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**St. Xavier's College (Autonomous), Mumbai**  
**Department of Botany**

**Programme: M.Sc. Botany**

***Programme Specific Outcomes (PSOs) for M.Sc. Botany***

Sr. No.	On completing M.Sc. Botany, the student will be able to:
PSO 1	Possess an in-depth understanding about cryptogams and phanerogams, regulation of biochemical processes, molecular mechanisms, palynological and embryological processes, plant pathology and biostatistics.
PSO 2	Develop advanced skills in laboratory techniques, identification of plants, microbial and molecular techniques, medicinal plants, handling of instruments, advanced software for biology, plant pathology, IPR, remote sensing and ethnobotany.
PSO 3	Make use of critical thinking to write an independent project, design and execute experiments in the field or the laboratory using all the necessary skills.
PSO 4	Use an interdisciplinary approach by integrating different fields of botany with other sciences to carry out research work.
PSO 5	Apply the acquired knowledge to offer solutions for different aspects of human and environmental well-being.



## Course Outcomes (COs): M.Sc. Botany

### Semester I

**Course Title: Cryptogams**

**Course Code: SBOT0701**

Sr. No.	On completing the course, the student will be able to:	PSOs addressed	Cognitive levels
CO 1	Recall the classification of algae up to orders, and correlate the distribution and thallus organization to diverse habitats, origins and evolution.	1, 5	R
CO 2	Know the techniques of culturing algae for biofuel and other purposes.	1, 2, 3	R, Ap
CO 3	Visualize the differences in occurrence, habit, morphology, anatomy, growth and reproduction by studying life cycles of important and diverse genera belonging to algae and bryophytes.	1, 5	R, U
CO 4	Understand the ecological and economic importance of bryophytes in addition to learning the classification up to orders.	1	R
CO 5	Judge the theories on origin and evolution of bryophytes, and observe the evolution of sporophyte in bryophytes.	1	R, U

**Course Title: Plant Taxonomy**

**Course Code: SBOT0702**

Sr. No.	On completing the course, the student will be able to:	PSOs addressed	Cognitive levels
CO 1	Analyse the concept of species, biotypes and ecotypes through knowledge of evolution, variation and speciation.	1	R, An
CO 2	Understand the concept of characters in taxonomy, their types, functions and their value in chemotaxonomy, molecular systematics and numerical taxonomy.	1,2	R, U
CO 3	Compare the principles of taxonomy and phylogeny to understand the phylogenetic relationships between plants.	1	R, U
CO 4	Compare the different classification systems from old to the present ones, and understand the development of these.	1	R, U
CO 5	Identify plants belonging to the designated families with the use of flora.	1, 2, 5	R, Ap



**Course Title: Plant Metabolism**  
**Course Code: SBOT0703**

Sr. No.	On completing the course, the student will be able to:	PSOs addressed	Cognitive levels
CO 1	Illustrate the organization of photosynthetic apparatus, and explain the different mechanisms of major enzymatic reactions carried by chloroplast.	1	U, Ap
CO 2	Summarize the assimilation of phosphorus, sulphur, cations and molecular oxygen in plants.	1	R, U
CO 3	Analyse plant responses to nutrition and mineral toxicity, and heterotrophic nutrition.	1, 2, 4	An
CO 4	Comprehend the regulation of glycolysis, C3, C4 and CAM pathways.	1	R, U
CO 5	Know secondary metabolites, and differentiate major pathways for their biosynthesis; connect their inter-relationships with primary metabolism.	1, 4	R, U

**Course Title: Molecular Biology**  
**Course Code: SBOT0704**

Sr. No.	On completing the course, the student will be able to:	PSOs addressed	Cognitive levels
CO 1	Understand the control and regulation of gene expression in eukaryotes at various stages.	1	R, U
CO 2	Comprehend the genetic control of development in plants.	1	R, U
CO 3	Identify the different molecular markers; make use of vectors and know the application of strategies to create transgenic plants with herbicide resistance.	1, 2, 4	R, U
CO 4	Discover the genetic mechanism in plants for resistance to stress, insects, viruses, herbicides, fungi, bacteria, salt and drought.	1, 2, 4	R, U
CO 5	Devise strategies to improve the nutritional content, quality, and yield of plant products; learn the use of plants as bioreactors.	1, 2	R, C



**Course Title: Cryptogams Practicals**  
**Course Code: SBOT0701PR**

Sr. No.	On completing the course, the student will be able to:	PSOs addressed
CO 1	Identify genera falling in major groups of algae and bryophytes.	1
CO 2	Use laboratory techniques to culture algae, estimate biomass and study the growth curves.	2

**Course Title: Plant Taxonomy Practicals**  
**Course Code: SBOT0702PR**

Sr. No.	On completing the course, the student will be able to:	PSOs addressed
CO 1	Identify plants in the field that belong to plant angiosperm families.	2
CO 2	Identify families, genus and species of plants using floras.	2

**Course Title: Plant Metabolism Practicals**  
**Course Code: SBOT0703PR**

Sr. No.	On completing the course, the student will be able to:	PSOs addressed
CO 1	Confidently use laboratory apparatus, glassware, equipment, instruments to perform enzyme assays, estimation and detection of plant compounds.	2
CO 2	Write down observations in scientific way, prepare graphs, analyse them and interpret the results.	3

**Course Title: Molecular Biology Practicals**  
**Course Code: SBOT0704PR**

Sr. No.	On completing the course, the student will be able to:	PSOs addressed
CO 1	Plan molecular biology experiments with plasmid and plant DNA.	2
CO 2	Use instruments to perform molecular biology experiments; observe the results and interpret them.	2, 3



## Semester II

**Course Title: Archegoniates**

**Course Code: SBOT0801**

Sr. No.	On completing the course, the student will be able to:	PSOs addressed	Cognitive levels
CO 1	Discuss the classification, general characters and interrelationships of various orders of pteridophytes, and know the life cycles of prominent genera from each class.	1, 5	R
CO 2	Know the cultivation methods and maintenance of ornamental ferns, and understand heterospory, apospory and apogamy.	1, 2	R, U
CO 3	Classify gymnosperms up to orders, and distinguish between general characters, affinities and interrelationships of various orders.	1, 5	R, U
CO 4	Recollect the process of fossilization and analyse the features seen in early non-vascular plants, ancient lycopods, pteridospermales, conifers and flowering plants.	1, 5	R, U
CO 5	Illustrate and compare the differences among fossil form genera with the present day living genera.	1	R, U

**Course Title: Anatomy and Medicinal Botany**

**Course Code: SBOT0802**

Sr. No.	On completing the course, the student will be able to:	PSOs addressed	Cognitive levels
CO 1	Describe different meristems, know their locations and functions, and learn their development according to different theories.	1	R, U
CO 2	Understand the mechanism of response of sensory organs to touch, light and gravity.	1, 4	R, U
CO 3	Know the features in wood useful in identification of wood, and methods followed in protection and treatment of wood based on their physical and mechanical properties.	1, 2	R, U
CO 4	Know the sources, geographical distribution and active constituents of selected medicinal plants.	1, 2, 5	R, U
CO 5	Perform methods prescribed for morphological examination of medicinal plants, quality control of crude drugs, and different standardization parameters.	1, 2, 3	Ap



**Course Title: Ecology**  
**Course Code: SBOT0803**

Sr. No.	On completing the course, the student will be able to:	PSOs addressed	Cognitive levels
CO 1	Summarize the mechanisms of ecological recycling of nutrients, and how climate change hampers the normal ecological processes.	1	R
CO 2	Make use of the knowledge of limiting factors in inferring the distribution of plants and dispersal of propagules.	1, 3, 4	Ap, R
CO 3	Reproduce the physical and environmental factors responsible for seed germination, and understand various hypotheses on biogeography, and theories of niche.	1	R, U
CO 4	Use the principles and methods of quantitative analysis to estimate diversity, density, and diversity-stability relationship.	1, 2, 3	U, Ap
CO 5	Understand the concepts of patterns, textures and scales in landscapes, describe various models of landscapes, know the causes of landscape patterns and their quantification.	1, 2, 3, 4	U

**Course Title: Plant Development**  
**Course Code: SBOT0804**

Sr. No.	On completing the course, the student will be able to:	PSOs addressed	Cognitive levels
CO 1	Comprehend the complex mechanisms of meristem development, and organization of root, leaf and flower.	1	R, U
CO 2	Understand the gene regulation during floral development, and hormone biochemistry in short-day and long-day plants.	1	R, U
CO 3	Employ the knowledge of pollen male sterility, sperm dimorphism in hybrid seed production and pollen storage.	1, 2, 3	U, Ap
CO 4	Use the knowledge of pollen-pistil interaction and fertilization mechanisms to understand sporophytic and gametophytic self-incompatibility in seed development.	1, 2	U, Ap
CO 5	Delineate the metabolic activity during programmed cell death and senescence.	1	U



**Course Title: Archegoniates Practicals**  
**Course Code: SBOT0801PR**

Sr. No.	On completing the course, the student will be able to:	PSOs addressed
CO 1	Distinguish between different groups of individuals belonging to pteridophytes and gymnosperms.	1
CO 2	Use the techniques in fossil study, observe, develop relation between different fossils, and interpret the observations.	1, 2

**Course Title: Anatomy and Medicinal Botany Practicals**  
**Course Code: SBOT0802PR**

Sr. No.	On completing the course, the student will be able to:	PSOs addressed
CO 1	Distinguish anatomically the different types of woods; double stain sections and prepare permanent slides of plant specimens.	2
CO 2	Perform experiments that will detect and estimate the constituents of medicinal importance in plants; prepare extracts of plant crude drugs.	2

**Course Title: Ecology Practicals**  
**Course Code: SBOT0803PR**

Sr. No.	On completing the course, the student will be able to:	PSOs addressed
CO 1	Sample and estimate density, diversity of plants in forest; prepare restoration plan of degraded coastal area.	2
CO 2	Measure quality of water based on various parameters in laboratory; solve problems on plant population growth and diversity.	2

**Course Title: Plant Development Practicals**  
**Course Code: SBOT0804PR**

Sr. No.	On completing the course, the student will be able to:	PSOs addressed
CO 1	Distinguish pollen grains morphologically based on their exine ornamentation.	1, 2
CO 2	Determine growth phases in plants by using anatomical, microscopical and biochemical laboratory techniques.	1, 2



### Semester III

**Course Title: Biostatistics**

**Course Code: SBOT0901**

Sr. No.	On completing the course, the student will be able to:	PSOs addressed	Cognitive levels
CO 1	Design and replicate experiments using knowledge of randomization techniques and variables in biostatistics.	1, 2, 3, 4	R, C
CO 2	Perform statistical tests (students t-test, chi-square test) to measure central tendency and correlations, after understanding hypothesis testing, errors and spread of data.	1, 2, 3, 4	R, Ap
CO 3	Solve, using computers, problems on regression ANOVA through the understanding of variance, and linear and non-linear models.	1, 2, 3, 4	Ap
CO 4	Understand the basics of multivariate statistics.	1, 2	U
CO 5	Use open-source computer programs such as R or PSPP for statistical analysis of sampled data.	1, 2, 3, 4	Ap

**Course Title: Plant Pathology**

**Course Code: SBOT0902**

Sr. No.	On completing the course, the student will be able to:	PSOs addressed	Cognitive levels
CO 1	Describe the variation among spore-bearing organs, their arrangements, spore release and dispersal in fungi; study the life cycles of few important fungi.	1	Ap, R
CO 2	Illustrate thallus morphology and reproduction in major categories of lichens.	1	R
CO 3	Classify plant diseases according to symptoms and understand host-pathogen relationships, in addition to dissemination of pathogens and epidemiology.	1, 2, 3, 4	R, U
CO 4	Diagnose some common plant diseases, know how they affect plants, at what stage, and their propagation mechanisms.	1, 2, 3, 4	R, An
CO 5	Use prevention and control methods against plant diseases, and protect stored products and perishables.	1, 2, 3, 4	R, Ap





**Course Title: Applied Botany**  
**Course Code: SBOT0903**

Sr. No.	On completing the course, the student will be able to:	PSOs addressed	Cognitive levels
CO 1	Use bioinformatics tools to find genes, motifs, and perform multiple sequence alignment and protein sequence analyses.	1, 2, 3	U, Ap
CO 2	Synthesize nanoparticles with some simple methods using biological material.	1, 2, 3	U, Ap
CO 3	Comprehend the concepts of cell differentiation, pathways for in-vitro regeneration and use them during plant tissue culture experiments.	1	U
CO 4	Understand plant breeding methods such as selection, hybridization, polyploidy and induced mutations.	1	U
CO 5	Employ methods in biocontrol of plant diseases, biodegradation of toxic chemicals, and phytoremediation of environmental pollutants.	1, 2, 3	R, U, Ap

**Course Title: Angiosperms – I (Phylogeny and Nomenclature)**  
**Course Code: SBOT0904**

Sr. No.	On completing the course, the student will be able to:	PSOs addressed	Cognitive levels
CO 1	Understand how the evolutionary methods of phylogenetic analysis have affected taxonomy based on systematic, monographic and floristic studies.	1	U, Ap
CO 2	Employ cladistics and phylogenetic techniques in classification, constructing phylogeny, and building phylogenetic trees.	1, 2, 3, 4	U, Ap
CO 3	Apply the knowledge of nomenclature rules to solve minor taxonomic problems.	1, 2, 3	R, U, Ap
CO 4	Learn the preparation of keys for taxonomic studies and for identification of plants or taxa.	1, 2, 3	R, U, Ap



**Course Title: Biostatistics Practicals**  
**Course Code: SBOT0901PR**

Sr. No.	On completing the course, the student will be able to:	PSOs addressed
CO 1	Use statistical analytical tools to interpret results; and use Microsoft Excel to tabulate, condense and analyse the data.	2, 3
CO 2	Solve statistical problems, and analyse data by using different statistical tests manually as well as by using software like PSPP and R.	2, 3

**Course Title: Plant Pathology Practicals**  
**Course Code: SBOT0902PR**

Sr. No.	On completing the course, the student will be able to:	PSOs addressed
CO 1	Distinguish between different groups of fungi and identify common fungi.	2, 3
CO 2	Diagnose major plant diseases by studying the disease symptoms in plants.	2, 3

**Course Title: Applied Botany Practicals**  
**Course Code: SBOT0903PR**

Sr. No.	On completing the course, the student will be able to:	PSOs addressed
CO 1	Use online bioinformatics databases and tools to perform basic bioinformatics exercises; synthesize nanoparticles using plant extracts.	2
CO 2	Use the technique of plant tissue culture; perform experiments of phytoremediation and effect of pollutants on plant growth.	2

**Course Title: Angiosperms – I (Phylogeny and Nomenclature) Practicals**  
**Course Code: SBOT0904PR**

Sr. No.	On completing the course, the student will be able to:	PSOs addressed
CO 1	Use keys for identification of genus and species of plants; perform cluster analysis using cladistic techniques.	2
CO 2	Collect plant specimens, arrange them, press them, preserve them, label them and prepare herbarium sheets.	2



### Semester IV

**Course Title: Instrumentation**

**Course Code: SBOT1001**

Sr. No.	On completing the course, the student will be able to:	PSOs addressed	Cognitive levels
CO 1	Use microscopy and aseptic techniques to isolate and maintain bacterial cultures.	1, 2, 3	R, Ap
CO 2	Understand the working and applications of centrifugation and spectroscopy/ spectrophotometry.	1, 2, 3	R, U
CO 3	Use chromatography techniques, and understand tracer techniques.	1, 2, 3, 4	R, Ap
CO 4	Carry out literature survey for topic selection.	1, 2, 3, 4	U, Ap
CO 5	Write a scientific project report or a paper.	1, 2, 3, 4	Ap

**Course Title: Angiosperms – II (Characters and Ethnobotany)**

**Course Code: SBOT1002**

Sr. No.	On completing the course, the student will be able to:	PSOs addressed	Cognitive levels
CO 1	Identify selected families, genera and species, and understand the affinities, phylogeny and interrelationships of these families.	1, 5	R
CO 2	Use plant anatomical characters in taxonomic problem-solving and studies.	1, 2, 3	U, Ap
CO 3	Employ the embryological and palynological characters to classify some families and to elucidate their affinities.	1, 2	U, Ap
CO 4	Recognize the principles of ethnobotanical research, ethics, bioprospecting, use of traditional knowledge, and equitable benefit-sharing models.	1, 2, 3, 4	R
CO 5	Carry out small ethnobotanical research based on the guidelines learnt.	1, 2, 3	Ap



**Course Title: Angiosperms – III (Taxonomic Aids)**  
**Course Code: SBOT1003**

Sr. No.	On completing the course, the student will be able to:	PSOs addressed	Cognitive levels
CO 1	Perform cluster analysis by understanding the principles of numerical taxonomy.	1, 2, 3	U, Ap
CO 2	Use progressive taxonomy methods in vegetation survey, floristics and ethnobotanical studies.	1, 2, 3	U, Ap
CO 3	Utilize library, literature, herbarium and garden resources in taxonomic studies.	1, 2, 3	U, Ap
CO 4	Apply knowledge of GIS and remote sensing to record plant distribution, as well as to carry out vegetation classification and resource management of forest, soil and water.	1, 2, 3, 4	U, Ap
CO 5	Understand the purpose and methods of plant quarantine.	1	U

**Course Title: Angiosperms – IV (Geography and IPR)**  
**Course Code: SBOT1004**

Sr. No.	On completing the course, the student will be able to:	PSOs addressed	Cognitive levels
CO 1	Understand the present status, affinities, phylogeny and interrelationships of selected plant families.	1	U
CO 2	Make use of cytological data at family, genus and species level for plant identification, and for studying phylogeny.	1, 2	R, Ap
CO 3	Evaluate theories of plant distribution and their role in phytogeographical regions of India.	1, 5	R, E
CO 4	Discuss the role of Indian endemic flora in plant-based discoveries.	1, 5	U
CO 5	Know the patent application process, patentable and non-patentable inventions, trademarks and industrial designs.	1, 2, 3, 3	R

**Course Title: Project**  
**Course Code: SBOT1001PR**

Sr. No.	On completing the course, the student will be able to:	PSOs addressed
CO 1	Perform series of laboratory / field experiments, generate data, analyze and interpret.	2, 3
CO 2	Prepare project report, or write a research / review paper	2, 3



**Course Title: Angiosperm – III (Taxonomic Aids) Practicals**

**Course Code: SBOT1003PR**

Sr. No.	On completing the course, the student will be able to:	PSOs addressed
CO 1	Prepare dichotomous key to distinguish plant specimens; use taxonomic literature and online databases to solve taxonomic problems.	2, 3
CO 2	Interpret remote sensing images; prepare plant diversity maps using online tools like Google Earth and QGIS.	2, 3

**Course Title: Angiosperm – IV (Geography and IPR) Practicals**

**Course Code: SBOT1004PR**

Sr. No.	On completing the course, the student will be able to:	PSOs addressed
CO 1	Prepare synoptic keys to the families, genus and species of plants.	2
CO 2	Know and understand the procedure of patent filing.	2