and K. Jayashree, 2008; Entrepreneurship Development. New Age International Publishers

7 (NSO-121) Physical and Health Education (NC) 1(0+1)

Practical

Physical Education: Introduction to physical education. Posture, exercise for good posture, physical fitness exercises for agility, strength, coordination. Endurance and speed. Rules and regulations of important games, skill development in any one of the games - football, hockey, cricket, volleyball, ball badminton, throw ball, tennis. Participation in one of the indoor games - shuttle badminton, chess and table tennis. Rules and regulations of athletic events, participation in any one of the athletic events - broad jump, high jump, triple jump, javelin throw, discuss throw, shot put, short and long-distance running, Safety education, movement education, effective way of doing day today activities. First-aid training, coaching for major games and indoor games. Asanas and indigenous ways for physical fitness and curative exercises. Exercises and games for leisure time, use and experience. Importance of Asanas and Surya namaskar. Free hand exercises and Yoga. Recreation: definition, agencies promoting recreation, camping and recreation. Note: Warming up and conditioning exercises are compulsory before the commencement of each class.

Suggested Reading:

- O.P. Aneja. Encyclopaedia of Physical education, sports and exercise science (4 volumes).
- Anil Sharma. Encyclopaedia of Health and Physical Education (7 Volumes).

- ❖ NV Chaudhery, R Jain. Encyclopedia of Yoga Health and Physical Education (7 Volumes).
- ❖ Pintu Modak, O P Sharma, Deepak Jain. Encyclopaedia of Sports and Games with latest rules and regulations (8 volumes).
- ❖ Edwin F Bryant. Yoga sutras of Patanjali.

8 **(NSO-114/NS0-115) National Service Scheme/National Corps (NC) 1(0+1)**

Practical

NSS:

Orientation of students in national problems, study of philosophy fundamentals rights, directive principles of state policy, socio-economic structure of Indian society, population problems, brief of five-year planning: Functional literacy, non-formal education of rural youth, eradication of evils, awareness programmes, consumer awareness, highlights of consumer act. Environment enrichment and conservation, health, family welfare nutrition.

NCC:

Introduction to NCC, defence services, system of NCC training foot drill, sizing, forming up in three ranks, open and close order march, dressing, getting on parade, dismissing and falling out, saluting, marching drill, shoulder arm, order arm, present arm, guard of honour, ceremonial drill, weapon training – rifle bayonet, light machine gun, sten machine carbie introduction and characteristic stripping, assembling and cleaning, loading, unloading and firing. Field craft, visual training, targets, judging distance, fire discipline and fire control orders, battle craft, field signals, description of ground, section formation, section battle drill, scouts and patrols, ambush field engineering, map reading, conventional signs, grid systems, use of service protractor, prismatic compass and its use, self-defence, general principles precautions and training, attacks and counter attacks, marching and searching first aid, hygiene and sanitation, civil defence, leadership and NCC song.

IX. STUDENT READY-PROGRAMME (ELP+RHWE) 40(0+40)

Practical

Students will practically gain hands on expertise for a semester in any two options out of commercial horticulture, protective cultivation of high value horticulture crops, processing of fruits and vegetables for value addition, floriculture and landscape gardening, production of bio inputs-biofertilizers and biopesticides, mass multiplication of plants and bio-molecules through tissue culture, mushroom culture and bee keeping. In one 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.

1) EXPERIENTIAL LEARNING PROGRAMME (ELP) 20(0+20)

1. Module-1 (HELP-421/HSC-221) Commercial Horticulture:

Nursery production of fruit crops: Raising of rootstocks, grafting and budding of rootstocks, management of grafted plants, plant certification, packaging and marketing, control. Nursery production of ornamentals: Production of plantlets. Production of potted plants, management and maintenance, marketing. Protected cultivation of vegetables and flower raising/procurement and transplanting, management and maintenance of the crop, postharvest handling, quality control and marketing.

2. Module-II

(HELP-422/HHP-421) Protective cultivation of high value horticulture crops:

Visit to commercial polyhouses, Project preparation and planning. Specialised lectures by commercial export house. Study of designs of green- house structures for cultivation of crops. Land preparation and soil treatment. Planting and production: Visit to export houses; Market intelligence; Marketing of produce; cost analysis; Visit to export houses; Market intelligence; Marketing of produce; cost analysis; institutional management. Report writing and viva-voce.

3. Module-III

(HELP-423/HPP-421) Processing of fruits and vegetables for value addition:

Planning and execution of a market survey, preparation of processing schedule, preparation of project module based on market information, calculation of capital costs, source of finance, assessment of working capital requirements and other financial aspects, identification of sources for procurement of raw material, production and quality analysis of fruits and vegetables products at commercial scale, packaging, labelling, pricing and marketing of product.

4. Module-IV (HELP-423/HFF-421)

Floriculture and landscape gardening:

Preparation of project report, soil and water analysis, preparation of land and layout Production and Management of commercial flowers. Harvesting and postharvest handling of produce. Marketing of produce, Cost Analysis, Institutional Management, Visit to Flower growing areas and Export House, Attachment with private landscape agencies. Planning and designing, site analysis, selection and use of plant material for landscaping. Formal and informal garden, features, styles, principles and elements of landscaping. Preparation of landscape plans of home gardens, farm complexes, public parks, institutions, high ways, dams and avenues. Making of lawns, use of software in landscape. Making of bouquets, button hole, wreath, veni and gazaras, car and marriage palaces. Dry flower Technology (identification of suitable species, drying, packaging and forwarding techniques).

5 Module-V (HELP-444/AB-421)

Bio-inputs: Bio-fertilizers and bio-pesticides:

Isolation and pure culture establishment of fertilisers and bio-pesticides. Culture methods and substrates. Scale of methods for bio-fertilizers pesticides. Substrate preparation and mixing techniques. Quality of bio fertilizers and bio pesticides. Testing the final product in small scale level, Storage, marketing and cost analysis of bio-fertilizers and pesticides fertilizers and bio pesticides.

6. Module-VI (HELP-426/HM-421)

Mass multiplication of plants and molecule through tissue culture:
Preparation of stock solutions of tissue culture media. Preparation of solid media and liquid media. Initiation of in vitro culture and multiplication (preparation of explant, inoculation and culturing (crop to selected). Sub-culturing, Hardening and establishment, Initiation callus cultures - suspension cultures, Induction of selected biomolecule callus, Harvesting and extraction of biomolecule, Marketing and cost analysis.

7 Module-VII

(HELP-427/APH-421) Mushroom culture:
Construction cultivation room/structure and Disinfection. Compost preparation & pasteurization, Procurement of mother culture and spawn preparation. Procurement of casing soil and preparation for production. Mushroom seeding, Casing with soil and maintenance, Harvesting, processing, Grading, packing, marketing and Cost economics of mushroom culture.

9 Module-VIII

(HELP-428/AEB-421) Bee keeping:
Procurement and arrangement of bee keeping equipments. Location and collection of potent nectar yielding bee flora seeds from wild. Raising/ enriching the high nectar yielding bee flora in the campus. Location and hiving the natural bee colony from the wild. Establishing the apiary with suitable/favourable necessaries. Maintenance and multiplication of hived colonies. Management of natural enemies and diseases of bees. Maintenance of bee colonies during dearth and honey flow seasons. Harvesting and Processing of honey and bee wax. Marketing and cost analysis.

2) (RHWE) RURAL HORTICULTURAL WORK EXPERIENCE PROGRAMME 20(0+20)
1. Placement in Industries (0+10)
2. Placement in Village (0+10)