

SHIVAJI UNIVERSITY, KOLHAPUR - 416 004, MAHARASHTRA PHONE : EPABX – 2609000, www.unishivaji.ac.in, bos@unishivaji.ac.in

ि शिवाजी विद्यापीठ, कोल्हापूर - ४१६ ००४,महाराष्ट्र

दूरध्वनी - ईपीएबीएक्स - २६०९०००, अभ्यासमंडळे विभाग दुरष्वनी ०२३१–२६०९०९३/९४



Ref.No. SUK/BOS/673 To,

With CGPA 3.52

Date: 08/09/2023

The Principals,

All Concerned Affiliated Colleges / Institutions.

Shivaji University, Kolhapur.

Subject : Regarding syllabi of Vocational Education Part-II under the Faculty of Inter-Disciplinary Studies.

Sir/Madam,

With reference to the subject, mentioned above, I am directed to inform you that the university authorities have accepted and granted approval to the syllabi of Vocational Education Part-II under the Faculty of Inter-Disciplinary Studies. as per National Education Policy 2020.(NEP)

1)	Printing & Publishing Part-II
2)	Automobile Part-II
3)	B.Voc in Nursing Part-II
4)	Horticulture Science and Technology Part-II

This syllabi shall be implemented from the academic year 2023-2024 onwards. A soft copy containing the syllabi is attached herewith and it is also available on university website www.unishivaji.ac.in. (Online Syllabus)

The question papers on the pre-revised syllabi of above mentioned course will be set for the examinations to be held in October /November 2023 & March/April 2024. These chances are available for repeater students, if any.

You are, therefore, requested to bring this to the notice of all students and teachers concerned.

Thanking you,

Yours faithfully,

Dr. S.M.Kubal (Dy Registrar)

Copy to:

			U U
1	Director, Board of Evaluation and Examination	7	Centre for Distance Education
2	The Dean, Faculty of IDS	8	Computer Centre / I.T.cell
3	The Chairman, Respective Board of Studies	9	Affiliation Section (U.G.) / (P.G.)
4	B.A.,B.Com.,B.Sc. Exam	10	P.G.Admission / P.G.Seminar Section
5	Eligibility Section	11	Appointment Section -A/B
6	O.E. I, II, III, IV Section	12	Dy.registrar (On/ Pre.Exam)

SHIVAJI UNIVERSITY, KOLHAPUR



"A++" Re accredited by NAAC (2021) with CGPA3.52

Faculty of Interdisciplinary

Studies Structure, Scheme

and Syllabus for Bachelor of

Vocational (B. Voc.)

Horticulture Science And Technology

Part II- Sem. III & IV (Subject to the modifications that will be made from time to time)

(NEP 2020) Choice Based Credit System (CBCS) w.e.f.June, 2023 onwards

As Per National Education Policy 2020

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, foliages & 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 Apprenticeshipertificate(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 ssessment 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, 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 2020onwards. **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)
5.STRUCTURE OF COURSE :	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.
7. INTAKE CAPACITY :	50 Students
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.

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

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

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 40marks, elective

and vocational theory papers shall carry 40marks. The internal evaluation for each paper shall carry 10 marks (Sem III: Group Activity and Sem IV : Case study or oral examination) 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 (08)	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 . Each paper having separate practical (GEC) 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:

In1st Year of B. Voc.1 Full Time and 1 Part Time Lecturer and 1 CHB Lecturer for Business communication.In 2ndYearof B. Voc. Total requirement of faculty (Inclusive of 1stYear) will be 3 Full time and 1CHB Lecturer for Financial Accounting1 CHB, Lecturer for Business Communication.n3rdYearof B. Voc.–Total requirement of faculty (Inclusiveof1st&2ndYear) will be 4 Full time and 1 part time and 1 CHB Lecturer for Business Communication.

SHIVAJI UNIVERSITY, KOLHAPUR

National Education Policy(NEP-2020)

Second Year Bachelor of Vocation (B. Voc.- Advanced Diploma)Course Structure for Level-6)

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

With Multiple Entry and Multiple Exit option

(To be implemented from the Academic Year 2023-24)

		Semest	ter II	I – D	urati	on: 6	Month	IS																
	Teaching Scheme							Evaluation Scheme																
Sr. No.	Course no.	Courses	No. of Lectures		No. of Lectures		No. of Lectures		No. of Lectures		No. of Lectures		No. of Lectures		No. of Lectures		Hours (T + P)	Credits	Theory	eory Internal/	Total Marks	Min Marks (Separate	Ex Dura (Hi	am ation rs.)
			Т	Р				Practical		passing)	Т	Р												
1.	AECC-CD111	Environmental science	4	2	6	-	-	-	-	-	-	-												
2.	BVHSTGEC112	Growth and Development of Horticultural Crops	4	2	6	4	40	10	50	18	2	-												
3.	BVHSTCC 113	Tropical and Sub Tropical Fruits	4	-	4	4	50	-	50	18	2	-												
4.	BVHSTCC 114	Tropical and Sub Tropical Vegetables	4	-	4	4	50	-	50	18	2	-												
5.	BVHSTCC 115	Temperate vegetables, bulbous, and tuber crops	4	-	4	4	50	-	50	18	2	-												
6.	BVHSTSEC-112	Growth and Development of Horticultural Crops	-	4	4	2	-	50	50	18	-	3												
7.	BVHSTSEC-113	Tropical and Sub Tropical Fruits	-	4	4	2	-	50	50	18	-	3												
8.	BVHSTSEC-114	Tropical and Sub Tropical Vegetables	-	4	4	2	-	50	50	18	-	3												
9.	BVHSTSEC-115	Temperate vegetables, bulbous, and tuber crops	-	-	2	2	-	50	50	18	-	-												
	Total		20	16	38	24	190	210	400	-														

		Semester IV – Durat	ion:	6 Mo	onths (A	Advanc	e Diplo	oma)						
	Teaching Scheme							Evaluation Scheme						
Sr. No.	Course no.	Courses	No Lec	o. of ctures	Hours (T + P)	Credits	Theory	Internal/ Practical	Total Marks	Min Marks (Separate passing)	Exam I (H	Ouration rs.)		
			Т	Р							Т	Р		
1.	AECC-CD116	Environmental science	4	2	6	4+4	70	30	100	28+14	3	-		
2.	BVHSTGEC117	Introduction to Plant Biotechnology	4	2	6	4	40	10	50	18	2	-		
3.	BVHSTCC 118	Seed Production of Vegetables, Tuber and Spice Crops	4	-	4	4	50	-	50	18	2	-		
4.	BVHSTCC 119	Breeding and seed production of ornamental crops	4	-	4	4	50	-	50	18	2	-		
5.	BVHSTCC 120	Principles and Methods of Plant Breeding and Horticulture Seed Production	4	-	4	4	50	-	50	18	2	I		
6.	BVHSTSEC-117	Introduction to Plant Biotechnology	-	4	4	2	-	50	50	18	-	3		
7.	BVHSTSEC-118	Seed Production of Vegetables, Tuber and Spice Crops	-	4	4	2	-	50	50	18	-	3		
8.	BVHSTSEC-119	Breeding and seed production of ornamental crops	-	4	4	2	-	50	50	18	-	3		
9.	BVHSTSEC-120	Principles and Methods of Plant Breeding and Horticulture Seed Production	-	-	2	2	-	50	50	18	-	-		
	Total		20	16	38	32	260	240	500	-		-		
	Grand Total		40	32	76	56	450	450	900	-		-		

•	Student Contact Hrs Per week: 36 hrs	
•	Student Contact This I er week. So his	

- Total marks for B.Voc.- Advanced Diploma: 900
- Theory and Practical Lectures: 48 Minutes Each

Total credits for B.Voc.- Advanced Diploma: 56

- AECC: Ability Enhancement Compulsory Course (Compulsory Environmental Science)
- Practical workload will for batch of 20 students
- Practical Examination will be conducted Semester wise for 50 Marks per course (subject).
- DSC: Discipline Specific Core Course Candidate can opt three courses (Subjects) from DSC.

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- GEC: Generic Elective Compulsory Course Candidate can opt any one course (Subject).
- There shall be separate passing for theory and practical courses.
- AECC & GEC Internal Evaluation should be done at college or respective departmental level
- <u>Exit option after Level 6</u>: Students can exit with Advance Diploma Course in Bachelor of Vocation with the completion of courses equal to minimum of 56 credits and also shall have to acquire additional CCC credits by successfully completing CCC-I and CCC-II courses which are assisted by Compulsory Civic Courses
- SEC-C & SEC-D are two parts of Vocational Advance Diploma Course-II.

SHIVAJI UNIVERSITY, KOLAPUR Bachelor of Vocation (B. Voc.) Part II - Sem. III Horticulture Science and Technology (AECC-CD) **Paper – I: Environmental Science-I**

Course/Paper No: AECC-CD111

Credits: 08

Theory: 4 lectures/weekTotal Marks: 100 (Theory 70 + Project 30)Practical: 02 lectures per week per batch of 20 students

Modules Prescribed for Theory: 70 Marks.

Bachelor of Vocation (B. Voc.) Part II - Sem. III Horticulture Science and Technology Generic Elective Compulsory Course (GEC- C) Paper Title: Growth and Development of Horticultural Crops. Course/Paper No:BVHSTGEC112 Theory: 4 lectures/week Total Marks: 50 (Theory 40 + Internal 10)

Objectives: i) To enable students - Plant growth and development

ii) To enable students – Bio regulators

iii) To enable students-Physiology of flowering

Course content:

Practical: 2 lectures/week/batch

Module I

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9

- 1.1 Theory- Plant growth and development definition, components of growth and phases of growth in Horticultural Crops
- 1.2 Different stages of growth and growth curve.
- 1.3 Growth analysis of Horticultural Crops, crop development and dynamics (case studies of annual/perennial Horticultural Crops)
- 1.4 Leaf area index (LAI), optimum LAI in Horticultural Crops and canopy development

Module II

- 2.1 Photosynthetic productivity Photosynthetic efficiency of C3 and C4 plants.
- 2.2 Translocation of assimilates theories of translocation of organic solute, source and sink relationship.
- 2.3 Plant bioregulators Auxins, gibberellins, cytokinin, ethylene, inhibitors and retardants, basic functions & biosynthesis.

Module III

- 3.1 Role of bioregulators in growth and development.
- 3.2 Role of bioregulators in propagation and flowering, fruit setting. Fruit thinning, fruit development, fruit drop and fruit ripening.
- 3.3 Photoperiodism long day, short day and day neutral plant and vernalization and its application in Horticultural Crops

Module IV

- 4.1Physiology of flowering, factors affecting flowering.
- 4.2 Training and pruning, physiological basis of training and pruning.
- 4.3 Physiology of fruit growth and development, fruit setting, factors affecting fruit setting and development.
- 4.4 Physiology of ripening fruit, climacteric and non-climacteric fruit, Physiology of fruits under post-harvest storage.
- 4.5Physiology of fruit growth and development, fruit setting, factors affecting fruit setting and development.

16

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References:

- 1.Salisbulry. 2007. Plant Physiology.CBS. New Delhi.
- 2. Taiz, L. 2010. Plant Physiology. SINAUR. USA.
- 3.Zeiger. 2003.Plant Physiology. PANIMA.New Delhi.UK.
- 4. Delvin, R.M. 1986. Plant Physiology. CBS. Delhi.
- 5. Richard, N. Arteca. 2004. Plant Growth Substances. CBS. New Delhi.
- 6.Jacobs, W. P. 1979. Plant Hormones And Plant Development. Cambridge Univ. London.
- 7.Basra, A. S. 2004. Plant Growth Regulators in Agriculture & Horticulture.HAWARTH press. New York.
- 8.Noggle G.R and Fritz T.G. Introductory Plant Physiology
- 9. Edward E. Durna. 2014. Principles Of Horticultural Physiology. CABI,
- 10.Lincoln Taiz and Eduards Zeiger (5th Edition). Plant physiology
- 11.Pandey and Sinha. Plant Physiology
- 12.Carl fedtke. Biochemistry and Physiology of Herbicide Action
- 13. Aswani pareek, S.K. Sopory, Hans Bohnert Govindjee. Abiotic stress adaptation in plants:
- 14.Physiological, Molecular and Genomic foundation
- 15.Horst Marschner, Mineral Nutrition of Higher plants e-reading: http://ecourses.iasri.res.in/

Bachelor of Vocation (B. Voc.) Part II - Sem. III Horticulture Science and Technology Discipline Specific Core Course (DSC– C-I) Paper Title: Tropical and Sub Tropical Fruits

Paper No BVHSTCC 113 Theory: 4 lectures/week Credits: 04 Total Marks: 50 (Theory)

Course Outcomes: The students will acquire knowledge of

i) To enable students -fruit crops

ii) To enable students -packaging and storage fruits crops

Course content:

Module I

- 1.1 Scope and importance of fruit growing in India and Maharashtra
- 1.2 Horticultural classification of fruits including genome classification
- 1.3 Horticultural zones of India and Maharashtra

Module II

- 2.1 Study of following crops with reference to 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.
- 2.2Mango, Banana Grapes, Citrus Papaya, Sapota, Guava Pomegranate, Litchi, Pineapple Amla ,Bael, Anona and Ber Fig ,Jackfruit, Avocado and Mangosteen Carambola, Durian, Rambutan and Bilimbi Loquat and Rose apple, Breadfruit and Passion fruit. Special production problems in mango (Spongy tissue, Black tip, Malformation, etc and their control measures Bearing in mango, causes: Alternate and irregular bearing, control measures.

Module III

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7

- 3.1 Citrus decline and casual factors and their management. Bud forecasting in grapes
- 3.2 Sex expression and seed production in papaya Latex extraction and rude papain production in papaya and economics of production Rain fed horticulture.

Module IV

- 4.1 Importance and scope of arid and semi-arid zones of India.
- 4.2 Characters and special adaptation of crops: ber, aonla, annona, jamun, wood apple, bael, pomegranate.
- 4.3 Characters and special adaptation of crops: Carissa, date palm, phalsa, fig, west Indian cherry and tamarind and Joint Agresco recommendations

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References:

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

Discipline Specific Core Course (DSC- C-II) Paper Title: Tropical and Sub Tropical Vegetables Paper No: BVHSTCC114 Theory: 4 lectures/week (Theory)

Course Outcomes: The students will acquire knowledge of

- 1. To prepare students to successfully grow vegetables for commercial vegetable production
- 2. Be familiar with vegetable crops environmental modification.

Course content:

Theory

Module I

- 1.1 Introduction, scope and importance of vegetable.
- 1.2 Area, production, economic importance and export potential of tropical and Subtropical vegetables and tuber crops.
- 1.3 Types of vegetable farming.

Module II

- 2.1 Vegetable classification.
- 2.2 Description of varieties and hybrid, climate and soil requirements, seedrate, 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
- 2.3 Tomato, chilli, brinjal, capsicum.

Module III

- 3.1Description of varieties and hybrid, climate and soil requirements, seedrate, 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
- 3.2 Okra, Cucumber, Pumpkin and squashes.
- 3.3 Bitter gourd, ridge gourd snake, gourd, bottle gourd, sponge gourd. Musk melon and water melon.

Module IV

- 4.1 Beans-French bear, cluster bean cowpea, yard long bean and dolichos bean
- 4.2 Leafy vegetables Amaranthus, Mustard, Coriander, Methi.
- 4.3 Under exploited cucurbits sweet gourd, pointed gourd, little gourd. Moringa and curry leaf, Agathi, Basella, Portulaca. Sorelle and Rooselle
- 4.4 Recommendations of joint Agresco.

References

1. B.R.Choudhary, 2009. A Text book on production technology of vegetables. Kalyani

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Publishers. Ludhiana.

- 2. S. Thamburaj, 2014. Text book of vegetable, tuber crops and Spices. ICAR, New Delhi
- 3. Choudhury, B. (ICAR). 1990. Vegetables. 8th edition, National Book Trust, New Delhi.
- 4. Haldavnekar, P.C.; Parulekar, Y.R.; Mali, P.C. and Haldankar, P.M, 2015. Vegetables Production Technology, Astral International.
- 5. K S Yawalkar, 2008. Vegetable crops in India. Agri-Horticultural Pub. House. Nagpur. 2004
- 6. K.L.Chadha, 1993. Advances in Horticulture. Malhotra publishing house. New Delhi
- 7. K.V.Kamath, 2007. Vegetable Crop Production. Oxford Book Company. Jaipur
- 8. M.K.Rana, 2008. Olericulture in India. Kalyani Publishers. Ludhiana
- 9. M.S.Dhaliwal, 2008. Handbook of Vegetable Crops. Kalyani Publishers. Ludhiana
- 10.Nath Prem, 1994. Vegetables for the Tropical Regions. ICAR New Delhi
- 11.P.Hazra, 2011. *Modern Technology in Vegetable Production*. New India Publishing Agency. New Delhi.
- 12. Pratibha Sharma, 2007. Vegetable : Disease Diagnosis and Biomanagement. Avishkar Publishers. Jaipur
- 13. Premnath, Sundari Velayudhan and Singh, D.P., 1987. *Vegetables for the tropical region*. ICAR, New Delhi.Publishing Co. Pvt. Ltd, New Delhi.
- 14. Shanmugavelu, K.G., 1989. Production Technology of Vegetable Crops. Oxford &IBH
- 15.Singh, D.K., 2007. *Modern Vegetable varieties and production*. IBN publishers, Technology International Book Distributing Co, Lucknow.
- 16.Singh, Umashankar, 2008. Indian Vegetables. Anmol Publications. Pvt.Ltd .New Delhi.
- 17.T.K.Bose, 2002. Vegetable Crops. Nayaprakash. Kolkata
- 18 T.R.Gopal Krishnan, 2007. *Vegetable Crops*. New India Publishing Agency. New Delhi. e-reading: http://ecourses.iasri.res.in/

Discipline Specific Core Course (DSC– C-III) Paper Title: Temperate vegetables, bulbous, and tuber crops Course no. Paper No: BVHSTCC115 Theory: 4 lectures/week Total Marks: 50 (Theory)

Course Outcomes: The students will acquire knowledge of

i) Cool season vegetable crops

ii) Scope and importance tuber crops

iii) Nutritional importance of tuber crops

Course content: Theory

Module I

- 13
- 1.1 Scope and Importance of cool season vegetable crops in nutrition and National economy.
- 1.2 Area, production, export potential, description of Temperate Vegetables.
- 1.3 Description of varieties and hybrids, origin, climate and soil, production technologies, post-harvest technology and marketing of Cabbage, Cauliflower, Sprouting Brocoli Chinesse cabbage

Module II

- 2.1 Description of varieties and hybrids, origin, climate and soil, production technologies, post-harvest technology and marketing of
- 2.2 Knol Khol Brussel's Sprout, Lettuce Pea, Broad Bean Palak, Spinach, coriander, fenugreek

Module III

- 3.1 Scope and importance tuber crops.
- 3.2 Nutritional importance of tuber crops.
- 3.3 Area, Production and export potential of various tuber crops, cultivation practices including soil and climate, season, seed rate, preparation of field planting, spacing, wate and nutrient ,weed management. Deficiencies and their management, Use of PGR'S and chemicals, Special intercultural operations, cropping system, Harvesting and yield. Economics of cultivation, Post-harvest handling, field and seed standards and marketing of Onion, Garlic, Radish, Carrot, Turnip, Beet root, Asparagus.

Module IV

- 4.1 Area, production, export potential, description of tuber crops.
- 4.2 Description of varieties and hybrids, origin, climate and soil, production technologies, post-harvest technology and marketing of Sweet potato Cassava Colocasia Xanthosoma, Amorphophallus, Greater yam, Aerial Yam, Lesser yam, Jerusalem artichoke, Horse Raddish Yam bean, Arrow root and Chinesepotato and other under exploited tubers.

References:

1. B.R.Choudhary 2009. A Text book on production technology of vegetables. Kalyani Publishers.

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Ludhiana.

- 2. S. Thamburaj. 2014. Text book of vegetable, tuber crops and Spices. ICAR, New Delhi.
- 3. Bose, T.K. 2003. Vegetable Crops. Naya udyog publishers, Kolkata. 2002. Naya Prakash, Calcutta.
- 4. Choudhery, B., 1990. Vegetables. 8th edition. National Book Trust, New Delhi.
- 5. Haldavnekar, P.C.; Parulekar, Y.R.; Mali, P.C. and Haldankar, P.M,2015. Vegetables Production Technology, Astral International.
- 6. K S Yawalkar, 2004. Vegetable crops in India. Agri-Horticultural Pub. House. Nagpur.
- 7. K.L.Chadha. 1993. Advances in Horticulture. Malhotra publishing house. New Delhi
- 8.K.V.Kamath. 2007. Vegetable Crop Production. Oxford Book Company. Jaipur
- 9. M.K.Rana, 2008. Olericulture in India. Kalyani Publishers. Ludhiana
- 10. M.S.Dhaliwal, 2008. Handbook of Vegetable Crops. Kalyani Publishers. Ludhiana
- 11. Nath Prem. 1994. Vegetables for the Tropical Regions. ICAR New Delhi
- 12. P.Hazra. 2006. Vegetable science. Kalyani Publishers . Ludhiana
- 13. P.Hazra. 2011. *Modern Technology in Vegetable Production*. New India Publishing Agency. New Delhi.
- 14. Pratibha Sharma,2007. Vegetables: Disease Diagnosis and Biomanagement. Avishkar Publishers. Jaipur
- 15. Prem Singh Arya, 1999. Vegetable Seed Production Principles. Kalyani Publishers, New Delhi.
- 16. Shanmugavelu, K.G. 1989. Production technology of vegetable crops. Oxford and IBH publishing Co. Pvt. Ltd, New Delhi.
- 17. Singh, Umashankar, 2008. Indian Vegetables. Anmol Publications. Pvt.Ltd. New Delhi.
- 18. T.K.Bose. 2002. Vegetable Crops. Nayaprakash. Kolkata
- 19. T.R.Gopal Krishnan, 2007. Vegetable Crops. New India Publishing Agency. New Delhi.
- Uma Shankar. 2008. Vegetable Pest Management Guide for Farmers. International Book Distribution Co. Publication. Lucknow.
 e-reading: http://ecourses.iasri.res.in/

Horticulture Science and Technology Skill Enhancement Courses (SEC– C-I)

Paper Title: Growth and Development of Horticultural Crops

Paper No: BVHSTCE112 Practical: 4 lectures/week **Credits: 02** Total Marks: 50 (Practical)

- 1. Estimation of photosynthesis potential of hort. Crops by IRGA
- 2. Estimation of leaf area & leaf area index in hort. Crops
- 3. Studies on growth analysis- measurement of growth by using Arc indicator and auxanometer.
- 4. Measurement of growth by different growth analysis equations.
- 5. Determination of harvest index in different hort. Crops
- 6. Studies on preparation of hormonal solutions.
- 7. Identification and use of synthetic plant hormone and growth retardant, bioassay of plant hormone.
- 8. Studies on PGR in induction of rooting in cutting in hort. Crops.
- 9. Study of role of PGR in fruit ripening.
- 10. Study of role of PGR in control of flower drops.
- 11. Studies of important physiological disorder and their remedial measures in fruit & vegetables I Macro elements
- 12. Studies of important physiological disorder and their remedial measures in fruit & vegetables –II- Microelements
- 13. Study of seed dormancy causes and methods of breaking dormancy with chemicals & growth regulators,.
- 14. Study of seed viability testing, germination types of seed germination factors affecting seed germination
- 15. Study of germination-methods of seed germination testing.
- 16. Project/Field visit/ Internship/ Field work /Hands on training

Bachelor of Vocation (B. Voc.) Part II - Sem. III Horticulture Science and Technology

Skill Enhancement Courses (SEC– C-II) Paper Title: Tropical and Sub Tropical Fruits

Course no. /Paper No: BVHSTCC113

Practical: 4 lectures/week

Credits: 02 Total Marks: 50 (Practical)

- 1. Description and identification of varieties based on flower and fruit morphology in tropical crops.
- 2. Description and identification of varieties based on flower and fruit morphology in subtropical crops.
- 3. Training and pruning of grapes, mango, guava and citrus.
- 4. Selection of site and planting system
- 5. Pre-treatment of banana suckers, desuckering in banana.
- 6. Sex forms in papaya, seed production in papaya, latex extraction and preparation of crude papain.
- 7. Use of plastics in fruit production.
- 8. Visit to commercial orchards and diagnosis of maladies.
- 9. Manure and fertilizer application including bio-fertilizer in fruit crops
- 10. Preparation and application of growth regulators in banana, grapes and mango.
- 11. Ripening of fruits.
- 12. Grading and packaging,
- 13. Production economics for tropical and sub-tropical fruits.
- 14. Mapping of arid and semi-arid zones of India.
- 15. Botanical description and identification of ber, fig, jamun, pomegranate, carissa, phalsa.
- 16. Botanical description and identification of wood apple, West Indian cherry, tamarind, amla, bael and annona.
- 17. Project/Field visit/ Internship/ Field work /Hands on training

Horticulture Science and Technology Skill Enhancement Courses (SEC– C-III) Paper Title: Tropical and Sub Tropical Vegetables

Course no./ Paper No: BVHSTCC114 Practical: 4 lectures/week

Credits: 02 Total Marks: 50 (Practical)

- 1. 1 Identification of tropical vegetable crops.
- 2. Identification of subtropical vegetable crops
- 3. Raising vegetable seedlings of improved varieties.
- 5. Field preparation and lay out for vegetable crops.
- 6. Seed treatment and sowing of vegetable corps.
- 7. Planting and transplanting of vegetables crops
- 8. Integrated weed management in vegetables crops.
- 9. Methods of irrigation and manuring.
- 10. Use of plant growth regulators in vegetables production.
- 11. Identification of nutritional deficiencies in vegetables crops and remedies.
- 12. Identification of physiological disorders in vegetables crops.
- 13. Harvesting indices and maturity standards.
- 14. Harvesting of vegetables.
- 15. Packaging and storage of vegetable crops.
- 16. Project preparation and cost of cultivation of any two vegetables.

Bachelor of Vocation (B. Voc.) Part II - Sem. III Horticulture Science and Technology

Skill Enhancement Courses (SEC- C-IV)

Paper Title: Temperate vegetables, bulbous, and tuber crops

Course no. /Paper No: BVHSTCC115 Term Work: 2 lectures/week

Credits: 02 Total Marks: 50(Internal)

- 1. Identification and description of temperate vegetables and tuber crops.
- 2. Botanical description of temperate vegetables and tuber crops.
- 3. Identification and description of commercially important varieties of temperate vegetables.
- 4. Propagation methods, nursery management Raising seedlings of temperate Vegetables.
- 5. Use of Plant Growth Regulators in temperate vegetables
- 6. Land preparation and layout of planting and Transplanting of temperate vegetables.
- 7. Identification of physiological disorders in temperate vegetables and remedies.
- 8. Methods of irrigation, Manures and Fertilizer application vegetable and tuber crops.
- 9. Identification of nutritional deficiencies in temperate vegetables and and tuber crops their control measures
- 10. Maturity indices and harvesting of temperate vegetables, Packaging and storage of temperate vegetables.
- 11. Important Pest and diseases in vegetables and tuber crops.
- 12. Study of various propagation methods in tuber crops.
- 13. Field preparation and planting of Sweet potato, Potato, Amorphophallus, Colocasia
- 14. Study of maturity indices and harvesting and Post-harvest handling curing to storage of tuber crops.
- 15. Preparation of commercially viable project proposal.
- 16. Visit to vegetable, tuber research station/ vegetable market /farmers field.

Generic Elective Compulsory Course (GEC– D) Paper Title: Introduction to Plant Biotechnology

Course no./ Paper No.BVHSTCE 117
Theory: 4 lectures/week
Practical: 2 lectures/week/batch

Credits: 04 Total Marks: 50 (Theory 40 + Internal 10)

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Course Outcomes: The students will acquire knowledge of

- i) To enable students about tissue culture
- ii) To enable students protoplast Culture
- iii) To enable students blotting techniques

Module I

- 1.1 History, scope and importance of Biotechnology in Crop Improvement
- 1.2 Plant Genetic Engineering, scope and importance in Crop Improvement
- 1.3 Totipotency and Morphogenesis, Definition, Importance of totipotency and morphogenesis.

Module II

- 2.1 Nutritional requirements of in-vitro cultures.
- 2.2 General techniques of tissue and cell culture.
- 2.3 Different composition of culture medium, components of tissue culture medium, importance of growth regulator in culture medium

Module III

- 3.1 Techniques of In-vitro cultures Types of culture, Micro-propagation, Anther culture, Pollen culture, Ovule culture, Embryo culture, Test tube fertilization, Endosperm culture.
- 3.2 Factors affecting above in-vitro culture; Factors affecting above invitro culture; Applications and Achievements.
- 3.3 Somaclonal variation, Introduction, causes, procedure and application in crop improvement. Manipulation and Fusion; Products of somatic hybrids and cybrids, Applications in crop improvement.

Module IV

- 4.1Somatic embryogenesis Types, direct and indirect embryogenesis, factors influencing somatic embryogenesis and synthetic seed production technology
- 4.2 Protoplast Culture, Introduction, method of protoplast fusion, selection of somatic hybrids and application of somatic hybridization.
- 4.3. Blotting techniques Types, procedure, Application, advantages and disadvantages.

References:

- 1. Singh, B D, 2004. Biotechnology Expanding Horizons 2nd Edn.Kalyani Publishers, New Delhi.
- 2. Gupta, P.K., 2015. Elements of Biotechnology 2nd Edn. Rastogi and Co., Meerut.
- 3. Razdan M K, 2014. Introduction to plant Tissue Culture 2nd Edn. Science Publishers, inc. USA.
- 4. Gautam V K, 2005. Agricultural Biotechnology. Sublime Publications
- 5. Thomar, R.S., Parakhia, M.V., Patel, S.V. and Golakia, B.A., 2010. Molecular markers and Plant biotechnology, New Publishers, New Delhi.
- 6. Purohit, S.S., 2004. A Laboratory Manual of Plant Biotechnology 2nd Edn. Agribios, India.
- 7. Singh, B.D. 2012. Plant biotechnology. Kalyani publishers, Ludhiana
- 8. Bilgrami, K.S. and Pandey, A.K.1992. Introduction to biotechnology. CBS Pub. New Delhi
- 9.Gupta, P.K. 1994. Elements of biotechnology. Rastogi Pub. Meerut.
- 10.Chahal, G.S. and Gosal, S.S.2003. Principles and procedures of plant approaches breeding
- 11.Biotechnological and conventional. Narosa Publishing House, New Delhi. e-reading: http://ecourses.iasri.res.in/

Horticulture Science and Technology Discipline Specific Core Course (DSC– D-I) Paper Title: Seed Production of Vegetables, Tuber and Spice Crops Course no. /Paper No: BVHSTCC118 Theory: 4 lectures/week Total Marks: 50 (Theory)

Course Outcomes: The students will acquire knowledge of

To know the seed production To know the types of seed To know the germination, viability and purity Module I 10 History of seed industry in India, Definition of seed and difference between grain and seed and classes, types of seed Importance and scope of seed production in india,

Principles of seed production

Module II

Role of climate (Light, humidity, temp. etc) on vegetable seed production. Agencies of pollination and isolation distance in vegetable seed production. Field standards and seed standards. Seed production methods in cole crops. (cabbage, cauliflower, knolkhol, broccoli) Seed production methods in solanaceous crops (tomato, chilli, brinjal, Bell peper)

Module III

Seed production methods in cucurbits (cucumber, Bitter gourds, pumpkin, Watermelon) Seed production methods in leafy vegetables (fenugreek, amaranthus, palak) Seed production methods in beans and peas (pea, french bean, dolichos bean)

Module IV

Seed production methods in bulb crops (onion, garlic) Seed production methods in tuber crops (potato, sweet potato) Seed production in root vegetables (radish, carrot) Seed production in seed spice crops(Coriander) Seed extraction, drying, processing and storage of seed. Seed testing for germination, viability and purity. Seed act / legislation Recommendations of Joint Agresco.

Reference Books: 1. Agarwal, P. K. 2010. *Techniques in Seed Science and Technology*. South Asian

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- 2. Agrawal R. L. 1999. Seed Technology. Oxford and IBH Publicity Company, New Delhi.
- 3. Arya, Prem Singh. 2003. Vegetable seed Production Principles. Kalyani Publishers.
- 4. Fageria, M. S. 2011. Vegetable Crops- Breeding and Seed Production. Kalyani
- 5. G.N. Kulkarni, 2002. Principles of Seed Technology. Kalyani Publishers, Ludhiana.
- 6. Geetharani, P. 2007. Seed Technology in Horticultural Crops. NPH Publications. Jodhpur.
- 7. Khare, D. and Bhole, M.S. 2000. Seed Technology. Scientific Publishers (India) Jodhpur.
- 8. L.O. Copeland, 1999. *Principles of Seed Science and Technology*. Springer Publications. Ludhiana.
- 9. N.P. Nema, 1988. Principles of seed certification and Testing. Allied Publications.
- 10. Nemgal Singh, P.K. Singh, Y.K. Singh and Virendrakumar, 2006. *Vegetable Seed Production Technology*. International book distributing co., Lucknow.
- 11 P. Hazra and M.G. Som, 2009. *Vegetable seed production and Hybrid Technology*. Kalyani Publishers, Ludhiana.
- 12 Prem Singh Arya, 2003. Vegetable breeding, production and seed production. Kalyani publishers, New Delhi.
- 13 Rattan lalAgarwal, 1995. Seed technology. Oxford & IBH, New Delhi
- 14 Raymond A.T., 2000. Vegetable Seed Production. Oxford University Press, USA
- 15. Singh, Prabhakar.2015. Seed Production Technology of vegetable. Daya Publishing House. New Delhi.
- 16. Singh, S.P. 2001. *Seed Production in Commercial Vegetables*. Agrotech Publishing Academy, Udaipur.
- 17. 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.
- 18 Vanangamudi, K.2010. *Vegetable Hybrid Seed Production and Management*. Agrobios. Jodhpur.

e-reading: http://ecourses.iasri.res.in/

Bachelor of Vocation (B. Voc.) Part II - Sem. IV (Advanced Diploma) Horticulture Science and Technology

Discipline Specific Core Course (DSC– D-II)Paper Title: Breeding and seed production of ornamental cropsCourse no. /Paper No: BVHSTCC 119Credits: 04Theory: 4 lectures/weekTotal Marks: 50 (Theory)

Course Outcomes: The students will acquire knowledge of i) To enable students – breeding of ornamental crops ii) To enable students- seed production of ornamental crops 10 Module I 1.1.Scope and importance of breeding of ornamental crops. 1.2 Objectives and techniques in ornamental plant breeding 1.3 Introduction, selection, hybridization, mutation and biotechnological technique for improvement of ornamental and flower crops. **Module II** 15 2.1 Rose 2.2 Jasmine, Hibiscus, Bouganvillea 2.3 Chrysanthemum, Gerbera, China Aster, Gaillardia, Dehlia, Zinnia, 2.4 Carnation, Marigold, Cosmos 2.5 Tuberose, Gladiolus, Lilium, 2.6 Orchid, Anthurium, Heliconia, Antirrhinium, 2.7 Petunia, Dianthus, Snapdragon, Pansy, Crossandra, Geranium Breeding for Pancratium disease resistance. Module III 10 3.1 Development of promising cultivars of important ornamentals and flower crops.

- 3.2 Role of heterosis and its exploitation
- 3.3 Production of F1 hybrids and utilization of male sterility.

Module IV

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- 4.1 Production of open pollinated seed.
- 4.2 Harvesting processing and storage of seeds
- 4.3 Seed certification.
- 4.4 Recommendations of Joint Agresco

References

- 1. Agarwal, P. K 1994. Principles of Seed Technology. ICAR Publication, NewDelhi.
- 2 .Agarwal, R. L. 1996. Seed Technology. Oxford&IBHPublishers, New Delhi.
- 3 .Bhattacharjee, S.K. and L.C. De. 2003. *Advanced Commercial Floriculture*. Aavishkar Publishers, Distributors, Jaipur (Rajasthan) India.
- 4. Bose, T. K., L.P. Yadav, P. Patil, P. Das and V.A. Partha Sarthy. 2003. *Commercial flowers*.

Partha Sankar Basu, Nayaudyog, 206, Bidhan Sarani, Kolkata-700006.

- 5. Callaway D.J. and M.B. Callaway. 2000. Breeding Ornamental Plants. Timber Press.
- 6. Harding, J., F.Singh and J.N. Mol. 1991. Genetics and Breeding of Ornamental Species. Springer Publishers.
- 7. Pal, B. P. 1966. *The Rose in India*. Directorate of Knowledge management in Agriculture, Indian council of Agriculture Research-New Delhi.
- 8. Singh, B. D. 1983. Breeding Principles and Methods. KalyaniPublishers, New Delhi.
- 9. Vainstein, A. 2002. Breeding for Ornamental: Classical and Molecular Approaches. Springer Publishers.

e-reading: http://ecourses.iasri.res.in/

Discipline Specific Core Course (DSC– D-III) Horticulture Science and Technology Paper Title: Principles and Methods of Plant Breeding Course no./Paper No: BVHSTCC 120 Credits: 04 Theory: 4 lectures/week Total Marks: 50 (Theory)

Course Outcomes: The students will acquire knowledge of

- 1. To enable students to develop varieties with better characteristics in higher yield, Disease resistance, flood resistance.
- 2. To develop varieties with better characteristics in Early to mature, Resistance to alkaline and saline soil conditions, Better quality, Drought resistance.

Module I

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- 1.1 Plant Breeding Introduction, definition aims and objective.
- 1.2 Significance of Plant Breeding
- 1.3 Genetic basis for Plant Breeding classical, quantitative and molecular.
- 1.4 Plant Breeding in India- limitations, major achievement and goal setting for future.

Module II

- 2.1 Mode of reproduction-sexual reproduction.
- 2.2 Mode of pollination- self and cross pollination.
- 2.3 Mechanism of pollination control.
- 2.4 Genetic components of polygenic variation and Breeding strategies.
- 2.5 Selection of basis of crop breeding

Module III

- 3.1 Hybridization and goals of hybridization
- 3.2 Hybridization and selection of plants
- 3.3 Population developed by hybridization- Simple crosses
- 3.4 Population developed by hybridization- Bulk crosses
- 3.5 Population developed by hybridization- Complex crosses

Module IV

- 4.1 General and special Breeding techniques.
- 4.2 Heterosis- Concept and types
- 4.3 Heterosis- Estimation and genetic basis.
- 4.4 Male sterility and its significance

References:

1. B.D. Singh. Plant breeding : principles and methods. Kalyani Publishers, Ludhiana.

2. D.S. Falconer. Introduction to quantitative genetics. Longman Scientific & Technical,

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Longman Group, UK, Ltd., England.

- 3. G K Kallo. Breeding of vegetables. Panima publishers, New Delhi
- 4. G. S. Chahal and S.S. Gosal. 2002. *Principles and Procedures of Plant Breeding*. Narosa Publishing House, New Delhi.
- 5. Hays and Garber. *Breeding crop plants*. Mc Graw Hill Publications, New York
- 6. J.R. Sharma. *Principles and practices of plant breeding*. Tata McGraw Publishing Company Ltd.,New Delhi
- 7. K. Mather and J.L Jinks. Introduction to Biometrical genetics. Chapman and Hall, London
- 8. Phundan Singh. Essentials of plant breeding. Kalyani Publishers
- 9. Poehlman, J.M. and Borthakar, D. 1995. *Breeding Asian Field Crops*. Oxford& IBH Publishing Co., New Delhi
- 10. Pundan Singh. Essentials of plant breeding. Kalyani. India
- 11. R.C. Chaudhary. Plant Breeding
- 12. R.K. Singh and B.D. Chaudhary. *Biometrical methods in quantitative genetic analysis*. Kalyani Publishers, Ludhiana.
- 13. R.W. Allard. Principles of plant breeding. John Wiley & Sons, New York.
- 14. V.L. Chopra. *Plant breeding: Theory and Practice*. Oxford & IBH Publishing CO. Pvt. Ltd., New Delhi.
- 15. W.R. Fehr. Principles of cultivar development: theory and technique (Vol. 1). Macmillan Publishing Company, New York. *e-reading:* http://ecourses.iasri.res.in/.

Bachelor of Vocation (B. Voc.) Part II - Sem. IV (Advanced Diploma) Horticulture Science and Technology Skill Enhancement Courses (SEC– D-I) Paper Title: Introduction to Plant Biotechnology Course no. /Paper No: BVHSTCE 117 Practical: 4 lectures/week Total Marks: 50 (Practical)

Practical: Lectures/Week/Batch

Practical: 50 Marks

- 1. General instruction and laboratory methods.
- 2. Plant tissue culture laboratory organization.
- 3. Plant tissue culture laboratory equipments and their uses.
- 4. Dry, Heat and Wet Heat sterilization methods
- 5. Chemical sterilization, Filtration and UV irradiation.
- 6. Preparation of solutions
- 7. Preparation of tissue culture media and their composition
- 8. Establishment and maintenance of callus culture from different explants, sub culture of callus.
- 9. Production of embryogenic callus.
- 10. Indiect organogenesis: Production of shoots and roots from callus
- 11. Acclimatization and Hardening
- 12. Micropropagation with shoot apex culture in different plants (Banana)
- 13. Demonstration of Gene transfer techniques, direct methods and indirect methods;
- 14. Demonstration of Confirmation of Genetic transformation.
- 15. Demonstration of gel-electrophoresis techniques.
- 16. Visit to tissue culture laboratory/ Hands on training.

Bachelor of Vocation (B. Voc.) Part II - Sem. IV (Advanced Diploma) Horticulture Science and Technology

Skill Enhancement Courses (SEC– D-II) Paper Title: Seed Production of Vegetables, Tuber And Spice crops Course no. /Paper No: BVHSTCC 118 Credits: 02 Practical: 4 lectures/week Total Marks: 50 (Practical)

Course Outcomes: The students will acquire knowledge of

- 1. Study of seed structure, size, shape etc.
- 2. Objectives and practices of field inspection.
- 3. Objectives and practices in rouging.
- 4. Seed sampling techniques and types of seed samples
- 5. Seed testing techniques for determination of percent germination, viability, purity.
- 6. Seed classes or types on the basis of physical and genetical purity
- 7. Harvesting, extraction, processing, drying of seeds.
- 8. Packaging, labelling and storage of Seeds.
- 9. Methods of seed production in cole crops.
- 10. Methods of seed production in root vegetables.
- 11. Methods of seed production in bulb crops.
- 12. Methods of seed production in solanaceous crops
- 13. Methods of seed production in cucurbitaceous crops.
- 14. Methods of seed production in leafy vegetables.
- 15. Methods of seed production in leguminous vegetables.
- 16. Visit to seed production plots, seed processing units and seed testing laboratory.

Horticulture Science and Technology Skill Enhancement Courses (SEC– D-III) Paper Title: Breeding and Seed Production of Ornamental crops

Course no. Paper No: BVHSTCC 119 Practical: 4 lectures/week Marks: 50 (Practical) Credits: 02 Total

Course Outcomes: The students will acquire knowledge of

- 1. Acquaintance with breeding tools for floricultural crops
- 2. Methods of emasculation and pollination, selfing
- 3. Study of floral biology and pollination of rose, jasmine, chrysanthemum, tuberose
- 4. Study of floral biology and pollination of gerbera, gladiolus, dahlia heliconia, lilium, gaillardia
- 5. Study of floral biology and pollination of petunia, hibiscus, bouganvillea, zinnia, cosmos
- 6. Study of floral biology and pollination of dianthus, snapdragon, pansy, crossandra, marigold, geranium
- 7. Study of floral biology and pollination of china aster, orchids, anthurium, carnation
- 8. Techniques of inducing polyploidy and mutation.
- 9. Production of pure and hybrid seeds rose, jasmine, chrysanthemum, tuberose
- 10. Production of pure and hybrid seeds gerbera, gladiolus, dahlia heliconia, lilium.
- 11. Production of pure and hybrid seeds petunia, hibiscus, bouganvillea, zinnia, cosmos
- 12. Production of pure and hybrid seeds china aster, orchids, anthurium, carnation
- 13. Harvesting, conditioning and testing of seeds
- 14. Practice in seed production methods.
- 15. Practice in seed production methods
- 16 .Visit to seed production industry/ fieldvisit/project.

Bachelor of Vocation (B. Voc.) Part II - Sem. IV (Advanced Diploma)

Horticulture Science and Technology Skill Enhancement Courses (SEC– D-IV) Paper Title: Principles and Methods of Plant Breeding

Course no. /Paper No: BVHSTCC 120 Term Work: 2 lectures/week

Credits: 02 Total Marks: 50(Internal)

Course Outcomes: The students will acquire knowledge of

- 1.Study of field equipments for plant breeders
- 2. Study selfing methods in plant breeding.
- 3. Study of floral biology and hybridization technique
- 4 Study Floral biology its measurement.
- 5. study of methods of emasculation
- 6. study of crossing techniques in major crops.
- 7. Determination of mode of reproduction in crop plants, handling of breeding material, segregating generations (pedigree, bulk and back cross methods),
- 8. Field layout, and maintenance of experimental records in self and cross pollinated crops.
- 9. Demonstration of hybrid variation and production techniques.
- 10. Hardy Weinberg Law and calculation,
- 11. Male sterility studies in horticultural crops
- 12. Incompatibility studies in horticultural crops
- 13. Calculation of inbreeding depression
- 14. Calculation of heterosis, heterobeltioses
- 15. Computation of GCA, SCA,.
- 16. Computation of GA, heritability
- 17. Visit to breeding station/ Hands on training/ Field visit.