Anekant Education Society's

Tuljaram Chaturchand College of Arts, Science and Commerce, Baramati

(Autonomous)

Course Structure for M. Sc. II (Botany)

SYLLABUS (CBCS) FOR M. Sc. Botany II (w. e. f. June, 2023)

Academic Year 2023-24

Sem.	Paper Code	Title of Paper	No. of Credits
III	PSBT 231	Angiosperms and Evolution	4
	PSBT 232	Developmental Botany	4
	PSBT 233	Computational Botany	4
	PSBT 234 A OR 234 B OR 234 C OR 234 D	Advanced Plant Physiology OR Advanced Mycology and Plant Pathology OR Bryology OR Angiosperm taxonomy	4
	PSBT 235	Practicals Based on PSBT 231, 232 and 233	4
	PSBT 236 A OR PSBT 236 B OR PSBT 236 C OR PSBT 236 D	Practicals based on special paper Advanced Plant Physiology OR Practicals based on special paper Advanced Mycology and Plant Pathology OR Practicals based on special paper Bryology OR Practicals based on special paper Angiosperm Taxonomy	4
	CC-23	Certificate Course – II	2
	SD-23	Skill Development – I	2
	PSBT 241	Plant Pathology	4

IV	PSBT 242	Industrial Botany	4
	PSBT 243	Plant Biotechnology	4
	PSBT 244 A PSBT 244 B PSBT 244 C PSBT 244 D	Advanced Plant Physiology OR Advanced Mycology and Plant Pathology OR Bryology OR Angiosperm taxonomy	4
	PSBT 245	Practicals Based on 241, 242 and 243	4
	PSBT 246	Research Projects and Summer Training	4
	SD-24	Skill Development – II	2
		Total Credits	55

M.Sc. Botany

Program Outcomes (Pos) for M. Sc. Program

PO1	**Disciplinary Knowledge:** Demonstrate comprehensive knowledge of the discipline that forms a part of a postgraduate programme. Execute strong theoretical and practical understanding generated from the specific programme in the area of work.
PO2	**Critical Thinking and Problem solving:** Exhibit the skill of critical thinking and understand scientific texts and place scientific statements and themes in contexts and also evaluate them in terms of generic conventions. Identify the problem by observing the situation closely, take actions and apply lateral thinking and analytical skills to design the solutions.
PO3	**Social competence:** Exhibit thoughts and ideas effectively in writing and orally; communicate with others using appropriate media, build effective interactive and presenting skills to meet global competencies. Elicit views of others, present complex information in a clear and concise way and help reach conclusions in group settings.
PO4	**Research-related skills and Scientific temper :** Infer scientific literature, build a sense of enquiry and able to formulate, test, analyse, interpret and establish hypothesis and research questions; and to identify and consult relevant sources to find answers. Plan and write a research paper/project while emphasizing on academics and research ethics, scientific conduct and creating awareness about intellectual property rights and issues of plagiarism.
PO5	**Trans-disciplinary knowledge:** Create new conceptual, theoretical and methodological understanding that integrates and transcends beyond discipline-specific approaches to address a common problem.
PO6	**Personal and professional competence:** Perform independently and also collaboratively as a part of a team to meet defined objectives and carry out work across interdisciplinary fields. Execute interpersonal relationships, self-motivation and adaptability skills and commit to professional ethics.
PO7	**Effective Citizenship and Ethics:** Demonstrate empathetic social concern and equity centred national development, and ability to act with an informed awareness of moral and ethical issues and commit to professional ethics and responsibility.
PO8	**Environment and Sustainability:** Understand the impact of the scientific solutions in societal and environmental contexts and demonstrate the knowledge of and need for sustainable development.
PO9	**Self-directed and Life-long learning:** Acquire the ability to engage in independent and life-long learning in the broadest context of socio-technological changes.

Class : M.Sc. II (Semester- III)

Paper Code : PSBT 231

Paper : I **Title of Paper: Angiosperms and Evolution**

Credit : 4 **Number of lectures: 60**

A) Learning Objectives:

1. To create awareness and inculcate knowledge of morphological and taxonomical diversity of local flora.
2. To give idea about economic importance of flowering plants.
3. To understand evolutionary concepts.

B) Course Outcome:

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

CO1. Describe the morphology and reproductive structure of Phanerogams.

CO2.Identify, describe and study in detail life cycle of Phanerogams.

CO3. Know scope of the Phanerogams diversity with special reference to Gymnosperms and Angiosperms.

CO4. Know different methods of conservation of Phanerogams.

CO5. Study the applications of cryptogams.

CO6. Describe and identify flowering plants.

CO7. Understand the local flora with respect to Phanerogams.

Credit I - Systematics and Classification of Angiosperms (15L)

1. Systematics: A key science, importance and relevance in conservation, taxonomic structure -taxonomic hierarchy, the species concept, categories and ranks, alpha and omega taxonomy, taxonomy as synthetic discipline. **5L**
2. International Code of Botanical Nomenclature (ICBN): Salient features-principles, important rules and recommendations, provisions for the governance of the code, appendices. **3L**
3. Systems of Angiosperm classification: Brief history of Pre-Darwinian and Post-Darwinian classification systems (any four), Phenetic versus phylogenetic systems, cladistics in taxonomy, angiosperm phylogeny group (APG). **4L**
4. Recent Systems of Classifications: By Armen L.Takhtajan, Arthur Cronquist, R. M. T. Dahlgren and Robert F. Thorne. **3L**

Credit II -Taxonomic Aspects of Angiosperms (15L)

1. Morphological variations, systematic position, inter-relationship, phylogeny and economic importance of families: Magnoliaceae, Ranunculaceae, Lauraceae, Moraceae, Urticaceae, Casuarinaceae, Alismataceae, Hydrocharitaceae, Aponogetonaceae, Bignoniaceae, Scrophulariaceae, Amaranthacaeae, Portulacaceae, Piperaceae, Aracaceae. **10L**
2. Phytogeography: Phytogeographic regions of India, endemism, hotspots and hottest hotspots. Endemism in Western Ghats, plant explorations, invasions and introductions. **5L**

Credit III: Evolution (15 L)

1. Emergence of evolutionary thought: Steps and preview of evolution, Lamarkism, Darwinism- Concepts of variation, adaption, struggle for fitness and natural selection; Neo-Darwinism, Spontaneity of mutations, evolutionary synthesis. **3L**
2. Origin of cells and Unicellular evolution: Origin of basic biological molecules, abiotic synthesis of organic monomers and polymers, Concepts of Opairn and Halden, Experiment of Miller (1953), The first cell, evolution of prokaryote, origin of eukaryotic cells, evolution of unicellular eukaryotes, anaerobic metabolism, photosynthesis and aerobic metabolism, RNA world theory. **4L**
3. Molecular Evolution: Concepts of natural evolution, molecular clocks, molecular tools in phylogeny, classification and identification, protein and nucleotide sequence analysis, origin of new genes and proteins, gene duplication and divergence. **4L**
4. The mechanism of evolution: Concepts and rate of change in gene frequency through natural selection, migration and random genetic drift, adaptive radiation and modification, isolation mechanism, speciation, allopatric and sympatricality, parapetric, convergent evolution, sexual selection, co-evolution. **4L**

Credit IV: Modern techniques in angiosperm taxonomy 15 L

1. **Anatomy in relation to taxonomy**: Wood and floral anatomy, anatomical characters of taxonomic importance, use of anatomical data in understanding the interrelationships, evolution of angiosperms and solving taxonomic problems. **3L**

2. **Palynotaxonomy**: Pollen morphology, Polarity, symmetry, NPC of pollen, exine stratification, excrescences, L/O pattern, palynogram; pollen characters of taxonomic importance. **3L**
3. **Chemotaxonomy**: Classes of compounds and their biological significance, stages in chemotaxonomic investigations. Criteria for use of chemical in plant taxonomy; Proteins and taxonomy- seed proteins, techniques of protein electrophoresis, analysis of A. A. sequence and its significance in systematics. **6L**
4. **Ultrastructural Systematics**: SEM and TEM studies and plant systematics; SEM and plant surface structure, TEM and dilated cisternae of endoplasmic reticulum and sieve element, plastids, applications of data in the classification of higher taxa. **3L**

References:

1. Flowers: How They Changed the World by William C. Burger, 2006.
2. Plant Taxonomy & Biosystematics: Classical &Modern, T. S. Rana, New India Publishing Agency, 2014
3. Vashishta P.C., A.R. Sinha, Anil Kumar. 2006. Gymnosperms. S. Chand.
4. Shivanna, K. R. and N. S. Rangaswamy. 1992. Pollen Biology- A Laboratory Manual. Springer-Verla
5. Stuessy T. F. 2002. Plant taxonomy. The systematic Evaluation of comparative data. Biseu Singh Mahendra Pal Sign Pehra Duk.
6. Verma P.S and Agarwal V.K. (2006) Cell Biology, Genetics, Molecular Biology,
7. Evolution, Ecology. S. Chand and Company, New Delhi.
8. Cooper G.M and Hausman R.E. (2007) (4^{th} Edn). The Cell molecular approach Sinauer associate, Inc, Suderland (USA).
9. Roy S.C and De K.K. (2005). (2^{nd}Edition). Cell Biology, New central Book Agency Private Ltd., Kolkata.
10. Plant Systematics by Michael G. Simpson, 2nd Edition, 2010.
11. Esau's Plant Anatomy: Meristems, Cells, and Tissues of the Plant body: Their Structure, Function, and Development by Ray F. Evert; Susan E. Eichhorn (Contribution by), 2006.

Mapping of Program Outcomes with Course Outcomes

Class: M. Sc. II (Sem. III) **Subject**: Botany

Course: Angiosperms and Evolution **Course Code**: PSBT 231

Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

	Programme Outcomes (POs)								
Course Outcomes	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO9
CO 1	3		2			1			3
CO 2	3		2			1			3
CO 3	3				2	1	1	1	1
CO 4		3	1	1			1		
CO 5					1				1
CO 6	3				1				1
CO 7		3				2			

Justification for the mapping

PO1: Disciplinary Knowledge

CO1. Describe the morphology and reproductive structure of Phanerogams.

CO2. Identify, describe and study in detail life cycle of Phanerogams.
CO3. Know scope of the Phanerogams diversity with special reference to Gymnosperms and Angiosperms.
CO6. Describe and identify the flowering plants.

PO2: Critical Thinking and Problem Solving

CO4. Know different methods of conservation of Phanerogams.
CO7. Understand the local flora with respect to Phanerogams.

PO 3: Social competence

CO1. Describe the morphology and reproductive structure of Phanerogams.
CO2. Identify, describe and study in detail life cycle of Phanerogams.
CO4. Know different methods of conservation of Phanerogams.

PO 4: Research-related skills and Scientific temper

CO4. Know different methods of conservation of Phanerogams.

PO5: Trans-disciplinary Knowledge

CO3. Know scope of the Phanerogams diversity with special reference to Gymnosperms and Angiosperms.
CO5. Study the applications of Phanerogams.
CO6. Describe and identify the flowering plants.

PO6: Personal and Professional Competence

CO1. Describe the morphology and reproductive structure of Phanerogams.
CO2. Identify, describe and study in detail life cycle of Phanerogams.
CO3. Know scope of the Phanerogams diversity with special reference to Gymnosperms and Angiosperms.
CO7. Understand the local flora with respect to Phanerogams.

PO 7: Effective Citizenship and Ethics

CO3. Know scope of the Phanerogams diversity with special reference to Gymnosperms and Angiosperms.
CO4. Know different methods of conservation of Phanerogams.

PO 8: Environment and Sustainability

CO3. Know scope of the Phanerogams diversity with special reference to Gymnosperms and Angiosperms.

PO 9: Self-directed and Life-long Learning

CO1. Describe the morphology and reproductive structure of Phanerogams.
CO2. Identify, describe and study in detail life cycle of Phanerogams.
CO3. Know scope of the Phanerogams diversity with special reference to Gymnosperms and Angiosperms.
CO5. Study the applications of Phanerogams.
CO6. Describe and identify the flowering plants.

Class : M.Sc. II (Semester- III)

Paper Code : PSBT 232

Paper : II **Title of Paper: Developmental Botany**

Credit : 4 **No. of lectures: 60**

A) Learning Objectives:

1. To study structure of plant development process.
2. To pertain knowledge of different embryological techniques.
3. To acknowledge the economic uses of plants

B) Course Outcome:

CO1. Students get knowledge of internal structure o f tissue system in plant.
CO2. Students are aware about microsporogenesis, megasporogenesis and embryogenesis.
CO3. Students get knowledge of tissue and tissue systems present in plant.
CO4. Students get knowledge of secondary growth in plants.
CO5. Students are able to know reasons for anomalous secondary growth in plants.
CO6. Students get knowledge of wood anatomy.
CO7. Students get knowledge of endosperm and seed.

TOPICS/CONTENTS:

Credit I- Process of Plant Development (15L)

1. Plant development- Concept, definitions and unique features. **1L**
2. Processes of development, cell growth, division and differentiation, competence, determination, commitment, specification, redifferentiation and dedifferentiation. Polarity and symmetry, organization of cells, tissues and tissue system of whole plant. Cell-cell interaction. **6L**
3. Factors affecting on development- intrinsic and extrinsic. **2L**
4. Vegetative development – structure and organization of seed embryo **1L**
5. Seed germination – Embryonal axis meristems, establishment of seedling organ. **1L**
6. Phenomenon of development, meristems as dynamic centers of cell regeneration, primordium to organ, juvenility – characteristics, transition to adult phase. **4L**

Credit II -Embryological Aspects of Development (15L)

1. Transition - vegetative to reproductive phase, morphological and histochemical changes in vegetative plant body. **2L**

2. Gametophyte development, stamen and microsporogenesis, male gametophyte or male germ unit development, carpel and megasporogenesis, female gametophyte or female germ unit formation. **4L**
3. Fertilization – Pollen tube growth and its path, its entry into embryo sac, gametic fusion, significance of double fertilization, abnormalities in fertilization. **3L**
4. Embryo development - Development of embryo in dicots and monocot, unorganized or reduced embryo. **3L**
5. Polyembryony, apomictic phenomenon Polyembryony – concept and classification of polyembryony, special cases and causes of polyembryony, apomixes concept, categories-agamospermy and vegetative reproduction apospory, parthenogenesis. **3L**

Credit III -Physiology and Molecular Basis of Plant Development (15L)

1. Physiology of plant development –Totipotency, light mediated development, hormonal control in development, light and hormonal signaling, cell lineages, cell fate mapping, specific gene expression. **6L**
2. Case study of organ culture, anther, pollen and protoplast culture and its role in understanding plant development **3L**
3. Molecular basis of plant development - Embryogenesis and seedling development, root, shoot and leaf development, gene expression during transition to flowering and flower development molecular genetics of gametophytes development. **6L**

Credit IV - Economic Botany (15L)

Source, method of cultivation and economic uses of

1. Cereals- rice, wheat, maize **1L**
2. Millets – sorghum, pear millet, finger millet **1L**
3. Legumes and nuts- gram, pigeon pea, soybean, peanut, almonds **2L**
4. Vegetables- sweet potato, beet, carrot, radish, potato, brinjal, onion, garlic, cabbage tomato, cucurbits. **1L**
5. Fruits- mango, citrus, grapes, banana, guava, papaya, pineapple. **2L**
6. Plant fibres- cotton, flax, sun-hemp, coir **1L**
7. Wood and Cork – Babul, deodar, pinewood, red sandalwood, teak **2L**

8. Rubber and its products **1L**
9. Fatty oils- Soybean oil, sunflower oil, peanut oil **1L**
10. Essential oils- jasmine oil, lavender oil, clove oil, rose oil **1L**
11. (a)Sugar industry and its byproducts **2L**
    (b)Spices- *Asafoetida*, turmeric, ginger, cinnamon, saffron.

REFERENCES:

1. P Maheshwari. Embryology of Angiosperms
2. Bhojwani and Bhatnagar. Embryology of Angiosperms
3. K Essau. Plant Anatomy
4. Cutter. Plant Anatomy
5. S N Pandey. Plant Anatomy
6. S N Pandey. Economic Botany
7. V Verma. Economic Botany
8. Bendre. Economic Botany
9. Hill. Economic Botany
10. Razdan. Plant Tissue Culture
11. Vasil. Plant Tissue Culture
12. P K Gupta. Elements of Biotechnology
13. Chawala. Introduction to Plant Biotechnology
14. C B Pawar. Cell Signaling
15. Biology of Plants. American Society of Plant Physiologists Maryland, USA.
16. Eng. Chong Pua Michae R. Davey: Plant Developmental Biology - Biotechnological Perspectives.
17. Advances in Economic Botany.
18. Galstone A.W. 1989. Life processes in Plants. Scientific American Library, Springer Verlag, New York, USA.
19. Moore T.C. 1989. Biochemistry and Physiology of Plant Hormones Springer –Verlag, New York, USA.

Choice Based Credit System Syllabus (2022 Pattern)

Mapping of Program Outcomes with Course Outcomes

Class: M. Sc. II (Sem. III) **Subject**: Botany

Course: Developmental Botany **Course Code**: PSBT 232

Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

	Programme Outcomes (POs)								
Course Outcomes	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO9
CO 1	3		2			1			3
CO 2	3		2			1			3
CO 3	3				2	1	1	1	1
CO 4		3	1	1			1		
CO 5					1				1
CO 6	3				1				1
CO 7		3				2			

Justification for the mapping

PO1: Disciplinary Knowledge

CO1. Describe the morphology and reproductive structure of Phanerogams.

CO2. Identify, describe and study in detail life cycle of Phanerogams.
CO3. Know scope of the Phanerogams diversity with special reference to Gymnosperms and Angiosperms.
CO6. Describe and identify the flowering plants.

PO2: Critical Thinking and Problem Solving

CO4. Know different methods of conservation of Phanerogams.
CO7. Understand the local flora with respect to Phanerogams.

PO 3: Social competence

CO1. Describe the morphology and reproductive structure of Phanerogams.
CO2. Identify, describe and study in detail life cycle of Phanerogams.
CO4. Know different methods of conservation of Phanerogams.

PO 4: Research-related skills and Scientific temper

CO4. Know different methods of conservation of Phanerogams.

PO5: Trans-disciplinary Knowledge

CO3. Know scope of the Phanerogams diversity with special reference to Gymnosperms and Angiosperms.
CO5. Study the applications of Phanerogams.
CO6. Describe and identify the flowering plants.

PO6: Personal and Professional Competence

CO1. Describe the morphology and reproductive structure of Phanerogams.
CO2. Identify, describe and study in detail life cycle of Phanerogams.
CO3. Know scope of the Phanerogams diversity with special reference to Gymnosperms and Angiosperms.
CO7. Understand the local flora with respect to Phanerogams.

PO 7: Effective Citizenship and Ethics

CO3. Know scope of the Phanerogams diversity with special reference to Gymnosperms and Angiosperms.
CO4. Know different methods of conservation of Phanerogams.

PO 8: Environment and Sustainability

CO3. Know scope of the Phanerogams diversity with special reference to Gymnosperms and Angiosperms.

PO 9: Self-directed and Life-long Learning

CO1. Describe the morphology and reproductive structure of Phanerogams.
CO2. Identify, describe and study in detail life cycle of Phanerogams.
CO3. Know scope of the Phanerogams diversity with special reference to Gymnosperms and Angiosperms.
CO5. Study the applications of Phanerogams.
CO6. Describe and identify the flowering plants.

Class: M.Sc. II (Semester- III)

Paper Code: PSBT 233

Paper: III **Title of Paper: Computational Botany**

Credits: 4 **No. of lectures: 60**

A) Learning Objectives:

1. To inculcate knowledge of use of computer for biological data analysis.
2. To give idea of importance of different software's used in bioinformatics.
3. To make aware about database significance.

B) Course Outcome:

CO1. Students will be expert in use of computer to solve biological problems.
CO2. Students can be master in solving biological problems with the help of statistics.
CO3. Students will apply their knowledge in various branches of biology.
CO4. Students' expertise in microscopic techniques.
CO5. Expertise in different centrifugation techniques.
CO6. Train to use different electrochemical techniques.
CO7. Students will apply their knowledge in various branches of biology.

TOPICS / CONTENTS:

Credit I- **(15 L)**

1. Introduction to Statistics :

Population, Sample, variable, Attributes-Concepts **9L**

Measures of central tendency – arithmetic mean, mode of median, mode.

Measures of dispersion range– variation, combined S. D. BOX plot, standard deviation, and coefficient of variance. Skewness and kurtosis.

2. Correlation and regression: **6L**

Bivariate correlation, positive correlation, negative correlation

Measures of correlation – Scatter diagram, Karl-Pearson's coefficient of correlation, Spearman's Rank correlation coefficient,

Regression – Equations of regression lines. Regression coefficient

Credit II- Experimental Statistics **(15 L)**

1. Design of experiments and analysis of variance **8L**

Sampling and sampling distributions – concept of sample and population.

Principles of design – randomization, replication, local control.

Guidelines for designing the experiments, size of plot, number of replications

Completely randomized design (CDR), Randomized block design (RBD), Latin Square Design (LSD), Analysis of variance table (ANOVA), One way and Two way ANOVA, Tukey's test for pairwise comparison of treatments

Dunnet's test for comparison of treatment means with control

Duncan's multiple range test

Mann–Whitney U test

2. Testing of hypothesis **7L**

Hypothesis, statistical hypothesis, critical region, level of significance, p-value

T-test: t-test for mean, chi-square test: chi-square test for goodness of fit, F- test.

NOTE – Emphasis be given on methodology and numerical problem solving rather than derivations and proofs.

Credit III - Bioinformatics **(15 L)**

Bioinformatics concept, Information resources NCBI (Functions), MGD. **1L**

Types of databases (Primary, secondary, composite. flat file relational, hierarchial) **2L**

Sequences used in bioinformatics (genomic DNA, cDNA, organellar DNA, expressed sequence tags (EST). Gene Sequence Tags (GST). **3L**

Statistical analysis and evaluation of BLAST results. **3L**

b. Multiple sequence alignments (Dynamic programming, progressive methods, iterative methods) **3L**

c. Use of Bioinformatics tools in analysis **2L**

d. Protein structure prediction, motifs and domains, designing of primers. **1L**

Credit IV-Biomathematics (15L)

1. Types of measurement and their units **1L**
2. Making solutions – moles and molarity, stock solutions and dilutions **4L**
3. Ions and electrical potentials – Nernst and Goldman equations **1L**
4. Osmolarity and osmotic pressure measurements **1L**
5. Quantification of chemical reactions – equilibrium constant, reaction rates **1L**
6. pH measurements and preparation of buffers **2L**
7. Measuring concentrations using spectrophotometry **1L**
8. Measurement of enzyme activity **2L**
9. Specific activity of radioisotopes, making radioisotope solutions **1L**

10. Cell counting using serial dilutions, haemocytometry **1L**

References:

1. Lab Math – Adams, D.S. I.K. Internations Pvt Ltd. New Delhi, 2004
2. Statistical Methods – Snedecor G.W. and Cochran W.G. Affiliated East-West Press Pvt. Ltd.1989
3. Statistical methods in Agriculture and Experimental Biology – Mead, R. and Curnow, R.N. Chapman and Hall, 1983
4. Practical statistics and experimental design for plant and crop science – Clewer, A.G. and Scarisbrick, A.H. John Wiley, New York, 2001
5. Bioinformatics - Westhead, DR, Parish JH and Twyman, RM, BIOS Scientific Publishers Ltd., Oxford, 2003
6. Bioinformatics – Sequence and genome analysis. D.W. Mount, CBS Publishers, New Delhi,2003
7. Bioinformatics and Molecular Evolution – Higgs PG and Attwood, TK
8. Fundamentals of Biostatistics by Irfan Ali Khan & Atiya Khanum, Ukaaz Publication, Hyderabad ISBN: 81-900441-0-9: 2009.
9. Bioinformatics: Methods and Applications: Genomics, Proteomics and Drug Discovery. Prentice-Hall of India Pvt.Ltd; 4th revised edition. P. Rastogi and N. Mendiritta. 2013
10. Advanced biotechnology, Dr. R. C. Dubey, S. Chand and Company Pvt. Ltd.New Delhi.

Choice Based Credit System Syllabus (2022 Pattern)

Mapping of Program Outcomes with Course Outcomes

Class: M. Sc. II (Sem. III) **Subject**: Botany

Course: Computational Botany **Course Code**: PSBT 233

Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

	Programme Outcomes (POs)								
Course Outcomes	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO9
CO 1		3		3					
CO 2		3							

CO 3	3								
CO 4						3			
CO 5									3
CO 6	3								
CO 7					2				

Justification for the mapping

PO1: Disciplinary Knowledge

CO3. Students will apply their knowledge in various branches of biology.
CO6. Students will apply their knowledge in various branches of biology.

PO2: Critical Thinking and Problem Solving

CO1. Students will be expert in use of computer to solve biological problems.
CO2. Students can be master in solving biological problems with the help of statistics.

PO 4: Research-related skills and Scientific temper

CO1. Students will be expert in use of computer to solve biological problems.

PO5: Trans-disciplinary Knowledge

CO7. Students' expertise in microscopic techniques.

PO6: Personal and Professional Competence

CO4. Students will be expert in use of computer to solve biological problems.

PO 9: Self-directed and Life-long Learning

CO5. Students can be master in solving biological problems with the help of statistics.

Class : M.Sc. II (Semester- III)

Paper Code : PSBT 234 (A)

Paper : IV **Title of Paper: Advanced Plant Physiology**

Credits : 4 **No. of lectures: 60**

A) Learning Objectives:

1. To train the students in physiological processes.
2. To make technosavy students.
3. To be acquainted mechanism and physiology life processes in plants.

B) Course Outcome:

CO1. Use knowledge for improvement of agricultural yield
CO2. Students aware about the plant to response environmental conditions.
CO3. Students get knowledge of internal activities in plant.
CO4. Development of expertise in plant physiology.
CO5. Get knowledge of plant metabolism.
CO6. Students get knowledge of plant cycle.
CO7 Students get knowledge of biomolecules.

TOPICS/CONTENTS:

Credit- I Germination and Mineral Nutrition (15L)

- Concept, seed viability and dormancy, methods of breaking seed dormancy, factors affecting on seed germination **7L**
- Physiological changes takes place during seed germination. Mobilization of reserve food,**8L**

Credit- II: Plant Growth and Development (15L)

- **Growth**, phases, measurement of growth, nature of growth curve and formulae for growth curve, Metabolism and allocation of resource during vegetative and reproductive growth, RGR. Factors affecting growth. C/ N ratio. **4L**
- **Plant hormones** – Biosynthesis, storage, breakdown and transport; physiological effects and mechanisms of action. (Auxins, GA, Cytokinins, ABA, Ethylene, Jasmonic acid, Brassinosteroides) **5L**
- Application of plant growth regulators in Agriculture. **1L**

- Physiology of flowering, Circadian Rhythms, photoperiodism and its significance, vernalization. **2L**
- Sensory photobiology - Structure, function and mechanisms of action of phytochromes, cryptochromes and phototropins; stomatal movement and biological clocks. **3L**

Credit- III Senescence and Ageing (15L)

- **Senescence**: Concept, definition, patterns of cellular senescence –cell, tissue, organ, whole plant, biological significance of senescence. **7L**
- Physiological and chemical changes takes place during senescence (pigment, protein, photosynthesis, oxidative, nucleic acid), functional and ultrastructural changes in chloroplast, mitochondrion and cell wall during senescence, PCD (Programmed Cell Death) in life cycle of plants. **8L**

Credit- IV: Biomolecules and Secondary metabolites (15L)

- Composition, structure and function of biomolecules (carbohydrates, lipids, proteins, nucleic acids and vitamins). **7L**
- Secondary metabolites - Biosynthesis of terpenes (IPP), Alkaloid (barberine) and Phenolics (Phenylpropanoid), flavonoides, Lignin. **8L**

References

1. Buchanan B.B, Gruissem W. and Jones R.L 2000. Biochemistry and Molecular Biology.
2. Biology of Plants. American Society of Plant Physiologists Maryland, USA.
3. Dennis D.T., Turpin, D.H. Lefebvre D.D. and Layzell D.B. (eds) 1997. Plant
4. Metabolism (Second Edition) Longman, Essex, England.
5. Nobel P.S 1999. Physiochemical and Environmental Plant Physiology (Second Edition) Academic Press, San Diego, USA.
6. Salibury F.B and Ross C.W 1992. Plant physiology (Fourth Edition) Wadsworth Publishing Company, California, USA.
7. Concept in Photobiology; Photosynthesis and Photomorphogenesis. Narosa Publishing House, New Delhi.

8. Taiz L. and Zeiger E. 1998. Plant Physiology (Sixth Edition). Sinauer Associates, Inc. Publishes, Massachusetts, USA.
9. Thomas B. and Vince-Prue D. 1997. Photoperiodism in Plants (Second Edition) Academic Press, San Diego, USA.
10. Verma S.K. and Verma Mohit 2007. A.T.B of Plant Physiology, Biochemistry and Biotechnology, S. Chand Publications.
11. Leninger A.C 1987. Principles of Biochemistry, CBS Publishers and Distributers (Indian Reprint).
12. Introduction to Plant Physiology (Forth Edition) William G. Hopkins and Norman.
13. Plant Physiology- Hans Mohr, Peter Schopfer, Springer Berlin publishers.

Choice Based Credit System Syllabus (2022 Pattern)

Mapping of Program Outcomes with Course Outcomes

Class: M. Sc. II (Sem. III) **Subject**: Botany

Course: Elective Papers – Advanced Physiology - I **Course Code**: PSBT 234 (A)

Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

	Programme Outcomes (POs)								
Course Outcomes	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO9
CO 1	3								
CO 2			3						
CO 3		3	3						
CO 4									
CO 5	3								
CO 6			3						
CO 7			3						

Justification for the mapping

PO1: Disciplinary Knowledge

CO1. Students will understand basic concepts in plant tissue culture.

CO5. Develop basic knowledge about applications of biotechnology.

PO2: Critical Thinking and Problem Solving

CO3. Understand the different plant transformation methods.

PO 4: Research-related skills and Scientific temper

CO2. Get expertise in micro propagation techniques.

CO4. Get expertise in skills of crop improvements and plant production.

CO6. Understand the different concepts in r-DNA technology.

CO7. Get expertise in different molecular techniques.

Class : **M.Sc. II (Semester- III)**

Paper Code : **PSBT 234(B)**

Paper : **IV**

Title of Paper : **Advanced Mycology and Plant Pathology**

Credits : **4** **No. of Lectures : 60**

A) Learning Objectives:

1. To study fungal habitat and habit diversity.
2. To study fungal ecology, physiology and genetics.
3. To understand industrial, agricultural and medicinal potential of fungi.

B) Course Outcome:

By the end of course students will be able to

CO1. Get knowledge about cryptogams to conserve Cryptogamic diversity.
CO2. Classify the cryptogams up to species level.
CO3. Get aware about the importance ofCryptogams.
CO4. Get knowledge about lifehistory of algae, fungi bryophytes.
CO5. Explain the role of Algae, Fungi and Bryophytes in human welfare.
CO6. Aware about plant conservation in society.
CO7. Analyze industrial applications of algae.

Credit - I : Fungi as Organism **(15L)**

1. Fungi and their significance (1L)
2. Relationship of fungi with plants and animals (1L)
3. Milestones in mycological and pathological studies (2L)
4. Fungal cell- structure and composition (1L)
5. Physiology of fungal growth (2L)
6. Fungal ecology (1L)
7. Palaeomycology and Ethnomycology (2L)
8. Outline classification of fungi - (2L)

E. A. Bessey System (1950)

Alexopoulos System (1962),

L. E. Hawkers System (1966),

Alexopoulos and Mims System (1979),

Webster and Weber System (2007)

9. Molecular method of fungal taxonomy (1L)
10. Fungi as model organism for genetical studies (2L)

Credit - II : Allied Fungi (15L)

(With respect to general characters, classification, structure, variation and importance)

1. **Myxomycota** - Acrasiomycetes, Protosteliomycetes, Dictyosteliomycetes, Myxomycetes. (6L)
2. **Plasmodiophoromycota** (2L)
3. **Straminipila** - Hyphochytridiomycota, Labyrinthulomycota and Oomycota (7L)

Credit - III : True Fungi (15L)

(With respect to general characters, classification, structural variation and pathological importance, if any)

1. **Chytridiomycota** - Chytridiomycetes (1L)
2. **Zygomycota** - Zygomycetes and Trichomycetes (2L)
3. **Ascomycota** - Archiascomycetes, Hemiascomycetes, Plectomycetes, Pyrenomycetes, Loculoascomycetes (6L)
4. **Basidiomycota** – Hymenomycetes - Agarics and Polypores, Homobasidiomycetes – Gasteromycetes, Heterobasidiomycetes – Auricularials, Dacrymycetales, Tremellales
5. **Teliomycetes** – Rust and Smut fungi (6L)

Credit - IV : Anamorphic Fungi and Allied Aspects (15L)

1. **Deuteromycota**- Classification, structural variations and importance (4L)
2. **Fungal Association**- Lichens, mycorrhizae (3L)
3. **Fungalecology**- Colonization strategies among fungi (2L)
4. **Ecological services of fungi**- bioremediation, biohydrometallurgy, microbiological sensors (2L)
5. **Fungi as Human pathogens**- Dermatomycosis (Tinea), intermediate and systemic mycosis, its symptoms, clinical aspects and control measures. (4L)

References:

1. Ainsworth *et al.*, 1973. The fungi VI –A, VI – B, Academic press.
2. John Webster and Weber, 2007. Introduction to Fungi, Cambridge.
3. Alexopolous C. J. Minms C.W. and Blackwell M., 1999. Introductory Mycology (4th Edition), Willey, New York.
4. Deacon J. W. Fungal Biology (4th Edition) , Blackwell Publishing, ISBN 1405130660
5. Kirk et al., 2001. Dictionary of fungi, 9th edition, Wallingford.
6. Mehrotra R. S. and Aneja K.R., 1990. An Introduction to mycology, New Age Publication.
7. Miguel U., Richard H., and Samuel A. 2000. Illustrated dictionary of mycology Elvira Aguirre Acosta Publisher.
8. Webster J., and Roland W. 2007. Introduction to fungi (3rd Edition), Cambridge University Press.
9. Dube H.C. 2010. An Introduction to fungi. Vikas Publication.
10. Vashista B. R. and Sinha A. K. 2008. Botany for Degree students- Fungi, S. Chand Publication.
11. Sharma O. P. 2011. Fungi and allied microbes. McGraw Hill Education Private Ltd., New Delhi.

Choice Based Credit System Syllabus (2022 Pattern)

Mapping of Program Outcomes with Course Outcomes

Class: M. Sc. II (Sem. III) **Subject**: Botany

Course: Elective Papers – Advanced Mycology - I **Course Code**: PSBT 234 (B)

Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

	Programme Outcomes (POs)								
Course Outcomes	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO9
CO 1		3							
CO 2	3								
CO 3	3								
CO 4	3								
CO 5	3								
CO 6	3								
CO 7	3								

Justification for the mapping

PO1: Disciplinary Knowledge

CO2. Understand heterothallism, heterokaryosis and parasexual cycle.
CO3. Get idea about fungal hormones and physiological specialization.
CO4. Role of fungi as saprotrophs.
CO5. Know fungi as pathologica lrelationships with other organisms.
CO6. Understand Industrial and biotechnological applications of fungi.
CO7. Get knowledge about entrepreneurship development in the field of Mushroom cultivation.

PO2: Critical Thinking and Problem Solving

CO1. Analyze primary and secondary metabolites of fungi.

Class : M.Sc. II (Semester- III)

Paper Code : PSBT 234 (C)

Paper : IV Title of Paper: Bryology

Credits : 4 No. of Lectures: 60

A) Learning Objectives:

1. To understand deep knowledge of season, collection, identification and life-cycle.
2. To study reproductive structures and develop In-situ
3. To develop innovative Ex-situ conservation techniques.

B) Course Outcome:

By the end of course students will be able to

CO1. Get knowledge about cryptogams to conserve Cryptogamic diversity.
CO2. Classify the cryptogams up to species level.
CO3. Get aware about the importance of Cryptogams.
CO4. Get knowledge about life history of algae, fungi bryophytes.
CO5. Explain the role of Algae, Fungi and Bryophytes in human welfare.
CO6. Aware about plant conservation in society.
CO7. Analyze industrial applications of algae.

Credit –I :

1. History, Classification, distribution, habitat, morphology, Taxonomy, anatomy, phylogeny, inter-relationship, origin and evolution and comparative discussions of Gametophytes and sporophytes in living members of Hepaticopsida (15 L)

Credit –II :

2. History, Classification, distribution, habitat, morphology, taxonomy, anatomy, phylogeny, inter-relationship, origin and evolution and comparative discussions of gametophytes and sporophytes in living members of Anthoceropsida. (15 L)

Credit –III :

3. History, Classification, distribution, habitat, morphology, Taxonomy, anatomy, phylogeny, inter-relationship, origin and evolution and comparative discussions of Gametophytes and sporophytes in living members of Bryopsida. (15 L)

Credit –IV :

4. Modern taxonomy of bryophytes with reference to epidermal tissue system, palynology and cytology w.r.t.Hepaticopsida, Anthoceropsida and Bryopsida. Innovative strategies for *In-situ* conservation. (15 L)

Recommended References :

1. Kashyap, S.R. 1929. Liverworts of Western Himalaya and Punjab Plain, Part-I.
2. Mahabale , T.T. 1941. On the chromosomal complex of two species of Riccia,
3. Jour.univ.Bombay, 16 : 1-16.
4. Mahabale, T.S. and Gorji, 1941. Chromosomes in *Riccia himalayensis*. Curr. Sci.10:28.
5. Mehra, P.N. 1967. Evolutionary trends in the Hepaticae. Phytomorphology. 17 : 47-58 1969-70. with particular refrence to Marchantiales.
6. Phytomorphology. 19(3) : 203-218.
7. Parihar, N.S. 1967. An Introduction to Embryophyta. Vol.I Central Book Depot, Allahabad.
8. Rashid, A. 1998. An Introduction to Bryophyta (Diversity, Development and Differntiation)
9. Smith, G.M.1955. Cryptogamic Botany,Vol-II Bryophytes and Pteridophytes. Edi. 2, New York.
10. Udar, R. 1950. Studies in Indian Ricciaceae. Proc. 37th Indian Sci. Cong.40.
11. Vashishtha, B.R. 1993. Botany for Degree Students: Bryophyta.
12. Watson, E.V. 1955. British mosses and liverworts. Cambridge, 419 p.
13. Chopra, R.S. 1975. Taxonomy of Indian mosses.
14. Chopra R.N. and P.K.Kumra 2005. Biology of Bryophytes.
15. A.J.E Smith. 1982. Bryophyte Ecology.
16. Chopra R.N and Satish Bhatiya 1990. Bryophyte Development- Physiology and Biochemistry

Websites :

Hattori Botanical Laboratory

https://www.google.com/search?q=Hattori+Boanical&rlz=1C1CHWL_enIN909IN909&oq=Hattori+Boanical&aqs=chrome..69i57.13143j0j8&sourceid=chrome&ie=UTF-8

Australian Bryological Research Journal.

https://www.researchgate.net/publication/317644372_AUSTRALASIAN_BRYOLOGICAL_NEWSLETTER_Participants_at_the_Xth_Australasian_Bryophyte

Bulletin of Bryology

https://www.jstor.org/stable/1221137?seq=1

Indian Bryological Society

https://www.google.com/search?q=Indian+Bryological+Society&rlz=1C1CHWL_enIN909IN909&sxsrf=ALeKk023HYYE2mATYEdgv6xi8Yfevl1t-Q:1594468636630&ei=HKkJX7D_Jcvez7sPwOmYqAU&start=10&sa=N&ved=2ahUKEwiw_cPFksXqAhVL73MBHcA0BlUQ8tMDegQICxAt&biw=1366&bih=657

World Bryological Society

https://www.google.com/search?q=Indian+Bryological+Society&rlz=1C1CHWL_enIN909IN909&sxsrf=ALeKk023HYYE2mATYEdgv6xi8Yfevl1t-Q:1594468636630&ei=HKkJX7D_Jcvez7sPwOmYqAU&start=10&sa=N&ved=2ahUKEwiw_cPFksXqAhVL73MBHcA0BlUQ8tMDegQICxAt&biw=1366&bih=657

Choice Based Credit System Syllabus (2022 Pattern)

Mapping of Program Outcomes with Course Outcomes

Class: M. Sc. II (Sem. III) **Subject**: Botany

Course: Elective Papers – Bryology - I **Course Code**: PSBT 234 (C)

Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

	Programme Outcomes (POs)								
Course Outcomes	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO9
CO 1	3								
CO 2	3								
CO 3								2	
CO 4	3			3					
CO 5	3								
CO 6						3			
CO 7	2								

Justification for the mapping

PO1: Disciplinary Knowledge

.CO1. Knowledge of bryophytes at different localities.

CO2. Understanding of practical applications of bryophytes.

CO4. Protocols for In-vitro general techniques of tissue culture in bryophytes.

CO5. Students are able to develop Ex-Situ conservation techniques of bryophytes.

CO7. Understanding the alternation of generations and evolution of bryophytes.

PO 4: Research-related skills and Scientific temper

CO4. Protocols for In-vitro general techniques of tissue culture in bryophytes.

PO6: Personal and Professional Competence

CO6. Understanding of economic importance of bryophytes.

PO 8: Environment and Sustainability

CO3. Development of Ex-situ conservation techniques.

Class : M.Sc. II (Semester- III)

Paper Code : : PSBT 234 (D)

Paper : IV Title of Paper: Angiosperm Taxonomy

Credits : 4 No. of lectures: 60

A) Learning Objectives:

1. To pertain classification and taxonomy of Angiosperms.
2. To know the rules to name a new plant species.
3. To know the brief account of different systems of classification.

B) Course Outcome:

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

CO1. Describe the morphology and reproductive structure of Phanerogams.

CO2.Identify, describe and study in detail life cycle of Phanerogams.

CO3. Know scope of the Phanerogams diversity with special reference to Gymnosperms and Angiosperms.

CO4. Know different methods of conservation of Phanerogams.

CO5. Study the applications of cryptogams.

CO6. Describe and identify flowering plants.

CO7. Understand the local flora with respect to Phanerogams.

Credit I (15 lectures)

Plant taxonomy: Importance of Angiosperm taxonomy and need for classification, definitions and concepts, hierarchical classification, general and special purpose classifications. Principles of taxonomy.

Botanical Nomenclature: history, scientific names, International Code of Nomenclature for Algae, Bryophytes, Angiosperms (ICBN): Salient features-Principles, Important Rules and Recommendations, Provisions for the governance of the Code, Appendices.

Taxonomy tools: Floras, monographs, revisions, Journals, Herbarium and botanical gardens, their role in teaching, research and conservation, important herbaria and botanical gardens. (Ex. Kew Botanical garden, AJCB Indian Botanic Garden, Kolkata and LBG, Shivaji University Kolhapur)

Credit II: **(15 lectures)**

Systems of classification: Phenetic and Phylognetic systems. Critical account of the systems of classifications of a) Bentham and Hooker b) Takhtajan c) Engler and Prantl d) Cladestics in taxonomy, General account of Angiosperm phylogeny group (APG)

Taxonomic evidence and techniques used there in a) Morphology b) Cytology c) Biochemistry d) Palynology e) Anatomy f) Embryology g) DNA sequence

Modern trends of taxonomy: Cytotaxonomy, Chemotaxonomy, numerical taxonomy and molecular systematics.

Species concept: Concept of taxa, concept of species- Biological and alternative species concepts; concept of genus and family. Plant Speciation: Allopatric, Peripatric, Sympatric, Parapatric, Apomictic speciation, Isolating mechanisms.

Credit III: **(15 lectures)**

Conservation biology: Biodiversity, its importance, assessment, Centers of diversity, loss and conservation, ethical principles of conservation biology, World organization for conservation of biodiversity, Ecological differentiation.

Species diversity: Species Richness, Species abundance. Red List categories of IUCN, means and ways for conservation. In situ and ex situ conservation strategies.

Endemism: Concept of endemism, categories, biodiversity of India, mega-centers of endemism in India; Keystone and flagship species, endemic plants of India with special reference to Western Ghats and Maharashtra, sacred grooves and their importance.

Credit IV: **(15 lectures)**

Distinguishing features of the following families:

a) **Dicotyledons:** Ranunculaceae, Polygalaceae, Rutaceae, Asclepidaceae, Meliaceae, Rosaceae, Moraceae, Passifloraceae, Plumbaginaceae, Sapotaceae, Boraginaceae.

b) **Monocotyledons:** Orchidaceae, Commelinaceae, Araceae, Arecaceae, Cyperaceae.

References:

1. Ahmedullah, M. and M. P. Nayar. 1987. **Endemic Plants of the Indian Region Vol I.** Botanical Survey of India.
2. Cooke, T. 1903-1908. **The Flora of Presidency of Bombay, Vol. I-III**.
3. Davis, P. H. and V. H. Heywood 1991. **Principles of Angiosperm Taxonomy. Today and Tommorow** Publications, New Delhi.
4. Endress Peter, K. 1994. **Diversity and Evolutionary Biology of Tropical Flowers**. Cambridge.
5. Erdtman, G. 1952. **Pollen Morphology and Plant Taxonomy. Angiosperms**. Hafner Publ. Co. New York.
6. Hutchinson, J. 1959. **Families of Flowering plants**.
7. Manilal, K. S. and M. S. Muktesh Kumar [ed.] 1998. **A Handbook of Taxonomic Training**. DST, New Delhi.
8. Naik, V. N. 1984. **Taxonomy of Angiosperms** Tata McGraw-Hill Publication Com. Ltd. New Delhi.
9. Paech, K. and M.V. Tracey. 1956. **Modern Methods of Plant Analysis. Vol-I & II**.Springer-Verlag.
10. Primak, R. B. 2004. **A Primer of Conservation Biology**. Sinauer Associales, Inc. Publishers
11. Shivanna, K. R. and B. M. Johri 1985. **The Angiosperm Pollen: structure and Function**. Wiley Eastern limited, New Delhi.
12. Synge, Hugh (ed.) 1980. **The biological aspects of Rare Plant Conservation**. John Wiley & Sons.
13. Takhtajan, A. 1962. **Flowering plants- Origin and Dispersal**.
14. Michel G. Shimpson**, Plant Systematics**, Third Edition, Elsevier Academic Press
15. Gurucharan Singh, **Plant Systematics an Integrated Approach**, Fourth Edition, CRC press, Taylor and Francis Group.

Mapping of Program Outcomes with Course Outcomes

Class: M. Sc. II (Sem. III) **Subject**: Botany

Course: Elective Papers – Angiosperm Taxonomy - I **Course Code**: PSBT 234 (D)

Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

	Programme Outcomes (POs)								
Course Outcomes	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO9
CO 1	3								
CO 2	3								
CO 3	3								
CO 4	3								
CO 5	3								
CO 6	3								
CO 7				2					

Justification for the mapping

PO1: Disciplinary Knowledge

CO1. Origin of Angiosperms.
CO2. Importance and need for classification, hierarchical classification.
CO3. Pre- and post- Darwinian systems of classification.
CO4. Fossil angiosperms of India.
CO5. Floral Biology.
CO6. Phytogeography.

PO 4: Research-related skills and Scientific temper

CO7. Dicotyledons and Monocotyledons families.

Class : M.Sc. II (Semester- III)

Paper Code : PSBT 235

Paper : I, II, III Title of Paper: Practical's Based on PSBT 231, 232 and 233

Credits : 4 **No. of lectures: 60 (15 Practical's)**

A) Learning Objectives:

1. To pertain taxonomical, embryological, computational techniques.
2. To provide the knowledge of different local families
3. To use different software's in bioinformatics.

B) Course Outcome:

By the end of course students will be able to

CO1. Develop identification skill in cryptogams.
CO2. Train in cell biology techniques.
CO3. Understand basic knowledge about life cycle of cryptogams.
CO4. Internal and external structure of cryptogams.
CO5. Explain basic knowledge about evolution of lower cryptogams.
CO6. Discuss spore dispersal mechanism.
CO7. Understand variations in cryptogamic diversity.

TOPICS/CONTENTS:

Practical's based on PSBT 231 Angiosperm Taxonomy (Any four)

1. Study of plant families (at least 6 locally available families- 4 of Dicotyledons and two of Monocotyledons. **5P**
2. Identification of genus and species of locally available wild plants (any four) **1P**
3. Preparation of vegetative and reproductive botanical keys of any six plants from different Families **1P**

Note:

1. Field trips of at least two days for collection and preparation of field notes and its submission.

Practicals based on PSBT 232 Developmental Botany (Any four)

1. Isolation of shoot apical meristems from seedling, young and mature vegetative plant and tracing the course of stomatal development and observations on stomatal types. **1P**

2. Histochemical analysis of secondary growth (primary to secondary axis) and comparison between vegetative SA and reproductively induced SA **1P**
3. Observations on **1P**

a) Microsporogenesis and development of male gametophyte (pollen)

b) Megasporogenesis and development of female gametophyte

c) Types of endosperm, dissection and isolation of endosperm **2P**

d) Observations on stages of embryo development, dissection and isolation of developing embryo (3 stages) and *in vitro* germination of spore/pollen **1P**

Practicals based on PSBT 233 Computational Botany (Any four)

1) t – test and F –test. **1P**
2) Correlation and Regression. **1P**
3) Chi-square test for goodness of fit and independent attributes. **1P**
4) Analysis of variance on the given data (ANOVA). **1P**
5) Tukey's test for pairwise comparison of treatments. **1P**
6) Databases and database searching and DNA and protein sequence comparisons. **1P**
7) Multiple sequence alignments, progressive methods, CLUSTAL. **1P**
8) Determining phylogenetic relationships using DNA and protein sequences. **1P**

Mapping of Program Outcomes with Course Outcomes

Class: M. Sc. II (Sem. III) **Subject**: Botany

Course: Practical based on PSBT 231, PSBT 232 and BPSO 233
Course Code: PSBT 235

Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

	Programme Outcomes (POs)								
Course Outcomes	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO9
CO 1				3					
CO 2						3			
CO 3	3								
CO 4	3								
CO 5	2								
CO 6								2	
CO 7	3								

Justification for the mapping

PO1: Disciplinary Knowledge

CO3. Understand basic knowledge about life cycle of cryptogams.
CO4. Internal and external structure of cryptogams.
CO5. Explain basic knowledge about evolution of lower cryptogams.
CO7. Understand variations in cryptogamic diversity.

PO 4: Research-related skills and Scientific temper

CO1. Develop identification skill in cryptogams.

PO6: Personal and Professional Competence

CO2. Train in cell biology techniques.

PO 8: Environment and Sustainability

CO6. Discuss spore dispersal mechanism.

Class : M.Sc. (Semester- III)

Paper Code : PSBT 236 (A)

Paper : IV

Title of Paper: Practicals based on PSBT 234 (A)Advanced Plant Physiology

Credits : 4 **No. of lectures: 60 (15 Practicals)**

A) Learning Objectives:

1. To create hands on training on physiological techniques.
2. To give idea of experimental methodologies for crop physiology.
3. To achieve up- to date level of understanding of plant physiology.

B) Course Outcome:

CO1. Use knowledge for improvement of agricultural yield
CO2. Students aware about the plant to response environmental conditions.
CO3. Students get knowledge of internal activities in plant.
CO4. Development of expertise in plant physiology.
CO5. Get knowledge of plant metabolism.
CO6. Students get knowledge of plant cycle.
CO7. Students get knowledge of biomolecules.

Practical's based on PSBT PSBT 234 (A) Advanced Plant Physiology

1. Testing of seed viability by TTC. **1P**
2. Estimation of total alkaloids. **1P**
3. Effect of various PGRs on seed germination. **2P**
4. Effect of various PGRs on seedling growth / enzymes. **2P**
5. Isolation of starch. **1P**
6. Comparative studies of accumulation of superoxide dismutase (SOD) in normal and salt stressed plants. **2P**
7. Effect of weed extracts on seed germination. **2P**
8. Studies on changes in acidity and TSS during grape/ guava ripening. **1P**
9. Studies on changes in NR activity during leaf senescence. **1P**
10. Estimation of Total flavonoids. **1P**

Note: Visit to advanced plant physiology laboratory and submission of report.

Mapping of Program Outcomes with Course Outcomes

Class: M. Sc. II (Sem. III) **Subject**: Botany

Course: Practical – Advanced Physiology - I **Course Code**: PSBT 236 (A)

Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

	Programme Outcomes (POs)								
Course Outcomes	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO9
CO 1	3								
CO 2	3	3							
CO 3				3					
CO 4									
CO 5	2			2					
CO 6	3			3					
CO 7	3			3					

Justification for the mapping

PO1: Disciplinary Knowledge

CO1. Use knowledge for improvement of agricultural yield.
CO3. Students get knowledge of internal activities in plant.
CO5. Get knowledge of plant metabolism.
CO6. Students get knowledge of plant cycle.
CO7. Students get knowledge of biomolecules.

PO2: Critical Thinking and Problem Solving

CO2. Students aware about the plant to response environmental conditions.

PO 3: Social competence

CO1. Use knowledge for improvement of agricultural yield.

PO 4: Research-related skills and Scientific temper

CO3. Students get knowledge of internal activities in plant.
CO5. Get knowledge of plant metabolism.
CO6. Students get knowledge of plant cycle.
CO7. Students get knowledge of biomolecules.

Class : **M.Sc. (Semester- III)**

Paper Code : **PSBT 236 (B)**

Paper : **III**

Title of Paper : **Practicals based on PSBT 234 (B) Advanced Mycology and Plant Pathology**

Credits : **4** **No. of lectures: 60 (15 Practicals)**

A) Learning Objectives:

1. To study the identification of fungi and preparation of their pure cultures.
2. To identify soil, air and water borne fungal pathogens.
3. To maintain industrially and agriculturally useful fungi for its biological potential.

B) Learning Outcome:

By the end of course students will be able to

CO1. Get knowledge about cryptogams to conserve Cryptogamic diversity.
CO2. Classify the cryptogams up to species level.
CO3. Get aware about the importance of Cryptogams.
CO4. Get knowledge about lifehistory of algae, fungi bryophytes.
CO5. Explain the role of Algae, Fungi and Bryophytes in human welfare.
CO6. Aware about plant conservation in society.
CO7. Analyze industrial applications of algae.

Practicals based on PSBT 3234 (B) Advanced Mycology

1. Preparation of culture medium for fungi CDA medium and Sabourard's medium (1P)
2. Isolation of aquatic by baiting method (1P)
3. Isolation of fungi from rhizosphere soil. (1P)
4. Isolation of plant pathogenic fungi from root, stem and fruits (2P)
5. Study of seed borne fungi. (2P)
6. Study of fungi from the following groups – (10P)

   Myxomycetes- any two

   Chytridiomycetes- any two

   Oomycetes- any four

   Pyrenomycetes- any four

   Loculoascomycetes- any two

Discomycetes- any four

Teliomycetes – any four

Gasteromycetes- any four

Hymenomycetes- any four

Deuteromycetes- any four

8. Preparation of stains and mounting media for study of fungi (1P)

Note: 1. Compulsory visit to Western Ghats for collection and observation of fungi (at least for three days).

2. Visit to any one Mycology Institute / Laboratory.

Choice Based Credit System Syllabus (2022 Pattern)

Mapping of Program Outcomes with Course Outcomes

Class: M. Sc. II (Sem. III) **Subject**: Botany

Course: Practical – Advanced Mycology - I **Course Code**: PSBT 236 (B)

Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

	Programme Outcomes (POs)								
Course Outcomes	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO9
CO 1	3								
CO 2		3							
CO 3			3						
CO 4	2								
CO 5			2						
CO 6								3	
CO 7									3

Justification for the mapping

PO1: Disciplinary Knowledge

CO1. Get knowledge about cryptogams to conserve Cryptogamic diversity.
CO4. Get knowledge about life history of algae, fungi bryophytes.

PO2: Critical Thinking and Problem Solving

CO2. Classify the cryptogams up to species level.

PO 3: Social competence

CO3. Get aware about the importance of Cryptogams.

CO5. Explain the role of Algae, Fungi and Bryophytes in human welfare.

PO 8: Environment and Sustainability

CO6. Aware about plant conservation in society.

PO 9: Self-directed and Life-long Learning

CO7. Analyze industrial applications of algae.

Class : M.Sc. (Semester- III)

Paper Code : PSBT 236 (C)

Paper : III Title of Paper: Practical's based on PSBT 234 (C) Bryology

Credits : 4 No. of lectures: 60 (11 Practical's)

A) Learning Objectives:

1. To understand season, collection, identification, morphology, anatomy.
2. To study reproductive structures.
3. To develop innovative techniques for In-situ conservation.

B) Course Outcome:

By the end of course students will be able to

CO1. Get knowledge about cryptogams to conserve Cryptogamic diversity.
CO2. Classify the cryptogams up to species level.
CO3. Get aware about the importance of Cryptogams.
CO4. Get knowledge about life history of algae, fungi bryophytes.
CO5. Explain the role of Algae, Fungi and Bryophytes in human welfare.
CO6. Aware about plant conservation in society.
CO7. Analyze industrial applications of algae.

Practical's based on PSBT 234 (C) Bryology

1. Study of any **six** living genera of Hepaticae (thalloid) w.r.t. morphology, anatomy of gametophytes and sporophytes. (03)
2. Study of any **four** living genera of leafy Jungermanniales (Hepaticae) w.r.t. morphology, anatomy of gametophytes and sporophytes. (02)
3. Study of any **four** living genera of Anthocerotales w.r.t. morphology, anatomy of gametophytes and sporophytes. (02)
4. Study of any **Six** living genera of Bryopsida w.r.t. morphology, anatomy of gametophytes and sporophytes. (03)
5. *In-situ* conservation techniques of bryophytes. (any two) (01)

Choice Based Credit System Syllabus (2022 Pattern)

Mapping of Program Outcomes with Course Outcomes

Class: M. Sc. II (Sem. III) **Subject**: Botany

Course: Elective Papers – Bryology - I **Course Code**: PSBT 236 (C)

Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

	Programme Outcomes (POs)								
Course Outcomes	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO9
CO 1	3								
CO 2	3								
CO 3								2	
CO 4	3			3					
CO 5	3								
CO 6						3			
CO 7	2								

Justification for the mapping

PO1: Disciplinary Knowledge

CO1. Knowledge of bryophytes at different localities.
CO2. Uderstanding of practical applications of bryophytes.
CO4. Protocols for In-vitro general techniques of tissue culture in bryophytes.
CO5. Students are able to develop Ex-Situ conservation techniques of bryophytes.
CO7. Understanding the alternation of generations and evolution of bryophytes.

PO 4: Research-related skills and Scientific temper

CO4. Protocols for In-vitro general techniques of tissue culture in bryophytes.

PO6: Personal and Professional Competence

CO6. Understanding of economic importance of bryophytes.

PO 8: Environment and Sustainability

CO3. Development of Ex-situ conservation techniques.

Class : M.Sc. II (Semester- III)

Paper Code : PSBT 236 (D)

Paper : III **Title of Paper: Practical's based on PSBT 234 (D) Angiosperm Taxonomy**

Credits : 4 **No. of Lectures: 60 (15 Practical's)**

A) Learning Objectives:

1. To pertain classification and taxonomy of Angiosperms.
2. To know the rules to name a new plant species.
3. To know the brief account of different systems of classification.

B) Learning Outcome:

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

CO1. Describe the morphology and reproductive structure of Phanerogams.

CO2. Identify, describe and study in detail life cycle of Phanerogams.

CO3. Know scope of the Phanerogams diversity with special reference to Gymnosperms and Angiosperms.

CO4. Know different methods of conservation of Phanerogams.

CO5. Study the applications of cryptogams.

CO6. Describe and identify flowering plants.

CO7. Understand the local flora with respect to Phanerogams.

Practical's based on PSBT 234 (D) Angiosperm Taxonomy

1. Study of at least 15 locally available families of flowering plants (8P)
2. Identification of genus and species of locally available wild plants (2P)
3. Preparation of botanical keys by using Flora's (1P)
4. Knowledge of at least 20 plant species from each of the following categories: A) Medicinal Plants. B) Exotic weeds C) Endemic plants. (2P)
5. Field tours within and around Campus, compilation of field notes and preparation of herbarium by using photographs of such plants. (2P)

Note: Botanical excursion of about one week duration to any botanically rich location preferable outside the State.

Mapping of Program Outcomes with Course Outcomes

Class: M. Sc. II (Sem. III) **Subject**: Botany

Course: Elective Papers – Angiosperm Taxonomy - I **Course Code**: PSBT 236 (D)

Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

	Programme Outcomes (POs)								
Course Outcomes	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO9
CO 1	3								
CO 2	3								
CO 3	3								
CO 4	3								
CO 5	3								
CO 6	3								
CO 7				2					

Justification for the mapping

PO1: Disciplinary Knowledge

CO1. Origin of Angiosperms.
CO2. Importance and need for classification, hierarchical classification.
CO3. Pre- and post- Darwinian systems of classification.
CO4 Fossil angiosperms of India.
CO5. Floral Biology.
CO6. Phytogeography.

PO 4: Research-related skills and Scientific temper

CO7. Dicotyledons and Monocotyledons families.