

SHIVAJI UNIVERSITY, KOLHAPUR



“A” Re accredited by NAAC
(2012) with CGPA 3.16

Faculty of Interdisciplinary Studies

Structure, Scheme and Syllabus for

Bachelor of Vocational (B. Voc.)

Horticulture Science And Technology

Part I- Sem. I & II

(Subject to the modifications that will be made from time to time)

Choice Based Credit System (CBCS) w.e.f. 2020-2021.

1. COURSE INFORMATION

Ministry of HRD, Government of India has introduced Entrepreneurship oriented Skill development courses of B.Voc./M.voc. courses. These courses will be run by NSQF approved institutes by using available infrastructure and facilities. In these courses the institute will conduct general education content and sector specific skills will be imparted by Skill Knowledge Providers/ Training Providers/ Industries.

During the three year duration of 'Horticulture Science And technology' a candidate is trained on professional skill, professional knowledge and Employability skill related to job role. In addition to this a candidate is entrusted to undertake project work, extracurricular activities and on job training to build up confidence. The broad components covered under Professional Skill subject are as below:-

During the three year duration the trainee learns about agro-meteorology, importance of different elements of weather & climate of agriculture, farm power and machinery, types and application of farm power, farm electricity, agricultural implements, basic knowledge on plant biology, Renewable energy, Soil properties, concept of formation of soil moisture and its conservation, role of organic matter in soil and its recycling water and their management, Soil fertility, fertilizers, manures & management of soil fertility and productivity, Introductory horticulture, fundamentals of horticultures, Importance and scope of horticulture, classification of horticultural plants etc. plant tissue culture techniques . The trainee learns about importance of fruits, flowers and vegetables, distribution of area production and productivity of fruits, vegetables and flowers, present situation and scope of development of horticultural crops, schemes on horticultural development, layout of plots and gardens, planning for home gardens, landscape gardens, experimental designs, fruit culture, vegetable propagation, cultivation of fruits& vegetables and its preservation, management of orchards, present situation of cultivation of different fruits, Vegetative propagation, different methods of vegetative propagation of fruits and flowers. cultivation of vegetables & spices, present situation in the cultivation of different vegetable crops, cultivation of flowers, climbers, foliage & other crops, cultivation of mushroom, care and management of potted plants, pest management, classes of insect pests diseases, integrated pest management, Seed production, marketing & trade management, quality of seeds and classification of seeds, Inventory control & maintenance of records, markets and marketing, trade and trading, methods of management of store, types of market, export of products etc.

2. Training scheme

The (NSQF) under Ministry of Skill Development & Entrepreneurship offers a range of vocational training courses catering to the need of different sectors of economy/ Labour market. The vocational training programmes are delivered under the aegis of NSQF. Horticulture Science and Technology with variants and Apprenticeship Training Scheme (ATS) are two pioneer schemes of NSQF for strengthening vocational training.

'Horticulture Science and Technology' is one of the popular courses delivered nationwide through network of NSQF. The course is of three years duration. It mainly consists of Domain area and Core area. The Domain area (Trade Theory & Practical) imparts professional skills and knowledge, while Core area (Employability Skills) imparts requisite core skill & knowledge and life skills. After passing out the training program at every level the trainee is awarded by Certificate given by college and university which is recognized worldwide.

Candidates require broadly demonstrating that they are competent to:

1. Read and interpret technical parameters/ documents, plan and organize work processes, identify necessary materials and tools;

2. Perform task with due consideration to safety rules, accident prevention regulations and environmental protection stipulations; Apply professional skill, knowledge & employability skills while performing jobs.
3. Document the technical parameters related to the task undertaken.

2.1 Development pathways

1. Can join as Horticultural consultants, Horticultural technician, Plant Care Worker, Nursery Staffer, Pest Management, Horticultural Inspector, Gardener, General, Nurseryman, Planter.
2. Can become Entrepreneur in the related field.
3. Can join Apprenticeship program me in different types of industries leading to National Apprenticeship certificate(NAC).
4. Can join Master Degree (Vocational) courses under NSQF as applicable.

3. LEARNING OUTCOME

Learning outcomes are a expression of total competencies of a learner and assessment will be carried out as per the assessment criteria.

LEARNING OUTCOMES (TRADE SPECIFIC)

1. Recognize metrological instruments and the miscellany within the vocation of horticulture subsequent safety precautions.
2. Preparation and organize life cycles of plants, scope of horticulture and introduction to fruits, flowers & vegetables.
3. Categorize fruits and vegetables based on season and edible parts.
4. Set up agro-meteorology instruments, scrutinize metrological information and documente the data.
5. Classify, select and maintain different farm power machinery.
6. Evaluate physical and chemical properties of soil, soil pH, different methods and ingredient use for correction of Acid soil.
7. Arrange, install and use different irrigation systems, Water lifting systems and water quality sssessment systems.
8. Identify diverse types of soil, methods of soil sampling and collection, study on soil physical characters, know soil test reports and different soil correction methods.
9. Study soil water holding capacity, Different methods and ingredients used for correction of Saline soil. Field visit for identification of soil troubles.
10. Plan and implement different soil correction method through drainage and agronomic practices.
11. Determine soil fertility and apply soil fertility management for enhancement of fertility of soil.
12. To concern Integrated Nutrient Management System (INMS) in the field.

13. Identify, set up and apply Bio-fertilizers.
14. Recognize the role of major and minor plant nutrients and its deficiency symptoms.
15. Produce special types of fruits, vegetables and flowers as per the requirements.
16. Use appropriate various cultivation techniques & methods to fruit crops & vegetable farms.
17. Preparation and implement different garden layouts and designs.
18. Identify and select different Vegetative propagation method & utilization of plant hormones.
19. Apply propagation techniques viz cutting, grafting, budding and layering.
20. Process and preserve vegetables and fruits using different techniques to prepare jam, jelly, squash, sauce, pickle, ketchup etc. its preservation and storage.
21. Develop the Cultivation techniques of different vegetables and spice crops.
22. Perform Floriculture and cultivation techniques for different Flowers, Climbers, Foliages and Medicinal plants to decorate.
23. Perform Cultivation of wild seasonal herbaceous flowering plants, wild tuberous plants, Betel Vine and Mushroom farming.
24. Apply Pest Management and control the Pest and Diseases of Horticultural Crops.
25. Use techniques of Seed Production, Processing and Packaging.
26. Maintain the records viz. Inventory Control, Maintenance of Records and Store management.
27. Conduct Market Survey and follow the legal requirement for trading as part of entrepreneurship development.
28. Develop the tissue culture techniques of different wild ornamental edible fruit and aromatic and medicinal plants.

JOB ROLE

Gardener, General; (Mali General) grows flowers, trees, shrubs, seedlings, vegetables, etc. in public or private gardens. Prepares soil and sows seeds, plants, seedlings etc. Waters seed-beds and growing plants. Weeds and hoes garden and prunes hedges and bushes. Sprays and dusts pesticides and evolves other measures to protect plants from diseases and wild animals. Prepares soil and lays lawn. Waters mows and levels lawns. Prepares paths and ensures their proper up-keep. Collects and preserves seeds for sowing. Supervises labourers engaged for assistance. Keeps implements etc. in good working order. May maintain green house for display. May cultivate vegetables and fruit trees. May specialize in ornamental gardening. May work in nursery for improving variety of plants from seeds, cuttings, grafting or budding and be designated as MALI, NURSERY. May sell plants, buy seeds, fertilizers, insecticides, etc. May pay wages to labourers employed.

Nurseryman; Mali, Nursery manages nursery on own account, or on behalf of employer to grow trees, plants, flowers, shrubs, creepers, seeds, bulbs etc. in open air or green houses for sale to customers. Decides kind and number of plants to be grown and method of planting, cultivating and treatment based on soil, climatic conditions, irrigation facilities etc. Selects and purchases seeds, fertilizers, insecticide. Equipment and machinery and other items. Plans preparation of beds and method of planting, depending on type of plants to be grown. Prepares bed by various processes such as breaking soil, mixing fertilizers, etc. sows seeds, plants, seedlings, cuttings or propagates plants by grafting, budding and other methods and makes water channels. Watches growth of sapling, seedlings, grafts and plants. Hoes and prunes excess growth and off-shoots of plants, dusts and sprays pesticides and takes other measures to protect plants from pets, wild animals, etc. Observes development of plants. Develops methods of grafting and budding./ Collects and preserves seeds for sale. Hires labour if necessary and undertakes planting, weeding, pruning etc. as required. Supervises their work and trains them. Maintains buildings and equipment in good condition.

Keeps records of cost and production statement. Sells seedling, seeds, bulbs etc. May specialize in landscape planting.

Planter; manages plantation on own account to grow plantation crops such as tea, coffee, rubber, etc. Arranges to procure seed according to type of crop such as tea, coffee, rubber, etc. Determines kinds of crop to be grown. Gets land cleared and prepared for growing crops by digging, ploughing, harrowing etc. Organizes and supervises various farm operations, sowing, manuring, weeding, spraying insecticide, and protection of crop from destruction by wild animals. Arranges harvesting of crop and supervises plucking, tapping and threshing of leaves, etc. Ensures proper maintenance and development of plantation estate. Maintains records relating to cost of production, sale and other accounts. May conduct research and organize demonstration. May arrange preservation of produce and partially process them prior to marketing. Is designated as Planter, Tea; Planter, Coffee; Planter, Cinchona; Planter, Cocoa; Planter, Rubber according to type of crop grown.

Key Features: Objectives

- i) To provide judicious mix of skills relating to a profession and appropriate content of General Education.
- ii) To ensure that the students have adequate knowledge and skills, so that they are work ready at each exit point of the programme.
- iii) To provide flexibility to the students by means of pre-defined entry and multiple exit points.
- iv) To integrate NSQF within the undergraduate level of higher education to enhance employability of the students and meet industry requirements. Such student apart from meeting the needs of local and national industry are also expected to be equipped to become part of the global workforce.
- v) To provide vertical mobility to students admitted in such vocational courses.

The certification levels will lead to Diploma/Advanced Diploma/B. Voc. Degree in Industrial Tool Manufacturing and will be offered by respective affiliating University.

Students may be awarded Level Certificate/Diploma/Advance Diploma /Degree as out-lined in the Table below:

Award	Duration after class X II	Corresponding NSQF level
Certificate	Sixth month	5
Diploma	1 Year	6
Advance Diploma	2 Year	7
B.Voc. Degree	3 Year	8

Course Structure

The course will consist of combination of practice, theory and hands on skills in the Capital Goods Sector.

Curriculum

The curriculum in each of the years of the programme would be a suitable mix of general education and skill development components.

Skill Development Components:

The focus of skill development components shall be to equip students with appropriate knowledge, practice and attitude, to become work ready. The skill development components will be relevant to the industry as per its requirements.

The curriculum will necessarily embed within itself, National Occupational Standards (NOSs) of specific job roles within the industry. This would enable the students to meet the learning outcomes specified in the NOSs.

The overall design of the skill development component along with the job roles selected will be such that it leads to a comprehensive specialization in few domains.

The curriculum will focus on work-readiness skills in each of the year of training.

Adequate attention will be given in curriculum design to practical work, on the job training, development of student portfolios and project work. Industrial Tool Manufacturing

A] Ordinance and Regulations: (As applicable to Degree vocational Course)

B] Shivaji University, Kolhapur

Syllabus For Bachelor vocational course in Horticulture Science and technology

1. TITLE: Subject- Horticulture Science and technology

Under the Faculty of interdisciplinary studies

2. YEAR OF IMPLEMENTATION:- Syllabi will be implemented from June 2020 onwards.

3. PREAMBLE:-

[Note :-The Adhoc Board of Studies should briefly mention foundation, core and applied components of the course/paper. The student should get into the prime objectives and expected level of study with required outcome in terms of basic and advance knowledge at examination level.]

4. DURATION

B. Voc. Part I, II and III (Three Years)

B. Voc. Part I - Diploma (One Year)

B. Voc. Part II - Advanced Diploma (Second Year)

B. Voc. Part III- Degree (Third Year)

B. Voc. Part – I, II and III

Two Semester Per Year

One general Papers per year / semester

One elective course paper per semester

Three Core course papers /Vocational Papers per semester

Five Practical papers per semester

One Project / Industry Visit/ Study Tour / Survey/Internship/Hands on training.

50 Students

7. INTAKE CAPACITY :

6. SCHEME OF EXAMINATION

Evaluation System: The evaluation system will be the same as followed by the Shivaji University, Kolhapur. This course is consists of a six semester and shall have a weight age for Internal Exams and for term end exams.

The achieved marks and percentage shall be conversion as determined below.

Grades and Grade Points

Letter Grade	Grade Points
O (Outstanding)	10
A+ (Excellence)	9
A (Very Good)	8
B+ (Good)	7
B (Above Average)	6
C (Average)	5
P (Pass)	4
F (Fail)	0
Ab (Absent)	0

Theory Examination– Attends of semester as per Shivaji University rules.

A) THEORY

The theory examination shall be at the end of the each semester. All the general theory shall carry 50marks, elective and vocational theory papers shall carry 50marks. Evaluation of the performance of the students in theory shall be on the basis of semester examination as mentioned above. The question paper will be set in the view of entire syllabus preferably covering each unit of the syllabus.

Nature of question paper for Theory examination (Excluding Business Communication Paper)–

Q.1 Multiple choice (10)	10 mks
Q.2 Long answer type (any two) out of three	20 mks
Q.3 Write short notes (any four) out of six	20 mks

B) PRACTICAL Each semester there will be external practical examination attendant of semester.

Evaluation of the performance of the students in practical shall be on the basis of semester examination .

Communication skill 10 mks

Each paper having separate practical (EC/CC) 50 mks

C) Project /field visit/ internship/fieldwork/Hands on training. 50 mks

Standard of Passing:

As per the guidelines and rules for B. Voc. (Attached Separately – Annexure I)

7. FEE STRUCTURE:

As per Government/University rules.

1. Refer website of concern affiliated college/institute to Shivaji University, Kolhapur.
2. Other fee will be applicable as per rules and norms of UGC and Shivaji University, Kolhapur.

8. ELIGIBILITY FOR ADMISSION:

As per guidelines obtained from UGC, NSQF and Shivaji University, Kolhapur by following rules and regarding reservations by Govt. of Maharashtra.

9. MEDIUM OF INSTRUCTION:

The medium of instruction shall be in English.

10. STRUCTURE OF COURSE- B. voc. Horticulture Science and Technology.

11. Eligibility for Admission : 10 + 2 from any faculty or equivalent Diploma /Advanced Diploma in any related stream.

12. Eligibility for Faculty : 1) M. Sc. (Horticulture/Botany) with NET / SET/ Ph.D.
2) M.A. (English) with NET/SET for Business Communication.

13. Eligibility for Laboratory Assistant cum clerk: B.Sc. (Horticulture/Botany) with MSCIT

14. Eligibility for Laboratory attendant cum gardener: Diploma in Horticulture.

15. Staffing Pattern:

Teaching:

In 1st Year of B. Voc. 1 Full Time and 1 Part Time Lecturer and 1 CHB Lecturer for Business communication. In 2nd Year of B. Voc. Total requirement of faculty (Inclusive of 1st Year) will be 3 Full time and 1 CHB Lecturer for Financial Accounting 1 CHB, Lecturer for Business Communication. 3rd Year of B. Voc. – Total requirement of faculty (Inclusive of 1st & 2nd Year) will be 4 Full time and 1 part time and 1 CHB Lecturer for Business Communication.

SHIVAJI UNIVERSITY, KOLHAPUR

STRUCTURE AND SYLLABUS OF B.VOC.

Bachelor of Vocational (B.Voc.) – Horticulture Science And Technology

Semester –I

Credits: 30

Course no.	Courses	Distribution of Marks			Credits			
		T	P	Project/Field visit/ Internship/ Field work	T	P	Project/Field visit/ Internship/ Field work	Total
BVHSTCS101	Business communication-I	40	10		3	2		5
BVHSTEC102	Fundamental of Soil Science	50	50		3	4		7
BVHSTCC 103	Fundamentals of Horticulture	50	50		3	3		6
BVHSTCC 104	Dry land Horticulture	50	50		3	3		6
BVHSTCC 105	Weed management	50	50		3	3		6
	Project/Field visit/ Internship/ Field work /Hands on training based on practical							
Total		240	210		15	15		30

Semester II

Credits: 30

Course no.	Courses	Distribution of Marks			Credits			
		T	P	Project/Field visit/ Internship/ Field work	T	P	Project/Field visit/ Internship/ Field work	Total
BVHSTCS106	Business communication-II	40	10		3	2		5
BVHSTEC107	Fundamentals of hydrology and management in Horticulture Crops	50	50		3	4		7
BVHSTCC 108	Plant propagation and Nursery Management	50	50		3	3		6
BVHSTCC 109	Plant Pathology	50	50		3	3		6
BVHSTCC 110	Introduction to floriculture crops	50	50		3	3		6
	Project/Field visit/ Internship/ Field work /Hands on training based on practical							
Total		240	210		15	15		30

***BVHSTCS: Bachelor of Vocational Horticulture Science And Technology Communication Skill.**

***BVHSTEC: Bachelor of Vocational Horticulture Science And Technology Elective Course.**

***BVHSTCC: Bachelor of Vocational Horticulture Science And Technology Core course.**

*** T: Theory**

*** P: Practical**

**** Non credit courses must be completed as per guidelines of Shivaji University, Kolhapur.**

SHIVAJI UNIVERSITY, KOLHAPUR
Bachelor of Vocational (B.Voc.) – Horticulture Science And Technology
Scheme of Teaching: B.Voc. - Part I and II Semester
Semester I

Course no.	Courses	Distribution of Work load (Per Week)	
		Theory	Practical
BVHSTCS101	Business communication-I	4	2
BVHSTEC102	Fundamental of Soil Science	5	4
BVHSTCC 103	Fundamentals of Horticulture	5	4
BVHSTCC 104	Dry land Horticulture	5	4
BVHSTCC 105	Weed management in Horticultural Crops	5	4
	Project/Field visit/ Internship/ Field work /Hands on training based on practical	-----	
Total		24	18

Semester II

Course no.	Courses	Distribution of Work load(Per Week)	
		Theory	Practical
BVHSTCS106	Business communication-II	4	2
BVHSTEC107	Fundamentals of hydrology and management in Horticulture Crops	5	4
BVHSTCC 108	Plant propagation and Nursery Management	5	4
BVHSTCC 109	Pathology	5	4
BVHSTCC 110	Introduction to floriculture crops	5	4
	Project/Field visit/ Internship/ Field work /Hands on training based on practical	-----	
Total		24	18

SHIVAJI UNIVERSITY, KOLAPUR
B. Voc. Part – I
Horticulture Science and Technology
Business Communication
Course no. BVHSTCS101

Total Workload: 02 lectures per week of 50 mins.

Distribution of Workload:

Theory: 04 lectures per week

Practical: 02 lectures per week per batch of 20 students

Credits 3+2

Module I: Vocabulary Development and Sentence formation	9
Topics: Vocabulary: Affixation What is a sentence? Types of sentence: Simple, compound, complex	
Module II: Drafting a Letter of Application and preparing CV/Resume	10
Topics: Structure of a letter of application for various posts CV/ Resume and its essentials	
Module III: Presenting Information/ Data	10
Topics: Presenting information/data using graphics like tables, pie charts, tree Diagrams, bar diagrams, graphs, flowcharts	
Module IV: Interview Technique	16
Topics: Dos and don'ts of an interview Preparing for an interview Presenting documents Language used in an interview Hypothetical Questions	

Practical: Based on the theory Modules:

1) Mock interview OR 2) Presentation of Information

Reference Books:

Sethi, Anjanee & Bhavana Adhikari. *Business Communication*. New Delhi: Tata McGraw Hill

Tickoo, Champa & Jayab Sasikumar. *Writing with a Purpose*. New York: OUP, 1979.

Sonie, Subhash C. *Mastering the Art of Effective Business Communication*. New Delhi:

Student Aid Publication, 2008.

Herekar, Prakash. *Business Communication*. Pune: Mehta Publications, 2007.

Herekar, Prakash. *Principals of Business Communication*. Pune: Mehta Publications, 2003.

Pradhan, N.S. *Business Communication*. Mumbai: Himalaya Publishing House, 2005.

SHIVAJI UNIVERSITY, KOLAPUR
B. Voc. Part – I
Horticulture Science and Technology
Semester I
Fundamental of Soil Science
Course no. BVHSTEC102

Work Load: 09
Theory: 5 Lectures/Week
Practical: 4 Lectures/Week/Batch

Credits 03+04
Theory: 50 Marks
Practical: 50 Marks

Objectives : To facilitate students
To know the formation of soil.
To be familiar with the properties of soil.

Course content:

Theory-

Module I **09**

- 1.1 Composition of earth's crust, Soil as a natural body- major components-Macroelements.
- 1.2 Formation of Soil – soil forming factors and Pedogenic processes.
- 1.3 Physical properties- Texture, methods of textural analysis, Stock's law, concept of assumptions, limitations, textural classes, use of textural triangle.

Module II **10**

- 2.1 Absolute Specific gravity/particle density, apparent specific gravity/bulk Density, porosity.
- 2.2 Factors influencing BD. Relation between BD & Porosity
Pore space: factors affecting capillary & non- capillary porosity
- 2.3 Soil colour, soil moisture and soil organic matter, significance of soil.

Module III **10**

- 3.1. Soil structure: definition, classification, clay prism like structure, and Genesis. factors influencing soil structure.
- 3.2 Soil air: composition, effect of- soil air, gaseous exchange on plant growth.
- 3.3 Soil Temperature : Sources, measurement of soil temperature and its effect on plant growth

Module IV **16**

- 4.1 chemical properties of Soil: organic, humus, inorganic, secondary silicate clays and hydrous oxides.
- 4.2 Ion exchange: cation and anion, importance of ion exchange
- 4.3 pH and nutrient availability, soil buffering capacity.
- 4.5 Soil water, measurement of soil water, soil microbes-benefits and harmful effects and soil erosion –types and control measures.

SHIVAJI UNIVERSITY, KOLAPUR
B. Voc. Part – I
Horticulture Science and Technology
Semester I
Fundamental of Horticulture Science
Course no. BVHSTCC103

Work Load-9

Theory: 5 Lectures/Week

Practical: 4 Lectures/Week/Batch

Credits: 3+3

Theory: 50 Marks

Practical: 50 Marks

Objectives: To enable students –

- i) To understand orchard management.
- ii) To know the various operations carried out in orchard.
- iii) To study the medicinal and aromatic plants.

Course content:

Theory

Module I

09

- 1.1. Horticulture- Branches, Importance and scope.
- 1.2 Selection of site for fruit and vegetable growing. Horticultural and Botanical classification of fruit and vegetable crops.
- 1.3 Fruit and vegetable Zones of India and Maharashtra.

Module II

09

- 2.1. Types of Orchards, Weed Management in Orchards, Different Steps in Planning and Layout of Orchards.
- 2.2 Vegetable gardens and kitchen garden.
- 2.3 Organic farming-Principles, importance and scope.

Module III

12

- 3.1 Pruning and training of fruit crops; Principles, objectives, types and methods of fruit crops, types and use of growth regulators in horticulture.
- 3.2 Bending, Notching, Girdling, Ringing, Juvenility and flower bud differentiation, unfruitfulness, pollination, pollinizers, fertilization and Parthenocarpy.
- 3.3 Role of growth regulators in horticulture.

Module IV

15

- 4.1 Cropping systems, intercropping, multi-tier cropping, mulching; objectives, types, merits and demerits.
- 4.2 Classification of bearing habits of fruit trees, factors influencing the fruitfulness and unfruitfulness.

SHIVAJI UNIVERSITY, KOLAPUR
B. Voc. Part – I
Horticulture Science and Technology
Semester I
Dry Land Horticulture Science
Course no. BVHSTCC104

Work Load-9

Theory: 5 Lectures/Week

Practical: 4 Lectures/Week/Batch

Objectives: To enable students –

- i) To understand dry land crop plants
- ii) To know the various operations carried out in dry lands
- iii) To study the dry plants.

Credits: 3+3

Theory: 50 Marks

Practical: 50 Marks

Course content:

Theory

Module I

10

- 1.1 Importance and limitation of dry land horticulture.
- 1.2 Present status and future scope of dry land horticulture. Constraints encounter in dry lands.
- 1.3 Agro-climatic features in rain shadow areas, scarce water resources, high temperature, soil erosion and run-off losses.

Module II

12

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

Module III

08

- 3.1 Water use efficiency-need based, economic and conjunctive use of water, Micro systems of irrigation.
- 3.2 Special techniques, planting and after care-use of seedling races, root stocks, *in-situ* grafting, deep pitting/planting and canopy management.

Module IV

15

- 4.1 Study drought resistance Characters and special adaptation of the following crop
- 4.2 Annona , Jamun, Pomegranate, Tamarind and Amla
- 4.3 Wood apple, Marking Nut, Bor, Bilimbi, Peru and Dragon fruit.

SHIVAJI UNIVERSITY, KOLAPUR
B. Voc. Part – I
Horticulture Science and Technology
Semester I
Weed management in Horticultural Crops
Course no. BVHSTCC105

Work Load-9

Theory: 5 Lectures/Week

Practical: 4 Lectures/Week/Batch

Objectives: To enable students –

- i) To understand weed plants/exotics
- ii) To study the weeds in dry land crops.
- iii) To know the various weed management techniques.

Credits: 3+3

Theory: 50 Marks

Practical: 50 Marks

Course content:

Theory

Module I	08
1.1 Weeds: Introduction, harmful and beneficial effects on horticultural crops.	
1.2 Classification of weeds.	
1.3 Propagation and dissemination of weeds.	
Module II	12
2.1 Weed biology and ecology, crop weed association with horticultural crops.	
2.2 Crop weed competition and allelopathy.	
2.3 Methods of weed control: physical, cultural, chemical and biological methods.	
Module III	10
3.1 Integrated weed management	
3.2 Herbicides: advantages and limitation of herbicide in India.	
3.3 Herbicide classification, formulations, methods of application.	
Module IV	15
4.1 Introduction to Adjuvants and their use in herbicides.	
4.2 Introduction to selectivity of herbicides, compatibility of herbicides with other agro Chemicals.	
4.3 Weed management in major field and horticultural crops. Shift of weed flora in cropping Systems. Problematic weeds and their control.	

SHIVAJI UNIVERSITY, KOLAPUR
B. Voc. Part – I
Horticulture Science and Technology
Semester I
Practical: I
Fundamental of Soil Science
Course no. BVHSTEC102

Work Load:4

Practical: 4 Lectures/Week/Batch

Credits:04

Practical: 50 Marks

1. Study of soil profile in field.
2. To study the water holding capacity of different soil samples.
3. Study of humus content in different soil Samples.
4. Determination of soil texture.
5. Calibration and applications of calorimeter and flame photometer.
6. Determination of soil pH and electrical conductivity.
7. Isolation of soil fungi by serial dilution method.
8. Introduction of analytical instruments and their principals; pH meter spectro-photometer, flame photometer and Conductometer.
9. Analysis of soil by using spectrophotometer (AAS).
10. Estimation of moisture from organic manures and its preparation for nutrient analysis.
11. Estimation of available macro and microelements in soil
12. Estimation of available phosphorus in soil.
13. Estimation of available sulphur in soil.
14. Fertilizer adulteration test / identification of adulteration in fertilizer / Detection of adulteration in fertilizers (Rapid test).
15. Determination of moisture content in soil.
16. Visits to Soil testing laboratory
17. Project/Field visit/ Internship/ Field work /Hands on training

SHIVAJI UNIVERSITY, KOLAPUR
B. Voc. Part – I
Horticulture Science and Technology
Semester I
Practical: II
Fundamental of Horticulture Science
Course no. BVHSTCC103

Work Load-4
Practical –4 Lectures/Week/Batch

Credits: 03
Practical: 50 Marks

1. Study of garden tools and implements in Horticulture.
2. Identification of horticultural crops.
3. Practice of asexual methods of propagation.
4. Study of Irrigation Methods to Horticultural Crops.
5. Layout and planting of orchards.
6. Fertilizer application in different Horticultural crops.
7. Preparation standard solutions (percentage and ppm).
8. Layout of nutrition garden(Simple And Random Block Design).
9. Preparation of nursery beds for sowing of vegetable seeds
10. Digging of pits for fruit plants, planting systems
11. Training and pruning of orchard trees
12. Preparation of fertilizer mixtures and field application, preparation and application of growth regulators
13. Layout of different irrigation systems.
14. Identification and management of nutritional disorder in fruits
15. Assessment of bearing habits, maturity standards, harvesting, grading, packaging and storage to be completed during field visit.
16. Visit to commercial orchards.
17. Project/Field visit/ Internship/ Field work /Hands on training

SHIVAJI UNIVERSITY, KOLAPUR
B. Voc. Part – I
Horticulture Science and Technology
Semester I
Practical III
Dry Land Horticulture Science
Course no. BVHSTCC104

Work Load-4

Practical: 4 Lectures/Week/Batch

Credits: 03

Practical: 50 Marks

1. Study of rainfall patterns
- 2- 3. Study of Contour bunding and Trenching.
4. Study of micro catchment areas.
5. Study of soil erosion and its control.
6. Study of evapotranspiration.
- 7-8. Study of Mulching in various horticultural crops.
- 8-9. Study of irrigation systems-Surface and Sub Surface.
10. Techniques of planting and aftercare in dry lands.
11. Horticultural practices in dry land plants.
12. Training in dry land horticultural plants.
13. Pruning in dry land horticultural plants.
14. Study of morphological and anatomical features of drought tolerant fruit crops.
15. Study of morphological and anatomical features of salinity tolerant fruit crops.
16. Project/Field visit/ Internship/ Field work /Hands on training

SHIVAJI UNIVERSITY, KOLAPUR
B. Voc. Part – I
Horticulture Science and Technology
Semester I
Practical IV
Weed management in Horticultural Crops
Course no. BVHSTCC105

Work Load-4

Practical: Lectures/Week/Batch

1. Identification of weeds.
2. Survey of weeds in orchards.
3. Survey of weeds in other habitats.
- 4-5. Calculations on weed control efficiency and weed index.
6. Study of Herbicide label information.
7. Formulation and use of Herbicides.
8. Study of herbicide application equipment and calibration.
9. Demonstration of methods of herbicide application.
10. Various methods of weed control in orchards.
11. Mechanical method of weed control.
12. Chemical method of weed control.
13. Biological method of weed control
14. Study of phytotoxicity symptoms of herbicides in different crops.
15. Preparation and submission of herbarium of weeds.
16. Economics of weed control practices.
17. Project/Field visit/ Internship/ Field work /Hands on training.

Credits: 03

Practical: 50 Marks

Reference books:

Text books:

1. Walia RK & Bajaj HK. 2003. *Text Book on Introductory Plant Nematology*. ICAR, New Delhi

Reference books:

1. Pathak, V. N. *Essentials of Plant Pathology*. Prakash Pub., Jaipur
2. Agrios, GN. 2010. *Plant Pathology*. Acad. Press.
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12. Dhingra OD & Sinclair JB. 1986. *Basic Plant Pathology Methods*. CRC Press, London, Tokyo.
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15. Rajeev K & Mukherjee RC. 1996. *Role of Plant Quarantine in IPM*. Aditya Books.
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17. Singh RS & Sitaramaiah K. 1994. *Plant Pathogens – Nematodes*. Oxford & IBH, New Delhi.
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20. D.K. Salunkhe and S.S. Kadam, 2013. *A handbook of Fruit Science and Technology*. CRC Press.
21. Denisen E.L., 1957. *Principles of Horticulture*. Macmillan Publishing Co., New York.
22. Edmond, J.B, Sen, T.L, Andrews, F.S and Halfacre R.G., 1963. *Fundamentals of Horticulture*. Tata McGraw Hill Publishing Co., New Delhi.
23. Gardner/Bardford/Hooker. J.R., 1957. *Fundamentals of Fruit Production*. Mac Graw Hill Book Co., New York.
24. Jitendra Singh, 2002. *Basic Horticulture*. Kalyani Publishers, Hyderabad.
25. K.V.Peter, 2009. *Basics Horticulture*. New India Publishing Agency
26. Kausal Kumar Misra and Rajesh Kumar, 2014. *Fundamentals of Horticulture*. Biotech Books.
27. Kumar, N., 1990. *Introduction to Horticulture*. Rajyalakshmi publications, Nagarcoil, Tamilnadu
28. NeerajPratap Singh, 2005. *Basic concepts of Fruit Science* 1stEdn. IBDC Publishers.
29. Prasad and Kumar, 2014. *Principles of Horticulture* 2ndEdn. Agrobios (India).
30. S. Prasad and U. Kumar, 2010. *A handbook of Fruit Production*. Agrobios (India).
31. *e-reading: http://ecourses.iasri.res.in*

32. Brady, N. C. 2016. The Nature and Properties of Soils. 15th edition Publisher: Pearson Education, ISBN: 978-0133254488.
33. Biswas, T.D.; Mukherjee, S.K.. 1995. Text Book of Soil Science 2nd sEd. Tata McGraw Hill Publisher, Delhi pp 433.
34. Das D. K. 2011. Introductory Soil Science, 3rd revised and Enlarged Ed, Kalyani Publisher, Ludhiana. pp. 645.
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39. T. Pradeep Kumar, B. Suma, Jyothi Bhaskar and K.N.Sathesan. 2008. *Management of Horticultural Crops*. New India Publishing Agency.
40. Fruit culture in India , Shyam Singh , S. Krishnamurthy & S. L. Katyal .
41. Production technology of fruit crops, K. G. Shanmugavellu .
42. **e-reading:** <http://ecourses.iasri.res.in/>
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44. Chadha, K.L. (ICAR)2002,2001. *Hand book of Horticulture*. ICAR, New Delhi
45. Gupta, O.P. 1984. *Scientific Weed Management*. Today and Tomorrow Printers and Publishers, New Delhi.
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47. Naidu, V.S.G.R., *Handbook of Weed Identification*. Directorate of Weed Research, Jabalpur.
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SHIVAJI UNIVERSITY, KOLHAPUR
Bachelor of Vocational (B.Voc.): Horticulture Science And Technology
Scheme of Teaching: B.Voc. - Part I

Semester II

Credits: 30

Course no.	Courses	Distribution of Marks			Credits			
		T	P	Project/Field visit/ Internship/ Field work	T	P	Project/Field visit/ Internship/ Field work	Total
BVHSTCS106	Business communication-II	40	10		3	2		5
BVHSTEC107	Fundamentals of hydrology and management in Horticulture Crops	40	50		3	4		7
BVHSTCC 108	Plant propagation and Nursery Management	40	50		3	3		6
BVHSTCC 109	Pathology	40	50		3	3		6
BVHSTCC 110	Introduction to floriculture crops	40	50		3	3		6
	Project/Field visit/ Internship/ Field work /Hands on training based on practical							
Total		200	210		15	15		30

Course no.	Courses	Distribution of Work load (Per Week)	
		Theory	Practical
BVHSTCS106	Business communication-II	4	2
BVHSTEC107	Fundamentals of hydrology and management in Horticulture Crops	5	4
BVHSTCC 108	Plant propagation and Nursery Management	5	4
BVHSTCC 109	Pathology	5	4
BVHSTCC 110	Introduction to floriculture crops	5	4
	Project/Field visit/ Internship/ Field work /Hands on training based on practical	-----	
Total		24	18

***BVHSTCS: Bachelor of Vocational Horticulture Science And Technology Communication Skill.**

***BVHSTEC: Bachelor of Vocational Horticulture Science And Technology Elective Course.**

***BVHSTCC: Bachelor of Vocational Horticulture Science And Technology Core course.**

* **T: Theory**

* **P: Practical**

** **Non credit courses must be completed as per guidelines of Shivaji University, Kolhapur.**

SHIVAJI UNIVERSITY, KOLAPUR
B. Voc. Part – I
Horticulture Science and Technology
Business Communication-II
Course no. BVHSTCS106
Semester–II

Distribution of Workload:	Credits 3+2
Theory:	04 lectures per week
Practical:	02 lectures per week per batch of 20students
Modules Prescribed for Theory:	
Module I: Group Discussion	12
Topics:	
Dos and Don'ts	
Preparing for a Group Discussion	
Initiating a Discussion, Eliciting Opinions, Views, etc.	
Expressing Agreement/Disagreement	
Making Suggestions; Accepting and Denying Suggestions	
Summing up.	
Module II: Business Correspondence	09
Topics:	
Drafting Memos	
Writing formal and informal e-mails	
Writing letter of inquiry and complaints	
Letter of Placing Orders and Tenders.	
Module III: English for Negotiation	08
Topics:	
Business Negotiations	
What is business negotiation?	
Agenda for Negotiation	
Stages of Negotiation	
Module IV: English for Marketing	16
Topics:	
Describing/Explaining a Product/Service	
Promotion of a Product	
Dealing/ bargaining with Customers	
Marketing a Product/Service: Use of Pamphlets, Hoardings, Advertisement	
Practical: Based on the theory Modules:	
I. Group discussion on various topics or II. Preparing advertisement copy for the promotion of a product	
ReferenceBooks:	
Herekar, Praksh. <i>Business Communication</i> . Pune: Mehta Publications, 2007.	
Herekar, Praksh. <i>Principals of Business Communication</i> . Pune:Mehta Publications, 2003	
John, David. <i>Group Discussions</i> .New Delhi: Arihant Publications.	
Pradhan, N. S. <i>Business Communication</i> . Mumbai: Himalaya Publishing House, 2005	
Rai, Urmila& S. M. Rai. <i>BusinessCommunication</i> .Mumbai: Himalaya Publishing House, 2007.	
Whitehead, Jeffrey & David H.Whitehead. <i>Business Correspondence</i> . Allahabad:WheelerPublishing,	

1996.

SHIVAJI UNIVERSITY, KOLAPUR
B. Voc. Part – I
Horticulture Science and Technology
Fundamentals of hydrology and management in Horticulture crops
Semester II
Course no. BVHSTEC107

Work Load:8

Theory: 4 Lectures/Week

Practical:4 Lectures/Week/Batch

Objectives: To enable students –

- i) To understand weed plants/exotics
- ii) To study the weeds in dry land crops.
- iii) To know the various weed management techniques.

Credits: 3+4

Theory: 50 Marks

Practical: 50 Marks

Module I

10

- 1.1 Water resources- Global water scenario, Hydrological cycle and Indian water Budget
- 1.2 Irrigated Area under principle crops-Grape, Lemon, Potato,Marigold.
- 1.3 Function of water for plant growth- Soil moisture and plant growth.

Module II

11

- 2.1 Effect of moisture stress on crop growth- moisture stress and plant response.
- 2.2 Types of water, rooting characteristics, moisture extraction pattern.
- 2.3 Water requirement of horticultural crops – net irrigation requirement, gross irrigation Requirement.

Module III

12

- 3.1 Lysimeter studies, Plant water potential-Consumptive use, Definition and use of pan evaporimeter- evaporation, transpiration, Evapo-transpiration and potential evapotranspiration.
- 3.2 Irrigation scheduling – critical stages of crop growth for irrigation.
- 3.3 Methods of Irrigation- border, check basin, ring and basin,furrow.

Module IV

12

- 4.1 Sub-surface irrigation methods Sprinkler- definition,advantages and limitations, Components, types of Sprinkle irrigation system, fertilizer applicator
- 4.2 Drip Irrigation System- Definition, advantages and limitatons , components, fertilizer applicator, Layout

SHIVAJI UNIVERSITY, KOLAPUR
B. Voc. Part – I
Horticulture Science and Technology
Plant propagation and Nursery Management
Semester II
Course no. BVHSTCC 108

Work Load-9

Theory: 4 Lectures/Week

Practical: 4 Lectures/Week/Batch

Objectives: To enable students –

- i) To understand weed plants/exotics.
- ii) To study the weeds in dry land crops.
- iii) To know the various weed management techniques.

Credits: 3+4

Theory: 50 Marks

Practical: 50 Marks

Module I

10

- 1.1 Definition and need of plant propagation and its potential.
- 1.2 Sexual and asexual methods of plant propagation-advantages and disadvantages.
- 1.3 Factors affecting vegetative propagation.
- 1.4 Seed germination and dormancy - internal and external factors affecting seed dormancy and seed treatment (Scarification and stratification).

Module II

15

- 2.1 Apomixis - definition, monoembryony, polyembryony, chimera.
- 2.2 Nursery techniques and nursery management- cuttings, layerings grafting, budding, runners, tubers, corms, rhizomes off sets, stolons and other specification organs.
- 2.3 Propagations structures - mist chamber, humidifiers, green house, glass house, cold frames, hot beds, polyhouses.

Module III

10

- 3.1 Use of growth regulators in plant propagation.
- 3.2 Selection and maintenance of mother trees, maintenance of mother trees & budwood certification.
- 3.3 Micrografting.
- 3.4 Characters of root stock and Scion relationship.

Module IV

10

- 4.1 Hardening of plants in nurseries.
- 4.2 Insect - pest & disease control in nursery.
- 4.3 Nursery registration act and record keeping.

SHIVAJI UNIVERSITY, KOLAPUR

B. Voc. Part – I

Horticulture Science and Technology

Plant Pathology

Semester II

Course no. BVHSTCC 109

Work Load-9

Theory: 4 Lectures/Week

Practical:4 Lectures/Week/Batch

Credits: 3+3

Theory: 50 Marks

Practical: 50 Marks

Objectives:

- i) To enable students about plant diseases.
- ii) To enable students about fungi, phytoplama.
- iii) To enable students about bacteria, viruses.

Module I

10

- 1.1 History of Plant Pathology with special reference to Indian work and development of Plant Pathology in ancient, dark, premodern, modern present eras.
- 1.2 Importance of plant diseases, scope and objectives of Plant Pathology in relation to the Diseases.
- 1.3 Classification of plant diseases on the basis of pathogen, symptoms and parts infected.
- 1.4 Causes of Plant Disease Biotic (fungi, bacteria, fastidious vesicular bacteria, Phytoplasmas.

Module II

15

- 2.1 Concepts of plant diseases Sign and symptoms, Classification of symptoms (Hyperplasia, Hypoplasia, Necrosis, chlorosis).
- 2.2 Study of phanerogamic plant parasites. Root Parasites-Orobanche, Striga.
- 2.3 Fungi, general morphology and characters: Plant diseases- Phytoplasmal-Little leaf disease of brinjal, Viral- Yellow Vein Mosaic Of Bhendi, Bacterial-Oil spot of pomegranate, Citrus Canker, Fungal- Downy mildew of grape, Early and blight disease of potato, Flower blight of marigold.

Module III

10

- 3.1 Reproduction in fungi:
- 3.2 Vegetative.
- 3.3 Asexual.
- 3.4 Sexual reproduction.

Module IV

10

- 4.1 Bacteria: general morphological characters, Classification and reproduction.
- 4.2 Viruses: Characters, Classification, structure, multiplication and transmission.

SHIVAJI UNIVERSITY, KOLAPUR
B. Voc. Part – I
Horticulture Science and Technology
Introduction to floriculture crops
Semester II
Course no. BVHSTCC 110

Work Load-9

Theory: 4 Lectures/Week

Practical: 4 Lectures/Week/Batch

Objectives:–

- i) To enable students about gardening.
- ii) To enable students about lawn making.
- iii) To know students about bonsai making .
- iv) To know students about Plant propagation.

Credits:3+3

Theory: 50 Marks

Practical: 50 Marks

Module I

10

- 1.1 History, Introduction, scope of gardening Aesthetic values.
- 1.2 Types of gardens in India.
- 1.3 Special types of gardens, trees, their design, their walk-paths, bridges, constructed features.
- 1.4 Floriculture industry: Area and production, industrial and economic importance in India.
- 1.5 Landscaping: principles and components.

Module II

10

- 2.1 Lawn making: importance, preparation of ground, suitable grasses, making and after care.
- 2.2 Designing rockery and water gardens.
- 2.4 Garden structures –Greenhouse, Glass house, Net house.

Module III

10

- 3.1 Propagation-planting shrubs and herbaceous perennials.
- 3.2 Importance, design values, propagation, planting- climbers and creepers.
- 3.3 Importance, design values, propagation, planting- palms and ferns.
- 3.4 Importance, design values, propagation, planting- cacti and succulents.

Module IV

15

- 4.1 Bio-aesthetic planning, Urban, villages, schools and avenues.
- 4.2 Beautifying railway stations, dam sites, hydroelectric stations, colonies, river banks, Planting material for play grounds.
- 4.3 Vertical gardens, Roof gardens
- 4.5 Bonsai: Concept and art of making bonsai.

SHIVAJI UNIVERSITY, KOLAPUR
B. Voc. Part – I
Horticulture Science and Technology
Fundamentals of hydrology and management in Horticulture crops
Semester II
Practical I
Course no. BVHSTEC107

Work Load-4

Practical: Lectures/Week/Batch

Credits:03

Practical: 50 Marks

1. Study of Weirs and Notches.
2. Study of Parshall flume and orifices.
3. Numericals on Weirs, Notches, Parshall flume and orifices.
4. Collection of field data for designing micro-irrigation system for orchard and vegetable crops.
5. Study of different components of drip irrigation system.
6. Study of different components of Spinkler irrigation system.
7. Study of fertilizer application system.
8. Study of different types of filters.
9. Study of acid and chlorination treatment to avoid clogging in micro irrigation system
10. Field evaluation of drip and micro-sprinkler irrigation system.
11. Estimation of soil moisture constants/contents.
12. Determination of Soil Moisture by Air Oven Method.
13. Estimation of irrigation efficiency of horticultural crops.
14. Estimation of water requirements of horticultural crops.
15. Study of Soil Moisture Conservation Practices.
16. Visit to Drip and sprinkler Irrigation Installation.

SHIVAJI UNIVERSITY, KOLAPUR
B. Voc. Part – I
Horticulture Science and Technology
Plant propagation and Nursery Management
Semester II
Practical II
Course no. BVHSTCC 108

Work Load-4

Practical: Lectures/Week/Batch

Credits:03

Practical: 50 Marks

1. Study of different nursery media for plant propagation.
2. Preparation of nursery beds and sowing seeds.
3. To study breaking of seed dormancy, including seed treatments for germination and growth.
4. Raising root stock in various containers.
5. Potting, reporting and preparation of plant material for potting.
6. Practicing different types of cutting and layering.
7. Practicing different types of runners, offsets and other specialized plant organs for propagation.
8. Practicing different budding method.
9. Practicing different grafting methods.
10. Preparation of growth regulators for seed germination and vegetative propagation.
11. Study of plant propagation and hardening of plants.
12. Digging, labeling and packing of nursery plant.
13. Nutrient application and plant protection measures in nursery.
14. Raising, maintenance and cost of different nursery structure.
15. Maintenance of nursery record.
16. Visit to established Govt. and Private Nurseries of adjoining areas.

SHIVAJI UNIVERSITY, KOLAPUR
B. Voc. Part – I
Horticulture Science and Technology
Plant Pathology
Semester II
Practical III
Course no. BVHSTCC 109

Work Load-4

Practical: Lectures/Week/Batch

Credits: 03

Practical: 50 Marks

1. Acquaintance with various laboratory equipments and microscopy.
2. General study of different structures of fungi.
- 3-5. To Study the symptoms of various plant diseases.
6. Staining and identification of plant pathogenic bacteria.
7. Study of phanerogamic plant parasites.
8. Preparation of culture media.
- 10-11. Isolation of fungi and bacteria from horticultural crops.
12. Technique of Koch's postulates.
13. Study of fungicides and their formulations.
14. Methods of pesticide application and their safe use.
15. Calculation of fungicide sprays concentrations.
16. Collection and preservation of disease specimen.
17. Visit to research centre.

SHIVAJI UNIVERSITY, KOLAPUR
B. Voc. Part – I
Horticulture Science and Technology
Introduction To Horticultural Crops
Semester II
Practical IV
Course no. BVHSTCC 109

Work Load-4

Practical: Lectures/Week/Batch

Credits:03

Practical: 50 Marks

1. Identification and description of annuals, herbaceous, perennials of horticultural crops.
2. Identification and description of climbers, creepers, foliage and flowering shrubs
3. Identification and description of trees, palms, ferns.
4. Identification and description of lawn grasses; cacti and succulents.
5. Planning and designing gardens-Formal.
6. Planning and designing gardens- Informal.
7. Functional uses of plants in the landscape.
8. Planning of house garden, roadside planting, avenues for new colonies, traffic islands.
9. Preparation of land for lawn making.
10. Description and design of garden structures
11. Layout of rockery, terrace garden, Japanese gardens and water garden
12. Layout of recreational and children's corner, terrarium.
13. Layout of traffic islands, bottle garden, dish garden.
14. Flower arrangement practices.
15. Bonsai practicing and training.
16. Visit to gardens/ nursery/ Hands on training.

References

Text Books:

1. R.K. Shivanappan Drip Irrigation Keerthi Publishing House Pvt. Ltd., 126-Sarojini Street, Ramnagar, coimtoore-461009
2. A.M. Michael Irrigation Theory and Practice-Reprint-2002 Vikas Publishing House Pvt. Ltd. New Delhi-110007
3. A.M. Michael and T.P. Ojha Principles of Agricultural Engineering Vol-II, Third Edition 1999 Jain Brothers, Karol Bagh, New Delhi
4. Y P Rao and S. R. Bhakar Irrigatin Technology Theory & Practices 2008 AgroTech publishing Academy, Udaipur
5. D. Lenka Irrigation and Drainage 2001 Kalyani Publishing, Ludhiana

Reference Book:

- 6 J.N. Luthin Drainage Engineering 1978 Wiley
7. Richey et al Agricultural Engineer's Handbook 1961 Tata McGraw-Hill Publishing Company Ltd, New York
- 8 S. K. Garg Hydrology and Water Resource Engineering Khanna Publications, New Delhi
9. *e-reading*: <http://ecourses.iasri.res.in/>
10. Chadha,K.L. (ICAR)2002,2001.*Hand book of Horticulture*. ICAR, New Delhi.
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12. Ganner,R.J. and Choudhri,S.A.1972.*Propagation of Tropical fruit trees*. Oxford and IBN publishing Co., New Delhi.
- 13.Guy W. Adriance and Feed R. Brison. *Propagation of Horticultural Plants*. Axis Books (India).
14. Hartman,H.T and Kester,D.E.1976.*Plant Propagation Principles and practices*. Prentice hall of India Pvt.Ltd., Bombay.
15. Hudson T. Hartmann, Dale E. Kester, Fred T. Davies, Jr. and Robert L. Geneve. *Plant Propagation- Principles and Practices(7th Edition)*. PHI Learning Private Limited, New Delhi-110001
16. Mukherjee,S.K. and Majumdar,P.K.1973.Propagation of fruit crops. ICAR, New Delhi.
17. S. Rajan and B. L. Markose (series editor Prof. K.V.Peter). *Propagation of Horticultural Crops- Horticulture Science Series vol.6*. New India Publishing Agency, PitamPura, New Delhi-110088.
18. Sadhu,M.K.1996. *Plant Propagation*. New age International Publishers, New Delhi.
19. Sarma,R.R.2002. *Propagation of Horticultural Crops*.Kalyani Publishers,(Principles and practices) New Delhi.
20. Symmonds,1996. *Banana*.II edition Longman, London.
21. T.K.Bose, S.K.Mitra, M.K.Sadhu, P. Das and D.Sanyal. *Propagation of Tropical & Subtropical Horticultural Crops, Volume 1(3rd Revised edition)*.NayaUdyog, 206, BidhanSarani, Kolkata 700006.
22. *e-reading*: <http://ecourses.iasri.res.in/>
23. Walia RK & Bajaj HK. 2003. *Text Book on Introductory Plant Nematology*. ICAR, New Delhi
24. Pathak, V. N. Essentials of Plant Pathology. Prakash Pub., Jaipur
25. Agrios, GN. 2010. *Plant Pathology*. Acad. Press.

26. Kamat, M. N. Introductory Plant Pathology. Prakash Pub, Jaipur
27. Singh RS. 2008. *Plant Diseases*. 8th Ed. Oxford & IBH. Pub. Co.
28. Singh RS. 2013. *Introduction to Principles of Plant Pathology*. Oxford and IBH Pub. Co.
29. Alexopoulos, Mims and Blackwel. Introductory Mycology
30. Mehrotra RS & Aggarwal A. 2007. *Plant Pathology*. 7th Ed. Tata Mc Graw Hill Publ. Co. Ltd.
31. Gibbs A & Harrison B. 1976. *Plant Virology - The Principles*. Edward Arnold, London.
32. Hull R. 2002. *Mathew.s Plant Virology*. 4th Ed. Academic Press, New York.
33. Verma JP. 1998. *The Bacteria*. Malhotra Publ. House, New Delhi.
34. Goto M. 1990. *Fundamentals of Plant Bacteriology*. Academic Press, New York.
35. Dhingra OD & Sinclair JB. 1986. *Basic Plant Pathology Methods*. CRC Press, London, Tokyo.
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