

St. Joseph's College (Autonomous), Bangalore - 560027

Department of Botany

Semester I

BO 118 : Microbiology and Algae

Unit I	Microbiology: <i>Historical account of microbiology, Brief contributions of Anton van Leeuwenhoek, Louis Pasteur, Robert Koch, Edward Jenner and Alexander Flemming.</i> <i>Scope of Microbiology (unit I self study)</i>	2 hrs
Unit II	Viruses: General characteristics, classification based on genetic material; Structure and multiplication of HIV, TMV. Immunology: Antigen-antibody reaction, T cell – B cell function, Innate and acquired immune system, Monoclonal antibody – Hybridoma technique, vaccines, hypersensitivity, autoimmunity. <i>Brief account of Viroids and prions. (self study)</i>	9 + 1 hrs
Unit III	Bacteria: General characteristics of bacteria. Physical and chemical structure of Gram positive and Gram negative bacterial cell walls. Structure of capsule, flagella, pili and endospore. (Ultrastructure of flagella and endospore only) Reproduction by binary fission. Genetic recombination by conjugation (F ⁺ and F ⁻ , Hfr types), Transduction (generalized and specialized types) and Transformation. A brief account of transposons. <i>A brief account of importance of bacteria in agriculture, industry, medicine and environment. (self study)</i>	10 + 2 hrs
Unit IV	Mycoplasma: General characteristics, structure, reproduction and its significance.	2 hrs
Unit V	Cyanobacteria: General characters, Structure and reproduction of <i>Anabaena</i> , <i>Scytonema</i> , <i>Spirulina</i> . <i>Economic importance of Cyanobacteria. (self study)</i>	3 + 1 hrs

Unit VI	Diversity of Algae: Habitat, thallus organization and reproduction ; Life cycles in algae: Haplontic, diplontic, haplobiontic and diplobiontic types	13 hrs
Unit VII	Systematic position, structure and reproduction of the following forms: <i>a) Volvox b) Hydrodictyon c) Spirogyra d) Chara</i> <i>e) Vaucheria f) Sargassum g) Batrachospermum</i>	15 hrs
Unit VIII	<i>Economic importance of algae(self study).</i>	2 hrs

PRACTICALS

- Gram staining of bacteria (*Rhizobium, Lactobacillus*).
- Haemocytometry (yeast).
- Demonstration of motility in bacteria by hanging drop technique.
- Study of Cyanobacterial forms: *Anabaena, Scytonema, Spirulina*.
- Algae-Study of morphology and reproduction of forms studied in theory.
- Demonstration of *Spirulina* culture
- Study of algae in natural habitats.
- Submission of Scrap book related to self study.

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- Dubey, R.C. and Maheshwari,D.K.2007. A text book of Microbiology, S Chand and Company, New Delhi.

St. Joseph's College (Autonomous), Bangalore - 560027

Department of Botany

Semester II

BO 218 : Fungi, Plant Pathology, Bryophytes and Anatomy

Unit I	Fungi General characteristics, habitat, structure and reproduction of fungi Outline of classification according to G.C.Ainsworth (1973) Detailed study of morphology and reproduction of <i>Stemonitis</i> , <i>Pythium</i> , <i>Rhizopus</i> , <i>Peziza</i> , <i>Puccinia</i> , <i>Agaricus</i> and <i>Cercospora</i> . <i>General account of Lichens (self study)</i> and Mycorrhizae and their significance <i>Economic importance of fungi (self study)</i>	20 + 3 hrs
Unit II	Plant pathology A general account of symptoms caused by viruses, bacteria, Mycoplasma and fungi. Study of tomato leaf curl, citrus canker, sandal spike, club root of crucifer, late blight of potato, smut of jowar, blast of rice, red rot of sugarcane (Etiology, disease symptoms, vectors if any, disease cycle and control measures only)	6 + 1 hrs
Unit III	Bryophytes Distribution, general characters, alternation of generation and classification of Bryophytes. Morphology, anatomy and reproduction of <i>Marchantia</i> , <i>Anthoceros</i> , <i>Funaria</i> (developmental details not required). <i>Economic importance of Bryophytes (self study)</i>	14 + 1 hrs
Unit IV	Anatomy Meristems – Classification, theories of organization (Apical, Histogen, Tunica-Corpus) and cytohistological zonation. Secretory tissues-types, structure and importance <i>Primary structure of root and stem (self study)</i> Secondary Growth of dicot stem and dicot root. Anomalous secondary growth in stem of <i>Boerhaavia</i> and <i>Dracaena</i> . Wood anatomy: Variation in wood structure: ring porous and diffuse porous Wood parenchyma ; uniseriate and multiseriate rays, apotracheal and	11 + 4 hrs

PRACTICALS:

- Study of *Stemonitis*, *Pythium*, *Rhizopus*, *Peziza*, *Puccinia*, *Agaricus* and *Cercospora*.
- Lichens, Mycorrhizae (Ecto, VAM only).
- Tomato leaf curl, citrus canker, sandal spike, club root, late blight, smut, blast, red rot diseases.
- Study of *Marchantia*, *Anthoceros* and *Funaria*.
- Anatomy of dicot and monocot stem and root (both primary and secondary).
- Anomalous secondary growth in *Boerhaavia* and *Dracaena*
- **Student's submission:** 3 Herbarium sheets of diseased plants.
- **Activity:** Cultivation of Oyster/milky mushroom

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- Bilgrami K.S and Dube H.C.(1976).a text book of modern plant pathology.Vikas Publication House,New Delhi.
- Parihar, N.S.(1962), Bryophyta,Central book depot,Allahabad.
- Srivastava, H.N(1993), Bryophyta,Predeep Publications, Allahabad.
- Watson.E.V.(1971)The structure and life of Bryophytes,Hutchinson and Co.,London.
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- Easu, K (1979) Anatomy of seed plants. Wiley Eastern Ltd. New Delhi.
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	ST.JOSEPH'S COLLEGE (AUTONOMOUS) BENGALURU- 560027 II B.Sc. Botany Semester – III BO-318: Pteridophytes, Gymnosperms and Paleobotany	60 hrs
Unit I	Pteridophytes	30 hrs
	General characteristics, distribution and affinities of Pteridophytes. <u>Classification (Smith-1955)</u>	2 + <u>1 hr</u>
	Systematic position, sporophytic structure, reproduction and lifecycle of <i>Psilotum</i> , <i>Lycopodium</i> , <i>Selaginella</i> , <i>Equisetum</i> , and <i>Marsilea</i> . (Development not required)	14 hrs
	Brief account of Stellar evolution, Heterospory and Seed habit. <u>Economic importance of Pteridophytes</u>	6 hrs + <u>1 hr</u>
	Study of fossil Pteridophytes : <i>Rhynia</i> , <i>Lepidodendron</i> and <i>Calamites</i>	4 + <u>2 hrs</u>
Unit II	Gymnosperms	15 hrs
	General characters and <u>classification by Sporne</u> . Salient features of Cycadales, Coniferales and Gnetales.	3 hrs + <u>1 hr</u>
	Details study of the structure and reproduction of a) <i>Pinus</i> b) <i>Gnetum</i> (Developmental details not required except male and female gametophytes)	10 hrs
	<u>Economic importance of Gymnosperms</u>	<u>1hr</u>
Unit III	Paleobotany	15 hrs
	Fossiliferous rocks and process of fossilization	2 hrs
	Types of fossils	2 hrs
	<u>Geological time scale</u> ; Determination of age of fossil (Carbon dating)	1hr + <u>1 hr</u>
	Techniques of studying fossils.	3 hrs
	A brief account of fossil genera : a) <i>Glossopteris</i> b) <i>Pentoxylon</i>	4 hrs
	Application of Paleobotany in prospecting fossil fuels <u>Contributions of Sahni.</u>	1hr + <u>1 hr</u>
Practicals BO 3P1	<ul style="list-style-type: none"> • Study of morphology, anatomy and reproductive structures of Pteridophytes mentioned in the theory • Study of <i>Pinus</i> - morphology, anatomy and reproductive structures • Study of <i>Gnetum</i> - morphology, anatomy and reproductive structures 	

	<ul style="list-style-type: none"> • Micropreparation: specimens from pteridophytes (<i>Selaginella</i>, <i>Equisetum</i> and <i>Marsilea</i> and gymnosperms (<i>Pinus</i> needle) • Study of fossil members (Pteridophytes and Gymnosperms) as mentioned in the syllabus with the help of slides/specimen • Fossiliferous rocks 	
References	<ul style="list-style-type: none"> • The morphology of Pteridophytes by K.R.Sporne, Hutchinsion Co., London (1970). • Pteridophytes by Rasheed, Vikas Publication, New Delhi. • Cryptogamic Botany Vol. II McGraw – Hill, New York. • The morphology of Pteridophytes by N.S.Parihar. Central Book Depot, Allahabad. • Morphology of vascular plants (lower groups) by Eames, A.J.1936. McGraw Hill, New York. • Studies in Paleobotany, Andrews, H.N. 1961. John Wiley, New York. • Andrews H.N. 1961 Studies in Paleobotany. John Wiley & Sons New York. • Baja Y.P.S. (ed) 1989. Biotechnology in Agriculture and Forestry Vol. 5. Trees II. Springer – Verlag, Berlin, Heidelberg. • Chamberlain C.J. 1935. Gymnosperms. Structure and evolution. Univ, Chicago Press, Chikcago. • Coulter, J.M. & Chamberlain C.J. 1917 Morphology of Gymnosperms. Univ Chicago Press, Chicago. • Bhatnagar S.P. and AlokMitra 1966 Gymnosperms. New age International (P) Ltd. Publishers. • Sporne K.R. 1974 The Morphology of Gymnosperms. Hutchinson Univ. Lib. London. • Shripad N. Agashe 1995 – Paleobotany. Oxford and I.B.H. New Delhi. • Dutta S.C. 1966 An Introduction to Gymnosperms. Asia Publications House, Mumbai. 	

NOTE:

Portions which are underlined are meant for self-study

ST.JOSEPH'S COLLEGE (AUTONOMOUS) BENGALURU- 560027 II B.Sc. BOTANY SEMESTER – IV BO-418: Embryology of Angiosperms, Palynology and Environmental Biology		30 hrs
	Embryology of Angiosperms	15 hrs
Unit I	Introduction Development and structure of anther <u>Types of microspore tetrads, pollinia</u> Development of male gametophyte	3 hrs + 1 hr
Unit II	Ovule and structure of an anatropous ovule. Types of Ovule. a) Unitegmic, Bitegmic and Ategmic ovules b) Crassinucellate and Tenuinucellate ovules c) Orthotropous, Anatropous, Hemitropous, Campylotropous, Amphitropous and Circinotropous Variations in ovule structure- Aril, integumentary tapetum, caruncle	3 hrs
Unit III	Types of Embryo sac development: (Monosporic- <i>Polygonum</i> type; Bisporic- <i>Allium</i> type and Tetrasporic- <i>Fritillaria</i> type. Double Fertilization, process and its significance	3hrs
Unit IV	<u>Differences between mature Dicot and Monocot embryos</u> Types of Endosperm : i) Nuclear ii) Cellular iii) Helobial	1 hr + 1 hr
Unit V	<i>In vitro</i> morphogenesis: Embryogenesis and Organogenesis Organ culture: Anther and embryo culture	3 hrs
	Palynology	3 hrs
Unit VI	Pollen morphology: Apertures, exine stratification and Ornamentation. Applications of Palynology	3 hrs
	Environmental Biology	12 hrs
Unit VII	Ecology: Introduction, sub-divisions and scope Ecological factors: Abiotic and biotic factors Abiotic factors: a) Climatic factors - temperature and light. b) Soil profile c) Edaphic factors and its effect on vegetation- soil water, soil microbes, and soil pH Biotic factors / Interspecific interactions- (definition with examples) Positive interactions a) Mutualism (<i>Rhizobium</i> , Lichens and Mycorrhiza)	6 hrs

	b) Commensalism (Epiphytes and Lianas). c) Proto cooperation (Bacteria) Negative interactions d) Parasitism (<i>Cuscuta</i> , <i>Rafflesia</i> , <i>Viscum</i> and <i>Santalum</i>) e) Allelopathy (<i>Eucalyptus</i>)	
Unit VIII	Ecosystem: definition, components, food chain, food web and ecological pyramids. Types of ecosystems: Pond and tropical rain forest ecosystem. Ecological succession: Hydrosere and xerosere	4 hrs
Unit IX	<u>Global environmental issues: Acid rain, Greenhouse effect & global warming and Ozone layer depletion, Eutrophication, Impact of pollution.</u>	<u>2 hrs</u>
Practicals BO 4P1	<ul style="list-style-type: none"> • T.S of young and mature anther • Whole mounts of pollen grains of – Grass, <i>Cocos nucifera</i>, <i>Hibiscus</i>, <i>Mimosa</i>, <i>Acacia</i>, <i>Tridax</i>, <i>Eucalyptus</i> and <i>Pollinia</i> of <i>Calotropis</i> • Germination of Pollen grains of <i>Catharanthus roseus</i> – Hanging Drop method • Types of ovules • Types of placentation • Mounting of endosperm of <i>Cucumis</i> • Mounting of embryo of <i>Tridax</i> • Study of morphological and anatomical features of : Halophytes b) Hydrophytes c) Xerophytes d) Parasites e) Epiphytes • Estimation of chloride in water samples using Harvey’s method • Estimation of dissolved oxygen in water samples using Winkler’s method 	
References	<ul style="list-style-type: none"> • Bhojwani & Bhatnagar S.P. 1992: The Embryology of angiosperms, Vikas Publication House, New Delhi. • Johri, B.M.(Ed) 1984: Embryology of angiosperms. Springer Verlag, Berlin. • Maheshwari P. 1950 : An Introduction to the embryology of angiosperms – Tata McGraw Hill, New Delhi. • Razdan M.K. 1993 : An Introduction to plant tissue culture. Oxford and IBH Delhi. • Erdtman, G. (1969) Handbook of Palynology. Hafner Pub. Co. New York. • Agashe S.N. (2006) Palynology and its application. Oxford and I B H Pub. Co. Pvt. Ltd. • Gregory, P.H. (1973) The Microbiology of the Atmosphere. 	

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	ST.JOSEPH'S COLLEGE (AUTONOMOUS) BENGALURU- 560027 II Year Undergraduate Course Semester – IV CBCS – Interdepartmental Elective BO OE-4118: Applied Botany	30 hrs
Unit I	Plants that heal/ Home remedies: Botanical name, brief description of part used and uses of the following plants as medicine – Tulsi, <i>Aloe vera</i> , Mint, Coleus, Hibiscus, Ginger, Garlic, Turmeric, Pepper, Fenugreek, Ajwain, Drumstick, Lady's finger, Papaya.	6 hrs
Unit II	Economic Botany: Botanical name, brief description of part used and uses of the following plants: (a) Oil yielding plants- Neem, Sunflower, Castor, Olive, Coconut, Eucalyptus, Sandal wood, Lemon grass. (b) Beverages- Coffee, Tea, Cocoa. (c) Spices & Condiments- Asafoetida, Cinnamon, Clove, Saffron, Cardamom.	6 hrs
Unit III	Home Gardening: Landscaping, Terrace gardening, Vertical gardening. Vermicomposting, Compost preparation using kitchen waste & leaf debris, Potting, Seeding, Manuring and Irrigation.	5 hrs
Unit IV	Mushroom Cultivation Introduction, nutritional and medicinal value of edible mushrooms. Poisonous mushrooms. Cultivation: mushroom spawn and process of grain spawn production. Mushroom farm layout. Steps in cultivation of oyster mushrooms (preparation of substrate, spawning, spawn running, cropping and harvesting). White button mushroom cultivation (substrate compositions, substrate preparation: outdoor and indoor composting, filling the compost, pasteurizing, spawning, spawn running, casing, cropping and harvesting). Processing and storage practices of mushrooms. Pests and disease control	13 hrs
References	<ul style="list-style-type: none"> • Dubey, R.C., 2005 A Text book of Biotechnology S.Chand& Co, New Delhi. • Kumaresan, V. 2005, Biotechnology, Saras Publications, New Delhi. • John JothiPrakash, E. 2004. Outlines of Plant Biotechnology.Emkay -Publication, New Delhi. • Sathe, T.V. 2004 Vermiculture and Organic Farming. Daya publishers. 	

	<ul style="list-style-type: none">• SubhaRao, N.S. 2000, Soil Microbiology, Oxford & IBH Publishers, New _Delhi.• Vayas,S.C, Vayas, S. and Modi, H.A. 1998 Bio-fertilizers and organic Farming AktaPrakashan• Bahl, N. 1988. Handbook of Mushroom.Oxford and IBH Publishing Co. Pvt. Ltd, New Delhi 37• Krishnamoorthy, A.S., Marimuthu, T. and Nakkern, S. 2005 Mushroom Biotechnology .TNAU Press, Coimbatore, India• Harander, S. 1991. Mushrooms.The Art of Cultivation Sterling Publishers.• Tripathi, D.P. 2005. Mushroom Cultivation.Oxford and IBH Publishing Co. Pvt. Ltd, New Delhi.	
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**St. Joseph's College Autonomous,
Bangalore – 560 027
III B.Sc. – BOTANY COURSE
Semester V
BO 5118: Taxonomy of Angiosperms (45 hrs)**

COURSE OBJECTIVES:

- To understand the basic principles of flowering plants focusing on classification and identification of unknown specimens.
- To appreciate the economic importance of flowering plants.

STUDENT LEARNING OUTCOME:

Upon successful completion of this course, students will be able to:

- Learn plant morphological terminologies and use it accurately in the description and identification of plant species.
- Identify and provide family characteristics of at least 20 flowering plant families in Bengaluru.
- Identify and/or verify unknown species using dichotomous keys.
- Learn how to collect and preserve plant specimens.
- Understand plant names and acquire a good overview of flowering plant evolutionary history.

Unit I	Introduction & Principles of taxonomy: Description - The plant body - Root, stem and leaves: types and their modifications. Inflorescence types, flower- parts and their arrangements, fruit-types; Identification, Nomenclature, Classification (phylogeny of Angiosperms, its significance).	5hrs
Unit II	Herbarium technique, herbaria, Botanical gardens and their importance. <i>Contributions of Carl Linnaeus and Indian Taxonomists (E.K. Janaki Ammal & Fr. Cecil J Saldanha). Botanical Survey of India(Self study)</i> . Outline classification of Bentham and Hooker's system, Engler and Prantl's system ("Syllabus der Pflanzenfamilien", ed. Melchior,1964), An introduction to APG System of classification.	3+2 hrs
Unit III	Principles and rules (ICN); ranks and names; binominal system, typification,	2 hrs
Unit IV	Modern systematics – Need for a synthetic approach, role of Palynology, phytochemistry and serology, DNA barcoding.	3 hrs
Unit V	Vegetative and floral characters of flowering plants used in taxonomy in the description of families. Salient features of the families given below – (according to Engler & Prantl "Syllabus der Pflanzenfamilien", ed. Melchior, 1964). Dicotyledon families: Magnoliaceae, Moraceae, <u>Brassicaceae</u> , Malvaceae, Fabaceae, Caesalpiniaceae, Mimosaceae, Rutaceae,	26+4 hrs

	<p>Euphorbiaceae, Apiaceae, Apocynaceae, Asclepiadaceae, Solanaceae, Lamiaceae, Acanthaceae, Rubiaceae, Cucurbitaceae and Asteraceae.</p> <p>Monocotyledon families: Poaceae, Liliaceae, <u>Cannaceae</u>, Musaceae and Orchidaceae.</p> <p>Brief economic uses of the members of the above mentioned families</p>	
Practicals	<p>BO 5P1</p> <ul style="list-style-type: none"> • Detailed studies of the following families with locally available plant specimens. <ol style="list-style-type: none"> 1. Magnoliaceae, Moraceae, Brassicaceae 2. Fabaceae, Caesalpiniaceae, Mimosaceae 3. Malvaceae, Rutaceae, Euphorbiaceae, 4. Apiaceae, Apocynaceae, Asclepiadaceae 5. Solanaceae, Lamiaceae, Acanthaceae 6. Rubiaceae, Cucurbitaceae, Asteraceae 7. Poaceae, Liliaceae, Orchidaceae 8. Musaceae and Cannaceae <ul style="list-style-type: none"> • Economic Botany: Common name, botanical name, family to which they belong, morphology of the part being used and uses of 9. a) Cereals and Millets: Rice, Wheat, Jowar, Ragi b) Pulses: Black gram, Bengal gram, Green gram c) Spices: Cardamom, Clove, Cinnamon. d) Fibres: Cotton, Coir and Jute 10. e) Paper and Pulp: Eucalyptus and Bamboo f) Sugar: Cane Sugar g) Beverages: Coffee and Tea h) Medicinal plants: Neem, Sarpagandha and Periwinkle. <ul style="list-style-type: none"> • Submission of five economically important plant products. • Preparation and submission of FIVE herbarium specimens and FIVE digital herbarium specimens (Soft copy). • Local field trip for studying plants and plant specimen collection. 	

References

- Ashok Bendre and Ashok Kumar (1980) Economic Botany. Rastogi and Publications, Meerut.
- Heywood V.H. (1967) Plant Taxonomy. Edward Arnold, London.
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- Bell, A. D. (1991) Plant Form: An Illustrated Guide to Flowering Plant Morphology. Oxford University Press, Oxford.

**ST. JOSEPH'S COLLEGE AUTONOMOUS,
BANGALORE- 560 027
III B.Sc. BOTANY, SEMESTER – V
BO-5218 : Molecular Biology and Plant Biotechnology (45 hrs)**

COURSE OBJECTIVES:

- To understand the basic principles of molecular biology and plant biotechnology.
- To apply the concepts of molecular biology and plant biotechnology to the field of plant sciences.

STUDENT LEARNING OUTCOME:

Upon successful completion of this course, students will be able to:

- Utilize the tools & techniques learnt in plant biotechnology.
- Apply the concepts of molecular biology in research.

Unit I	<p>Molecular Biology:</p> <p>a) DNA as genetic material (<i>Griffith's experiment; Avery, McLeod and McCarty experiment, Hershey Chase experiment, (Self study)</i>);</p> <p>b) Chemical nature of nucleic acids: Nucleosides and nucleotides, purines, pyrimidines and chemical modifications (Structures).</p> <p>c) Watson & Crick model of DNA, forms of DNA (A, B and Z) and functions. DNA replication – models (conservative, dispersive and semiconservative) <i>Meselson and Stahl's experiment (self study)</i>, Mechanisms of DNA replication in Prokaryotes.</p> <p>d) RNA: types of RNA (Coding & non-coding), structure and function.</p> <p>e) Central dogma of molecular biology; Genetic code – characteristics & wobble hypothesis,</p> <p>f) Protein synthesis in Prokaryotes – Mechanism of Transcription & Translation.</p> <p>g) Prokaryotic gene regulation: inducible (Lac Operon) and repressible operon systems. Eukaryotic gene regulation (GAL4 model)</p>	12 hrs +3hrs
Unit II	<p>Plant biotechnology:</p> <p>Steps in cloning & raising transgenic plants: DNA isolation, amplification (PCR and Agarose Gel electrophoresis), cloning into vectors (using tools such as Restriction endonucleases, Ligases, Plant Binary Vectors (pCambia)), validation of cloning by Sanger's sequencing. <i>Agrobacterium</i> mediated transformation (<i>Arabidopsis</i> floral dip method).</p>	12 hrs
Unit III	<p>Brief concepts of Agrobiodiversity, Antiterminator, Biopesticide, Bioremediation, Bioprospecting, Germplasm, <i>in situ</i> conservation, Synthetic seeds.</p> <p>A brief account of Golden Rice, Flavr Savr Tomato and Bt Cotton.</p> <p>Molecular pharming; production of secondary metabolites in plants (alkaloids and flavonoids with 2 examples each). <i>Edible plant vaccines (Self study)</i>.</p>	9 hrs +1 hr

Unit IV	Biological nitrogen fixation in non-leguminous plants Production of drought, salinity and disease resistant plants <u><i>Achievements of Indian institutes in developing commercially important transgenic plants with respect to Rice & Coconut. (Self study)</i></u>	4 hrs +2hrs
Unit V	Intellectual property rights (IPR) – patenting; biosafety and biohazards	2 hrs
Practicals	BO 5P2 1. Qualitative tests for secondary metabolites (Alkaloids, Phenolics, Saponins, Anthocyanins, and Flavonoids) 2. Estimation of DNA by DPA method 3. Extraction and estimation of proteins by Lowry Lopez method 4. Determination of ascorbic acid content of plant sample 5. Extraction and estimation of total phenolics from plant samples 6. Isolation of genomic DNA from plant samples (Cauliflower/ pea shoot tip/ onion root tip) by CTAB method and 7. Separation of DNA (of experiment no. 6) by AGE. 8. Enzyme assays (oxidases and peroxidases) 9. Spotters (PCR, AGE, Southern blot, pUC18, Ti plasmid, pBR322) 10. Problems on Gene mapping – reconstructing the sequence	
References	<ul style="list-style-type: none"> • Brown T. A., 1990. Gene cloning: An introduction, 2nd ed., Chapman & Hall. • Brown T. A., 2010. Gene cloning and DNA analysis, 6th edition, Wiley and Blackwell publishers. • David J. Merrell, 1962. Evolution and Genetics. The modern theory of Evolution. Publishers: Holt, Rinehart and Winston, New York. • Freifelder D., 1987. Molecular Biology, 2nd edition. Jones and Bartlett publishers, Boston. • Grierson D. and Covey S. N., 1988. Plant Molecular Biology, 2nd edition, Blackie, Chapman and Hall, New York, USA. • Halford N. G., 2006. Plant Biotechnology: current and future applications of genetically modified crops. John Wiley Publishers. • Jha A. P., 1993. Genes and Evolution. MacMillan India Ltd. • Kahl A. and Schell J. S., 1982. Molecular Biology of plant tumour, Academic Press, New York. • Lewin, B., 2000. Genes VIII, Pearson Prentice Hall • Malacinski GM & Freifelder D., 1998. Essentials of Molecular Biology, Jones & Bartlett Publishers. • Perry Gustafson J., Ledyard Stebbins G., Francisco J. Ayala- Genetics, Development and evolution - 17th Stadler Genetics Symposium - Ed. Plenum Press New York and London. (1986) • Sinha U. and Sunita Sinha., 1985. Cytogenetics, Plant breeding and Evolution. Vikas Publications Private Ltd. • Strickberger., 1990. Evolution. Jones and Bartlett Publishers, Boston, 	

	London. • Verma and Agarwal., 1998. Cell Biology, Genetics, Molecular Biology, Evolution and Ecology - S. Chand and Company Ltd.	
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	ST. JOSEPH'S COLLEGE, (AUTONOMOUS) BENGALURU - 560027 III B.Sc., BOTANY COURSE SEMESTER – VI BO-6118 : PLANT PHYSIOLOGY AND PHYTOCHEMISTRY	(45Hrs)
	COURSE OBJECTIVES: <ul style="list-style-type: none"> • To understand the role of water, light and other environmental factors in plant growth and development. • To know about absorption, translocation and utilization of water and other minerals. • To understand the concept of photosynthesis, respiration and the energy flow and various metabolic cycles with their integration. • To understand changes during growth process (germination to flowering and to abscission). STUDENT LEARNING OUTCOME: <ul style="list-style-type: none"> • The student will be able to explain the water and solute transport processes in plants. • To explain the importance of photosynthesis and respiration in plants. To explain the role of light and plant hormones in plant growth and development. 	
Unit I	Water relations of plants : Diffusion, osmosis, imbibition, plasmolysis, water potential and its components.	2 hrs
	Absorption of water and ascent of sap: The mechanism of water absorption, factors affecting the rate of water absorption. Ascent of sap: <u>Pulsation theory of J.C. Bose</u> and Transpiration pull and cohesion-tension theory of Dixon and Jolly.	2+<u>1</u> hrs
	Transpiration: Stomatal opening and closing mechanism: K ⁺ ion theory, factors influencing transpiration, <u>antitranspirants and guttation.</u>	2+<u>1</u> hrs
Unit II	Mineral nutrition of plants: <u>Mineral elements in plants.</u> The essential elements and their functions, symptoms of deficiency, ion antagonism; hydroponics, aeroponics and foliar nutrition. Absorption of mineral salts: Ion uptake mechanism, factors affecting mineral uptake, ion channels.	3+<u>1</u> hrs

Unit III	Phloem transport: Transport of organic solutes (use of radioactive isotopes, tracer, and autoradiography), vein loading and unloading; transport mechanism (protoplasmic streaming hypothesis, Mass flow hypothesis). Factors affecting phloem transport.	4 hrs
Unit IV	Photosynthesis: Bioenergetics – Laws of thermodynamics, structure of chloroplast and Ultrastructure of thylakoid membrane, principles of light absorption, photosystems I and II. Photosynthetic electron transfer and photophosphorylation, mechanism of ATP synthesis (Chemiosmotic hypothesis), mechanisms of carbon fixation and carbohydrate synthesis, C ₃ cycle, C ₄ pathway, CAM pathway. <u>Factors affecting the rate of photosynthesis and Blackmann’s law of limiting factors.</u> Photorespiration: Mechanism, organelles involved and significance	10+1 hrs
Unit V	Respiration : Ultrastructure of cristae, Respiratory Quotient, Glycolysis, TCA cycle, ETS and Oxidative phosphorylation, anaerobic respiration (Alcoholic fermentation), Pentose phosphate pathway – significance.	8 hrs

	Factors affecting the rate of respiration.	
Unit VI	Plant growth and photobiology : <u>Definition of growth and sigmoid growth curve.</u> Growth regulators – Auxins, Gibberellins, Cytokinins, Abscisic acid and Ethylene. <u>Role of plant hormones in growth and development.</u> Plant movements. Dormancy, seed viability and germination. Phytochrome and its role in growth and development, Photoperiodism, vernalization, ABC Model, Florigen concept and Biological clocks.	8+2 hrs

Practicals	BO 6P1 <ol style="list-style-type: none"> 1. Cytoplasmic streaming under different temperatures. 2. Observation of plasmolysis and determination of osmotic potential by plasmolytic method 3. Study of stomatal types and determination of Stomatal Index in monocot and dicot leaves 4. Setting up of Solution culture/ hydroponics for demonstration of deficiency syndrome 5. To study the effect of temperature on membrane permeability. Extraction of phloem sap and estimation of the constituents 6. Separation of photosynthetic pigments by paper chromatography and finding their Rf values 7. Effect of different wave lengths of light and CO₂ concentration on photosynthesis 8. Estimation of fructose in different fruits 9. Estimation of Leghaemoglobin 10. Instruments as spotters (Clinostat, Arc auxanometer, Ganong's potometer, suction force by thistle funnel, Ganong's respirometer) 11. Estimation of total chlorophyll by spectrophotometer method 	
References	<ul style="list-style-type: none"> • Salisbury F.B. and Ross C.W. 1986. Plant Physiology. CBS Pub. New Delhi. • Srivastava, H. N, (2007). Plant Physiology, Rastogi Publications • Mukherji, S. and Gupta A. K, (2005). Plant physiology. New Central Book Agency, New delhi. • Dey, P.M., & Horborne, J.N., 1977. Plant Biochemistry, Academic Press, New York • Goodwin & Mercep., 1993. Introduction to plant biochemistry, Pergamon Press, New York. 	
	<ul style="list-style-type: none"> • Hall, D.O., & Rao, K.K., 1999. Photosynthesis 6th ed., Published in association with the Institute of Biology, Cambridge University Press. • Moore, T.C., 1989. Biochemistry and Physiology of Plant hormones, Narosa Pub. House, New Delhi. • Singh, B.N., & Mengel, K., 1995. Plant physiology and biochemistry, Panima Pub. Corporation, New Delhi. • Singal, G.S., Genger, G.C., Sopory, S.K., Irrgang, K.D., & Govindjee, 1999. Concepts in photobiology, photosynthesis and photomorphogenesis, Narosa Pub. House, New Delhi. • Stumpf, P.K., & Conn, E., (eds) 1988. The biochemistry of plants - A comprehensive treatise, Academic Press, New York. 	

	ST.JOSEPH'S COLLEGE, (AUTONOMOUS), BANGALORE- 560027 III B.SC. BOTANY COURSE SEMESTER – VI BO-6218: Cytology, Genetics, Plant breeding & Propagation	(45 hrs)
<p>COURSE OBJECTIVES:</p> <ul style="list-style-type: none"> • To understand the cell cycle, its regulations and detailed structure of nucleus of plant cell and its components. • To understand the principles of genetics and their deviations. • To understand the methods and techniques in plant breeding & propagation <p>STUDENT LEARNING OUTCOME: Upon successful completion of this course, students will be able to:</p> <ul style="list-style-type: none"> • Apply the principles of genetics in research fields. • Apply the different methodologies to propagate plants naturally and artificially. 		

CYTOLOGY (18hrs)		
Unit I	Cell cycle and its regulation, Mitosis & Meiosis. Chromosomes: General Structure, types of chromosomes based on position and number of centromeres. Concept of heterochromatin and euchromatin; Karyotype definition and procedure. Idiogram. Techniques to study chromosomes – Types of staining, chromosome painting, FISH. <u>Special chromosomes – Polytene and B Chromosomes in plants and its significance (Self study)</u>	7hrs +2hrs
Unit II	Types of mutations. Physical and Chemical mutagens. Chromosomal aberrations and their cytological and evolutionary significance: <ul style="list-style-type: none"> • Numerical aberrations – euploidy and aneuploidy • Structural aberrations – deletion, duplication, inversion and translocation 	9 hrs
GENETICS (18 hrs)		
UNIT III	Introduction to genetics, Mendel's experimental work, Monohybrid, dihybrid and test cross, Mendel's laws of inheritance.	2 hrs
	Deviations from Mendelian principles- Incomplete dominance, co-dominance and lethal genes Concept of epigenetics	2 hrs
	Intergenic interactions - Supplementary and complementary genes. Epistasis (dominant epistasis only), multiple factor and polymeric genes (plant examples only). Genetic problems based on gene interactions.	5 hrs
	Linkage - concept, types and discovery of linkage. Crossing over - concept, types, significance and process of crossing over.	3 hrs
	Genetic mapping in maize. (Three point test cross) Sex determination in plants (<i>Melandrium</i>)	2 hrs 1hr
Unit IV	Extrachromosomal inheritance: a) Cytoplasmic male sterility (Maize) b) Mitochondrial inheritance (Petite yeast) and c) Chloroplast inheritance (<i>Mirabilis</i>)	3 hrs

	PLANT BREEDING AND PLANT PROPAGATION (9hrs)	
Unit V	Scope and objectives of plant breeding. Contributions of Indian Scientists (any two) to plant breeding.	1 hr
	Vegetative propagation – Natural (root, stem and leaf) and Artificial (cutting, grafting and layering)	3 hrs
	Techniques of crop improvement - selection, introduction and hybridization	2 hrs
	Hybridization - types, inter-varietal, inter-specific and inter-generic. Methods of hybridization - Pedigree, bulk, back-cross and multiple cross Techniques of hybridization Mutation breeding	2 hrs
	Heterosis – types, effects and genetic basis Quarantine laws	1 hrs
PRACTICALS BO – 6P2 CYTOLOGY, GENETICS, PLANT BREEDING & PROPAGATION		
	<ol style="list-style-type: none"> 1. Preparation of solutions and stains; staining techniques 2. Study of permanent slides in Mitosis 3. Preparation and study of mitosis using root tips of <i>Allium cepa</i>. 4. Study of permanent slides in Meiosis 5. Preparation and study of meiosis using flower buds of <i>Allium cepa</i>. 6. Seed viability testing of any three species by TTC method Submission to the batch teacher: Preparation of permanent slides in Mitosis (2) and Meiosis (2) (total 4 slides). Plant breeding <ol style="list-style-type: none"> 7. Natural vegetative propagation: root, stem and leaf modifications 8. Artificial methods of vegetative propagation: Stem cutting, Layering (air layering, simple layering), Approach grafting and bud grafting – T budding Genetic problems based on <ol style="list-style-type: none"> 9. Linkage mapping 10. Recombination frequency 	