



Resolution No.: Meeting-2/ Dated 18/9/2021

## **Bharatiya Vidya Bhavan's**

**M. M. College of Arts, N.M. Institute of Science, H.R.J.  
College of Commerce. (Bhavan's College) Autonomous**

**(Affiliated to University of Mumbai)**



**Syllabus for: S.Y.B.Sc BOTANY**

**Program: B.Sc.**

**Program Code: BH.BSc**

**Course Code: (BH.USBO)**

**Choice Based Credit System (CBCS)  
with effect from academic year 2022-23**



## PROGRAM OUTCOMES

PO	PO Description
	<b>A student completing Bachelor's Degree in Science program will be able to:</b>
<b>PO-1</b>	Apply knowledge and experience to foster personal growth and better appreciation of the diverse world in which we live.
<b>PO-2</b>	Communicate competently through writing, reading, speaking, and to be able to connect to the world in a meaningful way
<b>PO-3</b>	Access scientific knowledge and have developed a scientific temperament
<b>PO4</b>	Besides knowing their specific core discipline knowledge learners will be able to understand common theme within the biological science fields and be capable to applying principles and basic concepts learnt from physics and chemistry
<b>PO5</b>	Solve Problems, generate and test hypotheses, make observations, collect data, analyze and interpret results, derive conclusions, and evaluate their significance within a broad scientific context
<b>PO6</b>	Develop interdisciplinary outlooks

## PROGRAM SPECIFIC OUTCOMES

PSO	DESCRIPTION
	<b>A student completing Bachelor's Degree in B.Sc. program in the subject of Botany will be able to</b>
<b>PSO-1</b>	To recognize and identify major groups of non-vascular and vascular plants and their phylogenetic relationships.
<b>PSO-2</b>	To understand the phylogeny of plants and study various systems of classification
<b>PSO-3</b>	To explore the morphological, anatomical, embryological details as well as economic importance of algae, fungi, bryophytes, pteridophytes, gymnosperms and angiosperms
<b>PSO-4</b>	To understand physiological processes and adaptations of plants and provide knowledge about environmental factors and natural resources and their importance for sustainable development
<b>PSO-5</b>	To carry out phytochemical analysis of plant extracts and application of the isolated compounds for treatment of diseases
<b>PSO-6</b>	To deal with all microbes and the technologies for their effective uses in industry and mitigation of environmental concerns
<b>PSO7</b>	To deal with all microbes and the technologies for their effective uses in industry and mitigation of environmental concerns
<b>PSO8</b>	To explain how current medicinal practices are often based on indigenous plant knowledge and to get introduced to different perspectives on treating ailments according to ethnomedicinal principles
<b>PSO9</b>	To understand patterns of heredity and variation among individuals, species and populations and apply principles for improvement of quality and yield.
<b>PSO10</b>	To apply statistical tools to gain insights into significantly different data from different sources.
<b>PSO11</b>	To acquire recently published knowledge in molecular biology, such as rDNA technology; PTC and bioinformatics and their applications



## PROGRAM OUTLINE

Sem ester	Core course 14 CREDIT(T+P) =2+1 /COURSE	Ability enhancement course CREDIT 2	Skill enhancement course CREDIT 2	Discipline specific elective* CREDIT 3	Generic elective 04 CREDIT 1	TOTA L CREDI TS																																																				
<b>I</b>	C1: Paper 101 of 3 courses selected	English Communication / Environmental Sc <b>(FC)</b>				20																																																				
	C2: Paper 102 of 3 courses selected						<b>II</b>	C3: Paper 201 of 3 courses selected	English Communication / Environmental SC <b>(FC)</b>				20	C4: Paper 202 of 3 courses selected				<b>III</b>	C5: Paper 301 of 2 courses selected		<b>(FC)</b>		<b>(SWAYAM/ Coursera) Optional for ECC</b>	20	C6: Paper 302 of 2 courses selected			C7: Paper 303 of 2 courses selected			<b>IV</b>	C8: Paper 401 of 2 courses selected		SEC2 <b>(FC)</b>		GE4 <b>(SWAYAM/ Coursera) Optional for ECC</b>	20	C9: Paper 402 of 2 courses selected			C10: Paper 403 of 2 courses selected			<b>V</b>	C11: Paper 501 of 1 course selected 3 Credits		Practical's based on 2 papers(C11 &12) - 2 Credits	Paper 503 of 1 course selected - 3 Credits	Applied component  T+ P (3+1=4 credits)	20	C12: Paper 502 of 1 course selected 3 Credits		Practical's based on 2 DSE papers- 2 Credits	Paper 504 of 1 course selected - 3 Credits	<b>VI</b>	C13: Paper 601 of 1 course selected 3 Credits		Practical's based on 2 papers(C13 &14) - 2 Credits
<b>II</b>	C3: Paper 201 of 3 courses selected	English Communication / Environmental SC <b>(FC)</b>				20																																																				
	C4: Paper 202 of 3 courses selected						<b>III</b>	C5: Paper 301 of 2 courses selected		<b>(FC)</b>		<b>(SWAYAM/ Coursera) Optional for ECC</b>	20	C6: Paper 302 of 2 courses selected			C7: Paper 303 of 2 courses selected					<b>IV</b>			C8: Paper 401 of 2 courses selected		SEC2 <b>(FC)</b>		GE4 <b>(SWAYAM/ Coursera) Optional for ECC</b>	20		C9: Paper 402 of 2 courses selected						C10: Paper 403 of 2 courses selected			<b>V</b>	C11: Paper 501 of 1 course selected 3 Credits		Practical's based on 2 papers(C11 &12) - 2 Credits	Paper 503 of 1 course selected - 3 Credits	Applied component  T+ P (3+1=4 credits)	20	C12: Paper 502 of 1 course selected 3 Credits		Practical's based on 2 DSE papers- 2 Credits	Paper 504 of 1 course selected - 3 Credits	<b>VI</b>	C13: Paper 601 of 1 course selected 3 Credits		Practical's based on 2 papers(C13 &14) - 2 Credits	Paper 603 of 1 course selected - 3 Credits	Applied component T+P (3+1=4 credits)	20
<b>III</b>	C5: Paper 301 of 2 courses selected		<b>(FC)</b>		<b>(SWAYAM/ Coursera) Optional for ECC</b>	20																																																				
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	C14: Paper 602 of 1 course selected 3 Credits		Practical's based on 2 DSE papers- 2 Credits	Paper 604 of 1 course selected - 3 Credits		
	<b>TOTAL CREDITS</b>					<b>120</b>

**Note-**

- 1. The final year B.Sc. students will have the options under DSE (Discipline specific Elective) to drop of one the core paper and do dissertations under the guidance of the departmental faculty/ Any research institute of national importance for both semester V & VI.**
- 2. CBCS system will allow the students from science streams in their final year to study the applied component of any of the science subjects available in the college (Eg- Final year Botany student can have the choice to select any one of the Applied components available with Zoology, Microbiology, Chemistry, Statistics, Physics, Mathematics, etc.).**



YEAR	SEMESTER	COURSE TYPE	COURSE CODE	COURSE TITLE	CREDITS
F.Y.B.Sc	I	Core course	BH.USBO101	Plant diversity I	02
F.Y.B.Sc.	I	Core course	BH.USBO102	Form and function I	02
F.Y.B.Sc.	I	Core course	BH.USBOP1	Plant Diversity I, Form and Function I (Practical I & II)	02
F.Y.B.Sc.	II	Core course	BH.USBO201	Plant diversity I	02
F.Y.B.Sc.	II	Core course	BH.USBO202	Form and function I	02
F.Y.B.Sc.	II	Core course	BH.USBOP2	Plant Diversity I, Form and Function I (Practical I & II)	02
S.Y.B.Sc	III	Core course	BH.USBO301	Plant diversity –II	02
S.Y.B.Sc	III	Core course	BH.USBO302	Form and function II	02
S.Y.B.Sc	III	Core course	BH.USBO303	Current trends in plant Sciences I	02
S.Y.B.Sc	III	Core course	BH.USBOP3	Botany practical (practical I, II & III)	03
S.Y.B.Sc	IV	Core course	BH.USBO401	Plant diversity –II	02
S.Y.B.Sc	IV	Core course	BH.USBO402	Form and function II	02
S.Y.B.Sc	IV	Core course	BH.USBO403	Current trends in plant Sciences I	02
S.Y.B.Sc	IV	Core course	BH.USBOP4	Botany practical (practical I, II & III)	03
T.Y.B.Sc.	V	Core course	BH.USBO501	Plant diversity – III	03
T.Y.B.Sc.	V	Core course	BH.USBO502	Plant diversity – IV	03
T.Y.B.Sc.	V	Skill enhancement course	BH.USBOP5	Practical paper I & II (based on 501&502)	02
T.Y.B.Sc.	V	Discipline specific elective	BH.USBO503	Form and functions- III	03
T.Y.B.Sc.	V	Discipline specific elective	BH.USBO504	Current trends in plant sciences – II	03
T.Y.B.Sc.	V	Skill enhancement course	BH.USBOP6	Practical paper III & IV (based on 503&504)	02
T.Y.B.Sc.	V	Generic elective	BH.USBOAC HO501	Horticulture and gardening –I	03



T.Y.B.Sc.	V	Generic elective	BH.USBOAC HO5P1	Practicals based on horticulture and gardening –I	01
T.Y.B.Sc.	VI	Core course	BH.USBO601	Plant diversity –III	03
T.Y.B.Sc.	VI	Core course	BH.USBO602	Plant diversity – IV	03
T.Y.B.Sc.	VI	Skill enhancement course	BH.USBOP7	Practical paper I & II (based on paper 601 &602)	02
T.Y.B.Sc.	VI	Discipline specific elective	BH.USBO603	Form and functions- III	03
T.Y.B.Sc.	VI	Discipline specific elective	BH.USBO604	Current trends in plant sciences – II	03
T.Y.B.Sc.	VI	Skill enhancement course	BH.USBOP8	Practical paper III & IV (based on paper 603 & 604)	02
T.Y.B.Sc.	VI	Generic elective	BH.USBOAC HO601	Horticulture and gardening –II	03
T.Y.B.Sc.	VI	Generic elective	BH.USBOAC HO6P1	Practicals based on Horticulture And Gardening –II	01
				<b>Total</b>	<b>70</b>

**DETAILED SYLLABUS – SEMESTER III****PREAMBLE**

F.Y.B.Sc syllabus has been revised last year, the committee has taken utmost care to maintain the continuity in the flow of information of higher level at S.Y.B.Sc. The syllabus is prepared keeping in view the requirement of Botany students. Hence some of the modules of have been upgraded in order to make the learners aware about the recent developments in various branches of Botany like Algae, Fungi, Bryophyta, Pteridophyta, Gymnosperms, Angiosperms, Genetics, Molecular Biology, Anatomy and Physiology. The content of Biostatistics, Bioinformatics, instrumentation Medicinal Botany & Cosmetology will raise the student's awareness in Interdisciplinary approach of learning.



<b>Programme: B.Sc.</b>				<b>Semester: III</b>	
<b>Course: BOTANY</b>				<b>Course Code: BH.USBO301</b>	
<b>Teaching Scheme</b>				<b>Evaluation Scheme (Theory)</b>	
<b>Lecture (Periods per week)</b>	<b>Practical (Periods per week per batch)</b>	<b>Tutorial (Periods per week per batch)</b>	<b>Credits (Theory +Practical )</b>	<b>Continuous Internal Assessment (CIA)</b>	<b>End Semester Examination (ESE)</b>
03	01	NA	02+01	(Marks - 40)	(Marks: 60)

**Pre-requisites:** Passed HSC/CBSC/ICSC from Science stream.

**Course Objectives:**

1. Plant diversity is an undergraduate S.Y. B.Sc. Botany course will deals with general characters of Phaeophyta, its reproduction along with economic importance; and also learn the stages of life cycle of *Anthoceros* and *Funaria*
2. The students will be able to learn angiosperm families like Leguminosae, Asteraceae, Apocynaceae, Amaranthaceae and Palmae & identifying them based on their morphological features.
3. The students will be able to learn the basic skills regarding modern techniques to study plant diversity which includes microscopy, preservation methods, chromatography and gel electrophoresis

**Course Outcomes:**

The students will able to:

- 1.They will understand in detail about the life-cycles of Sargassum (Phaeophyta member) and the use of algae in various application, along with life-cycle of *Anthoceros* and *Funaria*
2. They will be able to identify and classify angiosperm plants families easily.
- 3 They will have comprehensive knowledge about basic concepts of preservation methods, microscopy, chromatography and gel electrophoresis.

**INDEX**

<b>Unit</b>	<b>Description</b>	<b>Periods</b>
1	Thallophyta (Algae & Bryophyta)	15
2	Angiosperms	15
3	Tools & Techniques to Study Plants	15
	PRACTICAL Paper I – Plant Diversity II BH.USBOP1	30
	<b>Total</b>	<b>75</b>





Detailed syllabus: Paper-I: Plant Diversity II BH.USBO301		
Units	Detailed descriptions	Lecture Period/ unit
1	<p><b>Unit I: Thallophyta (Algae &amp; Bryophyta)</b></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> General Characters of Division Phaeophyta: Distribution, Cell structure, range of thallus, Economic Importance.</li> <li><input type="checkbox"/> Structure, life cycle and systematic position of <i>Sargassum</i> / <i>Padina</i></li> <li><input type="checkbox"/> General Account of Class Anthocerotae and Musci</li> <li><input type="checkbox"/> Structure, life cycle and systematic position of <ul style="list-style-type: none"> <li>o <i>Anthoceros</i></li> <li>o <i>Funaria</i></li> </ul> </li> </ul>	15
2	<p><b>Unit II: Angiosperms</b></p> <p>Systematics: Objectives and Goals of Plant systematic</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Plant Nomenclature</li> <li><input type="checkbox"/> Taxonomy in relation to <ul style="list-style-type: none"> <li>Anatomy</li> <li>Palynology</li> <li>Chemical constituents</li> <li>Embryology</li> <li>Cytology</li> <li>Ecology</li> </ul> </li> </ul> <p>With the help of Bentham and Hooker's system of Classification for flowering plants study the vegetative, floral characters and economic importance of the following families:</p> <ol style="list-style-type: none"> <li>1. Leguminosae</li> <li>2. Asteraceae</li> <li>3. Apocynaceae</li> <li>4. Amaranthaceae</li> <li>5. Palmae</li> </ol>	15
3	<p><b>Unit III: Tools &amp; Techniques to Study Plants</b></p> <p>Preservation methods for plants: Dry and Wet method</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Microscopy – Principle and working of Light, and electron microscope.</li> <li><input type="checkbox"/> Chromatography- Principles and techniques in paper and thin layer chromatography.</li> <li><input type="checkbox"/> Principles and techniques of <b>Horizontal and Vertical</b> electrophoresis.</li> </ul>	15



Unit	Practical's Semester-III Paper I Plant Diversity II BH.USBOP1	Periods /unit
1	Algae & Bryophyta 1. Study of stages in the life cycle of <i>Sargassum/ Padina</i> from fresh/ preserved material and permanent slides. 2. Economic importance and range of thallus in Phaeophyta 3 Study of stages in the life cycle of <i>Anthoceros</i> from fresh/ preserved material and permanent slides. 4 Study of stages in the life cycle of <i>Funaria</i> from fresh/ preserved material and permanent slides.	10
2	Angiosperms - Study of plants for anatomy in relation to taxonomy. -Study of plants for Phenols and Flavanoids (chemotaxonomy). - Study of one plant from each family prescribed for theory: morphological peculiarities and economic importance of the members of these families.	10
3	Techniques to study Plant Diversity - Preparation of herbarium and wet preservation technique - Chromatography: Separation of amino acids by circular paper chromatography - Separation of Carotenoids by thin layer chromatography - Horizontal and Vertical Gel Electrophoresis – Demonstration	10

#### Text books

1. Andrew Lack, David Evans (2021) BIOS Instant Notes in Plant Biology. CRC Press.
2. Practical In Botany S.Y.B.Sc. Sem III & IV Sheth Publication
3. Botany-I (Plant Diversity)- Dr Avinash Patil, Dr Bindu, Dr Lalsahab (2017)
4. Botany-II (Forms & Function)- Dr Avinash Patil, Dr Aruna, Dr Avhad

#### Reference Books:

1. John Albert Raven, Anthony Larkum, Arthur R. Grossman (2020) Photosynthesis in Algae: Biochemical and Physiological Mechanisms
2. Douglas Soltis, Pamela Soltis, Peter Endress, Mark Chase, Steven Manchester, Walter Judd, Lucas Majure, and Evgeny Mavrodiev (2005). Phylogeny and Evolution of the Angiosperms Revised and Updated Edition Second Edition, Revised
3. BP Pandey · 2001, College Botany - Volume I. S. Chand Publication.



4. BP Pandey · 2001, College Botany - Volume III. S. Chand Publication.
5. BP Pandey · 2007, Botany for Degree Students - Year II. S. Chand Publication.
6. S.M. Reddy · 2001, University Botany I: (Algae, Fungi, Bryophyta And Pteridophyta. New Age International Publication Limited. New Delhi.
7. A.M Bendre 2008, Practical Botany. Rastogi Publication, Gangotri.
8. B.R. Vashishta, Dr. A. K. Sinha, Dr. V.P. Singh. 2010. Botany For Degree Students -ALGAE. S. Chand Publication.
9. B.R. Vashishta, Dr. A. K. Sinha, Dr. Adarsh Kumar. 2011. Botany For Degree Students Bryophyta. S. Chand Publication
10. O.P Sharma. 2017. Algae. McGraw Hill Education.
11. O.P Sharma. 2017. Bryophyta. McGraw Hill Education.
12. Bhojwani SS, Bhatnagar SP, Dantu PK (2020). The embryology of angiosperms.

**Self-evolving topics**

1. Identify taxonomic position of plants and also use principle of nomenclature and classification in Botany by asking students to make a report of Plant diversity in Bhavan's Campus.

**Self-Study material-**

1. The students show study the basic classification of cryptogams and Phanerogams using the classical books under the guidance of the faculty members.
2. Basic understanding of the fundamental principles of Chemistry and physics should also be revived by the students.
3. The ebooks circulated by the faculty members for the subject/ topic (Each unit) concerned should be studied in detail.



<b>Programme: B.Sc.</b>				<b>Semester: III</b>	
<b>Course: BOTANY</b>				<b>Course Code: BH.USBO302</b>	
<b>Teaching Scheme</b>				<b>Evaluation Scheme (Theory)</b>	
<b>Lecture (Periods per week)</b>	<b>Practical (Periods per week per batch)</b>	<b>Tutorial (Periods per week per batch)</b>	<b>Credits (Theory +Practical )</b>	<b>Continuous Internal Assessment (CIA)</b>	<b>End Semester Examination (ESE)</b>
03	01	NA	02+01	<b>(Marks - 40)</b>	<b>(Marks: 60)</b>
<b>Pre-requisites:</b> Passed HSC/CBSC/ICSC from Science stream.					
<b>Course Objectives:</b>					
<p>1. The student will deals with both conceptual and practical tools for studying the cell organelles, mitosis and meiosis.</p> <p>2. They will learn about plastid inheritance and chromosomal aberrations and will also be able to learn the concept of sex determination in monoecious and dioecious plants</p> <p>3. The students will learn about the idea of nucleic acid, DNA, RNA and mechanism of replication in prokaryotes and eukaryotes.</p>					
<b>Course Outcomes:</b>					
The students will able to:					
<p>1. The student will gain knowledge about the cell organelles, mitosis and meiosis.</p> <p>2. The student will gain knowledge about the plastid inheritance, chromosomal aberrations and also of sex determination in monoecious and dioecious plants</p> <p>3. The student will gain knowledge about mechanism of replication in prokaryotes and eukaryotes.</p>					
<b>INDEX</b>					
<b>Unit</b>	<b>Description</b>				<b>Periods</b>
1	Cell Biology				15
2	Cytogenetics				15
3	Molecular Biology				15
	Practical Paper II – Form And Function-II BH.USBOP2				30
	<b>Total</b>				<b>75</b>



Detailed syllabus: Paper-II: Form And Function-II BH.USBO302		
Units	Detailed descriptions	Lecture Period/ unit
1	<p><b><u>Unit I: Cell Biology</u></b></p> <p>□ Ultrastructure and functions of the following cell organelles:</p> <ul style="list-style-type: none"> <li>○ Mitochondrion (membranes, cristae, F1 particles and matrix)</li> <li>○ Peroxisomes and Glyoxysomes</li> <li>○ Ribosomes (prokaryotic, eukaryotic and subunits)</li> </ul> <p>□ Cell Division and its significance</p> <ul style="list-style-type: none"> <li>○ Cell Cycle, structure of Interphase Nucleus (nuclear envelop, chromatin network, nucleolus and nucleoplasm)</li> <li>○ Mitosis &amp; Meiosis &amp; its Differences</li> </ul> <p>Nucleic Acids: Types, structure and functions of DNA and RNA</p>	15
2	<p><b><u>Unit II: Cytogenetics</u></b></p> <ul style="list-style-type: none"> <li>• Variation in Chromosome structure (Chromosomal Aberrations) Definition, Origin, Cytological and Genetic Effects of the following: Deletions, Duplications, Inversions and Translocations.</li> <li>• Sex determination, Sex linked, sex influenced and sex-limited traits: Sex determination- Chromosomal Methods: heterogametic males and heterogametic females. Sex determination in monoecious and dioecious plants. <b>Genic Balance Theory of sex determination in <i>Drosophila</i>, Lyon's Hypothesis of X chromosome inactivation.</b> Sex linked- eye colour in <i>Drosophila</i>, Haemophilia, colour blindness Sex influenced- baldness in man</li> <li>• Extranuclear Genetics Organelle heredity: <ul style="list-style-type: none"> <li>○ Chloroplast determines heredity - Plastid transmission in plants, Streptomycin resistance in <i>Chlamydomonas</i>.</li> </ul> </li> </ul> <p>Male sterility in maize</p>	15
3	<p><b><u>Unit III: Molecular Biology</u></b></p>	15



	<ul style="list-style-type: none"> <li>• DNA replication: Modes of Replication, Meselson and Stahl Experiment, DNA replication in prokaryotes and eukaryotes- enzymes involved and molecular mechanism of replication.</li> <li>• Protein Synthesis: <ul style="list-style-type: none"> <li>○ Central dogma of Protein synthesis</li> <li>○ Transcription in prokaryotes and eukaryotes: promoter sites, initiation, elongation and termination.</li> </ul> </li> <li>RNA processing: Adenylation &amp; Capping.</li> </ul>	
	<b>Practical Semester-III Paper II – Form and Function- II</b>	<b>Periods /unit</b>
<b>1</b>	<b>Cell Biology</b> <ol style="list-style-type: none"> <li>1. Study of the ultra-structure of cell organelles prescribed for theory from Photomicrographs.</li> <li>2. Estimation of DNA from plant material (one Std &amp; one Unknown, No Std Graph).</li> <li>3. Estimation of RNA from plant material (one Std &amp; one Unknown, No Std Graph).</li> </ol>	<b>10</b>
<b>2</b>	<b>Cytogenetics</b> <ol style="list-style-type: none"> <li>4. Study of inheritance pattern with reference to Plastid Inheritance.</li> <li>5. Study of cytological consequences of chromosomal aberrations (Laggards, Chromosomal Bridge, Ring chromosome, Chromosomal ring) from permanent slides or photomicrographs.</li> <li>6. Study of mitosis and meiosis from suitable plant material.</li> </ol>	<b>10</b>
<b>3</b>	<b>Molecular Biology</b> <ol style="list-style-type: none"> <li>7. DNA sequencing- Sanger's method.</li> </ol> Determining the sequence of amino acids in the protein molecule synthesised from the given m-RNA strand (prokaryotic and eukaryotic).	<b>10</b>

**Text books**

1. Andrew Lack, David Evans (2021) BIOS Instant Notes in Plant Biology. CRC Press.
2. Practical In Botany S.Y.B.Sc. Sem III & IV Sheth Publication
3. Botany-II (Forms & Function)- Dr Avinash Patil, Dr Aruna, Dr Avhad (2017)

**Reference Books:**

1. Griffiths, A.J.F and Gilbert, W.M (2nd edn). Modern genetic analysis. W.H. Freeman and Company, New York.
2. Strickberger, M.W: Genetics (4th edn). Mcmillan Publishing company, New York.
3. Janet Iwasa and Wallace Marshall, 2016 (8<sup>th</sup> edition) Karp's Cell and Molecular Biology. Wiley & Sons, Inc.
4. Geoffrey M. Cooper, 2018 (8th edition), The Cell: A Molecular Approach. Sinauer Associates Inc
5. Bruce Alberts, Karen Hopkin, Alexander D. Johnson, David Morgan, Martin Raff, Keith Roberts, Peter Walter, 2019 (5<sup>th</sup> edition) Essential Cell Biology. W. W. Norton & Company.
6. Veer Bala Rastogi, 2021 Cell Biology. Medtech.
7. William S. Klug, Michael R. Cummings, Charlotte A. Spencer, Michael A. Palladino, Darrell Killian, 2019 (11<sup>th</sup> edition), Concepts of Genetics. Pearson Education.
8. Benjamin Pierce, 2019 (7<sup>th</sup> edition) Genetics: A Conceptual Approach. W H Freeman & Co.
9. James D. Watson, 2017 (7<sup>th</sup> edition), Molecular Biology of The Gene. Pearson Education.

**Self-evolving topics**

**Evaluate the impact of variation in DNA, chromosome numbers etc on organisms.**

**Self-Study material-**

1. The students should study the basic understanding of cytology and genetics using the classical books under the guidance of the faculty members.
2. Basic understanding of the fundamental principles of Chemistry and physics should also be revived by the students.
3. The ebooks circulated by the faculty members for the subject/ topic (Each unit) concerned should be studied in detail.



<b>Programme: B.Sc.</b>				<b>Semester: III</b>	
<b>Course: BOTANY</b>				<b>Course Code: BH.USBO303</b>	
<b>Teaching Scheme</b>				<b>Evaluation Scheme (Theory)</b>	
<b>Lecture (Periods per week)</b>	<b>Practical (Periods per week per batch)</b>	<b>Tutorial (Periods per week per batch)</b>	<b>Credits (Theory +Practical )</b>	<b>Continuous Internal Assessment (CIA)</b>	<b>End Semester Examination (ESE)</b>
03	01	NA	02+01	<b>(Marks - 40)</b>	<b>(Marks: 60)</b>
<b>Pre-requisites:</b> Passed H.Sc./CBSc/ICSC from Science stream.					
<b>Course Objectives:</b>					
<p><b>Current trends in plant sciences</b> is an undergraduate S.Y.B.Sc. Botany course that deals with study of Pharmacognosy understand about Pharmacopoeia.</p> <ol style="list-style-type: none"> <li>1. Students will be able to study adulterants based on the knowledge of macroscopic features, microscopy, and chemical tests.</li> <li>2. Students will also learn about forestry in terms of agro-forestry and urban forestry, organic farming, silviculture, plant-based fibers, spices and paper.</li> <li>3. Students will be able to get to know about the industries based on plant products: Aromatherapy, Nutraceuticals, Enzymes and Biofuels.</li> </ol>					
<b>Course Outcomes:</b>					
<ol style="list-style-type: none"> <li>1. The students will understand monograph study from pharmacopoeia and detection of adulterants.</li> <li>2. Gain knowledge about plant product sources pertaining to fibers, spices, condiments and paper.</li> <li>3. The students will gain knowledge about Aromatherapy, concept of Nutraceuticals, important industrial enzymes and different types of biofuels.</li> </ol>					
<b>INDEX</b>					
<b>Unit</b>	<b>Description</b>				<b>Periods</b>
1	Pharmacognosy and Phytochemistry				15
2	Forestry and Economic Botany				15
3	Industry based on plant products				15
	PRACTICAL Semester-III Paper-III Current trends in Plant Sciences I BH.USBOP3				30
	<b>Total</b>				<b>75</b>





<b>Detailed syllabus: Paper-I: Current trends in Plant Sciences I BH.USBOP3 BH.USBO303</b>		
<b>Units</b>	<b>Detailed descriptions</b>	<b>Lecture Period/ unit</b>
<b>1</b>	<p><b>Unit1: Pharmacognosy and phytochemistry</b></p> <p>Introduction to pharmacopoeia- <b>US, British, European, Indian</b></p> <p>Indian pharmacopoeia, Indian Herbal Pharmacopoeia and Ayurvedic Pharmacopoeia</p> <p>Study of Monograph from pharmacopoeia</p> <p>Secondary Metabolites: Sources, properties, uses and adulterants, regional and seasonal variations</p> <p>Adulterants:</p> <ul style="list-style-type: none"> <li>➤ <i>Saraca asoca, Polyalthia longifolia</i></li> <li>➤ <i>Terminalia arjuna, Terminalia tomentosa</i></li> <li>➤ <i>Bacopa monnieri, Centella asiatica</i></li> <li>➤ <i>Abrus, Glycyrrhiza</i></li> </ul> <p><i>Phyllanthus amarus (Bhuiamla)/ <b>Phyllanthus madaraspatisis,</b></i> <b><i>Phyllanthus imblica</i></b></p>	<b>15</b>
<b>2</b>	<p><b>Unit 2: Forestry and Economic Botany</b></p> <p>Forestry: Outline of types of forest in India</p> <p>Forestry: Agro-forestry, Urban forestry, organic farming, Silviculture</p> <p>Economic Botany:</p> <ul style="list-style-type: none"> <li>➤ Types of fibers: <b>Coconut</b>, Jute and cotton</li> <li>➤ Current trends in Fiber industries</li> <li>➤ Spices and condiments: <b>Nutmeg</b>, Saffron and cardamom</li> </ul> <p>Commercial market of spices</p>	<b>15</b>
<b>3</b>	<p><b>Unit 3: Industry based on plant products</b></p> <p>Aromatherapy- Introduction, Uses with few examples. <b>Lavender</b>, Jojoba, lemon, jasmin</p> <p>Botanical and nutraceuticals -<i>Spirulina, Chlorella, Vanillin, Garcinia indica/ Garcinia cambogia</i>, and <i>Kale</i>.</p> <p>Enzymes industry: Cellulases, Papain, Bromelain <b>Biofuels.</b></p>	<b>15</b>
<b>Unit</b>	PRACTICAL Semester-II Paper III Current trends in Plant Sciences I BH.USBOP3	<b>Periods /unit</b>



1	Study of - ➤ <i>Phyllanthus amarus</i> ➤ <i>Saraca asoka</i> ➤ <i>Bacopa monnieri</i>	10
2	Study of biodiversity (Visit to National Park/ Botanical Garden) ➤ Sources of: Fibres & Paper Spices & condiments-	10
3	Preparation of herbal cosmetics (Face pack/ De-tanning cream/ Gel) Estimation of crude fibre in cereals & their products Preparation & evaluation of probiotic foods Evaluation of nutraceutical value of mushroom/ wheat germ	10

#### Text books

1. Andrew Lack, David Evans (2021) BIOS Instant Notes in Plant Biology. CRC Press.
2. Verma V (2010). Text book of Economic Botany. Ane Books Pvt Ltd
3. Dhole A., Dhole V., Yeligar V., Magdum C. (2009). Textbook of Pharmacognosy and Phytochemistry, 1st Edition, Pharma Career Publications.
4. Practical In Botany S.Y.B.Sc. Sem III & IV Sheth Publication
5. Botany-III (Current trends in Plant Sciences)- Dr Dhuri, Dr Drashana Patil, Dr Jathar (2017)
6. William Charles Evans, Trease and Evans Pharmacognosy (2009) Elsevier Health Sciences, (16<sup>th</sup> edition )

#### Reference Books:

1. Gokhale, S.B., Kokate, C.K., Purohit, A.P., (2009) A Textbook of Pharmacognosy, Pune, Nirali Publication
2. Kochhar, S.L. (2012) Economic Botany in Tropics, MacMillan & Co. New Delhi, India.
3. Sen S (1992). Economic Botany, New Central Book Agency, Kolkata.
4. Krishnan, P.R., Kalia, R. K., Tewari, J.C., Roy, M.M., (2014) Plant Nursery Management: Principles and Practices, Jodhpur, Central Arid Zone Research Institute
5. Negi S.S. (2008) Handbook of Forestry.
6. Sagwal S. S. (2016) Introductory Forestry. Kalyani Publisher, New Delhi
7. Kochhar, S.L. (2016). **Economic Botany**- A Comprehensive Study (5th Edition), University of Delhi.



8. Shabir, Annamalai, Manzoor (2021). Plant Extracts: Applications in Food Industry, (1st Edition), Elsevier.

9. Gokhale, S.B., Kokate, C.K., Purohit, A.P., (2009) A Textbook of Pharmacognosy, Pune, Nirali Publication.

**Self-evolving topics**

1. Elementary knowledge of primary and secondary metabolites.
2. Primary analysis of crude drug obtained from leaves and bark.
3. Mushroom industry – Cultivation and its commercial significance

**Self-Study material-**

1. The students show study the basic understanding of about traditional knowledge (Ayurveda, Batch flower remedy etc.) under the guidance of the faculty members.
2. Basic understanding of the fundamental principles of Chemistry and physics should also be revived by the students.
3. The ebooks circulated by the faculty members for the subject/ topic (Each unit) concerned should be studied in detail.


**Details of Conduct of Practical Examination (Evaluation Scheme):**
**A External Assessment 100%-50marks**

Particulars	Paper I (BH.USBOP1)	Paper II (BH.USBOP2)	Paper III (BH.USBOP3)
Laboratory work	40	40	40
Journal	05	05	05
Viva	05	05	05
	50	50	50

The students are required to present a duly certified journal for appearing at the semester end practical examination, failing which they will not be allowed to appear for the examination. In case of report of loss of Journal, a "Lost Certificate", should be obtained from Head/ Coordinator of the department; failing which the student will not be allowed to appear for the practical examination.

**Note-** Two short field excursion/ Long excursion for 2-4 days for habitat studies are compulsory. Field work of not less than eight-hour duration to one period per week for a batch of 15 students. The field excursion will be counted for 1-2 Credits for the student.

### Modality of Assessment

Theory Examination Pattern:

A) Internal Assessment- 40%- 40 Marks

Sr No	Evaluation type	Marks
CIA-1	Internal Class Test with Objective type questions and Short Notes	20
CIA-2	Assignment/ Presentation/debate/ Analysis/ Project work/ Internship/ Training/ Paper presentation in national or international Seminar/Conference/ Report writing for Short/long excursion etc.	20
	<b>TOTAL</b>	<b>40</b>

**Assignment types can include: (Some examples are-)**

- 1.Role of plants in the functioning of ecosystem
- 2.Phylogeny of plant diversity
- 3.Symptoms of Fungal diseases cycle and its impact on crops provide the control measures.



## CIA-2 for Semester 3

Paper	301	302	303
<b>Assignment type</b>	Exploration/ survey/ analysis	Power point presentations/ Assignment writing/ etc.	Survey/ Assignment writing/ etc.
<b>Skill assessed</b>	Research skills	Presentation/ Language/ data collection & compilation, etc.	Research skills/ data gathering and compilation, etc.
<b>Topic's</b>			
<b>a</b>	Study of algae from bhavans lake	Sex determination in heterogametic males	Study of different adulterants used in food and beverages
<b>b</b>	Study of list of bryophytes found in Bhavans campus.	Sex determination in heterogametic females	Study of different adulterants used in ayurvedic medicines
<b>c</b>	Study of angiosperms and its diversity in Bhavans campus.	How proteins are related to genes?	Study of different face-packs/ creams etc. used in cosmetic industry and utility of plants in it.
<b>d</b>	Tools and techniques used in collection of algae & Bryophytes	History of discovery of DNA in your own words?	Which products from forest can be economically exploited sustainably
<b>e</b>	Tools and techniques used in collection of angiosperms and its preservation	Protein synthesis in prokaryotes and eukaryotes.	Which 5-10 plants are exploited across the globe for its economic importance?



**B) External Examination 60%- 60 Marks Semester End Theory Examination (offline mode)**

Duration of examination: **2hours**

Paper Pattern:

1. There shall be three questions from each unit.
2. There shall be an internal choice in first the questions.
3. The fourth question would be a mixed of all units
4. All four questions shall be compulsory.

Paper Pattern:(Semester end Examination III)

Sr.no	Questions on	Question	Option	Marks	Total marks
1	Unit-I	A or A and B	Any two out of three	8 or 8 marks and 7marks	15
2	Unit-II	A or A and B	Any two out of three	8 or 8 marks and 7marks	15
3	Unit-III	A or A and B	Any two out of three	8 or 8 marks and 7marks	15
4	All Units	A, B, C, D and E	Any three out of Five	5 marks each	15
				Total	60

## Overall Examination & Marks Distribution Pattern

### Semester III

Course BH.USBO	301, 302 &303			401,402 &403			Grand
	Internal	External	Total	Internal	External	Total	
<b>Theory</b>	<b>120</b>	<b>180</b>	<b>300</b>	<b>120</b>	<b>180</b>	<b>300</b>	<b>600</b>
<b>Practical</b>	--	150	150	--	150	150	300
							900

### Rubrics of evaluation for ESE

Unit	Knowledge	Understanding	Analysis & critical thinking	Total marks/unit
1	06	05	04	15
2	06	05	04	15
3	06	05	04	15
4	06	05	04	15
Total per objective	24	20	16	60

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**Rubrics of evaluation for CIA-2-** Assignment/ Presentation/debate/ Analysis/ Project work/ Internship/ Training/ Paper presentation in national or international Seminar / Conference/ Report writing for Short/long excursion etc.

**Class:** \_\_\_\_\_ **Roll No** \_\_\_\_\_ **Topic** \_\_\_\_\_

Parameters	Max Marks	80 – 100% Excellent	60 -80% Good	40 – 60% Satisfactory	20 – 40% Poor	0-20% very poor
<b>CONTENT</b>	10					
Content: Introduction –	02					
Content: Development	03					
Content:– Conclusion -	03					
Content: - Bibliography	02					
<b>Effective communication skill</b>	10					
Language, Style and Structure;	05					
Teaching aids;	05					
Total	20					



<b>Programme: B.Sc.</b>				<b>Semester: IV</b>	
<b>Course: Botany</b>				<b>Course Code: BH.USBO401</b>	
<b>Teaching Scheme</b>				<b>Evaluation Scheme (Theory)</b>	
<b>Lecture (Periods per week)</b>	<b>Practical (Periods per week per batch)</b>	<b>Tutorial (Periods per week per batch)</b>	<b>Credits (Theory +Practical)</b>	<b>Continuous Internal Assessment (CIA)</b>	<b>End Semester Examination (ESE)</b>
03	01	NA	02+01	(Marks - 40)	(Marks: 60)
<b>Pre-requisites:</b> Passed HSC/CBSC/ICSC from Science stream.					
<b>Course Objectives:</b>					
1 Plant diversity is an undergraduate S.Y. B.Sc. Botany course will deals with general characters of Ascomycetae fungi, life-cycles of <i>Erysiphe</i> , <i>Xylaria</i> and Lichens along with Plant Pathology and various application of fungi and Lichens					
2 The students will able learn the various type of Fossils along with the life cycle of <i>Selaginella</i> and <i>Rhynia</i> , based on their morphological & anatomical features.					
3 The students will be able to learn Salient features and economic importance of Coniferophyta and study the life cycle of <i>Pinus</i> and <i>Cordaites</i> based on their morphological & anatomical features					
<b>Course Outcomes:</b>					
The students will able to:					
1.Gain detailed knowledge about the general characters and life-cycles of <i>Erysiphe</i> , <i>Xylaria</i> (Ascomycetae fungi) and Lichens and their various applications					
2. Understand type and the process of fossil formation along with life cycle of <i>Selaginella</i> and <i>Rhynia</i>					
3 Gain comprehensive knowledge about Salient features and economic importance of Coniferophyta along with life cycle of <i>Pinus</i> and <i>Cordaites</i> .					
<b>INDEX</b>					
<b>Unit</b>	<b>Description</b>				<b>Periods</b>
<b>1</b>	Unit I: Thallophyta: Fungi, Plant Pathology and Lichens Fungi				15
<b>2</b>	Unit II: Pteridophyta and Paleobotany				15
<b>3</b>	Unit III: Gymnosperms				15
<b>1</b>	PRACTICAL Paper I – Plant Diversity II BH.USBOP1				30
	<b>Total</b>				<b>75</b>





Detailed syllabus: Paper I -- Plant Diversity II BH.USBO401		
Units	Detailed descriptions	Lecture period /unit
1	<p><b>Unit I: Thallophyta: Fungi, Plant Pathology and Lichens Fungi</b></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> General characters of Ascomycetae</li> <li><input type="checkbox"/> Structure, life cycle and systematic position of <i>Erysiphe</i> and <i>Xylaria</i></li> <li><input type="checkbox"/> Plant Pathology- Symptoms, causative organism, disease cycle and control measures of Powdery mildew and Late blight of potato</li> <li><input type="checkbox"/> Lichens- Classification, Structure, Method of Reproduction, Economic Importance and Ecological Significance of Lichens.</li> </ul>	15
2	<p><b>Unit II: Pteridophyta and Paleobotany</b></p> <p>Pteridophyta</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Salient features and classification upto orders (with examples of each) of Psilophyta and Lepidophyta (G M Smith's system of classification to be followed)</li> <li><input type="checkbox"/> Structure, life cycle and systematic position of <i>Selaginella</i></li> <li><input type="checkbox"/> Paleobotany- The geological time scale; Formation and types of fossils; Structure and systematic position of form genus <i>Rhynia</i></li> </ul>	15
3	<p><b>Unit III: Gymnosperms</b></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Salient features, classification up to orders (with examples of each) and economic importance of Coniferophyta (Chamberlain's system of classification to be followed)</li> <li><input type="checkbox"/> Structure life cycle and systematic position of <i>Pinus</i></li> <li><input type="checkbox"/> Structure and systematic position of the form genus <i>Cordaites</i></li> </ul>	15
Unit	Practicals Semester-IV Paper I Plant Diversity II BH.USBOP1	Periods /unit
1	<p>Fungi and Plant Pathology</p> <p>1 Study of stages in the life cycle of <i>Erysiphe</i> from fresh/ preserved material and permanent slides.</p> <p>2 Study of stages in the life cycle of <i>Xylaria</i> from fresh/ preserved material and permanent slides.</p> <p>3 Study of fungal diseases as prescribed for theory.</p> <p>4 Study of Lichens (crustose, foliose, &amp; fruticose).</p>	10
2	Pteridophyta and Palaeobotany	10



	5-6 Study of stages in the life cycle of <i>Selaginella</i> from fresh/ preserved material and permanent slides. 7 Study of form genera <i>Rhynia</i> with the help of permanent slides/ photomicrographs.	
<b>3</b>	Gymnosperms 8- Study of stages in the life cycle of <i>Pinus</i> from fresh/ preserved material and permanent slides. 9- Study of the form genus <i>Cordaites</i> with the help of permanent slide/ photomicrographs.	<b>10</b>

**Text books**

1. Andrew Lack, David Evans (2021) BIOS Instant Notes in Plant Biology. CRC Press.
2. Practical In Botany S.Y.B.Sc. Sem III & IV Sheth Publication
3. Botany-I (Plant Diversity- II)- (2017). TechMack Publication.

**Reference Books:**

1. Agashe SN (1995) Paleobotany, Oxford and IBH Publ. Co.Pvt. Ltd., New Delhi.
2. Anold AC (2005 Repr.) An Introduction to Paleobotany, Agrobios (India), Jodhpur.
3. Bhatnagar Sp and Motia A (1996) Gymnosperms. New Age International, New Delhi.
4. Biswas C and Johri BM (1997) Gymnosperms. Narso. Pub., New delhi.
5. Chamberlain CJ (1986) Structure and Evolution. CBS Punlishers, New Delhi
6. Rashid A (1999) An introduction to Pteridophyta. Vikas Publishing house Pvt.Ltd. New Delhi.
7. Sharma OP (1990) textbook of Pteridophyta. Mac Millan India Ltd. Delhi.
8. Smith GM (1955) Cryptogamic Botany Vol. II Mc Grew Hill.
9. Sundara Rajan S. (1999) Introduction to Pteridophyta. New Age International Publishers, New Delhi.
10. Parihar NS (1976) Biology and morphology of the Pteridophytes. Central Book Dep
11. Vashishta B.R./ Sinha A.K. & Kumar Adarsh (2016), Botany for Degree Students: Fungi (Revised Multi-Colour Edition, S. Chand Publication
12. BP Pandey · ( 2001 ) College Botany - Volume I, S. Chand Publication
13. BP Pandey · ( 2001 ) College Botany - Volume III, S. Chand Publication
14. BP Pandey · ( 2007 ) Botany for Degree Students - Year II, S. Chand Publication
15. A.M Bendre ( 2008 ) Practical Botany, Rastogi Publication, Gangotri
16. Chhaya Biswas, B.M. Johri · (2013) , The Gymnosperms , Springer-Verlag Berlin
17. Anil Kumar · ( 2006 ) Botany for Degree Students: Gymnosperms, S. Chand Publication

18. K.U. Kramer, P.S. Green · (2013), Pteridophytes and Gymnosperms, Springer-Verlag Berlin
19. B.R. Vasishta, Dr. A.K. Sinha ( 2014) Botany For Degree Students Fungi S.Chand Publications
20. P Sharma ( 2017) Pteridophyta McGraw Hill Education

**Self-evolving topics**

Recognize fungal diseases; Powdery mildew and Late blight of potato  
Differentiating between the different types of lower plants and its characteristics

**Self-Study material-**

1. The students show study the basic understanding of about cryptogams and phanerogams under the guidance of the faculty members.
2. Basic understanding of the fundamental principles of Chemistry and physics should also be revived by the students.
3. The ebooks circulated by the faculty members for the subject/ topic (Each unit) concerned should be studied in detail.



<b>Programme: B.Sc.</b>				<b>Semester: IV</b>	
<b>Course: Botany</b>				<b>Course Code: BH.USBO402</b>	
<b>Teaching Scheme</b>				<b>Evaluation Scheme (Theory)</b>	
<b>Lecture (Periods per week)</b>	<b>Practical (Periods per week per batch)</b>	<b>Tutorial (Periods per week per batch)</b>	<b>Credits (Theory +Practical)</b>	<b>Continuous Internal Assessment (CIA)</b>	<b>End Semester Examination (ESE)</b>
03	01	NA	02+01	(Marks - 40)	(Marks: 60)
<b>Course Objectives:</b>					
<ol style="list-style-type: none"> <li>1. The student will study primary and secondary growth in plants parts, formation of growth rings, mechanical tissue system etc.</li> <li>2. They will also learn about basic physiological pathways occurring in plant ranging from respiration to photoperiodism and vernalization mechanisms.</li> <li>3. The students will learn about the biogeochemical cycles, environmental factors and community ecology</li> </ol>					
<b>Course Outcomes:</b>					
<ol style="list-style-type: none"> <li>1. The student will gain knowledge about how different plant tissue and organs have originated and modify their structure and functions with respect to their environment.</li> <li>2. The student will gain knowledge of various physiological processes in plant body</li> <li>3. The student will gain the knowledge of biogeochemical cycles, community ecology, Soil organic matter analysis and quadrant study in field</li> </ol>					
<b>INDEX</b>					
<b>Unit</b>	<b>Description</b>				<b>Periods</b>
<b>1</b>	Unit I: Anatomy				15
<b>2</b>	Unit II: Plant Physiology and Plant Biochemistry				15
<b>3</b>	Unit III: Ecology and Environmental Botany				15
<b>1</b>	PRACTICAL Paper I – Plant Diversity II BH.USBOP1				30
	<b>Total</b>				<b>75</b>



Detailed syllabus: Paper II --Form and Function- II BH.USBO402		
Units	Detailed descriptions	Lecture period /unit
1	<p><b><u>Unit I: Anatomy</u></b></p> <ul style="list-style-type: none"> <li>• Normal Secondary Growth in Dicotyledonous stem and root.</li> <li>• Growth rings, periderm, lenticels, tyloses, heart wood and sap wood.</li> <li>• Mechanical Tissue system               <ul style="list-style-type: none"> <li>○ Tissues providing mechanical strength and support and their <b>disposition</b></li> <li>○ I-girders in aerial and underground organs</li> </ul> </li> <li>• Types of Vascular Bundles.</li> </ul> <p><b>Secretary and glandular tissue</b></p>	15
2	<p><b><u>Unit II: Plant Physiology and Plant Biochemistry</u></b></p> <ul style="list-style-type: none"> <li>• Respiration: Aerobic: Glycolysis, TCA Cycle, ETS &amp; Energetic of respiration; Anaerobic respiration.</li> <li>• Photorespiration</li> <li>• Photoperiodism: Phytochrome Response and Vernalization with reference to flowering in higher plants, Physico-chemical properties of phytochrome, Pr-Pfr interconversion, role of phytochrome in flowering of SDPs and LDPs;</li> </ul> <p>Vernalization mechanisms and applications.</p>	15
3	<p><b><u>Unit III: Ecology and Environmental Botany</u></b></p> <ul style="list-style-type: none"> <li>• Biogeochemical Cycles- Carbon, Nitrogen and Water.</li> <li>• Ecological factors: Concept of environmental factors (<b>Biotic &amp; Abiotic</b>). <b>Types of Biotic Interactions</b>. Soil as an edaphic factor, Soil composition, types of soil, soil formation, soil profile.</li> </ul> <p>Community ecology- Characters of community - Quantitative characters and qualitative characters</p>	15
Unit	<b>PRACTICAL Semester-IV Paper II FORM AND FUNCTION II BH.USBOP2</b>	Periods /unit
1	<p>Anatomy</p> <ol style="list-style-type: none"> <li>1. Study of normal secondary growth in the stem and root of a Dicotyledonous plant.</li> </ol>	10



	<p>2. Types of mechanical tissues, mechanical tissue system in aerial, underground organs.</p> <p>3. Study of conducting tissues- Xylem and phloem elements in Gymnosperms and Angiosperms as seen in LS and through maceration technique.</p> <p>4. Study of different types of vascular bundles.</p> <p>5. Growth rings, periderm, lenticels, tyloses, heart wood and sap wood.</p> <p>6. <b>Study of secretary and glandular tissue</b></p>	
2	<p>Plant Physiology and Plant Biochemistry</p> <p>7. Q10 – germinating seeds using Phenol red indicator.</p> <p>8. NR activity – <i>in-vivo</i>.</p> <p>9. Estimation of proteins by Lowry's method (Prepare standard graph).</p>	10
3	<p>Ecology and Environmental Botany</p> <p>10. Study of the working of the following Ecological Instruments- Soil thermometer, Soil testing kit, Soil pH, Wind anemometer.</p> <p>11. Mechanical analysis of soil by the sieve method &amp; pH of soil.</p> <p>12. Quantitative estimation of organic matter of the soil by Walkley and Blacks Rapid titration method.</p> <p>13. Study of vegetation by the list quadrat method.</p>	10

#### Text books

1. Andrew Lack, David Evans (2021) BIOS Instant Notes in Plant Biology. CRC Press.
2. Practical In Botany S.Y.B.Sc. Sem III & IV Sheth Publication
3. Botany-II (Forms & Function- II)- (2017)
4. Plants and Environment- A Text Book of Plant Ecology (3rd edition). By Daubenmire R.F. 1974. John Wiley & Sons. New York.

#### Reference Books:

1. Ro.Roy, (2010) Plant Anatomy. (2nd revised edition), New Central Book Agency.
2. Richard Crang, Sheila Lyons-Sobaski, Robert Wise (2018) Plant Anatomy: A Concept-Based Approach to the Structure of Seed Plants. (1st edition) Springer Nature Switzerland.



3. Biju Dharamapalan, (2016) Plant Biochemistry- An Introduction. Alpha Science International Limited.
4. Manju A. Lal and Satish C. Bhatla, (2018) Plant Physiology, Development and Metabolism. Springer Nature Singapore Pte Ltd.
5. Angus S. Murphy, Ian M. Moller, Lincoln Taiz, Eduardo Zeiger (2018). Fundamentals of Plant Physiology. Sinauer Associates Inc.
6. S. L. Kochhar, Sukhbir Kaur Gujral, (2020) Plant Physiology: Theory and Applications. Cambridge University Press. (2nd edition),
7. Russell K Monson (2014) Ecology and the environment, Springer Science+ Business Media New York.
8. S. N. Pandey and B. K. Sinha (2014)., Plant Physiology Vikas Publishing House Pvt. Ltd.,
9. Salisbury F.B and Ross C.W (1992). Plant physiology (Fourth Edition) Wadsworth Publishing Company, California, USA.
10. Kumar H.D. (1996) Modern Concepts of Ecology (3rd edition). Vikas Publishing House Pvt., Ltd. Delhi.
11. Kumar.H.D. (1997) General Ecology. Vikas Publishing Pvt. Ltd., Delhi.
12. Weaver. J.E. and Clements. S.E. (1966) Plant Ecology. Tata McGraw Publishing Co. Ltd. Bombay.
13. Esau (2006) Plant Anatomy: Meristems, Cells, and Tissues of the Plant Body: Their Structure, Function, and Development
14. Dickison, W.C. (2000). Integrated Plant anatomy. Cambridge, U.K.: Academic press Inc
15. Bhatla, S.C., Lal, M.A. (2018). Plant Physiology, Development and Metabolism. Singapore: Springer Nature, Singapore Pvt Ltd
16. Hopkins, W. G., Huner, N. P. A. (2009). Introduction to Plant Physiology, 4th edition. New Delhi, Delhi: Wiley India Pvt. Ltd
17. Taiz, L., Zeiger, E., Moller, I. M., Murphy, A. (2015). Plant Physiology and Development, 6th edition. Sunderland, Massachusetts: Sinauer Associates Inc
18. Sharma, P.D. (2010). Ecology and Environment, 8th edition. Meerut, U.P.: Rastogi Pub.
19. Cheplick, G.P. (2015) Approaches To Plant Evolutionary Ecology. Oxford University Press Inc

**Self-evolving topics**

1. Design strategies for restoration of ecosystem.
2. To apply and achieve sustainable development goals.



**Self-Study material-**

1. The students should study the basic understanding of about internal structure of the plants, which they have studied in their lower semesters/ classes.
2. Basic understanding of the fundamental principles of Chemistry and physics should also be revived by the students.
3. The ebooks circulated by the faculty members for the subject/ topic (Each unit) concerned should be studied in detail.





<b>Programme: B.Sc.</b>				<b>Semester: IV</b>	
<b>Course: Botany</b>				<b>Course Code: BH.USBO403</b>	
<b>Teaching Scheme</b>				<b>Evaluation Scheme (Theory)</b>	
<b>Lecture (Periods per week)</b>	<b>Practical (Periods per week per batch)</b>	<b>Tutorial (Periods per week per batch)</b>	<b>Credits (Theory +Practical)</b>	<b>Continuous Internal Assessment (CIA)</b>	<b>End Semester Examination (ESE)</b>
03	01	NA	02+01	(Marks - 40)	(Marks: 60)
<b>Course Objectives:</b>					
<ol style="list-style-type: none"> <li>1. Students will learn about the Different types of garden and garden locations. The student will get to know about the concept of national parks and botanical garden.</li> <li>2. The students will learn about application of Biotechnology in field of plant Science and get familiarized with the concept of Recombination DNA Tech and Organ culture.</li> <li>3. Solving problems of biostatistics and getting hand- on training on bioinformatics. Databases and tools is also the prime objective of the course</li> </ol>					
<b>Course Outcomes:</b>					
<ol style="list-style-type: none"> <li>1. They will become expert in planning different types of gardens and can think of starting their own business.</li> <li>2. Students will gain the Information about Various Plant tissue culture technique along with knowledge of Recombination DNA technology.</li> <li>3. They will have in-depth Information about Biostatistical tools and Bioinformatics Databases along with Scopes of Bioinformatics in India.</li> </ol>					
<b>INDEX</b>					
<b>Unit</b>	<b>Description</b>				<b>Periods</b>
<b>1</b>	Horticulture and Gardening Introduction to Horticulture:				15
<b>2</b>	Unit II: Biotechnology				15
<b>3</b>	Unit III : Biostatistics and Bioinformatics. Biostatistics				15
<b>1</b>	Practical Semester-IV Paper III Current trends in Plant Sciences I BH.USBO403				30
	Total				<b>75</b>



Detailed syllabus: Paper III Current trends in Plant Sciences II BH.USBO403		
Units	Detailed descriptions	Lecture period /unit
1	<p><b>Unit I: Horticulture and Gardening Introduction to Horticulture:</b></p> <p>Branches of Horticulture Gardening:</p> <p>Locations in the garden- edges, hedges, lawn, flower beds, avenue, water garden (with names of two plants for each category).</p> <p>Focal point.</p> <p>Types of garden</p> <p>Formal and informal gardens- <b>Zen Garden, Japanese, Mughal, French, English, Nakshatra garden</b></p> <p>National Park: Sanjay Gandhi National Park.</p> <p>Botanical Garden: Veer Mata Jijabai Udyan (Victoria Garden).</p>	15
2	<p><b>Unit II: Biotechnology</b></p> <p>Introduction to plant tissue culture</p> <p>Laboratory organization and techniques in plant tissue culture</p> <p>Totipotency</p> <p>Organogenesis</p> <p>Organ culture – root cultures, meristem cultures, anther and pollen culture, embryo culture.</p> <p>R-DNA technology</p> <p>Gene cloning</p> <p>Enzymes involved in Gene cloning</p> <p>Vectors used for Gene cloning.</p>	15
3	<p><b>Unit III: Biostatistics and Bioinformatics</b></p> <p>Biostatistics:</p> <p>The chi square test.</p> <p>Correlation – Calculation of coefficient of correlation.</p> <p>Bioinformatics :</p> <p>Information technology: History and tools of IT, Internet and its uses.</p> <p>Introduction to Bioinformatics- goal, need, scope and Limitation.</p> <p>Bioinformatics <b>Databases- NCBI</b></p> <p>Aims of Bioinformatics:</p> <p>Data organization, Tools of Bioinformatics- tools for web search</p> <p>Data retrieval tools- Entrez,</p>	15



	BLAST Bioinformatics programme in India.	
<b>Unit</b>	<b>Practical-Semester-IV Paper III Current trends in Plant Sciences I BH.USBOP3</b>	<b>Periods /unit</b>
<b>1</b>	Horticulture 1 Study of five examples of plants for each of the garden locations as prescribed for theory 2 Preparation of garden plans – formal and informal gardens 3 Bottle and dish garden preparation.	<b>10</b>
<b>2</b>	Biotechnology 4 Various sterilization techniques 5 Preparation of Stock solutions, Preparation of MS medium. 6 Seed sterilization, callus induction 7 Regeneration of plantlet from callus. 8 Identification of the cloning vectors – pBR322, pUC 18, Ti plasmid.	<b>10</b>
<b>3</b>	Biostatistics and Bioinformatics 9 Chi square test 10 Calculation of coefficient of correlation 11 Web Search – Google, Entrez. 12 BLAST	<b>10</b>

**Text books**

1. Andrew Lack, David Evans (2021) BIOS Instant Notes in Plant Biology. CRC Press.
2. Practical In Botany S.Y.B.Sc. Sem III & IV Sheth Publication
3. Botany-III (Current Trends in Plant Sciences- II)- (2017)
4. Baxevanis A. D., Francis Ouellette B. F. (2001). Bioinformatics A Practical Guide to the Analysis of Genes and Proteins. John Wiley & sons Inc.,

**Reference Books:**

1. Rosalind Creasy (2010). Edible Landscaping.
2. Huimin Zhao, Sang Yup Lee, Jens Nielsen, Gregory Stephanopoulos (2021). Protein Engineering, Tools and Applications.
3. Sang Yup Lee, Jens Nielsen, Gregory Stephanopoulos (2021). Metabolic Engineering, Concepts and Applications
4. Bernard Rosner (2015). Fundamentals of Biostatistics 8th Edition, Harvard University.



5. Zoe Eastwood (2019). Handbook of Plant Biotechnology.
6. DNA Technology: A reference Handbook, 2<sup>nd</sup> Edition (Contemporary world Issues), 2016.
7. Stewart C.N. (2008). Plant Biotechnology and Genetics: Principle, Techniques and application.
8. Jin Xiong (2007). Essential Bioinformatics, Cambridge University Press,
9. Charles Malkoff (2017). Bioinformatics, Proteomics and Genomics.
10. Douglas W. Tallamy and Rick Darke (2014). The Living Landscape: Designing for Beauty and Biodiversity in the Home Garden Book. Timber Press.

### Self-evolving topics .

Develop entrepreneurial skills.

Validate and document scientific data

Analyze the data scientifically

Apply bioinformatics tools for predicting the functioning of DNA and proteins

Instilling the confidence in students to become an entrepreneur

### Self-Study material-

1. The students show study the basic understanding of garden and plants which are commonly seen in gardens.
2. Basic understanding of the fundamental principles of Chemistry and physics should also be revived by the students. Basic knowledge of statistics needs to be studied.
3. The ebooks circulated by the faculty members for the subject/ topic (Each unit) concerned should be studied in detail.

### Details of Conduct of Practical Examination (Evaluation Scheme):

#### A External Assessment 100%-50marks

Particulars	Paper I (BH.USBOP1)	Paper II (BH.USBOP2)	Paper III (BH.USBOP3)
Laboratory work	40	40	40
Journal	05	05	05
Viva	05	05	05
	50	50	50

The students are required to present a duly certified journal for appearing at the semester end practical examination, failing which they will not be allowed to appear for the examination. In case of report of loss of Journal, a "Lost Certificate", should be obtained from Head/ Coordinator of the department; failing which the student will not be allowed to appear for the practical examination.

**Note-** Two short field excursion/ 2-4 days long excursion for habitat studies are compulsory .Field work of not less than eight-hour duration to one period per week for a batch of 15 students- **2 Credits**



### Modality of Assessment

Theory Examination Pattern:

A) Internal Assessment- 40%- 40 Marks

Sr No	Evaluation type	Marks
CIA-1	Internal Class Test with Objective type questions and Short Notes	20
CIA-2	Assignment/ Presentation/debate/ Analysis/ Project work/ Internship/ Training/ Paper presentation in national or international Seminar/Conference/ Report writing for Short/long excursion etc.	20
	<b>TOTAL</b>	<b>40</b>

**Assignment types can include:**

- 1.Role of plants in the functioning of ecosystem
- 2.Phylogeny of plant diversity
- 3.Symptoms of Fungal diseases cycle and its impact on crops provide the control measures.

#### CIA-2 for Semester 4

Paper	401	402	403
<b>Assignment type</b>	Field report/ Survey	Assignment writing	Project preparation
<b>Skill assessed</b>	Technical	Presentation and writing	Analytical/ application/ Problem solving/ Presentation
<b>Topic's</b>			
<b>a</b>	Collection of 5 plants with fungal diseases and its identification	Role of anatomy in plant classification in angiosperms	Nearby Garden visit and drawing its layout plan and mentioning each location with plant list.
<b>b</b>	Study of gymnosperms in Bhavans campus and develop key for its identification	Role of plants in the functioning of ecosystem	Potential of India in exporting PTC of ornamental plants
<b>c</b>	Study of pteridophytes in Bhavans campus and develop key for its identification	Role of anatomy in plant classification in gymnosperms	Potential of India in exporting PTC of medicinal plants
<b>d</b>	Study of 5 common fungi which spoils the food	Utility of C3 and C4 plants with respect to the Climate change	Application of principles of Biostatistics in garden or campus plants
<b>e</b>	Symptoms of Fungal diseases cycle and its impact on crops provide the control measures.	Why CAM plants are more suitable for growth in xeric condition as compared to C3 & C4 plants?	Study of garden of Bhavan's campus



**C) External Examination 60%- 60 Marks Semester End Theory Examination (offline mode)**

Duration of examination: **2hours**

Paper Pattern:

1. There shall be three questions from each unit.
2. There shall be an internal choice in first the questions.
3. The fourth question would be a mixed of all units
4. All four questions shall be compulsory.

Paper Pattern:(Semester end Examination IV)

Sr.no	Questions on	Question	Option	Marks	Total marks
1	Unit-I	A or A and B	Any two out of three	8 or 8 marks and 7marks	15
2	Unit-II	A or A and B	Any two out of three	8 or 8 marks and 7marks	15
3	Unit-III	A or A and B	Any two out of three	8 or 8 marks and 7marks	15
4	All Units	A,B,C,D and E	Any three out of Five	5 marks each	15
				Total	60



## Overall Examination & Marks Distribution Pattern

### Semester-IV

Course BH.USBO	301,302 &303			401,402 &403			Grand
	Internal	External	Total	Internal	External	Total	
Theory	120	180	300	120	180	300	600
Practical	--	150	150	--	150	150	300
							900

### Rubrics of evaluation for ESE

Unit	Knowledge	Understanding	Analysis & critical thinking	Total marks/unit
1 from all units	06	05	04	15
2	06	05	04	15
3	06	05	04	15
4	06	05	04	15
Total per objective	24	20	16	60

**Rubrics of evaluation for CIA-2-** Assignment/ Presentation/debate/ Analysis/ Project work/ Internship/ Training/ Paper presentation in national or international Seminar/Conference/ Report writing for Short/long excursion etc.

**Class:** \_\_\_\_\_ **Roll No** \_\_\_\_\_ **Topic** \_\_\_\_\_

Parameters	Max Marks	80 – 100% Excellent	60 -80% Good	40 – 60% Satisfactory	20 – 40% Poor	0-20% very poor
<b>CONTENT</b>	10					
Content: Introduction	02					
Content: Development	03					
Content:– Conclusion -	03					
Content: - Bibliography	02					
Effective communication skill	10					
Language, Style and Structure;	05					
Teaching aids;	05					
Total	20					