



Karmaveer Bhaurao Patil University, Satara

**Syllabus for
B. Sc. III (Botany)**

**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 Botany

PREAMBLE:

The B.Sc. Botany 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. Botany 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 botany. 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 botany, 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. (Botany) 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: **Botany**

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

3. DURATION: **01 year**

4. PATTERN: **Semester examination**

5. MEDIUM OF INSTRUCTION: **English**

6. 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 - One Papers out of two for each semester.

7. COURSE TITLE

1) Fifth Semester

Sr. No.	Vertical	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	BBT 351	Microbiology & Plant Pathology	2	2	BBP 356	1	2
2.	DSC II	BBT 352	Cell Biology	2	2			
3.	DSC III	BBT 353	Taxonomy of Angiosperms	2	2			
4.	DSE I	BBT 354	Plant Physiology	2	2	BBP 357	1	2
5.	DSE I	BBT 355	Horticultural techniques					
6.	AEC	AEC III	English	2	2	--	--	--
7.	VSC	--	--	--	--	BBPVSC III	1	2
8.	SEC	--	--	--	--	--	--	--
9.	CEP	--	--	--	--	BBPCEP I	1	2
10.	OJT	--	--	--	--	BBPOJT I	2	4

2) Sixth Semester

Sr. No.	Vertical	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	BBT 361	Genetics & Plant Breeding	2	2	BBP 366	1	2
2.	DSC II	BBT 362	Plant Molecular Biology	2	2			
3.	DSC III	BBT 363	Plant Biotechnology	2	2			
4.	DSE I	BBT 364	Bioinformatics & Biostatistics	2	2	BBP 367	1	2
5.	DSE I	BBT 365	Industrial and Environmental Microbiology					
6.	AEC	AEC IV	English	2	2	--	--	--
7.	VSC	--	--	--	--	BBPVSC IV	1	2
8.	SEC	--	--	--	--	BBPSEC III	1	2
9.	CC	BBTCCI	--	2	2	--	--	--
10.	FP	--	--	--	--	BBPFP I	1	2

8. EVALUATION STRUCTURE:

- Internal evaluation of theory papers shall carry a weightage of 40%.
- For the internal evaluation of theory papers, departments have the flexibility to adopt a variety of assessment methods, including class tests, assignments, record books, tutorials, seminars, case studies, fieldwork, project work, quizzes, and similar tools for CCE I and CCE II.
- CCE III shall consist of multiple-choice questions.
- Each CCE will carry 10 marks for 2-credit theory papers and 20 marks for 4-credit theory papers, and the best two scores will be considered for final mark entry.
- Internal evaluation of practical papers shall carry a weightage of 50%.
- For practical examinations, internal evaluation will be based on student performance, attendance, journal records, and viva voce.

Semester V (5.5)

Vertical	Course Category	Course Code	Internal Evaluation			ESE	Total Marks	Credits
			CCE-I	CCE-II	CCE-III			
DSC	T	BBT 351	10	10	10	30	50	02
	T	BBT 352	10	10	10	30	50	02
	T	BBT 353	10	10	10	30	50	02
	P	BBP 356	25			25	50	02
DSE (1 Theory Papers Out of 2)	T	BBT 354	10	10	10	30	50	02
	T	BBT 355	10	10	10	30	50	02
	P	BBP 357	25			25	50	02
AEC	T	AEC III	10	10	10	30	50	02
VSC	P	BBPVSC III	25			25	50	02
CEP	P	BBPCEP I	25			25	50	02
OJT	P	BBPOJT 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	BBT 361	10	10	10	30	50	02
	T	BBT 362	10	10	10	30	50	02
	T	BBT 363	10	10	10	30	50	02
	P	BBP 366	25			25	50	02
DSE (1 Theory Papers Out of 2)	T	BBT 364	10	10	10	30	50	02
	T	BBT 365	10	10	10	30	50	02
	P	BBP 367	25			25	50	02
AEC	T	AEC IV	10	10	10	30	50	02
VSC	P	BBPVSC IV	25			25	50	02
SEC	P	BBPSEC III	25			25	50	02
CC	T	BBPCC I	10	10	10	30	50	02
FP	P	BBPFP 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

9. 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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	Board of Studies in Botany	
	Programme: B. Sc.	Semester – V
	Type : DSC	Marks: 50
	Credits : 2	From: A. Y. 2026-27
Name of the Course: BBT 351 Microbiology and Plant Pathology		
Course Objectives: By the end of the course, students will be able to:		
1. Recall fundamental concepts of microbiology, including microbial diversity and their roles in ecosystems. 2. Understand the principles of microbial genetics, including gene structure, mutation, and genetic recombination. 3. Explain the basics of plant pathology, including pathogen interactions and mechanisms of disease development. 4. Apply knowledge to identify and classify plant diseases based on symptoms and causal organisms.		
Course Outcomes: By the end of the course, students should be able to:		
1. Analyze the significance of microorganisms in agriculture, industry, and environmental processes. 2. Evaluate genetic variations in microorganisms and their applications in biotechnology and disease control. 3. Diagnose plant diseases by assessing symptoms and identifying pathogens. 4. Develop effective disease management strategies using biological, chemical, and integrated approaches.		
Module	Title and Contents	Hrs.
Module 1	Module 1: Microbiology 1.1 General characters of microbes: Bacteria, Viruses, Actinomycetes and Phytoplasma 1.2 Methods in Microbiology: Staining for microbes-bacteria and, PPLO, Sterilization Methods, Pure Culture Techniques 1.3 Industrial Microbiology: Applications of micro-organisms with reference to production of Antibiotics (Penicillin), Organic Acids (Lactic Acid), Alcohol (Ethyl Alcohol), Microbial Pesticides: Concept, Types and Significance	08
Module 2	Module 2: Microbial Genetics 2.1 Bacterial genome 2.2 Recombination in Bacteria: Transformation and Transduction 2.3 DNA and RNA viruses	07

	2.4 Importance of microbial genetics	
Module 3	Module 3: Plant Pathology 3.1 Concept and Importance of Plant Pathology, General symptoms of plant diseases 3.2 Transmission of Pathogen: Air, Seed, Soil and Water 3.3 Methods of plant disease management: Physical, Mechanical, Chemical and Biological 3.4 Role of quarantine in plant disease management	08
Module 4	Module 4: Study of Plant diseases 4.1 Phytoplasma – Grassy shoot disease of Sugarcane. 4.2 Viral – Yellow vein mosaic of Bhendi. 4.3 Bacterial – Citrus canker. 4.4 Fungal – a) Downy mildew of Bajara, b) Leaf spot of Turmeric, c) Grain Smut of Jowar, d) Anthracnose of Bean.	07
Reference Books:- 1. Agrios, G.N. "Plant Pathology". New York: Academic Press, 2005 2. Casida, L.E.J.R. "Industrial Microbiology". New Delhi: New Age International Private Limited, 2019 3. Dileep, C., Reshma, T.S. "Plant Protection and Plant Health Management". New Delhi: MedTech Science Press, 2024 4. Madigan, M.T., Martinko, J.M., Bender, K.S., Buckley, D.H., Stahl, D.A. "Brock Biology of Microorganisms". Chennai: Pearson Education, 2017 5. Schlegel, H.G., Ebner, G.T.V.M., Deaner. "General Microbiology". Cambridge: Cambridge University Press, 2008 6. Sharma, P.D. "Plant Pathology". Meerut: Rastogi Publications, 2016 7. Singh, R.S. "Principles of Plant Pathology". New Delhi: MedTech Science Press, 2017 8. Tortora, G., Funke, B., Case, C., Weber, D., Bair, W. "Microbiology: An Introduction" New York: Addison-Wesley, 2018 9. Willey, J., Sherwood, L., Woolverton, C. "Prescott's Microbiology". New York: McGraw-Hill Education, 2020		
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

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	Yashwantrao Chavan Institute of Science, Satara	
	Board of Studies in Botany	
	Programme: B. Sc.	Semester – V
	Type : DSC	Marks: 50
	Credits : 2	From: A. Y. 2026-27
Name of the Course: BBT 352 Cell Biology		

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

1. Recall the fundamental concept of the cell as the basic unit of life, including its structure and functions.
2. Understand the role of the cytoskeleton in maintaining cell shape, movement, and intercellular interactions.
3. Describe the structure and functions of subcellular organelles and their roles in cellular metabolism.
4. Explain the stages of the cell cycle and mechanisms of cell division, including mitosis and meiosis.

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

1. Analyze the structural and functional organization of prokaryotic and eukaryotic cells.
2. Evaluate the significance of the cytoskeleton in intracellular transport, signaling, and cell communication.
3. Compare and contrast the roles of different subcellular organelles in maintaining cellular homeostasis.
4. Demonstrate the ability to differentiate between various cell division processes and predict their biological consequences.

Module	Title and Contents	Hrs.
Module 1	Module 1: Cell as a unit of life 1.1 History of cell biology 1.2 Prokaryotic and Eukaryotic cell (Ultrastructure) 1.3 Cell membrane: Structure, Lipid bilayer, Fluid Mosaic Model, Role 1.4 Cytoplasm: Composition and role 1.5 Nucleus: Structure and role, Nuclear Envelope, Nuclear Pore Complex, DNA Packaging in Eukaryotes	08
Module 2	Module 2: The Cytoskeleton and Cellular Interaction 2.1 Microfilaments, Intermediate filaments and Microtubules: Structure and Role 2.2 Cell wall: Structure, Composition and Role 2.3 Cell to cell interaction: Symplastic and Apoplastic pathway	07

Module 3	Module 3: Sub Cellular Structures 3.1 Mitochondria and Chloroplasts: Structure and Role 3.2 Endoplasmic Reticulum, Golgi body and Lysosomes: Structure and Role 3.3 Peroxisomes and Glyoxysomes: Structure and Role	08
Module 4	Module 4: Cell Cycle and Cell division 4.1 Cell cycle and its phases 4.2 Cell division: Mitosis and Meiosis with their significance 4.3 Apoptosis and autophagy	07

Reference Books:-

1. Alberts B., Johnson A., Lewis J., Morgan, D., Raff, M., Roberts, K., Walter, P. "Molecular Biology of the Cell". New York: Garland Science, 2014
2. 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
3. Berk, A., Kaiser, C.A., Lodish, H., Amon, A., Ploegh, H., Brestcher, A., Krieger, M., Martin, K.C. "Molecular Cell Biology". USA: W. H. Freeman & Co Ltd., 2016
4. Cooper, G.M., Hausman, R.E. "The Cell: A Molecular Approach". Sunderland: Sinauer Associates Inc., 2013
5. Johnson, G., Lippincott-Schwartz, J., Pollard, T.D., Earnshaw, W.C. "Cell Biology". Amsterdam: Elsevier - Health Sciences Division, 2017
6. Karp, G., Iwasa, J., Marshall, W. "Cell and Molecular Biology: Concepts and Experiments". New York: John Wiley & Sons Inc., 2020
7. Plopper, G. Ivankovic, D.B. "Principles of Cell Biology". Burlington: Jones and Bartlett Publishers, Inc., 2020

Evaluation Pattern:

Total Marks: 50

Internal Continuous Evaluation: (20 Marks)	End Semester Examination: (30 Marks)
• CCE I • CCE II • CCE III	• Question -1 • Question -2 • Question -3

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	Board of Studies in Botany	
	Programme: B. Sc.	Semester – V
	Type : DSC	Marks: 50
	Credits : 2	From: A. Y. 2026-27
Name of the Course: BBT 353 Taxonomy of Angiosperms		

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

1. Recall fundamental concepts of plant taxonomy and systematics, including their significance in botanical studies.
2. Understand the principles of hierarchical classification and the species concept.
3. Identify different types of taxonomic evidence used in plant classification, including morphological, anatomical, and molecular data.
4. Apply taxonomic keys and classification principles to study and differentiate plant families.

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

1. Analyze the role of taxonomy and systematics in biodiversity conservation and plant identification.
2. Evaluate different hierarchical classification systems and their relevance in modern plant taxonomy.
3. Interpret taxonomic evidence from multiple sources to determine phylogenetic relationships among plant species.
4. Classify and describe plant families based on diagnostic morphological and anatomical characteristics.

Module	Title and Contents	Hrs.
Module 1	Module 1: Plants, Taxonomy and Systematics 1.1 Plants and Kingdoms of Life • Two Kingdom System • Two Empires Three Kingdoms • Five Kingdom System • Six or Seven Kingdoms? • The Plant Kingdom 1.2 Taxonomy and Systematics • Basic Components (Principles) of Systematics • Aims of Systematics • Advancement Levels in Systematics	08
Module 2	Module 2: Hierarchical Classification	07

	2.1 Taxonomic groups, categories and ranks 2.2 Utilization of categories 2.3 Species concept 2.4 Intraspecific ranks 2.5 Genus 2.6 Family	
Module 3	Module 3: Taxonomic Evidences 3.1 Morphology 3.2 Anatomy 3.3 Palynology 3.4 Micromorphology and ultrastructure 3.5 Chromosomes	08
Module 4	Module 4: Study of Plant Families 4.1 Study of following families with reference to systematic position (As per Bentham and Hooker's system of classification), salient features, floral formula, floral diagram and any five examples with their economic importance – Annonaceae, Brassicaceae, Myrtaceae, Rubiaceae, Solanaceae, Apocynaceae, Nyctaginaceae and Amaryllidaceae	07
Reference Books:- 1. Manilal, K.S., Muktesh Kumar, M.S. "A Handbook of Taxonomic Training". New Delhi: DST, 1998 2. Naik, V.N. "Taxonomy of Angiosperms". New Delhi: Tata McGraw-Hill Publication Com. Ltd., 1984 3. Pandey, B.P. "A Textbook of Botany: Angiosperms". New Delhi: S. Chand Publications, 2001 4. Patil, D. A. "Plant Taxonomy: Theory, Principles & Practices". Jodhpur: Scientific Publishers, 2021 5. Sharma, O. P. "Plant Taxonomy" (2nd Edition). New Delhi: Tata McGraw-Hill Publication Com. Ltd., 2017 6. Singh, G. "Plant Systematics: An Integrated Approach". Enfield NH: Science Publishers Inc., 2004		
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

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	Programme: B. Sc.	Semester – V
	Type : DSE	Marks: 50
	Credits : 2	From: A. Y. 2026-27
Name of the Course: BBT 354 Plant Physiology		
Course Objectives: By the end of the course, students will be able to: 1. Recall the fundamental concepts of plant water relations, including water potential, osmosis, and transpiration. 2. Understand the role of essential mineral nutrients in plant growth and metabolism. 3. Explain the process of photosynthesis, including light and dark reactions, and factors affecting its efficiency. 4. Describe various plant growth regulators and their role in plant development.		
Course Outcomes: By the end of the course, students should be able to: 1. Analyze the movement of water in plants and its significance in maintaining cellular functions. 2. Evaluate the role of macro- and micronutrients in plant physiology and diagnose nutrient deficiency symptoms. 3. Interpret the impact of environmental factors on photosynthetic efficiency and crop productivity. 4. Apply knowledge of plant growth regulators to enhance crop yield and improve plant development.		
Module	Title and Contents	Hrs.
Module 1	Module 1: Plant Water Relationship 1.1 Structure and physicochemical properties of water; Role of water in plant life; Forms of water in soil; Root hair as water absorbing part of the plant – movement of water in plant 1.2 Water transport processes (Mechanism of water absorption: active and passive absorption theories, water transport through xylem and tracheids) 1.3 Transpiration: Definition, types, mechanism of stomatal movements, significance of transpiration, Anti-transpirants, Guttation 1.4 Ascent of Sap- Introduction, concept, theories (cohesion of water theory; Root pressure theory)	08
Module 2	Module 2: Mineral Nutrition 2.1 Introduction; Essential elements (Macro and Micronutrients); criteria of essentiality 2.2 Mineral nutrient uptake - Passive (Diffusion), Active (Carrier Concept) 2.3 Mineral deficiencies and plant disorders; role of deficiency symptoms of	07

	N, P, K, Mn, Zn, Cobalt treating nutritional deficiencies 2.4 Role of essential elements in agriculture and horticulture	
Module 3	Module 3: Photosynthesis 3.1 Introduction; ultra-structure of chloroplast; photosynthetic pigments (Chlorophylls, Carotenoids and Phycobilins) 3.2 Mechanism of photosynthesis: a) Light reaction - Photolysis of water, Photosystem I and II, Photophosphorylation - Cyclic and Non-cyclic; b) Dark reaction: C ₃ , C ₄ and CAM pathways of carbon fixation. Significance of photosynthesis	08
Module 4	Module 4: Growth and Development 4.1 Growth: Introduction; Definition, Region of growth, Phases of growth, growth curve, Grand period of growth 4.2 Plant growth regulators: Introduction and definition; Discovery, site of synthesis, Physiological (Practical applications) roles of growth regulators – Auxins, Cytokinins, Gibberellins, Ethylene and Absciscic acid. 4.3 Reproductive growth: Concept of photoperiodism; SDP, LDP, Day neutral plants; concept of vernalization	07
Reference Books:- 1. Bidwell, R.G.S. "Plant Physiology". New York: Macmillan Pub. Co., 1974 2. Grewal, R.C. "Plant Physiology". New Delhi: Campus Books International, 2000 3. Hopkins, W.G. "Introduction to Plant Physiology". New York: John Wiley & Sons, Inc., 1995 4. Jain, V.K. "Fundamentals of Plant Physiology". New Delhi: S. Chand & Company Ltd., 2017 5. Pandey, S.N. "Plant Physiology". New Delhi: Vikas Publishing House (P) Ltd., 1991 6. Salisbury, F.B., Ross, C.W. "Plant Physiology (4 th Edition)". California: Wadsworth Publishing Co., 1992 7. Taiz, L., Zeiger, E. "Plant Physiology (2 nd Edition)" Massachusetts: Sinauer Associates Inc. Publishers, 1998 8. Verma, V. "Text Book of Plant Physiology". New Delhi: Emkay Publications, 1970		
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

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	Programme: B. Sc.	Semester – V
	Type : DSE	Marks: 50
	Credits : 2	From: A. Y. 2026-27
Name of the Course: BBT 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

	PGR's 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: (20 Marks)		End Semester Examination: (30 Marks)
• CCE I • CCE II • CCE III		• Question -1 • Question -2 • Question -3

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	Yashavantrao Chavan Institute of Science, Satara	
	Board of Studies in Botany	
	Programme: B. Sc.	Semester – V
	Type : DSC	Marks: 50
	Credits : 2	From: A. Y. 2026-27
Name of the Course: BBP 356 Practicals based on Theory paper BBT 351, BBT 352, and BBT 353		

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

1. Describe and explain the principles of media preparation, sterilization techniques, staining methods, and basic plant pathology concepts.
2. Perform microbiological techniques such as isolation of soil fungi, inoculation methods (spread, streak, stab), and preparation of herbarium specimens.
3. Examine and differentiate plant diseases based on causal organisms, symptoms, and control measures, and to analyze cellular structures using microscopic techniques.
4. Evaluate taxonomic characters of plant families and construct systematic identification using local flora and morphological observations.

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

1. Prepare and sterilize culture media, perform staining techniques, and apply microbial inoculation methods accurately.
2. Isolate and identify soil fungi, analyze plant diseases with respect to symptoms, etiology, and control strategies.
3. Examine cell structures, perform micrometry, karyotype analysis, and evaluate anatomical and cytological features.
4. Classify plants based on morphological traits, prepare herbarium specimens, and identify genus and species using taxonomic keys and local flora.

Practical No.	Title and Contents	No. of hours per practical
1.	Preparation and sterilization of potato dextrose agar medium.	04
2.	Isolation and separation of soil fungi by serial dilution method.	04
3.	Inoculation of microorganisms using spread plate, streak plate and stroke/stab techniques.	04
4.	Study of different types of stains: Cotton blue, Dien's stain, Gram's stain and other stains.	04
5.	Study of plant diseases w.r.t. causal organism, symptoms, effects and control measure: Grassy Shoot disease of Sugarcane; Citrus Canker; Yellow Vein Mosaic of Bhendi; White Rust of Crucifers; Early leafspot (Tikka) disease of ground nut	04
6.	To measure the length and breadth of the given cell sample by using micrometer.	04
7.	Study of cell structure in Onion, Hydrilla leaf and Spirogyra filament.	04
8.	To identify the different types cells present in the leaf cross section.	04

9.	Study of karyotype analysis using suitable plant material or photographs.	04
10.	Isolation of chloroplast from plants.	04
11.	Study of flowering twig morphology.	04
12.	Study of vegetative and floral characters of Family Annonaceae, Brassicaceae, Myrtaceae, and Rubiaceae.	04
13.	Study of vegetative and floral characters of Family Solanaceae, Apocynaceae, Nyctaginaceae and Amaryllidaceae.	04
14.	Study of preparation of herbarium.	04
15.	Identification of genus and species using local flora.	04
16.	Submission of local plant herbarium /crop diseases (any ten).	04

Reference Books:-

1. Agrios, G.N. "Plant Pathology". New York: Academic Press, 2005
2. 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
3. Dileep, C., Reshma, T.S. "Plant Protection and Plant Health Management". New Delhi: MedTech Science Press, 2024
4. Karp, G., Iwasa, J., Marshall, W. "Cell and Molecular Biology: Concepts and Experiments". New York: John Wiley & Sons Inc., 2020
5. Manilal, K.S., Muktesh Kumar, M.S. "A Handbook of Taxonomic Training". New Delhi: DST, 1998
6. Naik, V.N. "Taxonomy of Angiosperms". New Delhi: Tata McGraw-Hill Publication Com. Ltd., 1984
7. Pandey, B.P. "A Textbook of Botany: Angiosperms". New Delhi: S. Chand Publications, 2001
8. Patil, D. A. "Plant Taxonomy: Theory, Principles & Practices". Jodhpur: Scientific Publishers, 2021
9. Schlegel, H.G., Ebner, G.T.V.M., Deaner. "General Microbiology". Cambridge: Cambridge University Press, 2008
10. Sharma, O. P. "Plant Taxonomy" (2nd Edition). New Delhi: Tata McGraw-Hill Publication Com. Ltd., 2017
11. Sharma, P.D. "Plant Pathology". Meerut: Rastogi Publications, 2016
12. Singh, G. "Plant Systematics: An Integrated Approach". Enfield NH: Science Publishers Inc., 2004
13. Singh, R.S. "Principles of Plant Pathology". New Delhi: MedTech Science Press, 2017



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

Marks: 50

Credits : 2

From: A. Y. 2026-27

Name of the Course: BBP 357 Practicals based BBT 355 Plant Physiology

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

1. Describe and explain fundamental principles of plant water relations, mineral nutrition, photosynthesis, and growth through laboratory-based experiments.
2. Perform and demonstrate physiological experiments such as osmosis, transpiration, photosynthesis, respiration, enzyme activity, and chromatographic separation techniques.
3. Analyze experimental data related to enzyme kinetics, growth patterns, and physiological processes, and differentiate plant responses under varying environmental conditions.
4. Evaluate experimental outcomes and design simple experiments or modifications to study plant physiological processes and interpret results scientifically.

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

1. Perform basic plant physiology experiments (osmosis, transpiration, photosynthesis, respiration) and explain underlying principles.
2. Conduct enzyme assays and chromatographic techniques, and analyze the effect of environmental factors such as pH, temperature, and light on plant processes.
3. Interpret experimental results, including growth curves, nutrient deficiency symptoms, and physiological responses, and evaluate plant performance under different conditions.
4. Demonstrate laboratory skills, maintain records, and critically assess experimental procedures and outcomes in plant physiology.

Practical No.	Title and Contents	No. of hours per practical
1.	Demonstration of osmosis using potato osmometer / dialysis membrane.	04
2.	Determination of water potential of plant tissue by plasmolytic method.	04
3.	Demonstration of stomatal movement and study of stomatal index using leaf peels.	04
4.	Study of deficiency symptoms of essential nutrients (N, P, K, Mn, Zn, Co) using charts/specimens.	04
5.	Demonstration of hydroponic culture for mineral nutrient uptake (theory-based practical/demonstration).	04
6.	Separation of photosynthetic pigments by paper chromatography / TLC.	04
7.	Study of rate of photosynthesis using Wilmott's bubbler / aquatic plant method.	04
8.	Demonstration of photolysis of water and oxygen evolution	04

	(Hydrilla experiment).	
9.	Study of growth curve by measuring seedling growth over time.	04
10.	Demonstration of effect of plant growth regulators (Auxin-induced cell elongation experiment).	04
11.	Study of photoperiodism (long day/short day plant response – demonstration).	04
12.	Determination of respiration rate during seed germination using Ganong's respirometer.	04
13.	Separation of amino acids by TLC.	04
14.	Study of effect of pH on dehydrogenase enzyme activity.	04
15.	Study of effect of temperature on catalase enzyme activity.	04

Reference Books:-

1. Bidwell, R.G.S. "Plant Physiology". New York: Macmillan Pub. Co., 1974
2. Grewal, R.C. "Plant Physiology". New Delhi: Campus Books International, 2000
3. Hopkins, W.G. "Introduction to Plant Physiology". New York: John Wiley & Sons, Inc., 1995
4. Jain, V.K. "Fundamentals of Plant Physiology". New Delhi: S. Chand & Company Ltd., 2017
5. Pandey, S.N. "Plant Physiology". New Delhi: Vikas Publishing House (P) Ltd., 1991
6. Salisbury, F.B., Ross, C.W. "Plant Physiology (4th Edition)". California: Wadsworth Publishing Co., 1992
7. Taiz, L., Zeiger, E. "Plant Physiology (2nd Edition)" Massachusetts: Sinauer Associates Inc. Publishers, 1998
8. Verma, V. "Text Book of Plant Physiology". New Delhi: Emkay Publications, 1970

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	Faculty of Science and Technology	
	Yashwantrao Chavan Institute of Science, Satara	
	Board of Studies in Botany	
	Programme: B. Sc.	Semester – V
	Type : DSE	Marks: 50
	Credits : 2	From: A. Y. 2026-27
Name of the Course: BBP 357 Practicals based BBT 354 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

	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 – V
	Type : VSC	Marks: 50
	Credits : 2	From: A. Y. 2026-27
Name of the Course: BBPVSC 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

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	Yashwantrao Chavan Institute of Science, Satara	
	Board of Studies in Botany	
	Programme: B. Sc.	Semester – V
	Type : CEP	Marks: 50
	Credits : 2	From: A. Y. 2026-27
Name of the Course: BBPCEP-I: Community Engagement Programme in Botany		
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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	Yashwantrao Chavan Institute of Science, Satara	
	Board of Studies in Botany	
	Programme: B. Sc.	Semester – V
	Type : OJT	Marks: 50
	Credits : 2	From: A. Y. 2026-27
Name of the Course: BBPOJT-I: On-Job-Training in Botany		
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

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	Programme: B. Sc.	Semester – VI
	Type : DSC	Marks: 50
	Credits : 2	From: A. Y. 2026-27
Name of the Course: BBT 361 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 Introduction 1.2 Principles of inheritance - a) Law of Dominance; b) Law of Segregation; c) Law of Independent Assortment; d) Back Cross and Test Cross 1.3 Gene interaction - a) Complementary gene interaction b) Supplementary gene interaction 1.4 Epistasis- Introduction, Dominant Epistasis, Recessive Epistasis 1.5 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	07

	2.2 Recombination (Crossing over): Definition, types, mechanism of 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 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 Barlett Publishers, 1998 7. Singh, B.D. "A text Book of Plant Breeding: Adynamic View Designed for Under Graduate 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 11. Verma, P.S., Agarwal, V.K. S. "Cell Biology, Genetics, Evolution and Ecology". New Delhi: S. Chand and Company Ltd., 2001		

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	
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	Board of Studies in Botany	
	Programme: B. Sc.	Semester – VI
	Type : DSC	Marks: 50
	Credits : 2	From: A. Y. 2026-27
Name of the Course: BBT 362: Plant Molecular Biology		

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

1. Explain the structure, organization, and function of genomes in prokaryotic and eukaryotic systems.
2. Illustrate the mechanisms of DNA replication and the factors regulating its fidelity and efficiency.
3. Analyze the molecular mechanisms of gene expression, including transcription and translation.
4. Evaluate recent advancements in molecular biology and their applications in biotechnology and genomics.

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

1. Describe the structural and functional organization of genomes in different organisms.
2. Explain the molecular basis of DNA replication and its regulation in prokaryotic and eukaryotic cells.
3. Examine the regulatory mechanisms involved in gene expression and their role in cellular function.
4. Critically evaluate recent discoveries in molecular biology and their implications in genetic engineering, medicine, and biotechnology.

Module	Title and Contents	Hrs.
Module 1	Module 1: Genome and it's Organization 1.1 Structure and functions of Nucleic acids: Nucleosides & Nucleotides, purines and pyrimidines 1.2 Watson and Crick model of DNA structure, A, B & Z forms of DNA, Supercoiled and relaxed DNA, denaturation and renaturation of DNA, melting temperature (T _m), hyperchromic effect 1.3 Nucleosome structure and packaging of DNA into higher order structures 1.4 Structural organization of Gene 1.5 Chloroplast DNA and Mitochondrial DNA	08
Module 2	Module 2: Replication of DNA 2.1 Evidence of Semi conservative nature of DNA replication	07

	2.2 Features of DNA replication 2.3 Mechanism of DNA replication in prokaryotes 2.4 Mechanism of DNA replication in eukaryotes	
Module 3	Module 3: Gene Expression 3.1 Central dogma of cell 3.2 Types of RNA: structure and function 3.3 Gene expression: Transcription and translation process 3.4 Gene regulation: operon concept 3.5 DNA damage and repair	08
Module 4	Module 4: Recent Updates in Molecular Biology 4.1 Molecular markers and their applications 4.2 Gene editing technology 4.3 Gene silencing techniques	07
Reference Books:- 1. Alberts B., Johnson A., Lewis J., Morgan, D., Raff, M., Roberts, K., Walter, P. "Molecular Biology of the Cell". New York: Garland Science, 2014 2. Berk, A., Kaiser, C. A., Lodish, H., Amon, A., Ploegh, H., Brestcher, A., Krieger, M., Martin, K. C. "Molecular Cell Biology". USA: W. H. Freeman & Co Ltd., 2016 3. Cooper, G. M., Hausman, R. E. "The Cell: A Molecular Approach". Sunderland: Sinauer Associates Inc., 2013 4. Karp, G., Iwasa, J., Marshall, W. "Cell and Molecular Biology: Concepts and Experiments". New York: John Wiley & Sons Inc., 2020 5. Mitra, S. "Elements of Molecular Biology". New Delhi: McMillan India Ltd., 1988		
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 : DSE	Marks: 50
	Credits : 2	From: A. Y. 2026-27
Name of the Course: BBT 363: Plant 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. Develop practical skills in plant biotechnology for applications in crop improvement, genetic modification, and bioinformatics.

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

1. Perform plant tissue culture techniques, including callus induction, organogenesis, and micropropagation.
2. Demonstrate recombinant DNA techniques, including plasmid isolation, restriction digestion, and transformation methods.
3. Analyze genetic modifications using molecular markers such as RAPD, SSR, or AFLP for plant identification and diversity studies.
4. Interpret genomic and proteomic data to understand gene expression, protein profiling, and functional genomics in plants.

Module	Title and Contents	Hrs.
Module 1	Module 1: Plant Biotechnology and Plant Tissue Culture 1.1 Introduction, History, Scope and Importance 1.2 Biotechnology in India 1.3 Plant Tissue Culture: Principles (Totipotency, cellular differentiation and competency), Culture media, and specific laboratory conditions 1.4 Types of tissue culture: Micropropagation, Anther culture, Embryo culture, Organ culture, Callus culture, Cell suspension culture, Protoplast culture, Somatic Embryogenesis, Somaclonal variation	08
Module 2	Module 2: Recombinant DNA Technology 2.1 Introduction, principle and enzymes involved in recombinant DNA technology 2.2 Cloning vectors: a) Prokaryotic - Plasmid, Lambda phage and	07

	Cosmid; b) Eukaryotic-YAC [Yeast Artificial Chromosomes] 2.3 Blotting techniques: Southern blotting and Northern Blotting	
Module 3	Module 3: Genetic Engineering 3.1 Introduction 3.2 Method of Gene transfer - Agrobacterium mediated, direct gene transfer by Electroporation, Microinjection, Micro-projectile bombardment in crop biotechnology 3.3 Reporter genes, selectable marker genes 3.4 Transgenic plants – (Any 2) Bt cotton, Bt Brinjal, Golden rice, recently introduced plants	08
Module 4	Module 4: Molecular Markers, Genomics, and Proteomics 4.1 Molecular markers and their applications - RAPD, ISSR, RFLP 4.2 DNA sequencing – Sanger's dideoxy method, Maxam-Gilbert sequencing 4.3 Genomics 4.4 Proteomics	07
Reference Books:- 1. Brown, T.A. "Gene cloning - An introduction". U.K.: Chapman Hill, 2006 2. Chawla, H.S. "Introduction to Plant Biotechnology". New Delhi: Oxford and IBH Publishing, 2020 3. De, K. K. "Plant Tissue Culture". New Delhi: New Central Book Agency (P) Ltd., 2008 4. Dubey, R.C., "A Text book of Biotechnology". New Delhi: S. Chand & Co., 2005 5. Gupta, P.K. "Elements of Biotechnology (Second Edition)". Meerut Rastogi Publications, 2010 6. Nagar, S., Adhav, M. "Practical Biotechnology and Plant Tissue Culture" New Delhi: S. Chand & Co., 2010 7. Razdan, M.K. "Introduction to Plant Tissue Culture (Second Edition)". New Delhi: Oxford & IBH Publishing Co. Pvt. Ltd., 2010 8. Singh, B.D. "Biotechnology". New Delhi: Kalyani Publishers, 2010 9. Singh, B.D. "Frontier Areas in Biotechnology". New Delhi: Kalyani Publications, 2004		
Evaluation Pattern:		
Total Marks: 50		
Internal Continuous Evaluation: (20 Marks)		End Semester Examination: (30 Marks)
• CCE I • CCE II • CCE III		• 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	Marks: 50
	Credits : 2	From: A. Y. 2026-27
Name of the Course: BBT 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,	07

	Oxford nanopore, Concept working and analysis databases and 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: (20 Marks)	End Semester Examination: (30 Marks)
• CCE I • CCE II • CCE III	• 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	Marks: 50
	Credits : 2	From: A. Y. 2026-27
Name of the Course: BBT 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: (20 Marks) • CCE I • CCE II • CCE III		End Semester Examination: (30 Marks) • Question -1 • Question -2 • Question -3

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	Faculty of Science and Technology	
	Yashavantrao Chavan Institute of Science, Satara	
	Board of Studies in Botany	
	Programme: B. Sc.	Semester – VI
	Type : DSC	Marks: 50
	Credits : 2	From: A. Y. 2026-27
Name of the Course: BBP 366 Practicals based on Theory paper BBT 361, BBT 362, and BBT 363		

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

1. Understand the fundamental principles of classical and molecular genetics, including linkage, crossing over, polygenic inheritance, and chromosomal behavior during meiosis.
2. Develop skills in cytogenetic techniques such as chromosome counting, detection of meiotic abnormalities, and karyotype/idiogram preparation.
3. Perform and analyze molecular biology techniques, including DNA isolation, quantification, electrophoresis, and PCR.
4. Demonstrate practical knowledge of plant biotechnology techniques such as tissue culture, genetic transformation, and preparation of culture media.

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

1. Explain and interpret genetic phenomena such as linkage, recombination, and polygenic inheritance using experimental data.
2. Perform cytological techniques for chromosome analysis and identify meiotic abnormalities in plant systems.
3. Isolate, quantify, and evaluate DNA quality using standard molecular techniques like CTAB method, spectrophotometry, and gel electrophoresis.
4. Demonstrate and design basic plant biotechnology experiments including tissue culture, PCR, and genetic engineering approaches such as Golden Rice development.

Practical No.	Title and Contents	No. of hours per practical
1.	Genetic examples on linkage, crossing over and polygene inheritance.	04
2.	Determination of chromosome count in PMCs in <i>Allium</i> / <i>Cyanotis</i> .	04
3.	Detection of meiotic anomalies in chromosomes in <i>Tradescantia</i> .	04
4.	Preparation of idiogram by using karyotype or chromosomal photographs.	04
5.	Breeding techniques in family Malvaceae, Fabaceae, and Poaceae.	04
6.	Isolation of genomic DNA from plant leaves using the CTAB method.	04
7.	Isolation of mitochondrial DNA.	04
8.	Quantification of DNA and its purity using a spectrophotometer.	04
9.	Agarose gel electrophoresis for DNA visualization and purity check.	04
10.	Demonstration of polymerase chain reaction using thermal cycler.	04
11.	Preparation of stock solutions of MS medium.	04
12.	Preparation of plant tissue culture medium (MS).	04
13.	Demonstration of techniques of <i>in vitro</i> culture using suitable	04

	explant.	
14.	Study of genetic transformation methods.	04
15.	Study of steps in genetic engineering for the production of Golden rice with the help of photographs.	04

Reference Books:-

1. Alberts B., Johnson A., Lewis J., Morgan, D., Raff, M., Roberts, K., Walter, P. "Molecular Biology of the Cell". New York: Garland Science, 2014
2. Berk, A., Kaiser, C. A., Lodish, H., Amon, A., Ploegh, H., Brestcher, A., Krieger, M., Martin, K. C. "Molecular Cell Biology". USA: W. H. Freeman & Co Ltd., 2016
3. Brown, T.A. "Gene cloning - An introduction". U.K.: Chapman Hill, 2006
4. Chahal, G.S., Gosal, S.S. " Principles and Procedures of Plant Breeding: Biotechnological and Conventional Approaches". New Delhi: Narosa Publishing Co., 2010.
5. Chawla, H.S. "Introduction to Plant Biotechnology". New Delhi: Oxford and IBH Publishing, 2020
6. De, K. K. "Plant Tissue Culture". New Delhi: New Central Book Agency (P) Ltd., 2008
7. Hartl, D.L., Jones, E.W. "Genetics: Principles and Analysis 4th edition". Massachusetts: Jones and Barlett Publishers, 1998
8. Karp, G., Iwasa, J., Marshall, W. "Cell and Molecular Biology: Concepts and Experiments". New York: John Wiley & Sons Inc., 2020
9. Mitra, S. "Elements of Molecular Biology". New Delhi: McMillan India Ltd., 1988
10. Nagar, S., Adhav, M. "Practical Biotechnology and Plant Tissue Culture" New Delhi: S. Chand & Co., 2010
11. Razdan, M.K. " Introduction to Plant Tissue Culture (Second Edition)". New Delhi: Oxford & IBH Publishing Co. Pvt. Ltd., 2010
12. Singh, B.D. " Plant Breeding: Principles and Methods". New Delhi: Kalyani Publications, 2018
13. Singh, B.D. "A text Book of Plant Breeding: Adynamic View Designed for Under Graduate Courses of Indian Universities. 3rd edition." New Delhi: Kalyani Publications, 2011
14. Singh, B.D. "Biotechnology". New Delhi: Kalyani Publishers, 2010
15. Singh, B.D. "Cytogenetics and Plant Breeding". New Delhi: Kalyani Publications, 2010
16. Singh, B.D. "Frontier Areas in Biotechnology". New Delhi: Kalyani Publications, 2004
17. Singh, B.D. "Genetics". New Delhi: Kalyani Publications, 2009
18. Verma, P.S., Agarwal, V.K. S. "Cell Biology, Genetics, Evolution and Ecology". New Delhi: S. Chand and Company Ltd., 2001

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	Yashavantrao Chavan Institute of Science, Satara	
	Board of Studies in Botany	
	Programme: B. Sc.	Semester – VI
	Type : DSE	Marks: 50
	Credits : 2	From: A. Y. 2026-27
Name of the Course: BBP 367 Practicals based on Theory paper BBT 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)	04

	through datasets.	
9.	Retrieval and interpretation of gene expression profiles using publicly available microarray databases.	04
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

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	Yashwantrao Chavan Institute of Science, Satara	
	Board of Studies in Botany	
	Programme: B. Sc.	Semester – VI
	Type : DSE	Marks: 50
	Credits : 2	From: A. Y. 2026-27
Name of the Course: BBP 367 Practicals based on Theory paper BBT 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	04

	assay.	
9.	Demonstration or case study-based analysis of microbial synthesis of bioplastics (PHA) or bioethanol.	04
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

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	Yashavantrao Chavan Institute of Science, Satara	
	Board of Studies in Botany	
	Programme: B. Sc.	Semester – VI
	Type : VSC	Marks: 50
	Credits : 2	From: A. Y. 2026-27
Name of the Course: BBPVSC 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

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	Yashavantrao Chavan Institute of Science, Satara	
	Board of Studies in Botany	
	Programme: B. Sc.	Semester – VI
	Type : SEC	Marks: 50
	Credits : 2	From: A. Y. 2026-27
Name of the Course: BBPSEC III: Artificial Intelligence in Botany		

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	12

	➤ Assessment using IUCN categories ➤ Identification of rare, endangered, or invasive species ➤ Documentation of threats and conservation needs	
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.

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	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: BBPFP-I: Field Project in Botany		
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