

St. Xavier's College (Autonomous),  
Mumbai



Syllabus of the courses offered by the  
Department of Botany  
(2017-18)

**DEPARTMENT OF BOTANY, ST. XAVIER'S COLLEGE (AUTONOMOUS), MUMBAI**

**Outline of MSc Botany Syllabus for all 4 Semesters (year 2017-18)**

Sem	Course	Course Title	Units	Title
I	MS.BOT. 1.01	Plant Diversity IV (Algae and Fungi)	I	Algae
			II	Applied phycology
			III	Fungi
			IV	Lichens and applied mycology
I	MS.BOT. 1.02	Plant Diversity V (Gymnosperms and Angiosperms)	I	Gynosperms
			II	Angiosperms- I
			III	Angiosperms- II
			IV	Angiosperms- III
I	MS.BOT. 1.03	Plant physiology and Biochemistry IV	I	Enzymes
			II	Photosynthesis I
			III	Photosynthesis II
			IV	Assimilation of nutrients in plants
I	MS.BOT. 1.04	Molecular biology	I	Gene regulation I
			II	Gene regulation II
			III	Biotechnology
			IV	Application of recombinant DNA technology
II	MS.BOT. 2.01	Plant diversity VI (Bryophytes and Pteridophytes)	I	Bryophytes I
			II	Bryophytes II
			III	Pteridophytes I
			IV	Pteridophytes II
II	MS.BOT. 2.02	Anatomy, Developmental Botany & Palynology	I	Anatomy I
			II	Wood anatomy
			III	Developmental Botany I
			IV	Developmental Botany II
II	MS.BOT. 2.03	Ecology and Environmental Botany-II	I	Natural resources and environmental pollution
			II	Autecology
			III	Population- structure and dynamics
			IV	Community structure and classification
II	MS.BOT. 2.04	Medicinal Botany	I	Sources and geographical distribution of medicinal plants
			II	Quality control of crude drugs
			III	Nutraceuticals
			IV	Screening of plants for biological activity
III	MS.BOT. 3.01	Biostatistics Bioinformatics and Nanotechnology	I	Biostatistics
			II	Bioinformatics
			II	Nanotechnology
			IV	Scientific writing
III	MS.BOT. 3.02	Plant pathology	I	Plant Pathogens, symptoms and classification of plant diseases
			II	Host defence mechanisms, prevention and control of plant diseases
			III	Plant diseases-I
			IV	Plant diseases-II
III	MS.BOT. 3.03	Horticulture	I	Operational Classification systems and essential environmental factors
			II	Plant propagation

			III	Cultivation of plants
			IV	Landscaping
III	MS.BOT. 3.04	Angiosperms IV	I	Evolution
			II	Phylogeny, Phylogenetic Techniques
			III	Nomenclature
			IV	Keys and GB
III	MS.BOT. 3.05	Plant Biochemistry- V	I	Vitamins and coenzyme
			II	Storage proteins and Lectins
			III	Plant metabolism
			IV	Nucleotide biosynthesis and degradation
IV	MS.BOT. 4.01	Techniques and Instrumentation	I	Microscopy and spectroscopy
			II	Centrifugation
			III	Chromatography
			IV	Tracer techniques
IV	MS.BOT. 4.02	Angiosperm V	I	Plant Families II
			II	Taxonomic Evidences in relation to Anatomy
			III	Taxonomic evidences in relation to embryology
			IV	Intellectual Property Rights (IPR)
IV	MS.BOT. 4.03	Angiosperms VI	I	Numerical Taxonomy ( Phenetics Methods: Taxometrics)
			II	Progressive taxonomy
			III	Tools in Taxonomy
			IV	Applied Taxonomy
IV	MS.BOT. 4.04	Angiosperms VII	I	Families-III
			II	Taxonomic Evidence
			III	Plant Geography
			IV	Ethnobotany
IV	MS.BOT. 4.05	Plant physiology V	I	Plant mineral nutrition
			II	Stress physiology I
			III	Stress physiology II
			IV	Stress physiology III
IV	MS.BOT. 4.06	Plant physiology VI	I	Plant growth regulators
			II	Plant responses to light
			III	Control of flowering
			IV	Senescence and programmed cell death
IV	MS.BOT. 4.07	Plant biochemistry VI and Biotechnology	I	Secondary Metabolites
			II	Signal transduction in Plants
			III	Plant tissue culture
			IV	Intellectual property rights

**DEPARTMENT OF BOTANY, ST. XAVIER'S COLLEGE (Autonomous), Mumbai.  
M. Sc. I Botany Syllabus (2017-2018)**

**Course: MS.BOT.1.01 PLANT DIVERSITY- IV (ALGAE AND FUNGI)**

**LEARNING OBJECTIVES**

The students will be able to understand-

- The morphology, structure and importance of the organisms.
- Classification and interrelationships between various groups and reasons behind the same.
- Applications of algae and fungi in different fields.

**Unit I: Algae:** Classification of Algae up to orders, according to the system proposed by G.M.Smith; diversification of habitat; general distribution, habitat distribution, thallus organization, origin and evolution, fossil algae. Study of the life cycle of following: *Scytonema, Volvox, Ulothrix, Gracillaria* and *Padina*.

**Unit II: Applied Phycology:** Algal collection and preservation, techniques of culturing Algae, concept of photo-bioreactor, Algae as biofuel, algae causing biological hazards.

**Unit III: Fungi:** Classification of fungi up to orders according to the system proposed by Alexopoulos. General account of spore bearing organs and their arrangements in various groups of fungi; spore release and dispersal. Study of following types: *Penicillium, Claviceps, Stemonitis, Trichoderma*.

**Unit IV: Lichens and Applied Mycology:** Role of lichens in biomonitoring. Thallus, morphology and reproduction in *Parmelia* and *Usnea*. Nutritive values of edible mushrooms, mushroom cultivation, poisonous mushrooms.

**Practicals MS.BOT.PR.1.01**

- 1) Study of the following type with reference to their systematic position, thallus and reproductive structures: *Scytonema, Lyngbya, Anabaena, Volvox, Scenedesmus, Ulothrix, Enteromorpha, Pithophora, Closterium, Nitella, Padina* and *Gracillaria*.
- 2) Study of the following type with reference to their systematic position, thallus and reproductive structure: *Penicillium, Stemonitis, Saprolegnia, Phytophthora, Xylaria, Peziza, Daedalea, Claviceps* and *Trichoderma*.
- 3) Estimation of biomass from suitable algal culture.
- 4) Study of growth curve of algae.
- 5) Study of *Parmelia* and *Usnea*.

**CIA-** multiple choice questions / assignments / presentation / field report / test.

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**DEPARTMENT OF BOTANY, ST. XAVIER'S COLLEGE (Autonomous), Mumbai.**  
**M. Sc. I Botany Syllabus (2017-2018)**

**Course: MS.BOT.1.02 PLANT DIVERSITY- V (GYMNOSPERMS AND ANGIOSPERMS)**

**LEARNING OBJECTIVES**

The students will be able to understand-

- Classification and interrelationships between order of gymnosperms.
- Various classification systems of angiosperms and the basis of their classification.
- Evolution and study of various taxonomic characters.
- The distinguishing characters of plants belonging to different families and the economic importance of these families.

**Unit I: Gymnosperms:** Classification of gymnosperms up to orders according to the system proposed by Coulter and C. J. Chamberlain. General characters, affinities and interrelationships of Cycadofilicales, Bennettitales, Cordaitales, Cycadales, Coniferales and Gnetales. Life cycle of *Araucaria*, *Cupresses*, *Podocarpus* and *Pinus*, form genera *Cordaites*, *Glossopteris*.

**Unit II: Angiosperms-I :** Origin and evolution of angiosperms; Principles of taxonomy and phylogeny of angiosperms for assessment of relationships, delimitation of taxa and attribution of rank: a) criteria, b) guidelines, c) practical considerations, d) use of categories. Evolution, variation and speciation, biosystematics categories, biotypes and ecotypes, concept of characters: introduction, type, function, values of taxonomic characters – numerical taxonomy, chemotaxonomy, molecular systematic.

**Unit III: Angiosperms-II :** Evolution of classification systems, ancient, modern and current systems of classification (excluding the systems covered at UG level).

**Unit IV: Angiosperms III:** Study of following plant families, their morphological peculiarities and economic importance: Menispermaceae, Portulacaceae, Guttiferae, Passifloraceae, Rhamnaceae, Sapindaceae, Lythraceae, Chenopodiaceae, Cyperaceae, Polygonaceae,.

**Practicals MS.BOT.PR.1.02**

- 1) Gymnosperms: Study of following types- *Cordaites* (Fossils), *Araucaria*, *Cupresses*, *Podocarpus*, *Pinus*.
- 2) Angiosperms: A study of the following plant families their morphological peculiarities and economic importance: Menispermaceae, Portulacaceae, Guttiferae, Passifloraceae, Rhamnaceae, Sapindaceae, Lythraceae, Chenopodiaceae, Cyperaceae, Polygonaceae,.
- 3) Identification of genus and species with the help of flora volumes (In addition to the above mentioned families, all families studied in undergraduate classes are included)
- 4) Field excursion.

**CIA-** multiple choice questions / assignments / presentation / field report / test.

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**DEPARTMENT OF BOTANY, ST. XAVIER'S COLLEGE (Autonomous), Mumbai.**  
**M. Sc. I Botany Syllabus (2017-2018)**

**Course: MS.BOT.1.03 PLANT PHYSIOLOGY AND BIOCHEMISTRY- IV**

**LEARNING OBJECTIVES**

The students will be able to understand

- The mechanism of enzyme actions, kinetics and inhibition.
- Structure and organization of photosynthetic apparatus and mechanism of electron transport and synthesis of ATP.
- Repair and regulatory mechanism governing the photosynthetic machinery and various pathways.
- Assimilation of nutrients in plants.

**Unit I: Enzymes** : Mode of action, Kinetics-  $K_m$  and  $V_{max}$ , Lineweaver-Burk Plot, Inhibition, immobilization of enzymes, allosteric enzymes.

**Unit II: Photosynthesis-I** : Chloroplast structure, organization of photosynthetic apparatus, light absorbing pigments, organization of light antenna systems, mechanism of electron transport, proton transport and ATP synthesis in chloroplast.

**Unit III: Photosynthesis-II**: Repair and regulation of photosynthetic machinery, role of carotenoids, regulation of C<sub>3</sub>, C<sub>4</sub> and CAM pathways.

**Unit IV: Assimilation of Nutrients in Plants**: Phosphorus, Sulphur, cations and molecular oxygen assimilation in plants.

**Practicals MS.BOT.PR.1.03**

Major experiments

- 1) Enzyme kinetics: Determination of  $K_m$  and  $V_{max}$  of the enzyme amylase.
- 2) Solvent extraction of chlorophyll a/b, xanthophylls and study of absorption pattern.
- 3) Study of Hill Reaction.
- 4) Extraction and estimation of GOT and GPT from suitable plant material.

Minor experiments

- 1) A study of the enzyme polyphenol oxidase from potato peels.
- 2) Study of ratio of chl.a and chl.b in C<sub>3</sub> and C<sub>4</sub> plants.
- 5) Quantitative study of diurnal fluctuation in titratable acid number (TAN) in CAM plant.
- 6) Immobilization of yeast cells and study of Invertase activity.

**CIA**- multiple choice questions / assignments / presentation / field report / test.

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**DEPARTMENT OF BOTANY, ST. XAVIER'S COLLEGE (Autonomous), Mumbai.  
M. Sc. I Botany Syllabus (2017-2018)**

**Course: MS.BOT.1.04 MOLECULAR BIOLOGY**

**LEARNING OBJECTIVES**

The students will be able to understand-

- The genetic regulation in cells of living organism.
- How the higher plant organism change over time and what are the molecular mechanisms underlying these changes.
- Identify the basic methods and approaches used in molecular biology.
- Explain the role played by the molecular components of the genetic machinery.

**Unit I: Gene Regulation I:** Control of gene expression in eukaryotes: Chromatin remodelling, Transcriptional control, mRNA processing control, mRNA translocation control, mRNA degradation control, Protein degradation control.

**Unit II: Gene Regulation II:** Genetic control of development in plants: Cell differentiation, function of gene regulation, Genes regulated by developmental program, environmental cues, Homeobox and homeobox proteins.

**Unit III: Biotechnology :** Recombinant DNA Technology: Vectors in gene cloning: PUC 19, phage, cosmid, BAC and YAC vectors, High and low copy number plasmids and its regulation, Restriction enzymes, Types of restriction enzymes, Process of gene cloning (*Agrobacterium*).

**Unit IV: Application of recombinant DNA technology:** application of recombinant DNA technology for production of herbicide resistant plants, insect resistant plants, improving seed storage proteins, golden rice.

**Practicals MS.BOT.PR.1.04**

- 1) Isolation of plasmid.
- 2) Quantification of DNA.
- 3) Agarose gel electrophoresis separation for plasmid DNA.
- 4) Restriction enzyme digestion and separation of fragments.
- 5) Transformation of *E.coli* cell by plasmid DNA.
- 6)  $\beta$ -galactoside expression and assay.

**CIA-** multiple choice questions / assignments / presentation / field report / test.

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DEPARTMENT OF BOTANY, ST. XAVIER'S COLLEGE (Autonomous), Mumbai.  
M. Sc. I Botany Syllabus (2017-2018)

**Course: MS.BOT.2.01 PLANT DIVERSITY- VI (BRYOPHYTES AND PTERIDOPHYTES)**

**LEARNING OBJECTIVES**

The students will be able to understand-

- The range of structural variation in bryophytes and pteridophytes.
- The classification (as per G. M. Smith) of bryophytes and pteridophytes up to orders.
- The significance of bryophytes as pioneer plants on land and their role in the origin of pteridophytes.
- The role of pteridophytes in the origin of seed plants.
- The economic importance of pteridophytes.

**Unit I: Bryophyta I :** Classification up to order as per the system proposed by G. M. Smith, ecological and economic importance of Bryophytes. Life cycle of following- *Targionia*, *Notothallus*, *Polytrichum*, *Porella*.

**Unit II: Bryophyta II :** Origin and evolution of Bryophyta with reference to habitat and form. Evolution of the Sporophyte in Bryophyta.

**Unit III: Pteridophyta I :** Classification of Pteridophyta (order level only). Study of life cycles of *Osmunda*, *Marsilea*, *Ophioglossum*, *Azolla*.

**Unit IV: Pteridophyta II :** Apospory and apogamy, Heterospory. Soral evolution, Fossil Pteridophytes. Economic importance of Pteridophyta. Cultivation and Maintenance of ornamental Ferns.

**Practicals MS.BOT.PR.2.01**

- 1) Study of vegetative and reproductive features of *Targionia*, *Notothallus*, *Polytrichum*, *Porella*.
- 2) Study of vegetative and reproductive features of *Osmunda*, *Marsilea*, *Ophioglossum*, *Azolla*.
- 3) Study of sori of ferns.

**CIA-** multiple choice questions / assignments / presentation / field report / test.

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**DEPARTMENT OF BOTANY, ST. XAVIER'S COLLEGE (Autonomous), Mumbai.**  
**M. Sc. I Botany Syllabus (2017-2018)**

**Course: MS.BOT.2.02 ANATOMY, DEVELOPMENTAL BOTANY & PALYNOLOGY**

**LEARNING OBJECTIVES**

The students will be able to-

- Differentiate between the different meristems, learn about their locations and functions, and their division according to different theories.
- Learn the mechanism of interaction of pollen and pistil during pollen germination and their role in applied biology.
- Understand the relationships and interactions of pollen during their formation and in tetrad conditions.
- Learn the different pollen proteins, their properties and their role as allergens.

**Unit I: Anatomy I:** Meristems and sensory and Tactile tissue system: Meristems: Definition type of meristems, Apical cell theory, Histogen theory and Tunica corpus theory. Sensory and tactile tissue system: Tactile sense organs, Gravitational and Optical sense organs.

**Unit II: Wood Anatomy:** Types of wood elements. Macroscopical and microscopical features of wood. Physical and mechanical properties of wood. Protection and treatment of wood.

**Unit III: Developmental Botany-I:** Organization of shoot and root apical meristems. Shoot and root development, leaf development and phyllotaxy. Transition of flowering. Floral meristems and floral development in *Arabidopsis* and *Antirrhinum*.

**Unit IV: Developmental Botany-II:** Pollen development and gene expression, male sterility, sperm dimorphism and hybrid seed production; pollen storage; pollen embryos. Types of embryo sacs. Pollen-pistil interaction and fertilization, sporophytic and gametophytic self-incompatibility (cytological, biochemical and molecular aspects). Seed development and fruit growth, embryo culture.

**Practicals MS.BOT.PR.2.02**

- 1) Study of wood elements in *Annona*, *Michelia*, *Sterculia* and *Thuja*, using the maceration technique.
- 2) Study of the following leaves with respect to leaf surface characters (wax, cuticle, epidermis, stomata, epidermal outgrowth): *Pistia*, *Ficus*, *Avicennia* and *Peperomia*.
- 3) Photosynthetic system in *Pinus* (arm palisade), *Cyperus*, *Ficus* and *Oxalis*.
- 4) Study of morphology of the pollens- excluding those covered at UG level.
- 5) Double staining of sections and making permanent slides (at least 5 different materials)
- 6) Study of pollen viability.

**CIA-** moodle/ project / assignment / presentation / field report / test.

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**DEPARTMENT OF BOTANY, ST. XAVIER'S COLLEGE (Autonomous), Mumbai.**  
**M. Sc. I Botany Syllabus (2017-2018)**

**Course: MS.BOT.2.03    ECOLOGY AND ENVIRONMENTAL BOTANY- II**

**LEARNING OBJECTIVES**

The students will be able to understand-

- Use of various microbes and plants that can help to prevent pollution and clean up polluted environment.
- The demands of a given species from its environment at each stage of its life cycle.
- The reaction of a species to the changes in its environment.
- Various characteristics that is unique to the population as a whole and not to an individual in the group.
- The theories explaining population growth and the analytical and synthetic characters used to express the characteristics of a community.

**Unit I: Natural resources and environmental Pollution :** Natural resources- renewable and non-renewable resources, conservation of natural resources, equitable use of resources. Bioremediation with reference to algae. Environmental monitoring and Impact assessment (EIA). Environmental legislation.

**Unit II: Autecology of species:** Shelford's law of tolerance. Combined concept of limiting factors. Ecological concept of Species and Individual. Species richness. Community resistance to invasion by Exotic species.

**Unit III: Population- Structure and Dynamics:** Basic concepts- Hardy-Weinberg Principle and Hardy-Weinberg equilibrium. Population characteristics. Population dynamics.

**Unit IV: Community structure and classification:** Classification of community, characters used in community structure, methods of study of communities, classification of communities and main concept of classification.

**Practicals MS.BOT.PR.2.03**

- 1) To record temperature, relative humidity, light intensity, wind speed and windfall.
- 2) To determine the minimum size of the quadrat by Species-Area-Curve method.
- 3) To study the plant community by quadrat method.
- 4) To study the vegetation by line transect method
- 5) To compare the biomass and net primary production.
- 6) Measurement of water quality based on hardness, total alkalinity, total solids and total dissolved solids in water samples and determine potability of water based on these parameters.

**CIA-** assignment / presentation / field report / test.

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**DEPARTMENT OF BOTANY, ST. XAVIER'S COLLEGE (Autonomous), Mumbai.  
M. Sc. I Botany Syllabus (2017-2018)**

**Course: MS.BOT.2.04 MEDICINAL BOTANY**

**LEARNING OBJECTIVES**

The students will be able to understand-

- The plant sources with medicinal properties and their distribution.
- The use of various macroscopical, microscopical and chemical evaluation parameters for authentication of crude drugs and detection of adulterants.
- The various groups of phytochemicals and their medicinal uses.
- Importance of nutraceutical as dietary supplements.
- The various biological properties of plants and estimation of their potency in various diseases.

**Unit I: Sources and Geographical Distribution of Medicinal Plants:** Sources and geographical distribution of medicinally important plants. Study of the following plant constituents: Alkaloids- Vasaka leaves, Cinchona bark. Glycosides- Digitalis, *Glycyrrhiza glabra*, *Dioscorea sp*, *Artemisia*. Tannins- *Terminalia bellerica*, *Terminalia chebula*. Essential oils- *Citronella*, Fennel, Lemon grass.

**Unit II: Quality control of crude drugs :** Morphological examination- Exomorphic characters. Microscopical evaluation- Anatomical characters. Chemical tests. Development of standardization parameters- Moisture content, Solvent extraction value, Bitter value, Foaming index, Heavy metals detection.

**Unit III: Nutraceuticals:** Introduction, Scope and future prospects. Nutraceuticals bridging the gap between food and drugs. Nutraceutical remedies for common disorders. Nutraceutical rich supplements.

**Unit IV: Biological activity of medicinal plants:** antibacterial, antidiabetic, antioxidant, hypertensive, antipyretic, immunomodulators, anticancer, antiprotozoal.

**Practicals MS.BOT.PR.2.04**

- 1) Identification of exomorphic and endomorphic features of plants studied in theory.
- 2) Solvent extractive value, moisture content of the given sample.
- 3) MIC of the plant extract inhibiting the growth of microorganisms.
- 4) Study of antioxidant activity of the plant extract.
- 5) Estimation of vitamin C in plant sample.
- 6) Estimation of vitamin E in plant sample.
- 7) Analyze the nutrition value of honey- detection of sugars by chromatography and estimation of total soluble sugars.

**CIA-** short questions / assignment / presentation / test.

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**DEPARTMENT OF BOTANY, ST. XAVIER'S COLLEGE (Autonomous), Mumbai.  
M. Sc. II Botany Syllabus (2017-2018)**

**Course: MS.BOT.3.01 BIOSTATISTICS, BIOINFORMATICS & NANOTECHNOLOGY**

**LEARNING OBJECTIVES:**

On completion of the course, the student shall be able to-

- Understand the basic concepts of statistics and apply them.
- Use open source computer programs like PSPP for statistical analysis of sampled data.
- Use the internet to conduct Bioinformatic Database searches.
- Develop the skills necessary for writing scientific works.

**Unit I: Biostatistics:** Chi square test, Hypothesis testing: Type I and type II errors, Null hypothesis, P-values- one v/s two tail P values, z-test, Test of significance, Introduction to ANOVA, One-way and two way ANOVA. Regression.

**Unit II: Bioinformatics:** Organization of biological data; Querying in databases; Gene finding, motif finding and multiple sequence alignment; Protein sequence analysis (theory and algorithms); Exploration of databases, retrieval of desired data.

**Unit III: Nanotechnology:** Introduction, synthesis of nanomaterials- various methods for green synthesis of nanomaterial- Polysaccharide, Tollens, Irradiation, Biological and Polyoxometalates methods. Biosynthesis of nanoparticles using biological agents like bacteria, fungi, actinomycetes, yeast, algae and plants.

**Unit IV: Scientific writing:** scientific writing- literature survey, journals (national and international covering plant sciences), selecting a topic, hypothesis; Aims and objective/s, introduction, method, results and discussion; Citing of references- analysing journal articles and essays, basic mechanics and major errors, citing and using sources. Executive summaries; formatting documents; revising your paper- typesetting punctuation, summarizing.

**Practicals MS.BOT.PR.3.01**

- 1) Using the software that provides a basic set of capabilities: frequencies, cross tabs comparison of means (t-tests and one way ANOVA); linear regression, logistic regression and re-ordering data, non-parametric tests, factor analysis, cluster analysis, principal component analysis, chi-square analysis.
- 2) Analyze the data for Hypothesis testing, Normal deviate test, Chi-square test, Correlation and regression, test of significance of means, paired and unpaired t-test, application of analysis of variance (ANOVA)
- 3) Multiple alignments- phylogenetic tree,
- 4) Motif finding.
- 5) Synthesis of nanoparticles and its characterization using UV-visible absorption spectrometry and antimicrobial activity of the fabricated nanoparticles.

**CIA-** moodle / assignment / presentation / field report / project / test.

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**DEPARTMENT OF BOTANY, ST. XAVIER'S COLLEGE (Autonomous), Mumbai.  
M. Sc. II Botany Syllabus (2017-2018)**

**Course: MS.BOT.3.02 PLANT PATHOLOGY**

**LEARNING OBJECTIVES**

- The students will be able to-
- Distinguish the various symptoms of plant diseases and understand host pathogen relationship.
- Analyze the preventive and control measures and the defense strategies used by plant host.
- Learn the method of studying plant diseases and recognize the factors responsible for causing the plant diseases.
- Understand the whole process of disease cycle in some economically important plants.

**Unit I: Plant pathogens, Symptoms and Classification of plant diseases:** Plant pathogens-Host pathogen relationship; Dissemination of pathogens; Epidemiology; Disease forecasting. Classification of plant diseases. Symptoms: Necrotic, Atrophic, Hypertrophic.

**Unit II: Host defence mechanism, Prevention and Control of Plant diseases :** Defence mechanisms of host; Prevention and control, Prophylaxis, therapy and Immunization.

**Unit III: Plant diseases-1 :** Methods of studying plant diseases. Post harvest diseases and protection of stored and perishable product. Microbes responsible for spoilage in storage: Diseases of post harvest durables i) Factors affecting spoilage, ii) Management of storage fungi; Diseases of post harvest perishables i) Factors affecting post harvest decays; ii) Management of post harvest decays of perishables.

**Unit IV: Plant diseases-2 :** Causal organism, symptoms, overview of life-cycle and control measures for following diseases: Fungal diseases- wart disease of potato, white rust of crucifers, red rot of sugarcane, downy mildew of pea / grape, tikka disease of ground nut, powdery mildew of cereals / grasses, looser smut of wheat, brown spot of rice. Bacterial diseases- citrus canker, bacterial brown rot of potato. Viral diseases- tobacco mosaic, leaf curl of potato. Diseases caused by nematodes- root knot disease of potato / sugarcane.

**Practicals MS.BOT.PR.3.02**

- 1) Study the symptoms and causal organism of the plant diseases mentioned in theory (at least three from group 1 and one each from the rest)
- 2) To identify the various symptoms of plant diseases.
- 3) Field trip to any Agricultural Institute / University.

**CIA-** open book test / assignment / presentation / field report / test/ MCQ.

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**DEPARTMENT OF BOTANY, ST. XAVIER'S COLLEGE (Autonomous), Mumbai.  
M. Sc. II Botany Syllabus (2017-2018)**

**Course: MS.BOT.3.03 HORTICULTURE**

**LEARNING OBJECTIVES**

The students will be able to understand-

- The classification systems and know the role of essential environmental factors.
- To recognize and employ the techniques of plant propagation methods.
- To identify the cultivation methods for various plant groups and understanding the required necessary conditions.
- To know and use the principles of landscape designing.

**Unit I: Operational Classification systems and Essential Environmental factors:**

Classification based on seasonal growth cycle- annual, biennial, perennial; Kinds of stem; Common stem growth forms- erect, decumbent, creeping, climbing; Classification of ornamental plants- Herbaceous ornamentals, Woody ornamentals. Classification based on adaptation (hardiness). Essential environmental factors- an overview, Abiotic- air, water, temperature, light, soil; Biotic- microorganisms, insects, birds, rodents.

**Unit II: Plant propagation:** Sexual: seminal- sowing seeds, hybrid seeds; transplanting. Asexual: cutting, budding, grafting, layering, underground plant parts, micropropagation, pre and post planting care.

**Unit III: Cultivation of plants:** ornamental plants, growing vegetables and fruit crops, succulents, floriculture, pest management.

**Unit IV: Landscaping:** goals of landscaping, categories of landscaping- residential and public, commercial, speciality; Landscape designing- basic principles, basic components; Selecting plants.

**Practicals MS.BOT.PR.3.03**

- 1) Garden tools and implements- Axe, shovel, knives, pruning shears, saw, secateurs, sieve, lawnmower, sprinkler, watering can, rubber hose, hand fork, labels (visit to a plant nursery).
- 2) Propagation by seed, cutting, layering, budding.
- 3) Biofertilizers- Identification of Nostoc, VAM and Rhizobium.
- 4) Identification of ornamental plants.
- 5) Physical properties of soil.
- 6) Measuring the soil pH and its correction by adding chemicals.
- 7) Formulating potting mix.
- 8) Preparing manure from vegetable wastes / preparing compost.

**CIA-** assignment / presentation / field report / test / MCQ.

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**DEPARTMENT OF BOTANY, ST. XAVIER'S COLLEGE (Autonomous), Mumbai.  
M. Sc. II Botany Syllabus (2017-2018)**

**Course: MS.BOT.3.04 ANGIOSPERMS- IV**

**LEARNING OBJECTIVES**

The students will be able to-

- Strengthen the fundamentals learnt in under graduate program and will learn new approaches for application of botanical knowledge in human welfare.
- Apply technological tools in unraveling the mystery of evolution, understand phylogeny, identification and understand diversity, using the knowledge in biodiversity, bioprospecting, green belt planning, and IPR.

**Unit I: Evolution** : Plesiomorphic and Apomorphic characters, Character weighing, The effects of evolutionary theory on systematic, monographic, and floristic development : Primitive versus advanced, Homology and Analogy, Parallelism and Convergence.

**Unit II: Phylogeny, Phylogenetic Techniques** : Use of cladistic in classification; Understanding phylogeny, constructing phylogeny, Monophyly, Paraphyly and polyphyly; Patterns of variation and phylogenetic trees; Building Trees- Rooting Technique, Distance methods, Maximum likely hood methods, Bootstrapping using trees. Phyllocode.

**Unit III: Nomenclature** : International code of Botanical Nomenclature 1830-Paris Code to 2011-Melbourne code; Major adaptations considered in these International Botanical Congress; Important Rules of ICBN, Typification, Type concept and Types of type, Basionym, Homonym, Tautonym, Taxonomic and nomenclature synonyms.

**Unit IV: Keys and GB: Types of keys-** single access and multi access keys, preparation of keys for Taxon, keys based on exomorphic characters. **Green-belt planning-** Concept and recommendations; Utility of GBP; List of plants, ornamental, Flowering, shady; Importance of Green Belt in the current environmental conditions in India.

**Practicals MS.BOT.PR.3.04**

- 1) Preparation of Dichotomous Key of Five Families ( min 5 genera / species from each family)
- 2) Use of keys for identification of family, genus and species.
- 3) Writing of species description using taxonomic terminology.
- 4) Cluster analysis of any family using Cladistics techniques based on morphological characters. (practical will continue the whole semester)
- 5) Preparation of Herbarium specimens. 10 specimens to be prepared and submitted during practical examination.
- 6) Study of published Floras, Revision and Monograph; identification, listing and analysis of their components.
- 7) Field excursion.

**CIA-** multiple choice questions / assignment / presentation / field report / test.

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**DEPARTMENT OF BOTANY, ST. XAVIER'S COLLEGE (Autonomous), Mumbai.**  
**M. Sc. II Botany Syllabus (2017-2018)**

**Course: MS.BOT.3.05 PLANT BIOCHEMISTRY- V**

**LEARNING OBJECTIVES**

The students will be able to-

- Perceive the actions and influence of vitamins and coenzymes in plants.
- Comprehend the significance of storage proteins and lectins, their biological role in plant growth and defense and their potential.
- Understand the pathways in carbohydrate metabolism and know the position and functions of various metabolic intermediates.
- Realize the mechanisms and steps involved in the synthesis and degradation of nucleotides.

**Unit II: Vitamins and Coenzymes:** general characteristics of vitamins; Structure, occurrence, functions and activity of all water soluble and fat soluble vitamins; Structure, classification and actions of various coenzymes.

**Unit II: Storage proteins and Lectins:** storage proteins and their storage mechanism. Plant lectins.

**Unit III: Plant metabolism :** carbohydrate metabolism- synthesis of sucrose, trehalose and starch; degradation of sucrose and starch; control of metabolism- The hexose phosphate pool, biosynthetic pathways that consume hexose phosphate, Catabolic pathways that generate hexose phosphates; Triose / pentose phosphate metabolite pool; Interaction between the hexose phosphate and pentose phosphate / triose phosphate pools. Mitochondrial metabolism- control of glycolysis and TCA cycle, cataplerosis and anaplerosis, anaplerotic reactions, reactions of reverse of TCA cycle, non-phosphorylating reactions and their role- cyanide resistant and rotenone sensitive pathways.

**Unit IV: Nucleotide Biosynthesis and Degradation:** Nucleotide structure, Nitrogenous bases- Pyrimidine bases, purine bases. Purine nucleotides biosynthesis and degradation. Pyrimidine nucleotides biosynthesis and degradation.

**Practicals MS.BOT.PR.3.05**

- 1) Estimation of ascorbic acid.
- 2) Estimation of vit A.
- 3) Separation of seed proteins by PAGE.
- 4) Estimation of total carbohydrates.
- 5) Determination of ATPase activity in plants.
- 6) Determination of acid phosphatase activity.
- 7) Inhibition of Acid Phosphatase.
- 8) Malate / succinate dehydrogenase activity assay and inhibition.

**CIA-** multiple choice questions / assignments / presentation / field report / test.

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**DEPARTMENT OF BOTANY, ST. XAVIER'S COLLEGE (Autonomous), Mumbai.  
M. Sc. II Botany Syllabus (2017-2018)**

**Course: MS.BOT.4.01 TECHNIQUES AND INSTRUMENTATION**

**LEARNING OBJECTIVES:**

The students will be able to-

- Understand the basic concepts of microscopy, centrifugation, chromatography and tracer techniques.
- Understand the applications of techniques mentioned above in biology

**Unit I: Microscopy and Spectroscopy:** The fluorescence microscopy- working of microscope and applications. Electron microscopy- construction and working of microscope, specimen preparation, scanning and transmission electron microscopy, application of electron microscopy. UV-visible spectrometer, IR, NMR, atomic absorption.

**Unit II: Centrifugation:** Principles; Preparative centrifugation- Differential, Rate-zonal, Isopycnic and Equilibrium isodensity centrifugation; Density Gradient Centrifugation- Nature of gradient materials, formation of density gradients, sample application to the gradient, removal of gradients from centrifuge tubes. Preparative centrifuges and their uses- General purpose centrifuges, High speed centrifuges, Preparative ultracentrifuges. Analytical ultracentrifugation- Principles, Construction and Applications.

**Unit III: Chromatography:** HPLC and GC- Principle, Support, Stationary phase, Detection systems. Ion exchange, Exclusion and Affinity Chromatography- Principle, materials, practical procedure, Applications.

**Unit IV: Tracer techniques:** Principle and application of tracer techniques in biology. Radioactive isotopes and autoradiography. Geiger Muller counter, Liquid Scintillation Counter.

**Practicals MS.BOT.PR.4.01 : No Practical course.**

**CIA-** moodle / project / assignments / presentation / field report / test.

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**DEPARTMENT OF BOTANY, ST. XAVIER'S COLLEGE (Autonomous), Mumbai.**  
**M. Sc. II Botany Syllabus (2017-2018)**

**Course: MS.BOT.4.02 ANGIOSPERM-V**

**LEARNING OBJECTIVES:**

The students will be able to-

- Learn the diversity, present status and interrelationships among different families apart from their characteristic features and economic importance.
- Know the importance of different anatomical, embryological and palynological features.
- To understand the use of IPR, patents, copyrights in protecting our traditional knowledge.

**Unit I: Families II: Angiosperm Diversity.** Study the following families with reference to its systematic position, distribution, salient features, floral formula, floral diagram, morphological peculiarities and enlist economic important plants and their uses. Nymphaeaceae, Onagraceae, Vitaceae, Nyctaginaceae, Balsaminaceae, Boraginaceae, Gentianaceae, Cyperaceae, Lentibulariaceae and Commelinaceae. A detailed study of the present status, affinities, phylogeny and interrelationships of the above families.

**Unit II: Taxonomic Evidences in relation to Anatomy:** Wood Anatomy, Trichomes, epidermal features & Stomata, Leaf Anatomy, Floral Anatomy.

**Unit III: Taxonomic Evidences in relation to Embryology and Palynology:** Families with distinct embryological features – Podostemaceae, Cyperaceae and Onagraceae. Specific examples of use of embryology in interpreting taxonomic affinities – *Trapa*, *Paeonia*, *Exocarpos*, Loranthaceae. Palynology – Basic structure of Pollen grains and pollen aperture types – Eurypalynous and Stenopalynous Taxa, Evolution of Pollen aperture types. Pollinia in Orchidaceae and Asclepiadaceae.

**Unit IV: Intellectual Property Rights (IPR):** IPR, Patent, Copy Right, India's IPR System, Traditional Knowledge and IPR, [www.iprindia.com](http://www.iprindia.com), [www.ipindia.nic.in](http://www.ipindia.nic.in), [www.copyright.gov.in](http://www.copyright.gov.in).

**Practicals MS.BOT.PR.4.02 :**

- 1) Study of Angiosperm families mentioned for theory with importance of its members.
- 2) Floral Anatomy – Calyx and Androecium in Lamiaceae, Androecium in leguminosae.
- 3) Study of leaf architecture. Prepare permanent slides of any leaf/ leaflet architecture (submission).
- 4) Study of Pollen apertures done in theory; pollinia of Orchidaceae and Asclepiadaceae.
- 5) Embryo mounting –dicot, monocot and polyembryony.
- 6) Study of trichomes, types of stomata.
- 7) A case Study of patent filling.
- 8) Field excursion.

**CIA-** multiple choice questions / assignment / presentation / field report / test.

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**DEPARTMENT OF BOTANY, ST. XAVIER'S COLLEGE (Autonomous), Mumbai.**  
**M. Sc. II Botany Syllabus (2017-2018)**

**Course: MS.BOT.4.03 ANGIOSPERMS-VI**

**LEARNING OBJECTIVES:**

The students will be able to-

- To understand the importance and application of numerical taxonomy, various taxonomic databases and the usefulness of internet in taxonomic studies.
- To understand the use of libraries, literature, herbarium and botanical gardens for taxonomic studies.

**Unit I: Numerical Taxonomy (Phenetics Methods: Taxometrics) :** Principles of Numerical Taxonomy, OUT, Taxonomic characters, coding of characters, Measuring resemblance, simple matching Coefficient, Taxonomic Distance, Cluster Analysis,

**Unit II: Progressive taxonomy:** Progressive taxonomy- Internet, Taxonomic databases (Kew, IPNI, the plantlist, tropicos, efloraindia, etc). Present status and future scope of Taxonomy in India- Vegetation survey, Floristics, Revisionary and monographic studies, Ethnobiological studies, Development and establishment of new herbaria, Role of taxonomists and job opportunities for taxonomists.

**Unit III: Tools in taxonomy: Library** – Literature: definition, origin, history and evolution of Literature of Taxonomy in India. Classification of Taxonomic Literature: Checklist, Catalogue, Floras, Monographs, Revisions, Encyclopedias, Indices, Dictionaries. Museum (Herbarium)- Definition, Steps involved in development of a herbarium, Maintenance of Herbarium, General account of Herbaria in India. Role of B.S.I in Herbaria, Private herbaria, Herbarium of KEW, Utility and importance of Herbaria in Taxonomy. **Garden-** Origin, History and Development of gardens in India. Types of Gardens, Kew Gardens. Role of gardens in taxonomic studies. Preservation of germplasm techniques and its importance in taxonomy.

**Unit IV: Applied Taxonomy: Remote Sensing-** History, Principles and types of Remote sensing; Advantages and limitations of remote sensing; Applications of Remote Sensing in Vegetation Classification and Forest resource Management; Remote sensing of soil and water. **Plant quarantine-** Purpose, Historical account, Plant protection organization, Exclusive quarantine, Regular quarantine, Domestic quarantine, Certification of plant materials.

**Practicals MS.BOT.PR.4.03 :**

- 1) Study of published floras (International, National, regional and local), revision, monograph and check list.
- 2) Nomenclature Exercises
- 3) Review of Taxonomic databases- theplantlist.org, IPNI< TROPICOS, eFloraindia.
- 4) Interpretation of remote sensing images.
- 5) Review of research paper (from any taxonomy related scientific journal)
- 6) Visit to plant quarantine Lab- report to be entered in journal.

**CIA-** short answer questions / assignment / presentation / field report / test.

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**DEPARTMENT OF BOTANY, ST. XAVIER'S COLLEGE (Autonomous), Mumbai.**  
**M. Sc. II Botany Syllabus (2017-2018)**

**Course: MS.BOT.4.04 ANGIOSPERMS- VII**

**LEARNING OBJECTIVES:**

The students will be able to-

- Learn the application of technological tools used in unravelling the mystery of evolution, phylogeny, identification and diversity, using the knowledge in plant geography and ethnobotany along with Taxonomy of angiosperms.

**Unit I: Families III:** Approaches to Angiosperm Taxonomy- Study the following families with reference to its systematic position, distribution, salient features, floral formula, floral diagram, morphological peculiarities. Enlist economic important plants and their uses. Oleaceae, Plumbaginaceae, Sapotaceae, Bignoniaceae, Caryophyllaceae, Loranthaceae, Urticaceae, Araceae and Orchidaceae. A detailed study of the present status, affinities, phylogeny and interrelationships of the above families.

**Unit II: Taxonomic evidence :** Taxonomic Evidences in relation with Cytology; Chromosome morphology, Chromosome behavior, Heterochromatin, Use of Cytological data at Family level, Use of Cytological data at family, genus and species level.

**Unit III: Plant Geography :** Historical Development, Physical geography of earth, theories of plant distribution, Static and Descriptive; major biomes of the world; minor biomes; Phytogeographical regions of India; Dynamic or interpretive plant geography. Endemism- role of Indian endemic flora in plant based discoveries.

**Unit IV : Ethnobotany:** Ethnobotany- Introduction; a brief history of ethnobotanical studies in the world and in India; scope of ethnobotany. Subdisciplines of ethnobotany. Interdisciplinary approaches, Knowledge of sociological and anthropological terms. Distribution of tribes in India. Knowledge of tribes of Maharashtra; Ethnobotanical works on these tribes. Methods in ethnobotanical research. Research design and cautions in data collections, Practical and field skills; Prior Informed Consent, PRA techniques, interviews and questionnaire methods, choice of resource persons. Ethnobotanical knowledge and communities: Ethnobotanical classification; Folk Taxonomy of Plants. Bioprospecting and commercial use of traditional knowledge. Medical ethnobotany, ethnopharmacology and the search of plant based drugs. Developing research partnerships: Ethics and research guidelines in ethnobotany, equitable research relationships. Equitable Benefit sharing models of the world.

**Practicals MS.BOT.PR.4.04 :**

- 1) Study of Angiosperm families mentioned for theory with reference to morphological peculiarities and economic importance of its members.
- 2) Morphological description of the entire plant.
- 3) Preparation of synoptic keys to the families; Preparation of synoptic keys to the genera; Preparation of synoptic keys to the species within a genus.
- 4) Study of Cytological characters of taxonomic value- study of Karyotypes of *Allium cepa* and *Aloe vera*.
- 5) Field excursion.

**CIA-** multiple choice questions / assignment / presentation / field report / test.

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**DEPARTMENT OF BOTANY, ST. XAVIER'S COLLEGE (Autonomous), Mumbai.  
M. Sc. II Botany Syllabus (2017-2018)**

**Course: MS.BOT.4.05 PLANT PHYSIOLOGY- V**

**LEARNING OBJECTIVES**

The students will be able to understand-

1. The various aspects of nutrition like heterotrophic and foliar nutrition.
2. Mineral toxicity.
3. Minerals in chemical fertilizers.
4. The role of various abiotic and biotic stresses faced by plants in different ways and the response and mechanisms used by plant to overcome them.

**Unit I: Plant Mineral nutrition:** Chemical fertilizers in crop production, biofortification, foliar nutrition, responses of to mineral toxicity, heterotrophic nutrition in higher plants (insectivorous plants)

**Unit II: Stress Physiology – I:** Abiotic stresses, Plant responses to- Water deficit, Heat stress, and heat shock-adaptation, Chilling and freezing – adaptation/acclimation, Flooding and oxygen deficit.

**Unit III: Stress Physiology – II:** Abiotic stress, Oxidative stress, Salinity stress and Oxygen deficiency.

**Unit IV: Stress Physiology – III:** Biotic stresses, Plant responses to pathogens.

**Practicals MS.BOT.PR.4.05 :**

- 1) Determination of iron (Fe) in plant digest.
- 2) Ash preparation.
- 3) Determination of phosphorus (P) from ash.
- 4) Estimation of proline in water stressed plants.
- 5) Estimation of proline in salt stressed plants.
- 6) Study of SOD in water stressed plants.
- 7) Study of SOD in salinity stressed plants.

**CIA-** multiple choice questions / assignment / presentation / field report / test.

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**DEPARTMENT OF BOTANY, ST. XAVIER'S COLLEGE (Autonomous), Mumbai.  
M. Sc. II Botany Syllabus (2017-2018)**

**Course: MS.BOT.4.06 PLANT PHYSIOLOGY-VI**

**LEARNING OBJECTIVES**

The students will be able to understand-

1. The significance of PGRs in modulating plant genome. Their role and exploitation in fruit ripening and preservation.
2. The functions of phytochromes in photophysiology, ecology and plant responses. The properties of phytochrome and their role in gene expression.
3. The contribution of various substrates, intermediates, factors and conditions in controlling the various catabolic pathways in mitochondrial respiration.
4. The gene regulating mechanisms in the development of various floral organs.
5. The process of senescence and the metabolic changes taking place in plant cell during senescence.

**Unit I: Plant Growth Regulators:** Modulation of plant genomes by natural and synthetic PGRs; Post Harvest Technology – Fruit ripening and Fruit preservation.

**Unit II: Plant responses to light:** Photochemical and biochemical properties of phytochrome, phytochrome induced whole plant response, ecological roles of phytochrome, functional domains of phytochromes, cellular and molecular mode of action and factors involved in phytochrome regulated gene expression. Photophysiology of blue light responses, blue light photoreceptors, signal transduction.

**Unit III: Control of flowering:** Floral organs, genes regulating the floral development –floral organ identity genes - MADS box genes, a model for floral evocation;

**Unit IV: Senescence and Programmed Cell Death:** Programmed cell death (PCD) an overview; Overview of Senescence- Pigment Metabolism during Protein metabolism, Oxidative metabolism during senescence, Degradation of nucleic acids during senescence, Regulation of metabolic activity during senescence, Endogenous PGRs and senescence.

**Practicals MS.BOT.PR.4.06**

- 1) Study of photomorphogenetic effect of lights on the development of seedlings i) Length of hypocotyls, Size and fresh weight of cotyledons, Differentiation of stomata in the lower epidermis, ii) Estimation of total chlorophyll, iii) Extraction and estimation of anthocyanin.
- 2) Effect of GA on  $\alpha$ -amylase induction in cereal grains.
- 3) Separation of sugars from ripe and unripe fruits by paper chromatography.
- 4) Estimation of organic acids by paper chromatography.
- 5) Estimation of carotenoids in the young, mature and senescent leaves.

**CIA-** multiple choice questions / assignment / presentation / field report / test.

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**DEPARTMENT OF BOTANY, ST. XAVIER'S COLLEGE (Autonomous), Mumbai.  
M. Sc. II Botany Syllabus (2017-2018)**

**Course: MS.BOT.4.07 PLANT BIOCHEMISTRY-VI AND BIOTECHNOLOGY**

**LEARNING OBJECTIVES**

The students will be able to understand-

1. The role of various secondary metabolites in plants, their classification, functions and the pathways involved in their synthesis.
2. The cruciality of secondary messengers in biological processes and the dependence of various metabolic pathways on them.
3. The process of tissue culture and its application.
4. The use of IPR, patents, copyrights in protecting our traditional knowledge.

**Unit I: Secondary Metabolites:** Cutins, waxes and suberin; Role of secondary metabolites; Classes of secondary metabolites– terpenes, phenolics and alkaloids and other nitrogen containing compounds; Overview of the major pathways of secondary-metabolite biosynthesis and their inter-relationship with primary metabolism; Biosynthesis and role of terpenes, phenolics and alkaloids and other nitrogen containing compounds.

**Unit II: Signal transduction in plants :** Second messengers- Cyclic-AMP, Cyclic-GMP, Cyclic-ADP-ribose, 1,2 – diacylglycerol, inositol 1,4,5-triphosphate, nitric oxide and Calcium ion and their role, structure of calmodulin MAPK cascade.

**Unit III: Plant tissue culture-** callus culture, organ culture, advantages, applications.

**Unit IV: Intellectual Property Rights (IPR):** IPR, Patent, Copy Right, India's IPR System, Traditional Knowledge and IPR.

**Practicals MS.BOT.PR.4.07 :**

- 1) Study of peroxidase activity.
- 2) Detection of tannins, saponins, alkaloids, flavonoids, steroids and triterpenoids, wax, cutin, etc.
- 3) Estimation of total alkaloids from plant material.
- 4) Estimation of total phenolics in plants.
- 5) Estimation of total flavonoids in plants.
- 6) Callus initiation.
- 7) Multiple shoot formation.

**CIA-** multiple choice questions / assignment / presentation / test.

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