



Karmaveer Bhaurao Patil University, Satara

**Syllabus for
B. Sc. III (Seed Technology)**

**Under
Faculty of Science and Technology
(As per NEP 2020)**

With effect from Academic Year 2026-2027

Syllabus for Bachelor of Science (B. Sc.) Part – III Seed Technology

PREAMBLE:

The B.Sc. Seed Technology course under the autonomy framework will be introduced in the academic year 2026-2027. It has been designed to meet the specific needs of B.Sc. Seed Technology students in accordance with the NEP 2020 guidelines. The curriculum has been developed to reflect the expanding scope of biological sciences. The focus is on equipping students with up-to-date knowledge while maintaining a strong foundation in classical Seed Technology. This approach will enable students to understand and appreciate contemporary interdisciplinary methods in plant science and their contributions to societal development. The course also includes new practical exercises, providing students with hands-on experience with the latest techniques currently in use. Additionally, the course is intended to inspire students to pursue higher studies in Seed Technology, become entrepreneurs, and seek employment in plant-based industries.

GENERAL OBJECTIVES OF THE COURSE:

1. To provide students with a solid foundation in plant science.
2. To foster a scientific mindset, encouraging students to be open-minded, critical, and curious.
3. To develop practical skills in conducting experiments and working with laboratory materials.
4. To help students understand scientific terms, concepts, facts, phenomena, and their interrelationships.
5. To raise students' awareness of natural resources and environmental issues.
6. To equip students with knowledge of plants and related subjects, enabling them to better understand nature and the environment for the benefit of humanity.
7. To empower students to apply their knowledge to enhance agriculture and related fields, promoting self-reliance.

PROGRAMME OUTCOMES

After completing the B.Sc. program, graduates will:

1. Possess a strong foundation of knowledge in their chosen field of study.
2. Develop a scientific mindset, becoming open-minded, critical, and curious, which will support their entry into research and innovation.

3. Be skilled in practical work, experiments, and the use of laboratory materials.
4. Be eligible to pursue higher studies in their field, both in India and abroad.
5. Qualify to appear for examinations for jobs in government organizations.
6. Meet the minimum eligibility requirements for various science-related job opportunities.
7. Be prepared to establish their own entrepreneurial ventures.
8. Enhance critical thinking, develop a scientific attitude, solve problems, improve practical skills, boost communication abilities, and strengthen social interactions.

PROGRAMME SPECIFIC OUTCOMES

After completing the B.Sc. (Seed Technology) program, students will:

1. Be able to explain, describe, discuss, and ask questions about various aspects of plant sciences.
2. Design and conduct experiments related to plant sciences.
3. Critically analyze the interactions between living and non-living entities in their surroundings.
4. Apply knowledge of plant sciences to develop sustainable solutions for both society and industry.
5. Utilize their understanding of plant sciences to become self-reliant, either by securing a job, establishing an agricultural setup, or launching a plant-based entrepreneurial venture.
6. Design and manage projects related to plant sciences.
7. Gain valuable skills in plant-based industries through internships.
8. Enhance research skills through research internships and in-house projects.
9. Present research findings at conferences and in research journals for publication.
10. Critically assess their role in contributing to environmental sustainability goals as responsible citizens.

1. TITLE: **Seed Technology**

2. YEAR OF IMPLEMENTATION: **2026-2027**

3. DURATION: **01 year**

4. PATTERN: **Semester examination**

5. MEDIUM OF INSTRUCTION: **English**

6. **ELIGIBILITY OF THE STUDENT:**

As per guidelines obtained from university by following rules and regarding reservations by Govt. of Maharashtra

7. **ELIGIBILITY OF THE CORE FACULTY:**

As per the rules and regulations of the University Grants Commission (UGC) and the Government of Maharashtra

8. STRUCTURE OF COURSE:

As per NEP-2020 (2.0)

Level	Sem.	Course				VSC/ SEC	FP	AEC	CEP/ CC	OJT	Total
		DSC		DSE*							
		T	P	T	P						
5.5	V	DSC I (2)	DSC P (2)	DSE I (2)	DSE P (2)	VSC (2)	--	AEC III (2)	CEP (2)	OJT (4)	22
		DSC II (2)									
		DSC III (2)									
5.5	VI	DSC I (2)	DSC P (2)	DSE I (2)	DSE P (2)	VSC (2)	FP (2)	AEC IV (2)	CC (2)	--	22
		DSC II (2)				SEC (2)					
		DSC III (2)									

* DSE - 2 Papers out of four for each semester.

9. COURSE TITLE

1) Fifth Semester

Sr. No.	Course	Theory				Practical		
		Course No. & Course Code	Title of Paper	No. of lectures per week	Credits	Course No. & Course Code	No. of Practical Per week	Credits
1.	DSC I	BSTT 351	Seed Production in Field crops	2	2	BSTP 356	1	2
2.	DSC II	BSTT 352	Seed Legislation and Certification	2	2			
3.	DSC III	BSTT 353	Genetics & Plant Breeding	2	2			
4.	DSE I	BSTT 354	Recent Trends in Seed Technology	2	2	BSTP 357	1	2
5.	DSE I	BSTT 355	Horticultural techniques					
6.	AEC	AEC III	English	2	2	--	--	--
7.	VSC	--	Advanced Botanical Skills III (Analytical Techniques and Microscopy)	--	--	BSTPVSC III	1	2
8.	SEC	--	--	--	--	--	--	--
9.	CEP	--	Community Engagement Programme in Seed Technology	--	--	BSTPCEP I	1	2
10.	OJT	--	On-Job-Training in Seed Technology	--	--	BSTPOJT I	2	4

2) Sixth Semester

Sr. No.	Course	Theory				Practical		
		Course No. & Course Code	Title of Paper	No. of lectures per week	Credits	Course No. & Course Code	No. of Practical Per week	Credits
1.	DSC I	BSTT 361	Seed Biotechnology	2	2	BSTP 366	1	2
2.	DSC II	BSTT 362	Seed Quality	2	2			
3.	DSC III	BSTT 363	Biofertilizers	2	2			
4.	DSE I	BSTT 364	Bioinformatics & Biostatistics	2	2	BSTP 367	1	2
5.	DSE I	BSTT 365	Industrial and Environmental Microbiology					
6.	AEC	AEC IV	English	2	2	--	--	--
7.	VSC	--	Advanced Botanical Skills IV (Molecular Biology Techniques)	--	--	BSTPVSC IV	1	2
8.	SEC	--	Artificial Intelligence in Seed Technology	--	--	BSTPSEC III	1	2
9.	CC	BSTTCCI	National Service Scheme	2	2	--	--	--
10.	FP	--	Field Project in Seed Technology	--	--	BSTPFP I	1	2

10. EVALUATION STRUCTURE:

Semester V (5.5)

Vertical	Course Category	Course Code	Internal Evaluation			ESE	Total Marks	Credits
			CCE-I	CCE-II	CCE-III			
DSC	T	BSTT 351	10	10	10	30	50	02
	T	BSTT 352	10	10	10	30	50	02
	T	BSTT 353	10	10	10	30	50	02
	P	BSTP 356	25			25	50	02
DSE (1 Theory Papers Out of 2)	T	BSTT 354	10	10	10	30	50	02
	T	BSTT 355	10	10	10	30	50	02
	P	BSTP 357	25			25	50	02
AEC	T	AEC III	10	10	10	30	50	02
VSC	P	BSTPVSC III	25			25	50	02
CEP	P	BSTPCEP I	25			25	50	02
OJT	P	BSTPOJT I	50			50	100	04
Total							550	22

Semester VI

Vertical	Course Category	Course Code	Internal Evaluation			ESE	Total Marks	Credits
			CCE-I	CCE-II	CCE-III			
DSC	T	BSTT 361	10	10	10	30	50	02
	T	BSTT 362	10	10	10	30	50	02
	T	BSTT 363	10	10	10	30	50	02
	P	BSTP 366	25			25	50	02
DSE (1 Theory Papers Out of 2)	T	BSTT 364	10	10	10	30	50	02
	T	BSTT 365	10	10	10	30	50	02
	P	BSTP 367	25			25	50	02
AEC	T	AEC IV	10	10	10	30	50	02
VSC	P	BSTPVSC IV	25			25	50	02
SEC	P	BSTPSEC III	25			25	50	02
CC	T	BSTPCC I	10	10	10	30	50	02
FP	P	BSTPFP I	25			25	50	02
Total							550	22

DSC: Discipline Specific Course; DSE: Discipline Specific Elective; AEC: Ability Enhancement Course; VSC: Vocational Skill Course; SEC: Skill Enhancement Course; OJT: On Job Training; FP: Field Project; CEP: Community Engagement Program; CC: Co-curricular Course; T: Theory; P: Practical

11. OTHER FEATURES:

A) LIBRARY:

Reference books, Textbooks, journals, and Periodicals are available in Institute and Departmental Library. (Separate reference lists are attached along with the respective course syllabus)

B) EQUIPMENT:

a) Computer, LCD projector, visualizer, smart board

b) Laboratory Equipment:

1. Microscope with a digital camera
2. Hot Air Oven
3. Digital weighing balance
4. Incubator
5. pH meter
6. Refrigerator
7. Microtome
8. Autoclave etc.

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	Yashavantrao Chavan Institute of Science, Satara	
	Board of Studies in Botany	
	Programme: B. Sc.	Semester – V
	Type: DSC IX	Marks: 50
	Credits: 2	From: A. Y. 2026-27
Name of the Course: BSTT 351 Seed Production in Field crops		
Course Objectives: By the end of the course, students will be able to: 1. Identify the different classes of seeds and their characteristics. 2. Describe the biological behaviour and reproductive mechanisms of major field crops. 3. Differentiate seed production practices among various crop groups (e.g., cereals vs. legumes). 4. Design a comprehensive seed production plan for a specific field crop, including land selection, agronomy, and isolation.		
Course Outcomes: By the end of the course, students should be able to: 1. Identify the specific seed production requirements for major field crops such as rice, wheat, maize, and pulses. 2. Describe the reproductive biology and pollination mechanisms of different field crops. 3. Analyze the influence of biotic and abiotic factors on seed yield and quality. 4. Distinguish between seed production practices in self-pollinated, cross-pollinated, and hybrid crops.		
Module	Title and Contents	Hrs.
Module 1	Module 1: Floral Biology of Cereal Crops 1.1 Basic principles in seed production and importance of quality seed. 1.2 Floral structure of crops. 1.3 Breeding and pollination mechanism in self- pollinated cereals viz. wheat, barley, paddy.	08
Module 2	Module 2: Floral Biology of Millet Crops 2.1 Floral structure, breeding and pollination mechanism in cross pollinated cereals viz maize, sorghum, bajra etc. 2.2 Methods and techniques of quality seed production in cross-pollinated cereals and millets	07
Module 3	Module 3: Floral Biology of Pulse Crops 3.1 Floral structure, breeding and pollination mechanism. 3.2 Methods and techniques of seed production in pulses (green gram, black gram, peas etc.).	08
Module 4	Module 4: Floral Biology of Oil Seed Crops 4.1 Floral structure, breeding and pollination mechanism.	07

	4.2 Methods and techniques of seed production in major oil seeds (groundnut, rape and mustard) and commercial fibers (cotton and jute).	
Reference Books: - 1. Agrawal, P.K., Dadlani, M. “Techniques in Seed Science and Technology (2nd Ed.)”. South Asian Publ. New Delhi, 1995 2. Agrawal, R.L. “Seed Technology (IIInd Ed.)”. Oxford & IBH Publ. Co. Daryaganj, New Delhi, 1997 3. McDonald, M.B. Jr., Copeland, L.O. “Seed Production: Principles and Practices”. Chapman & Hall, 1997		
Evaluation Pattern:		
Total Marks: 50		
Internal Continuous Evaluation (20Marks): • CCE-I: Home Assignment: 10 Marks • CCE-II: Short and long answer questions Test/ Seminar/Open Book Test/Quiz/Case study/ Book review/Field work/ Industry visit: 10 Marks • CCE-III: MCQ Test :10 Marks Note: Internal evaluation (Best of two CCE Marks will be considered)		End Semester Examination: (30 Marks) • Question -1 • Question -2 • Question -3

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	Programme: B. Sc.	Semester – V
	Type: DSC X	Marks: 50
	Credits: 2	From: A. Y. 2026-27
Name of the Course: BSTT 352 Seed Legislation and Certification		
Course Objectives: By the end of the course, students will be able to: 1. Identify key national and international seed laws, policies, and regulatory bodies. 2. Interpret the legal framework governing seed production, sale, and intellectual property rights (IPR). 3. Apply certification standards and procedures to real-world seed production scenarios. 4. Compare seed certification systems across regions or countries.		
Course Outcomes: By the end of the course, students should be able to: 1. Identify regulatory bodies and their roles in seed legislation and certification (e.g., Seed Certification Agencies, OECD, ISTA). 2. Describe procedures involved in seed certification, including field inspection and sampling. 3. Prepare and process documentation required for seed certification, registration, and labeling. 4. Analyse compliance issues related to seed laws and identify gaps in documentation or procedures.		
Module	Title and Contents	Hrs.
Module 1	Module 1: Seed Quality 1.1 Historical development of Seed Industry in India. 1.2 Seed quality: concept and factors affecting seed quality during different stages of production, processing and handling. 1.3 Seed quality control: concept and objectives. 1.4 Central Seed Certification Board (CSCB).	08
Module 2	Module 2: Seed Legislation 2.1 Regulatory mechanisms of seed quality control- organizations involved in seed quality control programmes 2.2 Seed legislation and seed law enforcement as a mechanism of seed quality control. 2.3 Acts: The Seed Act (1966), 2.4 Seed Rules (1968), Seed (Control) Order 1983; New Seed Bill-2004	07
Module 3	Module 3: Seed Certification 3.1 Seed Certification- history, concept and objectives of seed certification; 3.2 Seed certification agency/organization and staff requirement	08

	3.3 legal status and phases of seed certification; Formulation, revision and publication of seed certification standards 3.4 Indian Minimum Seed Certification Standards (I.M.S.C.S.); general and specific crop standards including GM varieties, field and seed standards	
Module 4	Module 4: Seed Organization 4.1 Introduction to WTO and IPRs. 4.2 Plant Variety Protection and its significance. 4.3 UPOV and its role. 4.4 Principles and applications; essential features of PPV & FR Act, 2001 and related Acts	07
Reference Books: - 1. Agarwal, R.L. "Seed Technology". Oxford & IBH, 1997 2. Anonymous, "Legislation on Seeds". NSC Ltd., Department of Agriculture and Cooperation, Ministry of Agriculture, New Delhi, 1992 3. Nema, N.P. Principles of Seed Certification and Testing. Allied Publs, 1986 4. Tunwar, N.S., Singh, S.N. Indian Minimum Seed Certification Standards. CSCB, Ministry of Agriculture, New Delhi, 1988 5. Alberts, B., Bray, D., Hopkin, K., Johnson, A.D., Johnson, A., Lewis, J., Raff, M., Roberts, K., Walter, P. "Essential Cell Biology". New York: Garland Science, 2009.		
Evaluation Pattern:		
Total Marks: 50		
Internal Continuous Evaluation (20Marks): • CCE-I: Home Assignment: 10 Marks • CCE-II: Short and long answer questions Test/ Seminar/Open Book Test/Quiz/Case study/ Book review/Field work/ Industry visit: 10 Marks • CCE-III: MCQ Test :10 Marks Note: Internal evaluation (Best of two CCE Marks will be considered)		End Semester Examination: (30 Marks) • Question -1 • Question -2 • Question -3

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	Programme: B. Sc.	Semester – V
	Type: DSC XI	Marks: 50
	Credits: 2	From: A. Y. 2026-27
Name of the Course: BSTT 353 Genetics and Plant Breeding		

Course Objectives: By the end of the course, students will be able to:

1. Explain the principles of Mendelian genetics and extra-chromosomal inheritance, emphasizing their significance in heredity and variation.
2. Analyze linkage, recombination, and quantitative inheritance, highlighting their role in genetic diversity and plant improvement.
3. Evaluate the effects of chromosomal aberrations and numerical variations on genome organization and plant development.
4. Apply plant breeding techniques for crop improvement by integrating genetic principles with modern biotechnological approaches.

Course Outcomes: By the end of the course, students should be able to:

1. Describe the fundamental principles of Mendelian and extra-chromosomal inheritance and their role in genetic transmission.
2. Illustrate and differentiate the mechanisms of linkage, recombination, and quantitative inheritance in plants.
3. Assess the impact of chromosomal variations on gene expression, plant traits, and evolutionary significance.
4. Develop effective plant breeding strategies using conventional and molecular breeding techniques to enhance crop productivity.

Module	Title and Contents	Hrs.
Module 1	Module 1: Mendelism and Extra Chromosomal Inheritance 1.1 Principles of inheritance - a) Law of Dominance; b) Law of Segregation; c) Law of Independent Assortment; d) Back Cross and Test Cross 1.2 Gene interaction - a) Complementary gene interaction; b) Supplementary gene interaction 1.3 Epistasis - Introduction, Dominant Epistasis, Recessive Epistasis 1.4 Extra -chromosomal Inheritance - Introduction, Plastid Inheritance and Mitochondrial Inheritance (with classical as well as latest examples).	08
Module 2	Module 2: Linkage, Recombination and Quantitative inheritance 2.1 Linkage: Definition, Linkage groups, types, Coupling and Repulsion Phase, significance in plant breeding 2.2 Recombination (Crossing over): Definition, types, mechanism of	07

	crossing over, significance in plant breeding 2.3 Quantitative inheritance: Polygene inheritance – Concept, examples 1] Kernel colour in wheat, and 2] Ear length in maize along with latest updates 2.4 Population genetics – Hardy-Weinberg’s Law.	
Module 3	Module 3: Variation in Chromosome Number and Structure 3.1 Chromosome number: Euploidy, Aneuploidy and Polyploidy 3.2 Chromosomal structure: Deletion, Duplication, Inversion and Translocation 3.3 Mutation: Spontaneous and Induced mutation; Types of mutagens – Physical and Chemical; Significance of mutations in plant breeding	08
Module 4	Module 4: Plant Breeding 4.1 Introduction, Definition, Aims and Objectives 4.2 Methods of Plant Breeding: Introduction and Acclimatization; Selection: i) Mass Selection; ii) Pure Line Selection; iii) Clonal Selection 4.3 Hybridization techniques in Self- and Cross-pollinated crops 4.4 Male Sterility and its significance 4.5 Mutation Breeding: Gamma Garden 4.6 Multiple Allelism: Introduction, Definition; Self-incompatibility in plants; Significance in plant breeding	07

Reference Books: -

1. Allard, A.W. “Principles of Plant Breeding”. New York: Wiley Publications, 2010
2. Chahal, G.S., Gosal, S.S. “Principles and Procedures of Plant Breeding: Biotechnological and Conventional Approaches”. New Delhi: Narosa Publishing Co., 2010
3. Gardener J., Simmons H.J., Snustad D.P. “Principles of Genetics 8th edition”. New York: John Wiley & Sons, 1991
4. Gupta, P.K. “Cytogenetics”. Meerut: Rastogi Publications, 2018
5. Gupta, P.K. “Genetics”. Meerut: Rastogi Publications, 1997
6. Hartl, D.L., Jones, E.W. “Genetics: Principles and Analysis 4th edition”. Massachusetts: Jones and Bartlett Publishers, 1998
7. Singh, B.D. “A Text Book of Plant Breeding: A Dynamic View Designed for Undergraduate Courses of Indian Universities. 3rd edition.” New Delhi: Kalyani Publications, 2011
8. Singh, B.D. “Cytogenetics and Plant Breeding”. New Delhi: Kalyani Publications, 2010
9. Singh, B.D. “Genetics”. New Delhi: Kalyani Publications, 2009
10. Singh, B.D. “Plant Breeding: Principles and Methods”. New Delhi: Kalyani Publications, 2018

Evaluation Pattern:

Total Marks: 50

Internal Continuous Evaluation (20Marks): • CCE-I: Home Assignment: 10 Marks • CCE-II: Short and long answer questions Test/ Seminar/Open Book Test/Quiz/Case study/ Book review/Field work/ Industry visit: 10 Marks • CCE-III: MCQ Test :10 Marks Note: Internal evaluation (Best of two CCE Marks will be considered)	End Semester Examination: (30 Marks) • Question -1 • Question -2 • Question -3
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	Programme: B. Sc.	Semester – V
	Type: DSE XII (E1)	Marks: 50
	Credits: 2	From: A. Y. 2026-27
Name of the Course: BSTT 354 Recent Trends in Seed Technology		

Course Objectives: By the end of the course, students will be able to:

1. Identify recent advancements and emerging tools in seed testing, processing, and enhancement.
2. Analyse the impact of advanced technologies on seed performance, shelf life, and field emergence.
3. Assess the challenges and limitations of integrating new technologies in small- and large- scale seed enterprises.
4. Imbibe the knowledge of establishment of seed testing labs and role of seed organizations

Course Outcomes: By the end of the course, students should be able to:

1. Identify recent developments in seed policies, international standards, and quality control systems.
2. Interpret the relevance of climate-resilient and stress-tolerant seed technologies.
3. Compare conventional practices with modern, technology-driven methods in seed production and processing.
4. Understand functioning of seed organizations in India and abroad.

Module	Title and Contents	Hrs.
Module 1	Module 1: Seed Testing 1.1 History, Objectives, importance, and Seed testing status in India 1.2 Germination testing: Concept, objectives, requirement, procedure and methods of seedling evaluation. 1.3 Seed viability: Principle, objectives and methods of TZ test, embryo excision test. 1.4 Seed moisture: Concept, objectives and methods for determination of seed moisture. 1.5 Seed Vigor testing: Concept, objectives and methods for determination of seed vigor	08
Module 2	Module 2: Seed purity analysis 2.1 Seed sampling and dividing: Concept, objectives. 2.2 Equipment's used e.g., Seed triers, seed dividers: procedure, handling and testing of samples. 2.3 Physical purity analysis: Concept, objectives, equipment's used in physical purity analysis, procedure, and purity components.	07

	2.4 Heterogeneity test: Concept, objectives, symbols used, method for test and calculations.	
Module 3	Module 3: Seed certification 3.1 Objectives and concept of seed certification. 3.2 Classes of Seeds- Nucleus, Breeders, and Foundation and Certified seeds. 3.3 Seed certification standards and field inspection. 3.4 Procedure of seed certification	08
Module 4	Module 4: Seed testing laboratory and organizations 4.1 Layout and infrastructure, staffing and equipment's. 4.2 National seed organizations- Central Seed Committee (CSC), Central Seed Testing Laboratory (CSTL), State Seed Certification Agencies (SSCA). 4.3 International seed organizations International Seed Testing Authority (ISTA), Association of Official Seed Analysts (AOSA), Organization for Economic Co- operation and Development (OECD), International Union for the Protection of New Varieties of plants (UPOV) 4.4 Seed producing companies in India (Any 3)	07
Reference Books: - 1. Agarwal, R.L. "Seed Technology". 2ndEd. New Delhi: Oxford and IBH Publishing Company Pvt., 2003 2. Chopra, V.L. "Plant Breeding Field crops". New Delhi: Oxford and IBH Publishing Company Pvt. Ltd., 2001 3. Joshi, A.K., Singh, B. D. "Seed Science and Technology". New Delhi: Kalyani Publishers, 2005 4. Khan, A.A. "Physiology and Biochemistry of Seed Dormancy and Germination". Amsterdam: North Holland Publication Company, 1977 5. Khare, D., Bhale, M.S. "Seed Technology". 2nd ed. Jodhpur: Scientific Publisher, 2014 6. Singh, B.D. "Plant Breeding". 2nd ed. Ludhiana: Kalyani Publication, 2006		
Evaluation Pattern:		
Total Marks: 50		
Internal Continuous Evaluation (20Marks): • CCE-I: Home Assignment: 10 Marks • CCE-II: Short and long answer questions Test/ Seminar/Open Book Test/Quiz/Case study/ Book review/Field work/ Industry visit: 10 Marks • CCE-III: MCQ Test :10 Marks Note: Internal evaluation (Best of two CCE Marks will be considered)		End Semester Examination: (30 Marks) • Question -1 • Question -2 • Question -3

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	Programme: B. Sc.	Semester – V
	Type: DSE XII (E2)	Marks: 50
	Credits: 2	From: A. Y. 2026-27
Name of the Course: BSTT 355 Horticultural Techniques		
Course Objectives: By the end of the course, students will be able to: 1. Remember fundamental concepts of horticulture and floriculture, including their scope and significance. 2. Understand principles of nursery management, including propagation techniques and seedling care. 3. Apply knowledge of olericulture and arboriculture in sustainable crop production. 4. Demonstrate basic skills in landscape gardening, including garden design and maintenance.		
Course Outcomes: By the end of the course, students should be able to: 1. Analyze the role of horticulture and floriculture in agriculture and economy. 2. Evaluate different nursery management practices and recommend improvements for better plant propagation. 3. Compare and contrast various cultivation techniques in olericulture and arboriculture for optimizing plant growth. 4. Design and create aesthetically pleasing and functional landscape gardens using scientific principles.		
Module	Title and Contents	Hrs.
Module 1	Module 1: Introduction to Horticulture and Floriculture 1.1 Introduction, Importance and divisions of horticulture 1.2 Floriculture: Introduction; a) Cultivation and management of important cut flowers: Rose, Gerbera; b) Flower arrangement, packing, storage, transportation and marketing of cut flowers 1.3 Pomology: Introduction; a) Cultivation and management of important fruit plants: Grapes, Mango; b) Fruit preservation technology: Physical methods (drying, freezing and heat); Chemical (sugar, salt, chemical preservatives); c) Fruit processing: Jam, Jelly, Squash, Pulp, Pickles	08
Module 2	Module 2: Nursery Management 2.1 Definition, objectives and scope, Infrastructure for nursery 2.2 Propagation practices: Sexual and Asexual propagation a) Sexual propagation – Seed sowing and transplantation of seedlings, advantages and disadvantages of sexual propagation b) Vegetative propagation Cutting – Definition, stem cutting (hard wood and soft wood cutting), use of	07

	PGRs for rooting Layering – Definition, Simple layering, Air layering Grafting – Definition, Whip grafting, Approach grafting Budding – Definition, T-budding, Patch budding c) Propagation of specialized vegetative structure – Bulbs, Corms, Tubers, Rhizomes	
Module 3	Module 3: Olericulture and Arboriculture 3.1 Olericulture: Introduction; Hydroponics, Cultivation and management of important vegetable crop: Capsicum, Tomato, Cucumber 3.2 Arboriculture: Introduction; Cultivation and management of important timber yielding plants: Teak, Dalbergia, Arjun, Babhul	07
Module 4	Module 4: Landscape Gardening 4.1 Introduction and principals of landscaping, importance and scope of landscape gardening 4.2 Garden elements: major and minor, basic patterns and steps in landscaping 4.3 Garden plants: trees, climbers, annuals, palms, ferns, cacti and succulents, criteria for plant selection, propagation of ornamental plants: sexual and vegetative methods, topiary technique 4.4 Garden styles and types: Terrace gardening, vertical garden, Lawn cultivation and marketing, Rock Garden, water garden, other garden components such as statues, garden benches, pathways and bridges 4.5 British gardens, Japanese gardens and their types, gardens for special purpose	08
Reference Books: - 1. Jules, J. “Horticultural Science (3rd Edition)”. San Francisco: W.H. Freeman and Co., 1979 2. Khan, M.R. “Horticulture and Gardening”. Pune: Nirali Prakashan, 1995 3. Kumar, N. “Introduction to Horticulture”. Nagercoil: Rajalakshmi Publications, 1997 4. Lancaster, P. “Gardening in India”. New Delhi: Oxford & IBH Publishing Co. Pvt. Ltd., 1997 5. Randhawa, G.S., Mukhopadhyay, A. “Floriculture in India”. Mumbai: Allied Publishers, 1986		
Evaluation Pattern:		
Total Marks: 50		
Internal Continuous Evaluation (20Marks): • CCE-I: Home Assignment: 10 Marks • CCE-II: Short and long answer questions Test/ Seminar/Open Book Test/Quiz/Case study/ Book review/Field work/ Industry visit: 10 Marks • CCE-III: MCQ Test :10 Marks Note: Internal evaluation (Best of two CCE Marks will be considered)		End Semester Examination: (30 Marks) • Question -1 • Question -2 • Question -3

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	Board of Studies in Botany	
	Programme: B. Sc.	Semester – V
	Type: DSC P	Marks: 50
	Credits: 2	From: A. Y. 2026-27
	Name of the Course: BSTP 356 Practical's based on Theory paper BSTT 351, BSTT 352, and BSTT 353	

Course Objectives: By the end of the course, students will be able to:

1. Apply principles of seed production, field management, and crop practices.
2. Analyze pollination methods, hybrid seed production, and genetic concepts.
3. Evaluate seed quality through testing, certification, and standards.
4. Develop practical skills in seed processing, storage, and field inspection.

Course Outcomes: By the end of the course, students should be able to:

1. Perform seed production and crop management practices effectively.
2. Analyze genetic principles and pollination techniques in crops.
3. Conduct seed testing and quality assessment procedures.
4. Demonstrate skills in seed certification, labeling, and inspection.

Practical No.	Title and Contents	No. of hours per practical
1.	Study of Field Selection, Land Preparation, and Crop Management Practices for Seed Production.	04
2.	Study of Pollination Techniques.	04
3.	Study of Seed Harvesting, Processing, Cleaning, Grading, and Packaging Techniques.	04
4.	Study of Seed Testing (Germination, Purity, Moisture) and Seed Quality Assessment.	04
5.	Study of Seed Treatment and Storage Methods for Maintaining Seed Viability and Health.	04
6.	Study of Seed Certification Standards, Types of Certifications, and Requirements.	04
7.	Study of Seed Testing, Quality Control, and Compliance with International Standards (ISTA).	04
8.	Study of Field Inspection Techniques.	04
9.	Study of Seed Labeling, Packaging, and Documentation for Certified Seeds.	04
10.	Case Study on Seed Certification Compliance (Field Visit and Practical Evaluation).	04
11.	Genetic examples on Linkage and crossing over.	04
12.	Study of meiosis using suitable material.	04
13.	Detection of meiotic anomalies in chromosomes in <i>Rhoeo</i> .	04
14.	Study of floral biology and pollination mechanisms in self- and cross-pollinated crops.	04
15.	Methods of emasculation.	04

Reference Books: -

1. Agarwal, R. L. Seed technology. Oxford & IBH Publishing Co. Pvt. Ltd., 2010.
2. Basra, A. S. Seed science and technology. Kalyani Publishers, 2006.
3. Desai, B. B. Seeds handbook: Biology, production, processing, and storage. Marcel Dekker Inc., 2004.
4. Agrawal, P. K., & Dadlani, M. Techniques in seed science and technology. South Asian Publishers, 1995.
5. Kapoor, K. C. Seed testing. S. Chand & Company Ltd., 2011.
6. Chahal, G. S., & Gosal, S. S. Principles and procedures of plant breeding. Narosa Publishing House, 2010.
7. Singh, B. D. Plant breeding: Principles and methods. Kalyani Publishers, 2015.
8. Ramamoorthy, K. Seed certification: Principles and practices. International Book Distributing Co., 2006.

Evaluation Pattern:**Total Marks: 50****Internal Continuous Evaluation: (25 Marks)**

- Student Attendance- 5 marks
- Student performance- 5 marks
- Journal- 5 marks
- Viva voce- 10 marks

End Semester Examination: (25 Marks)

- Question -1
- Question -2
- Question -3
- Question - 4

	Karmaveer Bhaurao Patil University, Satara (A State Public University Est. u/s 3(6) of MPUA 2016) Faculty of Science and Technology	
	Yashavantrao Chavan Institute of Science, Satara	
	Board of Studies in Botany	
	Programme: B. Sc.	Semester – V
	Type: DSE P	Marks: 50
	Credits: 2	From: A. Y. 2026-27
	Name of the Course: BSTP 357 Practical's based BSTT 354 Recent Trends in Seed Technology	

Course Objectives: By the end of the course, students will be able to:

1. Apply seed testing methods to assess germination, viability, moisture, and vigor.
2. Analyze the effect of modern techniques like microbial treatment, nanotechnology, and seed coating.
3. Evaluate advanced tools such as molecular markers, genomics, and AI in seed improvement.
4. Understand practical skills in seed sampling, storage, and laboratory techniques.

Course Outcomes: By the end of the course, students should be able to:

1. Perform basic seed testing methods for quality evaluation.
2. Analyze the impact of modern seed technologies on seed performance.
3. Use advanced tools for seed quality and improvement studies.
4. Demonstrate practical skills in seed handling and laboratory techniques.

Practical No.	Title and Contents	No. of hours per practical
1.	Study of Microbial Seed Treatment for Enhancing Seed Health.	04
2.	Study of seed germination percentage by Germination paper, sand and soil method.	04
3.	Study seed viability test by TTC method.	04
4.	Study seed moisture by oven dry method.	04
5.	Study seed vigor testing by physical method.	04
6.	Study of Role of Nanotechnology in Seed Protection and Germination.	04
7.	Study of seed triers.	04
8.	Role of Genomic Tools in Seed Improvement.	04
9.	Study of Seed Coating for Seed Protection.	04
10.	Application of Molecular Markers in Seed Quality Assessment	04
11.	Use of Artificial Intelligence in Seed Sorting and Grading	04
12.	Study of Seed Priming Techniques for Enhanced Germination	04
13.	Evaluation of Biofertilizer Seed Treatment on Germination and Growth	04
14.	Cryopreservation Techniques for Long-term Seed Storage	04
15.	Visit to seed testing laboratory.	04

Reference Books: -

1. Agarwal, R. L. Seed technology. Oxford & IBH Publishing Co. Pvt. Ltd., 2010.
2. Basra, A. S. Seed science and technology. Kalyani Publishers, 2006.
3. Desai, B. B. Seeds handbook: Biology, production, processing, and storage. Marcel Dekker Inc., 2004.
4. Agrawal, P. K., & Dadlani, M. Techniques in seed science and technology. South Asian Publishers, 1995.
5. Kapoor, K. C. Seed testing. S. Chand & Company Ltd., 2011.

Evaluation Pattern:**Total Marks: 50****Internal Continuous Evaluation: (25 Marks)**

- Student Attendance- 5 marks
- Student performance- 5 marks
- Journal- 5 marks
- Viva voce- 10 marks

End Semester Examination: (25 Marks)

- Question -1
- Question -2
- Question -3
- Question - 4

	Karmaveer Bhaurao Patil University, Satara (A State Public University Est. u/s 3(6) of MPUA 2016) Faculty of Science and Technology	
	Yashavantrao Chavan Institute of Science, Satara	
	Board of Studies in Botany	
	Programme: B. Sc.	Semester – V
	Type: DSE P	Marks: 50
	Credits: 2	From: A. Y. 2026-27
	Name of the Course: BSTP 357 Practical's based BSTT 355 Horticultural Techniques	

Course Objectives: By the end of the course, students will be able to:

1. Describe and explain fundamental concepts of horticulture, floriculture, nursery management, olericulture, arboriculture, and landscape gardening.
2. Perform practical techniques such as seed sowing, vegetative propagation (cutting, layering, grafting, budding), flower arrangement, and preparation of fruit products.
3. Analyze cultivation practices, plant characteristics, and post-harvest handling methods, and differentiate among various horticultural crops and ornamental plants.
4. Evaluate horticultural practices and design nursery layouts, garden plans, and simple landscape models using scientific principles.

Course Outcomes: By the end of the course, students should be able to:

1. Demonstrate nursery practices and propagation techniques including seed sowing, cutting, layering, grafting, and budding.
2. Perform horticultural operations such as flower arrangement, fruit processing, and use of garden implements effectively.
3. Identify and analyze different horticultural crops, ornamental plants, and timber species, and evaluate their cultivation and management practices.
4. Design basic landscape plans, prepare reports/posters, and apply scientific knowledge for sustainable horticultural practices.

Practical No.	Title and Contents	No. of hours per practical
1.	Study of important cut flowers – Morphology and cultivation practices of Rose and Gerbera.	04
2.	Demonstration of flower arrangement techniques (bouquet, vase arrangement).	04
3.	Study of post-harvest handling – Packing, storage, and transportation of cut flowers.	04
4.	Preparation of fruit products – Jam / Jelly / Squash (any one).	04
5.	Study of fruit preservation methods – Drying and chemical preservation (demonstration).	04
6.	Seed sowing and transplantation techniques in nursery beds.	04
7.	Study of vegetative propagation by cutting (hardwood and softwood).	04
8.	Study of layering techniques – Air layering.	04
9.	Study of grafting techniques – Whip grafting and Approach grafting.	04
10.	Study of budding techniques – T-budding and Patch budding.	04

11.	Study of vegetable crops – Cultivation practices of Tomato / Capsicum / Cucumber (any one).	04
12.	Demonstration of hydroponics (soilless culture system).	04
13.	Study of timber-yielding plants – Teak, Dalbergia, Arjun, Babhul (morphology and uses).	04
14.	Study of ornamental plants – Rose, Gerbera, Marigold; indoor plants; hedge and edge plants.	04
15.	Preparation of landscape design / garden layout (including lawn, pathways, and garden components).	04

Reference Books: -

1. Jules, J. "Horticultural Science (3rd Edition)". San Francisco: W.H. Freeman and Co., 1979
2. Khan, M.R. "Horticulture and Gardening". Pune: Nirali Prakashan, 1995
3. Kumar, N. "Introduction to Horticulture". Nagercoil: Rajalakshmi Publications, 1997
4. Lancaster, P. "Gardening in India". New Delhi: Oxford & IBH Publishing Co. Pvt. Ltd., 1997
5. Randhawa, G.S., Mukhopadhyay, A. "Floriculture in India". Mumbai: Allied Publishers, 1986

Evaluation Pattern:

Total Marks: 50

Internal Continuous Evaluation: (25 Marks)	End Semester Examination: (25 Marks)
• Student Attendance- 5 marks • Student performance- 5 marks • Journal- 5 marks • Viva voce- 10 marks	• Question -1 • Question -2 • Question -3 • Question - 4

	Karmaveer Bhaurao Patil University, Satara (A State Public University Est. u/s 3(6) of MPUA 2016) Faculty of Science and Technology	
	Yashavantrao Chavan Institute of Science, Satara	
	Board of Studies in Botany	
	Programme: B. Sc.	Semester – V
	Type: VSC III	Marks: 50
	Credits: 2	From: A. Y. 2026-27
	Name of the Course: BSTPVSC III: Advanced Botanical Skills III (Practical Based Course: Analytical Techniques and Microscopy)	

Course Objectives: By the end of the course, students will be able to:

1. Explain the principles and applications of chromatographic and spectroscopic techniques used for analyzing plant pigments, amino acids, and secondary metabolites.
2. Operate instruments such as TLC, HPLC, GC, and confocal microscopy for qualitative and quantitative analysis of plant-derived samples.
3. Distinguish between different plant cell types, tissues, and biomolecules using microscopy and histochemical techniques.
4. Assess the reliability and effectiveness of various separation and identification methods in plant biochemical and anatomical investigations.

Course Outcomes: By the end of the course, students should be able to:

1. Describe the fundamental principles of chromatography, spectroscopy, and microscopy used in plant analysis.
2. Demonstrate proficiency in performing TLC, paper chromatography, and microscopy techniques for separating and identifying plant biomolecules and cell structures.
3. Interpret chromatograms, spectra, and micrographs to identify compounds and structures, comparing results across different techniques.
4. Design and present a laboratory report that integrates multiple analytical methods to investigate biochemical and anatomical features of plant tissues.

Practical No.	Title and Contents	No. of hours per practical
1.	Separation of plant pigments using Thin-Layer Chromatography (TLC).	04
2.	Separation of amino acids using Circular Paper Chromatography.	04
3.	Demonstration of High-Performance Thin Layer Chromatography (HPTLC).	04
4.	Demonstration of High-Performance Liquid Chromatography (HPLC).	04
5.	Demonstration of Column Chromatography.	04
6.	Demonstration of detection of metal ions in biological samples.	04
7.	Demonstration of Gas Chromatography (GC)	04
8.	Identification of functional groups in biomolecules using Fourier-Transform Infrared Spectroscopy (FTIR).	04
9.	Demonstration of identification of secondary metabolites in medicinal plants.	04
10.	Identification of plant cell types and tissues using bright field	04

	microscopy.	
11.	Observation of unstained live cells using phase contrast microscope.	04
12.	Demonstration of imaging of subcellular structures in plant tissues using confocal microscopy.	04
13.	Demonstration of autofluorescent compounds in plant cells.	04
14.	Demonstration of ultrastructural analysis of leaf epidermis and trichomes using scanning electron microscope (SEM).	04
15.	Measurement of cell size using an ocular and stage micrometer.	04
16.	Localization of starch, proteins, and lignin in plant tissues using histochemical staining.	04

Reference Books: -

1. Holme, D.J., Peck, H. "Analytical Biochemistry". New Jersey: Prentice Hall, 1998
2. Miller, J.M. "Chromatography: Concepts and Contrasts". New York: Wiley-Interscience, 2004
3. Murphy, D.B. "Fundamentals of Light Microscopy and Electronic Imaging". New York: Wiley-Blackwell, 2012
4. Neelam, V. "Practical Manual of Histology for Medical Students". New Delhi: Jaypee Brothers Medical Publishers, 2016
5. Pavia, D.L., Lampman, G.M., Kriz, G.S. "Introduction to Spectroscopy". Noida: Cengage India Private Limited, 2015
6. Wilson, K., Walker, J. "Principles and Techniques of Biochemistry and Molecular Biology". Cambridge: Cambridge University Press, 2010

Evaluation Pattern:

Total Marks: 50

Internal Continuous Evaluation: (25 Marks)	End Semester Examination: (25 Marks)
• Student Attendance- 5 marks • Student performance- 5 marks • Journal- 5 marks • Viva voce- 10 marks	• Question -1 • Question -2 • Question -3 • Question - 4

	Karmaveer Bhaurao Patil University, Satara (A State Public University Est. u/s 3(6) of MPUA 2016) Faculty of Science and Technology	
	Yashavantrao Chavan Institute of Science, Satara	
	Board of Studies in Botany	
	Programme: B. Sc.	Semester – V
	Type: CEP I	Marks: 50
	Credits: 2	From: A. Y. 2026-27
	Name of the Course: BSTPCEP-I: Community Engagement Programme in Seed Technology	
Course Objectives: By the end of the course, students will be able to: 1. Familiarize students with local ecological and botanical issues affecting rural or urban communities. 2. Promote application of botanical knowledge for sustainable community development. 3. Foster critical thinking and teamwork in addressing community-centric plant-related problems. 4. Develop communication skills for effective outreach and awareness in botanical sciences.		
Course Outcomes: By the end of the course, students should be able to: 1. Identify and describe key plant-based challenges (e.g., deforestation, invasive weeds, lack of herbal knowledge, crop failures) in local communities. 2. Apply botanical concepts (e.g., organic farming, medicinal plant cultivation, home gardening, biodiversity conservation) in real-life community settings. 3. Analyze community needs, collaborate with stakeholders, and develop viable green solutions (e.g., composting units, seed banks, tree plantations). 4. Design and deliver educational materials (e.g., pamphlets, talks, demonstrations) to raise awareness about plant conservation and sustainable practices among community members.		
Practical No.	Title and Contents	No. of hours per practical
1.	Field Project on Community Engagement Programme and Presentation	04

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	Yashavantrao Chavan Institute of Science, Satara	
	Board of Studies in Botany	
	Programme: B. Sc.	Semester – V
	Type: OJT I	Marks: 100
	Credits: 2	From: A. Y. 2026-27
Name of the Course: BSTPOJT-I: On-Job-Training in Seed Technology		

Course Objectives: By the end of the course, students will be able to:

1. Recognize and explain workplace structure, professional ethics, safety practices, and standard operating procedures relevant to the assigned organization.
2. Apply theoretical knowledge and technical skills in real work situations under supervision, following established protocols and guidelines.
3. Analyze work processes, identify problems, and interpret practical challenges encountered during on-job training.
4. Evaluate workplace practices and performance, and develop solutions, reports, or improvements based on experiential learning.

Course Outcomes: By the end of the course, students should be able to:

1. Demonstrate knowledge of workplace operations, safety norms, and professional conduct, and apply discipline-specific skills effectively.
2. Perform assigned tasks independently or collaboratively, using appropriate tools, techniques, and standard procedures.
3. Analyze practical problems, interpret data or observations, and suggest feasible solutions in a professional setting.
4. Evaluate their performance, prepare structured reports, and communicate findings effectively, demonstrating readiness for professional employment.

Practical No.	Title and Contents	No. of hours per practical
1.	On-Job-Training	120

	Karmaveer Bhaurao Patil University, Satara (A State Public University Est. u/s 3(6) of MPUA 2016) Faculty of Science and Technology	
	Yashavantrao Chavan Institute of Science, Satara	
	Board of Studies in Botany	
	Programme: B. Sc.	Semester – VI
	Type: DSC XIII	Marks: 50
	Credits: 2	From: A. Y. 2026-27
Name of the Course: BSTT 361 Seed Biotechnology		
Course Objectives: By the end of the course, students will be able to: 1. Understand the fundamental concepts and techniques of plant tissue culture, genetic engineering, and molecular biology. 2. Demonstrate recombinant DNA techniques, including gene cloning, transformation, and expression analysis. 3. Analyze different molecular markers and their applications in plant genomics and proteomics. 4. Impart the knowledge about the embryo culture.		
Course Outcomes: By the end of the course, students should be able to: 1. Recall key concepts and tools used in seed biotechnology. 2. Apply molecular and genetic techniques in seed analysis and improvement. 3. Analyze the impact of biotechnological interventions on seed performance. 4. Learn the applications of plant tissue culture.		
Module	Title and Contents	Hrs.
Module 1	Module 1: Introduction to Seed Biotechnology 1.1 Introduction, Definition, history of Biotechnology 1.2 Scope of Biotechnology in conservation of quality seed and their improvement. 1.3 Different culture methods and regeneration protocols for plants	08
Module 2	Module 2: DNA Replication 2.1 Evidence of Semi conservative nature of DNA replication 2.2 Features of DNA replication 2.3 Mechanism of DNA replication in prokaryotes 2.4 Mechanism of DNA replication in eukaryotes	07
Module 3	Module 3: Plant Tissue Culture 3.1 Embryo culture, Plant material and callus principles and technique 3.2 In vitro flowering, Anther and pollen culture production of dihaploides and their utility. 3.3 Production and maintenance disease free clones through tissue culture.	08

Module 4	Module 4: Applications of Plant Tissue Culture 4.1 Plant improvement for agriculture, horticulture and forestry. 4.2 Production of secondary metabolites. 4.3 Preservation of plant genetic resources and germplasm conservation.	07
Reference Books: - 1. Poehlmann, M. "Breeding of field crops". Henry Holt and Co., New York, 1959 2. Strickberger, M.W. "Genetics". Pearson Education Inc. , and Dorling Kindersley Publ., 1985 3. Reinert, J.R., Bajaj, Y.P.S. Applied and fundamental aspects of plant cell, tissue and organ culture. Springer and Verlag, Berlin, 1997 4. Allard, R. D. "Principles of Plant Breeding". John Wiley and Sons, Inc., 1999 5. Purohit, S.S. "Agricultural Biotechnology". Agro Botanica. India, 1999 6. Levin, B. "Genes VII". Oxford Uni. Press, 2000 7. Sharma, K.V.S. Statistics made simple: Do it yourself on PC, PHI, 2002		
Evaluation Pattern:		
Total Marks: 50		
Internal Continuous Evaluation (20Marks): • CCE-1: Home Assignment: 10 Marks • CCE-II: Short and long answer questions Test/ Seminar/Open Book Test/Quiz/Case study/ Book review/Field work/ Industry visit: 10 Marks • CCE-III: MCQ Test :10 Marks Note: Internal evaluation (Best of two CCE Marks will be considered)		End Semester Examination: (30 Marks) • Question -1 • Question -2 • Question -3

	Karmaveer Bhaurao Patil University, Satara (A State Public University Est. u/s 3(6) of MPUA 2016) Faculty of Science and Technology	
	Yashavantrao Chavan Institute of Science, Satara	
	Board of Studies in Botany	
	Programme: B. Sc.	Semester – VI
	Type: DSC XIV	Marks: 50
	Credits: 2	From: A. Y. 2026-27
Name of the Course: BSTT 362: Seed Quality		

Course Objectives: By the end of the course, students will be able to:

1. Define key terms related to seed quality (e.g., viability, vigor, purity).
2. Explain the significance of seed quality in crop production.
3. Demonstrate proper seed sampling techniques.
4. Propose improvements to an existing seed testing laboratory setup.

Course Outcomes: By the end of the course, students should be able to:

1. Perform standard seed quality tests such as germination, moisture content, and purity tests.
2. Compare and contrast different seed storage and treatment methods based on quality outcomes.
3. Evaluate the effectiveness of different seed processing techniques on seed quality parameters
4. Develop a standard operating procedure (SOP) for seed testing in a laboratory.

Module	Title and Contents	Hrs.
Module 1	Module 1: Seed Quality Control 1.1 Introduction: Structure of monocot and dicot seeds 1.2 Seed quality: objectives, concept and components and their role in seed quality control 1.3 Instruments, devices and tools used in seed testing. 1.4 ISTA and its role in seed testing	08
Module 2	Module 2: Seed Sampling 2.1 Seed Sampling: definition, objectives, seed-lot and its size. 2.2 Types of samples: sampling devices; procedure of seed sampling; sampling intensity 2.3 Methods of preparing composite and submitted samples; sub-sampling techniques, dispatch, receipt and registration of submitted sample in the laboratory 2.4 Sampling in the seed testing laboratory.	07
Module 3	Module 3: Seed Germination Testing 3.1 Germination: importance; definitions; requirements for germination,	08

	instrument and substrata required; 3.2 Principle and methods of seed germination testing; working sample and choice of method 3.3 General procedure for each type of method; duration of test; seedling evaluation; calculation and reporting of results; 3.4 Dormancy: definition, importance, causal mechanisms, types and methods for breaking dormancy	
Module 4	Module 4: Viability and Vigour Testing 4.1 Viability and vigour testing: definition and importance of viability tests; 4.2 Different viability tests; quick viability test (TZ- test) - advantages, principle, preparation of seeds and solutions, procedure, evaluation and calculation of test results. 4.3 Vigour testing: concept, historical development, definitions. 4.4 Principles and procedures of different methods used for testing	07
Reference Books: - 1. Joshi, A.K., Singh, B.D. "Seed Science and Technology". New Delhi: Kalyani Publishers, 2017 2. Khan, A.A. "Physiology and Biochemistry of Seed Dormancy and Germination". North Holland, Amsterdam, 1977 3. Mondal, S.S. "Seed Production of field crops". New Delhi: New India PublishersAgency, 2009 4. Singh, B.D. "Plant Breeding: Principles and Methodology". New Delhi: K		
Evaluation Pattern:		
Total Marks: 50		
Internal Continuous Evaluation (20Marks): • CCE-I: Home Assignment: 10 Marks • CCE-II: Short and long answer questions Test/ Seminar/Open Book Test/Quiz/Case study/ Book review/Field work/ Industry visit: 10 Marks • CCE-III: MCQ Test :10 Marks Note: Internal evaluation (Best of two CCE Marks will be considered)		End Semester Examination: (30 Marks) • Question -1 • Question -2 • Question -3

	Karmaveer Bhaurao Patil University, Satara (A State Public University Est. u/s 3(6) of MPUA 2016) Faculty of Science and Technology	
	Yashavantrao Chavan Institute of Science, Satara	
	Board of Studies in Botany	
	Programme: B. Sc.	Semester – VI
	Type: DSC XV	Marks: 50
	Credits: 2	From: A. Y. 2026-27
Name of the Course: BSTT 363: Biofertilizers		
Course Objectives: By the end of the course, students will be able to: 1. Understand the role, classification, and applications of biofertilizers in sustainable agriculture. 2. Demonstrate the methods for isolation, identification, and application of biofertilizers and biocontrol agents. 3. Analyse the significance of mycorrhizal associations and their role in plant nutrient uptake. 4. Develop skills in organic farming practices and the integration of biofertilizers and biocontrol strategies for eco-friendly agriculture.		
Course Outcomes: By the end of the course, students should be able to: 1. Identify and classify different types of biofertilizers. 2. Perform laboratory techniques for culturing and evaluating biocontrol agents. 3. Assess the impact of mycorrhizal fungi on plant growth and nutrient uptake through practical observations. 4. Implement organic farming practices by integrating biofertilizers and biocontrol agents for sustainable crop production.		
Module	Title and Contents	Hrs.
Module 1	Module 1: Introduction of Biofertilizers 1.1 Introduction, History, types and importance of biofertilizers 1.2 Classification of biofertilizers (based on microorganisms used in biofertilizers production) 1.3 Nitrogen cycle in nature and its importance 1.4 Process of nodule formation, Role of Nif and Nod gene in Biological Nitrogen Fixation 1.5 Enzyme nitrogenase and its component 1.6 Biochemistry of nitrogen fixation 1.7 Isolation and mass multiplication of – <i>Rhizobium</i>	08
Module 2	Module 2: Biocontrol Agent 2.1 Bio-control: Introduction, sources and advantages. 2.2 Important commercial products – Source, preparation and uses of Pyrethrins, Azadirachtin, Nicotine, Trichoderma, Trichogramma 2.3 Importance of Verticillium/ Beauveria/ Metarhizium/ Nomuraea/ Paecilomyces/ Hirsutella thompsoni as biopesticides and their mass	07

	production	
Module 3	Module 3: Biofertilizers used in Agriculture 3.1 Introduction, Importance, Isolation and mass multiplication 3.2 Bacterial fertilizers: Azotobacter, Azospirillum 3.3 Phosphorus solubilizing bacteria, Potash mobilizing bacteria 3.4 Blue green Algal: Cyanobacteria (BGA) – Nostoc, Anabaena. 3.5 Higher plants: Azolla, Legumes	08
Module 4	Module 4: Mycorrhizal Association and Organic Farming 4.1 Mycorrhizal association, types of mycorrhizal association, taxonomy, occurrence and distribution, phosphorus nutrition, growth and yield – colonization of VAM – isolation and inoculum production of VAM, and its influence on growth and yield of crop plants 4.2 Organic farming – Green manuring and organic fertilizers, recycling of biodegradable municipal, agricultural and Industrial wastes, bio compost making methods, types and method of vermicomposting, field Application	07
Reference Books: - 1. Coppel, H.C., Martin, J.W. “Biological Control of Insect Pest Suppression”. Berlin: Springer, 1977 2. De Bach, P. “Biological Control of Insect Pest and Weeds”. Chapman and Hall, New York, 1964 3. Dilworth, M.J., Glenn, A.R. “Biology and Biochemistry of Nitrogen Fixation”. Amsterdam: Elsevier, 1991 4. Gautam, R.D. “Biological Suppression of Insect Pests”. New Delhi: Kalyani Publisher, 2006 5. Huffaker, C.B., Messenger, P.S. “Theory and Practice of Biological Control”. New York: Academic Press, 1976 6. Motsara, I.M.R., Bhattacharyya, P., Srivastava, B. “Biofertilizer Technology, Marketing and Usage- A Source Book-cum-glossary”. New Delhi: FDCO, 1995		
Evaluation Pattern:		
Total Marks: 50		
Internal Continuous Evaluation (20Marks): • CCE-1: Home Assignment: 10 Marks • CCE-II: Short and long answer questions Test/ Seminar/Open Book Test/Quiz/Case study/ Book review/Field work/ Industry visit: 10 Marks • CCE-III: MCQ Test :10 Marks Note: Internal evaluation (Best of two CCE Marks will be considered)		End Semester Examination: (30 Marks) • Question -1 • Question -2 • Question -3

	Karmaveer Bhaurao Patil University, Satara (A State Public University Est. u/s 3(6) of MPUA 2016) Faculty of Science and Technology	
	Yashavantrao Chavan Institute of Science, Satara	
	Board of Studies in Botany	
	Programme: B. Sc.	Semester – VI
	Type: DSE XVI (E1)	Marks: 50
	Credits: 2	From: A. Y. 2026-27
Name of the Course: BSTT 364: Biostatistics and Bioinformatics		

Course Objectives: By the end of the course, students will be able to:

1. Understand the fundamental concepts of bioinformatics, transcriptomics, and statistical analysis in biological research.
2. Demonstrate the use of bioinformatics tools for sequence analysis, gene expression studies, and transcriptome profiling.
3. Apply biostatistical methods, including sampling techniques, measures of central tendency, dispersion, and hypothesis testing.
4. Develop analytical skills in correlation, regression, and data interpretation for biological datasets.

Course Outcomes: By the end of the course, students should be able to:

1. Utilize bioinformatics tools and databases for gene sequence retrieval, alignment, and annotation.
2. Analyze transcriptomic data for differential gene expression using computational approaches.
3. Perform statistical calculations, including mean, median, standard deviation, and variance, to interpret biological data.
4. Interpret correlations and regression models to establish relationships in biological research.

Module	Title and Contents	Hrs.
Module 1	Module 1: Introduction of Bioinformatics 1.1 Introduction, Aim, Scope and Branches of Bioinformatics 1.2 Biological Databases: Classification Format and Retrieval system of Biological Database, National Center for Biotechnological Information (NCBI), Basic Local Alignment Search Tool (BLAST) 1.3 Protein Information Resource (PIR) - Concept, Resources, Databases and Data Retrieval 1.4 Genome Information Resources (GIR) – Concept, Resources, Databases 1.5 Applications of Bioinformatics- BLAST, Molecular Phylogeny (Concept, Methods, Analysis and Consistency, use of MEGA 6 software)	08
Module 2	Module 2: Transcriptomics 2.1 Introduction to transcriptomics and expression profiling 2.2 RNA sequencing techniques: Microarray, RNAseq-Sanger, Illumina, Oxford nanopore, Concept working and analysis databases and	07

	bioinformatic tools, Microarray databases and bioinformatics tools 2.3 Investigative techniques – EST, SAGE, SNP 2.4 Applications in basic research and medical genetics, Metagenomics, Toxicogenomics, Pharmacogenomics, Gene disease association	
Module 3	Module 3: Introduction to Biostatistics and Sampling 3.1 Introduction, definition, terminology 3.2 Types of statistics: Descriptive and inferential 3.3 Types of variables: Quantitative and qualitative or categorical variables 3.4 Scope, applications and uses of biostatistics 3.5 Sample and sampling 3.6 Collection and presentation of data - Types of data, techniques of data collection - Census method, sampling method - simple random, stratified and systematic sampling. Classification, tabulation, graphical representation - Histogram and polygon.	08
Module 4	Module 4: Measures of Central Tendency, Dispersion, Correlation and Regression 4.1 Simple arithmetic mean, its merits and limitations 4.2 Averages of position: Median and mode, their merits and limitations 4.3 Meaning of dispersion 4.4 Range: Computation in individual, discrete and continuous series, coefficient of range, merits and limitations 4.5 Mean deviation and standard deviation: computation for grouped and ungrouped data, merits and limitations 4.6 Variance: Definition, coefficient of variance 4.7 Definition and types of correlation 4.8 Coefficient of correlation and its properties 4.9 Methods of studying correlation: Scatter diagram and Karl Pearson's, coefficient of correlation, coefficient of determination (r^2) 4.10 Regression analysis: Definition and types of regression, linear regression	07
Reference Books: - 1. Annadurai, B. "A Textbook of Biostatistics". New Delhi: New Age International (P) Limited, 2007 2. Attwod, T., Perry-Smith, D. "Introduction to Bioinformatics (Cell and Molecular Biology in Action)". New Jersey: Prentice Hall, 1999 3. Attwood, T.K., Perry-Smith, D.J., Phukan, S. "Introduction to Bioinformatics". London: Pearson Education, 2008 4. Banerjee, P. K. "Introduction to Biostatistics (A Textbook of Biometry)". New Delhi: S. Chand and Company, 2007		

5. Campbell, R. C. "Statistics for Biology". Cambridge: Cambridge University Press, 1967
6. Ghosh, Z., Mallick, B. "Bioinformatics: Principles and Applications". Noida: OUP India, 2008
7. Huber, W., Holmes, S. "Modern Statistics for Modern Biology". Cambridge: Cambridge University Press, 2018
8. Mendiratta, N., Rastogi, P., Rastogi, S.C. "Bioinformatics: Methods and Applications: Genomics, Proteomics and Drug Discovery". New Delhi: PHI Learning, 2022
9. Prasad, S. "Elements of Biostatistics: For Undergraduate Students". Meerut: Rastogi Publications, 2012
10. Satyanarayana, L., Indrayan, A. "Biostatistics for Medical, Nursing and Pharmacy Students". New Delhi: Prentice-Hall of India, 2006
11. Singh, R. "Bioinformatics: Genomics and Proteomics". Noida: Vikas Publishing House Pvt. Ltd., 2014.

Evaluation Pattern:

Total Marks: 50

Internal Continuous Evaluation (20Marks):

- CCE-I: Home Assignment: 10 Marks
- CCE-II: Short and long answer questions Test/ Seminar/Open Book Test/Quiz/Case study/ Book review/Field work/ Industry visit: 10 Marks
- CCE-III: MCQ Test :10 Marks

Note: Internal evaluation (Best of two CCE Marks will be considered)

End Semester Examination: (30 Marks)

- Question -1
- Question -2
- Question -3

	Karmaveer Bhaurao Patil University, Satara (A State Public University Est. u/s 3(6) of MPUA 2016) Faculty of Science and Technology	
	Yashavantrao Chavan Institute of Science, Satara	
	Board of Studies in Botany	
	Programme: B. Sc.	Semester – VI
	Type: DSE XVI (E2)	Marks: 50
	Credits: 2	From: A. Y. 2026-27
Name of the Course: BSTT 365: Industrial and Environmental Microbiology		

Course Objectives: By the end of the course, students will be able to:

1. Understand the principles of industrial microbiology, microbial fermentation, and their applications in biotechnology.
2. Demonstrate the production and characterization of microbial products used in industrial applications.
3. Analyze the role of microorganisms in environmental sustainability, including bioremediation and waste management.
4. Develop skills in applied microbial ecology, focusing on interactions between microorganisms and their environments.

Course Outcomes: By the end of the course, students should be able to:

1. Identify and explain the industrial applications of microorganisms in fermentation and bioprocessing.
2. Perform laboratory techniques for microbial product extraction, purification, and characterization.
3. Evaluate microbial bioremediation techniques for pollutant degradation and environmental restoration.
4. Interpret microbial community dynamics and ecological interactions in various environments.

Module	Title and Contents	Hrs.
Module 1	Module 1: Introduction to Industrial Microbiology 1.1 Scope and history of industrial microbiology. 1.2 Types of fermentation processes (batch, fed-batch, continuous). 1.3 Bioreactors: Types, design, and operation. 1.4 Downstream processing: Recovery and purification of products.	08
Module 2	Module 2: Microbial Products of Industrial Use 2.1 Primary metabolites: Alcohols, organic acids. 2.2 Secondary metabolites: Antibiotics, vitamins, and enzymes. 2.3 Microbial production of bioplastics and biofuels. 2.4 Quality control in microbial industries.	07

Module 3	Module 3: Environmental Microbiology and Bioremediation 3.1 Role of microbes in the biogeochemical cycles (carbon, nitrogen, sulfur, phosphorus). 3.2 Microbial bioremediation: Types, mechanisms, and case studies. 3.3 Wastewater treatment: Microbial processes in primary, secondary, and tertiary treatment. 3.4 Phytoremediation and microbial interactions in the rhizosphere.	08
Module 4	Module 4: Applied Microbial Ecology 4.1 Microbial communities in extreme environments (halophiles, thermophiles). 4.2 Microbes in agriculture: Biofertilizers, biopesticides, and plant growth-promoting rhizobacteria (PGPR). 4.3 Industrial pollution and biodegradation of xenobiotics. 4.4 Emerging trends: Metagenomics, synthetic biology in environmental microbiology.	07
Reference Books: - 1. Atlas, R.M., Bartha, R. "Microbial Ecology: Fundamentals and Applications". USA: Addison Wesley Longman, 1998 2. Casida, L.E. "Industrial Microbiology". New York: Wiley Eastern Limited, 1968 3. Pelczar, M.J., Chan, E.C.S., Krieg, N.R. "Microbiology: Concepts and Applications". New York: McGraw-Hill, 1993 4. Prescott, L.M., Harley, J.P., Klein, D.A. "Microbiology". New York: McGraw-Hill, 2008 5. Singh, D.P., Singh, H.B. "Microbial Bioremediation". Berlin: Springer, 2013 6. Stanbury, P.F., Whitaker, A., Hall, S.J. "Principles of Fermentation Technology". Oxford: Pergamon Press, 1995 7. Subba Rao, N.S. "Soil Microorganisms and Plant Growth". New Delhi: Oxford & IBH Publishing, 1995		
Evaluation Pattern:		
Total Marks: 50		
Internal Continuous Evaluation (20Marks): • CCE-I: Home Assignment: 10 Marks • CCE-II: Short and long answer questions Test/ Seminar/Open Book Test/Quiz/Case study/ Book review/Field work/ Industry visit: 10 Marks • CCE-III: MCQ Test :10 Marks Note: Internal evaluation (Best of two CCE Marks will be considered)		End Semester Examination: (30 Marks) • Question -1 • Question -2 • Question -3

	Karmaveer Bhaurao Patil University, Satara (A State Public University Est. u/s 3(6) of MPUA 2016) Faculty of Science and Technology	
	Yashavantrao Chavan Institute of Science, Satara	
	Board of Studies in Botany	
	Programme: B. Sc.	Semester – VI
	Type: DSC P	Marks: 50
	Credits: 2	From: A. Y. 2026-27
Name of the Course: BSTP 366 Practical's based on Theory paper BSTT 361, BSTT 362, and BSTT 363		
Course Objectives: By the end of the course, students will be able to: 1. To learn preparation of MS medium and basic tissue culture techniques. 2. To understand seed germination and dormancy breaking methods. 3. To study seed testing instruments and seed quality. 4. To gain basic knowledge of biofertilizers and useful microorganisms.		
Course Outcomes: By the end of the course, students should be able to: 1. Students can prepare culture media and perform simple lab techniques. 2. Students can test seed germination and identify dormancy methods. 3. Students can use seed testing instruments. 4. Students can understand and isolate useful microbes like <i>Rhizobium</i> and <i>Trichoderma</i>.		
Practical No.	Title and Contents	No. of hours per practical
1.	Preparation of stock solutions of MS medium.	04
2.	Preparation of plant tissue culture medium (MS).	04
3.	Sterilization of MS medium and preparation of slants.	04
4.	Demonstration of techniques of <i>in vitro</i> culture using suitable ex-plant.	04
5.	Isolation of genomic DNA	04
6.	Study of seed germination.	04
7.	Study of methods to break seed dormancy	04
8.	Study of instruments used for seed testing	04
9.	Effects of priming; methods for hydrogel encapsulation of artificial endosperm, hydrophobic coating	04
10.	Visits to seed production plots	04
11.	Study of nitrogen fixing organisms.	04
12.	Media used for biofertilizers, Biopesticides and bioagents	04
13.	production.	04
14.	Isolation of <i>Rhizobium</i> from root nodules.	04
15.	Estimating the efficiency of <i>Trichoderma</i> through pot culture experiments	04

Reference Books: -

1. Bhojwani, S.S., & Razdan, M.K. Plant Tissue Culture: Theory and Practice. 2004.
2. Narayanaswamy, S. Plant Cell and Tissue Culture. 1994.
3. Purohit, S.S. Plant Tissue Culture. 2010.
4. Agrawal, P.K. Seed Technology. 1993.
5. Kapoor, A.C. Seed Science and Technology. 2001.
6. Dubey, R.C. A Textbook of Biotechnology. 2014.
7. Subba Rao, N.S. Soil Microbiology. 2005.
8. Rangaswami, G., & Bagyaraj, D.J. Agricultural Microbiology. 2006.

Evaluation Pattern:**Total Marks: 50****Internal Continuous Evaluation: (25 Marks)**

- Student Attendance- 5 marks
- Student performance- 5 marks
- Journal- 5 marks
- Viva voce- 10 marks

End Semester Examination: (25 Marks)

- Question -1
- Question -2
- Question -3
- Question - 4

	Karmaveer Bhaurao Patil University, Satara (A State Public University Est. u/s 3(6) of MPUA 2016) Faculty of Science and Technology	
	Yashavantrao Chavan Institute of Science, Satara	
	Board of Studies in Botany	
	Programme: B. Sc.	Semester – VI
	Type: DSE P	Marks: 50
	Credits: 2	From: A. Y. 2026-27
	Name of the Course: BSTP 367 Practical's based on Theory paper BSTT 364	

Course Objectives: By the end of the course, students will be able to:

1. Understand the fundamental concepts of bioinformatics, biological databases, and transcriptomics tools used for sequence and expression analysis.
2. Develop practical skills in retrieving, analyzing, and interpreting biological data using bioinformatics software and databases.
3. Apply statistical methods for collection, classification, and analysis of biological data.
4. Enhance analytical and problem-solving abilities through interpretation of molecular data, phylogenetic relationships, and statistical correlations.

Course Outcomes: By the end of the course, students should be able to:

1. Explain and utilize bioinformatics databases and tools for sequence retrieval, alignment, and phylogenetic analysis.
2. Analyze transcriptomic data and interpret gene expression patterns using relevant bioinformatics approaches.
3. Perform and interpret basic biostatistical analyses including measures of central tendency, dispersion, correlation, and regression.
4. Evaluate and present biological data effectively using appropriate graphical and statistical methods.

Practical No.	Title and Contents	No. of hours per practical
1.	Study of bioinformatics resources to familiarize with the scope, branches, and applications of bioinformatics using online resources and case studies.	04
2.	Retrieval of nucleotide and protein sequences from National Center for Biotechnology Information databases (GenBank, PubMed, Protein).	04
3.	Study of sequence alignment using BLAST.	04
4.	Retrieval and analysis of protein sequence information from Protein Information Resource.	04
5.	Accessing genome-related databases and extracting genomic information using genome browsers.	04
6.	Construction of phylogenetic trees using MEGA and interpretation of evolutionary relationships.	04
7.	Exploration of gene expression databases and tools used in transcriptome analysis.	04
8.	Understanding workflows of RNA-seq (Illumina/Sanger/Nanopore) through datasets.	04
9.	Retrieval and interpretation of gene expression profiles using	04

	publicly available microarray databases.	
10.	Identification and analysis of genetic variations and expression tags using bioinformatics tools.	04
11.	Collection of primary data and its classification, tabulation, and graphical representation (histogram and frequency polygon).	04
12.	Demonstration and comparison of sampling methods: simple random, stratified, and systematic sampling.	04
13.	Calculation of mean, median, and mode for biological datasets and interpretation.	04
14.	Calculation of range, mean deviation, standard deviation, and coefficient of variation.	04
15.	Determination of correlation coefficient (Karl Pearson's method), scatter diagram, and linear regression analysis with biological data.	04

Reference Books: -

1. Annadurai, B. "A Textbook of Biostatistics". New Delhi: New Age International (P) Limited, 2007
2. Attwod, T., Perry-Smith, D. "Introduction to Bioinformatics (Cell and Molecular Biology in Action)". New Jersey: Prentice Hall, 1999
3. Attwood, T.K., Perry-Smith, D.J., Phukan, S. "Introduction to Bioinformatics". London: Pearson Education, 2008
4. Banerjee, P. K. "Introduction to Biostatistics (A Textbook of Biometry)". New Delhi: S. Chand and Company, 2007
5. Campbell, R. C. "Statistics for Biology". Cambridge: Cambridge University Press, 1967
6. Ghosh, Z., Mallick, B. "Bioinformatics: Principles and Applications". Noida: OUP India, 2008
7. Huber, W., Holmes, S. "Modern Statistics for Modern Biology". Cambridge: Cambridge University Press, 2018
8. Mendiratta, N., Rastogi, P., Rastogi, S.C. "Bioinformatics: Methods and Applications: Genomics, Proteomics and Drug Discovery". New Delhi: PHI Learning, 2022
9. Prasad, S. "Elements of Biostatistics: For Undergraduate Students". Meerut: Rastogi Publications, 2012
10. Satyanarayana, L., Indrayan, A. "Biostatistics for Medical, Nursing and Pharmacy Students". New Delhi: Prentice-Hall of India, 2006
11. Singh, R. "Bioinformatics: Genomics and Proteomics". Noida: Vikas Publishing House Pvt. Ltd., 2014

Evaluation Pattern:

Total Marks: 50

Internal Continuous Evaluation: (25 Marks)	End Semester Examination: (25 Marks)
• Student Attendance- 5 marks • Student performance- 5 marks • Journal- 5 marks • Viva voce- 10 marks	• Question -1 • Question -2 • Question -3 • Question - 4

	Karmaveer Bhaurao Patil University, Satara (A State Public University Est. u/s 3(6) of MPUA 2016) Faculty of Science and Technology	
	Yashavantrao Chavan Institute of Science, Satara	
	Board of Studies in Botany	
	Programme: B. Sc.	Semester – VI
	Type: DSE P	Marks: 50
	Credits: 2	From: A. Y. 2026-27
	Name of the Course: BSTP 367 Practical's based on Theory paper BSTT 365	

Course Objectives: By the end of the course, students will be able to:

1. Understand the principles of industrial microbiology, fermentation processes, bioreactor design, and downstream processing.
2. Develop practical skills in the production and analysis of microbial products such as alcohols, organic acids, enzymes, and antibiotics.
3. Apply microbiological techniques for environmental analysis, including bioremediation, wastewater treatment, and study of microbial communities.
4. Enhance analytical abilities in evaluating microbial roles in agriculture, pollution control, and emerging fields such as metagenomics and synthetic biology.

Course Outcomes: By the end of the course, students should be able to:

1. Explain and perform basic fermentation processes and operate laboratory-scale bioreactor systems.
2. Isolate, produce, and evaluate industrially important microbial products and assess their quality.
3. Analyze and interpret environmental samples for microbial activity, including nutrient cycling, bioremediation, and wastewater treatment.
4. Evaluate and apply microbial technologies in agriculture, environmental sustainability, and emerging biotechnological applications.

Practical No.	Title and Contents	No. of hours per practical
1.	Demonstration and comparison of batch, fed-batch, and continuous fermentation using schematic models or case studies.	04
2.	Study of laboratory-scale bioreactor/fermenter components and their functions (impeller, aeration, pH, temperature control).	04
3.	Determination of growth curve of bacteria/yeast and identification of lag, log, stationary, and death phases.	04
4.	Demonstration of filtration, centrifugation, and solvent extraction for product recovery.	04
5.	Fermentation of sugars using <i>Saccharomyces</i> and estimation of alcohol production.	04
6.	Production and quantitative estimation of organic acids (e.g., citric acid) by microbial fermentation.	04
7.	Screening of antibiotic-producing microorganisms: Isolation and screening using agar diffusion method (zone of inhibition).	04
8.	Production of industrial enzymes (e.g., amylase) and their activity assay.	04
9.	Demonstration or case study-based analysis of microbial synthesis	04

	of bioplastics (PHA) or bioethanol.	
10.	Microbial load determination (CFU count) and contamination analysis in industrial samples.	04
11.	Isolation of nitrogen-fixing or phosphate-solubilizing bacteria from soil samples.	04
12.	Screening of microorganisms for degradation of pollutants (e.g., hydrocarbons or dyes).	04
13.	Determination of BOD/COD or microbial analysis of wastewater samples.	04
14.	Isolation and characterization of plant growth-promoting rhizobacteria.	04
15.	Observation/analysis of halophiles or thermophiles OR demonstration of metagenomic data analysis using available datasets.	04

Reference Books: -

1. Atlas, R.M., Bartha, R. "Microbial Ecology: Fundamentals and Applications". USA: Addison Wesley Longman, 1998
2. Casida, L.E. "Industrial Microbiology". New York: Wiley Eastern Limited, 1968
3. Pelczar, M.J., Chan, E.C.S., Krieg, N.R. "Microbiology: Concepts and Applications". New York: McGraw-Hill, 1993
4. Prescott, L.M., Harley, J.P., Klein, D.A. "Microbiology". New York: McGraw-Hill, 2008
5. Singh, D.P., Singh, H.B. "Microbial Bioremediation". Berlin: Springer, 2013
6. Stanbury, P.F., Whitaker, A., Hall, S.J. "Principles of Fermentation Technology". Oxford: Pergamon Press, 1995
7. Subba Rao, N.S. "Soil Microorganisms and Plant Growth". New Delhi: Oxford & IBH Publishing, 1995

Evaluation Pattern:

Total Marks: 50

Internal Continuous Evaluation: (25 Marks)	End Semester Examination: (25 Marks)
• Student Attendance- 5 marks • Student performance- 5 marks • Journal- 5 marks • Viva voce- 10 marks	• Question -1 • Question -2 • Question -3 • Question - 4

	Karmaveer Bhaurao Patil University, Satara (A State Public University Est. u/s 3(6) of MPUA 2016) Faculty of Science and Technology	
	Yashavantrao Chavan Institute of Science, Satara	
	Board of Studies in Botany	
	Programme: B. Sc.	Semester – VI
	Type: VSC IV	Marks: 50
	Credits: 2	From: A. Y. 2026-27
	Name of the Course: BSTPVSC IV: Advanced Botanical Skills IV (Practical Based Course: Molecular Biology Techniques)	

Course Objectives: By the end of the course, students will be able to:

1. Explain the principles behind molecular techniques such as DNA isolation, gel electrophoresis, PCR, and protein estimation methods.
2. Perform nucleic acid and protein isolation, quantification, and analysis using standard molecular biology protocols.
3. Evaluate the quality and purity of nucleic acids and proteins using spectrophotometry, gel electrophoresis, and chromatographic techniques.
4. Design experimental workflows involving gene expression analysis, protein profiling, and molecular docking for plant research.

Course Outcomes: By the end of the course, students should be able to:

1. Recall and explain key concepts of molecular techniques such as PCR, DNA fingerprinting, PAGE, and protein purification.
2. Isolate genomic/plasmid DNA and proteins, quantify them, and analyze purity and integrity using electrophoretic and spectrophotometric methods.
3. Analyze DNA/protein data, evaluate experimental results such as A260/A280 ratios or gel profiles, and interpret gene expression patterns from RT-qPCR.
4. Construct a mini-project or protocol involving DNA/protein analysis and in silico protein docking to investigate a plant molecular biology question.

Practical No.	Title and Contents	No. of hours per practical
1.	Isolation of plant genomic DNA.	04
2.	Isolation of plasmid DNA.	04
3.	Estimation of plant genomic DNA.	04
4.	Determination of nucleic acid purity (A260/A280 ratio).	04
5.	Agarose gel electrophoresis.	04
6.	Demonstration of Polymerase Chain Reaction (PCR) using thermal cycler.	04
7.	Demonstration of DNA fingerprinting.	04
8.	Demonstration of restriction digestion and ligation.	04
9.	Demonstration of gene expression using real time PCR (RT qPCR).	04
10.	Estimation of protein concentration using Lowry method.	04
11.	Estimation of protein concentration using the Bradford method.	04
12.	Demonstration of protein purification using column chromatography.	04
13.	Protein separation and analysis using Polyacrylamide Gel	04

	Electrophoresis (PAGE).	
14.	Protein profiling in plant samples using SDS-PAGE.	04
15.	Demonstration of 2D protein profiling	04
16.	Demonstration of protein docking.	04
Reference Books:- 1. Carson, S., Miller, H., Srougi, M.C., Witherow, D.S. "Molecular Biology Techniques: A Classroom Laboratory Manual". Cambridge: Academic Press Inc., 2019 2. Hames, B.D., Rickwood, D. "Gel Electrophoresis of Proteins: A Practical Approach". Oxford: Oxford University Press, 1981 3. Innis, M.A., Gelfand, D.H., Sninsky, J.J. "PCR Protocols: A Guide to Methods and Applications". Cambridge: Academic Press Inc., 1990 4. Sambrook, J., Russell, D.W. "Molecular Cloning: A Laboratory Manual". U.S.A.: Cold Spring Harbor Laboratory Press, 2000 5. Scopes, R.K. "Protein Purification: Principles and Practice". New York: Springer-Verlag Inc., 1993 6. Wilson, K., Walker, J. "Principles and Techniques of Biochemistry and Molecular Biology". Cambridge: Cambridge University Press, 2010		
Evaluation Pattern:		
Total Marks: 50		
Internal Continuous Evaluation: (25 Marks) • Student Attendance- 5 marks • Student performance- 5 marks • Journal- 5 marks • Viva voce- 10 marks		End Semester Examination: (25 Marks) • Question -1 • Question -2 • Question -3 • Question - 4

	Karmaveer Bhaurao Patil University, Satara (A State Public University Est. u/s 3(6) of MPUA 2016) Faculty of Science and Technology	
	Yashavantrao Chavan Institute of Science, Satara	
	Board of Studies in Botany	
	Programme: B. Sc.	Semester – VI
	Type: SEC III	Marks: 50
	Credits: 2	From: A. Y. 2026-27
	Name of the Course: BSTPSEC III: Artificial Intelligence in Seed Technology	

Course Objectives: By the end of the course, students will be able to:

1. Understand the principles and applications of artificial intelligence tools in plant identification and biodiversity studies.
2. Develop practical skills in field survey, plant documentation, and the use of AI-enabled mobile applications for species identification.
3. Apply quantitative methods for analyzing plant diversity using indices such as alpha, beta, and gamma diversity.
4. Enhance analytical and digital competencies through database creation, QR code generation, and evaluation of conservation status of plant species.

Course Outcomes: By the end of the course, students should be able to:

1. Use and evaluate AI-based tools for accurate plant identification and biodiversity assessment.
2. Conduct field surveys and analyze plant diversity using appropriate ecological indices.
3. Develop and manage digital plant databases and generate QR codes for scientific documentation and dissemination.
4. Assess and interpret the conservation status of plant species and propose suitable conservation strategies.

Practical No.	Title and Contents	No. of hours per practical
1.	Study of AI-based mobile applications for plant identification (Compare 2–3 apps; evaluate accuracy, features, limitations)	04
2.	Field survey of plant diversity in three local areas (Systematic sampling, GPS tagging, photographic documentation)	04
3.	Quantitative analysis of biodiversity (Calculation of alpha, beta, and gamma diversity indices)	04
4.	Validation of AI-based identification (Compare AI results with standard floras/taxonomic keys important academic addition)	04
5.	Development of digital plant database (Include scientific name, family, habit, location, uses, images)	04
6.	Generation and application of QR codes (Link QR codes to plant database; field labeling concept)	04
7-10.	Project Work: AI-based plant diversity assessment project ➤ Survey, identification using AI tools ➤ Data validation and error analysis ➤ Preparation of a structured report (with maps, tables, graphs)	16

11-13.	Conservation Status Assessment ➤ Assessment using IUCN categories ➤ Identification of rare, endangered, or invasive species ➤ Documentation of threats and conservation needs	12
14.	Case study on local conservation strategies (Protected areas, sacred groves, agroforestry systems, etc.)	04
15.	Data visualization and presentation (Graphs, charts, diversity indices, and digital reporting using Excel or similar tools)	04
Reference Books: - 1. Bonnet, P., Joly, A., Davis, C. "Plant biodiversity science in the era of artificial intelligence. Lausanne: Frontiers Media SA., 2022 2. Qiao, Y., Valente, J., Zhang, Z., Su, D., He, D. "AI, sensors and robotics in plant phenotyping and precision agriculture. Lausanne: Frontiers Media SA., 2022 3. Zhou, Y., Xia, Q., Zhang, Z., Quan, M., Li, H. "Artificial intelligence and machine learning for the green development of agriculture in the emerging manufacturing industry in the IoT platform, Acta Agriculturae Scandinavica, Section B Soil & Plant Science, 2022; 72:284-299.		
Evaluation Pattern:		
Total Marks: 50		
Internal Continuous Evaluation: (25 Marks) • Student Attendance- 5 marks • Student performance- 5 marks • Journal- 5 marks • Viva voce- 10 marks		End Semester Examination: (25 Marks) • Question -1 • Question -2 • Question -3 • Question - 4

	Karmaveer Bhaurao Patil University, Satara (A State Public University Est. u/s 3(6) of MPUA 2016) Faculty of Science and Technology	
	Yashwantrao Chavan Institute of Science, Satara	
	Board of Studies in Botany	
	Programme: B. Sc.	Semester – VI
	Type: CC	Marks: 50
	Credits: 2	From: A. Y. 2026-27
Name of the Course: BSTTCC I National Service Scheme		
Course Objectives: By the end of the course, students will be able to: 1. Describe the basic concepts of NSS, including its motto, symbol, aims, objectives, and organizational structure. 2. Explain and apply the principles of NSS programs and activities in community engagement, including village adoption and special camping programs. 3. Analyze the factors affecting national integration and evaluate the role of NSS in overcoming social, cultural, and regional barriers. 4. Develop and organize special programs related to legal awareness, health, first aid, leadership, and community development.		
Course Outcomes: By the end of the course, students should be able to: 1. Identify and explain the fundamental concepts, structure, and functions of NSS. 2. Participate effectively in NSS regular activities and implement community-based programs such as special camps and outreach initiatives. 3. Examine issues related to national integration and assess the impact of social barriers and NSS interventions. 4. Design and execute awareness programs (legal, health, first aid, leadership) and demonstrate leadership and teamwork skills in community service.		
Module	Title and Contents	Hrs.
Module 1	Module 1: Introduction to Basic concept of NSS 1.1. Basic of NSS, the motto, Symbol, Badge, Symbol, NSS song, 1.2. Aims and objective of NSS. 1.3. Classification of NSS program 1.4. Organizational structure, roles, and responsibilities of various, 1.5. NSS functionaries.	08
Module 2	Module 2: NSS Program and activities 2.1. NSS Regular activities in adopted villages, Slums and with Voluntary Organizations 2.2. Contributions of Special Camping Program, Planning and preparation of special camping program 2.3. Guidelines for the success of Camp	07

	2.4. Importance of a successful camping program 2.5. Organization, administration. 2.6. Involvement in community.	
Module 3	Module 3: National Integration 3.1. Introduction 3.2. Need for National integration 3.3. Various obstacles in the way of National Integration: caste, religion, language, and provisional problems etc.	08
Module 4	Module 4: Special Program 4.1. Legal awareness 4.2. Health awareness 4.3. First-aid 4.4. Career guidance 4.5. Leadership training - cum - Cultural Program 4.6. Globalization and its Economic Social Political and Cultural impacts	07
Reference Books: - 1. Ahuja, R. "Social Problems in India". South Asia Books, 2014 2. Dubal, R.S., Gaikwad, M.N. "Handbook of NCC". Pune: Tanvi Prakashan, 2020 3. NSS Handbook & Action Plan. Bharath University Chennai, 2017-18		
Evaluation Pattern:		
Total Marks: 50		
Internal Continuous Evaluation: (20 Marks) • CCE I • CCE II • CCE III		End Semester Examination: (30 Marks) • Question -1 • Question -2 • Question -3

	Karmaveer Bhaurao Patil University, Satara (A State Public University Est. u/s 3(6) of MPUA 2016) Faculty of Science and Technology	
	Yashavantrao Chavan Institute of Science, Satara	
	Board of Studies in Botany	
	Programme: B. Sc.	Semester – VI
	Type: FP	Marks: 50
	Credits: 2	From: A. Y. 2026-27
Name of the Course: BSTPFP-I: Field Project in Seed Technology		
Course Objectives: By the end of the course, students will be able to: 1. Identify and classify local flora using standard taxonomic principles. 2. Design and conduct field-based research related to plant ecology, diversity, or conservation. 3. Analyze and interpret ecological and botanical data gathered during fieldwork. 4. Communicate scientific findings effectively through written reports and presentations.		
Course Outcomes: By the end of the course, students should be able to: 1. Recognize and differentiate plant species in their natural habitat and classify them up to family level using dichotomous keys and floras. 2. Formulate research questions, design a field study, and implement data collection protocols to investigate ecological or botanical phenomena. 3. Analyze field data using basic statistical methods and interpret patterns and relationships within the context of ecological principles. 4. Prepare a structured project report, present findings clearly, and defend their conclusions with scientific reasoning and visual aids.		
Practical No.	Title and Contents	No. of hours per practical
1.	Field Project Proposal Writing and Presentation	04