



**KALINGA  
UNIVERSITY**

**SCHEME OF EXAMINATION**

**&**

**DETAILED SYLLABUS**

**For**

**M.Sc Botany  
(Semester Mode)**

**(w.e.f. 2019-20)**

**Department of Botany  
Kalinga University  
New Raipur, Chhattisgarh**

Semester I					
Paper Code	Subjects	Credits	End Term	Internal Marks	Total Marks
MBOT101	Phycology	4	70	30	100
MBOT102	Mycology	4	70	30	100
MBOT103	General Microbiology	4	70	30	100
MBOT104	Cell and Molecular Biology	4	70	30	100
MBOT101-P	Practical's- Phycology	1.5	30	20	50
MBOT102-P	Practicals- Mycology	1.5	30	20	50
MBOT103-P	Practicals- General Microbiology	1.5	30	20	50
MBOT104-P	Practicals- Cell and Molecular Biology	1.5	30	20	50
	<b>TOTAL</b>	<b>22</b>	<b>400</b>	<b>200</b>	<b>600</b>
Semester II					
Paper Code	Subjects	Credits	End Term	Internal Marks	Total Marks
MBOT201	Bryophytes, Pteridophytes and Gymnosperms	4	70	30	100
MBOT202	Evolution, Taxonomy & Morphology of Angiosperms	4	70	30	100
MBOT203	Plant Biochemistry and Biotechnology	4	70	30	100
MBOT204	Ecology & Biodiversity Conservation	4	70	30	100
MBOT201-P	<b>Practicals-</b> Bryophytes, Pteridophytes and Gymnosperms	1.5	30	20	50
MBOT202-P	<b>Practicals-</b> Evolution, Taxonomy & Morphology of Angiosperms	1.5	30	20	50
MBOT203-P	<b>Practicals-</b> Plant Biochemistry and Biotechnology	1.5	30	20	50
MBOT204-P	<b>Practicals-</b> Ecology & Biodiversity Conservation	1.5	30	20	50
	<b>TOTAL</b>	<b>22</b>	<b>400</b>	<b>200</b>	<b>600</b>

Semester III					
Paper Code	Subjects	Credits	End Term	Internal Marks	Total Marks
MBOT301	Anatomy, Development, Reproduction and Embryology of Angiosperms	4	70	30	100
MBOT302	Cytogenetic and Plant Breeding	4	70	30	100
MBOT303	Plant Physiology & Metabolism	4	70	30	100
MBOT304A MBOT304B MBOT304C	Biostatistics Herbal Medicine Applied Microbiology	4	70	30	100
MBOT301-P	<b>Practicals-</b> Reproduction and Embryology of Angiosperms	1.5	30	20	50
MBOT302-P	<b>Practicals-</b> Cytogenetic and Plant Breeding	1.5	30	20	50
MBOT303-P	<b>Practicals-</b> Plant Physiology	1.5	30	20	50
MBOT304-P	<b>Practicals-</b> Biostatistics/Herbal Medicine/Applied Microbiology	1.5	30	20	50
	<b>TOTAL</b>	<b>22</b>	<b>400</b>	<b>200</b>	<b>600</b>
Semester IV					
Paper Code	Subjects	Credits	End Term	Internal Marks	Total Marks
MBOT401	Plant, Cell, Organ & Tissue Culture	4	70	30	100
MBOT402	Biochemical, Molecular Techniques and Bioinformatics	4	70	30	100
MBOT403A MBOT403B MBOT403C	Plant Pathology Limnology Forest Ecology	4	70	30	100
MBOT404	Project Work/Dissertation (Presentation +Viva)	5	100	50	150
MBOT401-P	<b>Practical's-</b> Plant Pathology	1.5	30	20	50
MBOT402-P	<b>Practical's-</b> Biochemical, Molecular Techniques and Bioinformatics	1.5	30	20	50
MBOT403-P	<b>Practical's-</b> Plant, Cell, Organ & Tissue Culture	2	30	20	50
	<b>Total</b>	<b>22</b>	<b>400</b>	<b>200</b>	<b>600</b>

# MBOT-101

External Term: 70

Internal Marks: 30

## Phycology

### UNIT I

Algae and their position in “Domains and Kingdoms” System, Trends in classification of algae. Cyanophyta: Ultrastructure; strategy of cell division; thallus organization, heterocyst. Detailed account of occurrence, habit, cell structure and reproduction of *Oscillatoria*, *Nostoc*, *Scytonema*, *Gleotricha*.

### UNIT II

Brief introduction, structural and reproductive features of, Xanthophyta, Bacillariophyta, Dinophyta. Chlorophyta – structure and evolution of thallus, unicellular eukaryotes (endosymbiotic theory). Detailed account of occurrence, habit, cell structure and reproduction of *Chlamydomonas*, *Volvox*, *Ulothrix*, *Oedogonium*, *Spirogyra*, *Vaucheria*.

### UNIT III

Charophyta and Euglenophyta: structure and reproduction and interrelationship. Detailed account of occurrence, habit, cell structure and reproduction of *Chara*, *Euglena*.

### UNIT IV

Phaeophyta: general account of morphology, anatomy, reproduction and life histories. Rhodophyta: classification, thallus structure, reproduction, reproductive strategies and life histories. Detailed account of occurrence, habit, cell structure and reproduction of *Ectocarpus*, *Polysiphonia*.

### UNIT V

Algae in diverse habitats, symbiotic algae, algal blooms and Phycoviruses. Algae as food, biofertilizers and source of agar. Algae and water pollution, algal toxins. Method of isolation of algae from fresh water and marine ecosystems. Maintenance and preservation of algal cultures. Mass cultivation of microalgae and macroalgae.

**Practical's**

**ALGAE**

1. Cyanophyta: - Range of thallus organization and reproductive structures, types showing unicellular, gonical, conical, filamentous, branched (pseudo and true branched).
2. Chlorophyta: - *Chlamydomonas*, *Gonium*, *Pandorina*, *Eudorina*, *Volvox*, *Chlorella*, *Pediastrum*, *Hydrodictyon*, *Scenedesmus*, *Ulothrix*, *Cladophora*, *Draparnaldia*, *Draparnaldiopsis*, *Frittschiella*, *Chara*, *Nitella*, *Coleochaete*, *Ulva*, *Caulerpa*, *Oedogonium*, *Zygnema*, *Spirogyra* .
3. Phaeophyta: -Ectocarpus, Dictyota, Padina, Sargassum.
4. Rhodophyta: -Porphyra, Batrachospermum, Gelidium, Gracillaria, Champia, Polysiphonia
5. To prepare culture media for fresh water algae
6. Isolation of Algae from soil and water samples.
7. To study the algal diversity of nearby pond and river through field visit.

**Suggested Readings/ Books**

1. Kumar H.D. (1988) Introductory Phycology. Affiliated East –West press Ltd. New Delhi.
2. Smith G.M. Cryptogamic Botany Vol (2 nd edition) Tata Mcgraw – Hill publishing Ltd Bombay – New Delhi
3. Lee, RE (2008) Phycology. Oxford University Press.
4. Fritsch, FE (1965) The Structures and Reproduction of Algae. Cambridge University Press
5. Kumar HD and Singh HN (1979) A textbook of Algae. McMillan Publishers Ltd.
6. Awasthi AK (2015) Textbook of Algae. Vikas Publishing House Pvt Ltd. New Delhi.
7. Sambamurthy AVSS (2005) A textbook of Algae. IK International,
8. Bellingier, EG and Sigee, DC (2010) Freshwater Algae- Identification and use as bioindicators. Wiley Publishers.

## MBOT-102

External Term: 70

Internal Marks: 30

## MYCOLOGY

### UNIT I

Conventional and Modern (Phylogeny based) classification of Kingdom Fungi. General characters of True and Pseudo fungi. Substrate relationship in fungi: cell ultra structure, unicellular and multicellular organization; cell wall composition; nutrition (saprobic, biotrophic and symbiotic), reproduction (vegetative, asexual, sexual), parasexuality, heterothallism.

### UNIT II

Myxomycota-Classification, biology and general characteristics and reproduction. Life cycle of *Chytriumyces*, *Coelomomyces*. Chytridiomycota- Classification, biology, general characteristics and reproduction. Generalized life cycle of a slime mould. Oomycota-Classification, biology, general characteristics and reproduction. Life cycle of *Pythium* and *Phytophthora*.

### UNIT III

Zygomycota- Classification, biology, general characteristics and reproduction. Life cycle of *Mucor*, *Rhizopus*, *Entomophthora*, Ascomycota-Classification, biology, general characteristics and reproduction. Life cycle of *Saccharomyces*, *Aspergillus*, *Neurospora*, *Peziza*.

### UNIT IV

Basidiomycota- Classification, biology, general characteristics and reproduction. Life cycle of *Agaricus*, *Ustilago*, *Puccinia*.

### UNIT V

Anamorphic fungi- Classification, Conidium ontogeny, types of conidiomata. Economic importance of fungi (food, medicine, plant, human and animal disease), Methods of isolation of fungi from different habitats. Preservation and maintenance of living fungi.

## MBOT102P

### Practical

1. To isolate fungi from soil using spread plate technique.
2. To calculate the CFU of fungi present in a soil sample.
3. To isolate keratinophilic fungi from soil using hair baiting technique.
4. To raise pure culture from a mushroom fruit body (*Agaricus bisporus*)
5. To study different fungi colonizing bread.
6. To isolate yeasts from rotten fruits and vegetables.
7. To isolate and identify fungi from infected fruit or vegetable.
8. To isolate DNA from a fungal colony.

### **Suggested Readings/ Books**

1. Alexopoulos, C. J. Mims, C.W. and Blackwell, M. 1996 Introductory Mycology, John Wiley & Sons Inc.
2. Mehrotra, RS. And Aneja, RS. (1998) An Introduction to Mycology. New Age Intermediate Press.
3. Webster, J and Weber R (2007) Introduction to Fungi (3<sup>rd</sup> Ed), Cambridge University Press.
4. Kendrick WB. The Fifth kingdom, Mycologue Publication, Canada.
5. Dube HC (2012) Introduction to Fungi (4<sup>th</sup> ed) Vikas Publishing House Pvt Limited.
6. Sharma OP (1989) Textbook of Fungi. McGraw Hill Publication.
7. Vashishta, BR. Sinha AK and Kumar A (2016) Botany for Degree students-FUNGI. S Chand Publishing.

## **GENERAL MICROBIOLOGY**

### **UNIT I**

Introduction to Microbiology, history of microbiology Germ theory of Louis Pasteur and Koch postulates. Microbial diversity- present status and future prospects. Three domains of life. General account of Archea.

### **UNIT II**

Eubacteria-classification, general account of Actinobacteria, Mycoplasma, Rickettsiae, Chlamydiae and their significance. Nitrogen fixation by microorganisms, *Rhizobium*-legume symbiosis and mycorrhiza. Anoxygenic photosynthesis with special reference to light reaction in purple bacteria; methanogenesis.

### **UNIT III**

Viruses- classification, general properties (viral genome, hosts), structure of viruses. General features of viral replication. Overview of bacterial, animal and plant viruses. Retroviruses.

### **UNIT IV**

Genetics of bacteria: genetic recombination, mechanism of transformation, conjugation and transduction in bacteria. Role of microorganisms in genetic engineering. Lytic cycle of T even bacteriophages and its regulation, lysogeny and its regulation in lambda phage; brief account of viroids and prions.

### **UNIT V**

Industrial microbiology-antibiotics production, vitamin and amino acids, enzymes from microbes. Fermentation process and its application in alcohol production. Water-borne pathogenic microbes; role of microbes in wastewater treatment with special reference to activated sludge. Basic design of a fermentor; biosensors; bioremediation of hydrocarbon and metal polluted waters.



## MBOT103P

### Practical

1. To prepare various medium (NA, SDA, PDA) for growth of microbes.
2. To isolate bacteria from various soil samples.
3. To isolate actinobacteria from soil.
4. To test the effect of different antibiotics on growth of bacteria.
5. To study amylase production by bacteria/ fungi using starch medium.
6. To isolate bacteria from waste water sample.
7. To perform gram staining of bacteria.
8. To perform CFU count in a given soil sample.
9. To isolate *Rhizobium* from root nodules of gram or pea.

### **Suggested Readings/ Books**

1. Madigan MT and Martino JM (2006) Brock Biology of Microorganisms (11<sup>th</sup> ed) Pearson Prentice Hall Publication.
2. Peclzar MJ, Chan, ECS, Krieg, NR (1993) Microbiology. Tata Mc Graw Hill.
3. Clifton, A (1958) Introduction to Bacteria. McGraw – Hills Book Co. New Delhi.
4. Casada LE (2019) Industrial Microbiology. New Age International Publishers.
5. Singleton, P. Bacteriology (6<sup>th</sup> ed). Wiley Publication.
6. Suresh K, Joe MM, Sivakumar PK (2010) An Introduction to Industrial Microbiology. S Chand Publishing.
7. Stanier RY, Ingrahm JL, Wheelis ML, Painter PR ( ) General Microbiology. McMillan
8. Schlegel HG (1993) General Microbiology. Cambridge University Press
9. Powar Daginawala (2015) General Microbiology Vol I &II. Himalaya Publishing.
10. Sullia SB and Shantharam S (2017) General Microbiology. Oxford and IBH Publishing.

## Cell and Molecular Biology

### UNIT-I

The dynamic cells, Structural organization of plant cell, specialized plant cell types chemical foundation. Cell wall- Structure and functions, Plasma membrane; structure, models and functions, site for ATPase, ion carriers channels and pumps, receptors. Plasmodesmata and its role in movement of molecule.

### UNIT-II

Chloroplast-structure and function, genome organization, gene expression, RNA editing, Mitochondria; structure, genome organization, biogenesis. Plant Vacuole - Tonoplast membrane, ATPases transporters as a storage organelle. Structure and function of other cell organelles- Golgi apparatus, lysosomes, endoplasmic reticulum and microbodies.

### UNIT-III

Nucleus: Structure and function, nuclear pore, Nucleosome organization, euchromatin and heterochromatin. Ribosome- Structure and functional significance. RNA and DNA Structure. A, B and Z Forms. Replication, transcription, translation in prokaryotes and eukaryotes. DNA damage and repair (Thymine dimer, photoreactivation, excision repair).

### UNIT-IV

Cell cycle and Apoptosis; Control mechanisms, role of cyclin dependent kinases. Retinoblastoma and E2F proteins, cytokinesis and cell plate formation, mechanisms of programmed cell death.

### UNIT-V

DNA/gene manipulating enzymes: endonuclease, ligase, polymerase, phosphatase, transcriptase, transferase, topoisomerase. Gene cloning: cloning vectors, molecular cloning and DNA libraries. Molecular genetic elements, insertion elements, transposons.

## **MBOT104P**

### **Practical**

1. Identification of different stages of mitosis from suitable plant material. (Onion root tips, garlic root tips).
2. Identification of meiosis from suitable plant material. (Onion / *Tradescantia* floral buds).
3. Isolation of cell organelles : Mitochondria, Chloroplast, Nucleus, Lysosomes and there assay by succinate dehydrogenase activity (Mitochondria), acid phosphatase activity (Lysosome), acetocarmine staining (Nucleus) and microscopic observation (Chloroplast)
4. Study of mitotic index from suitable plant material.
5. Study of cyclosis in cells of suitable plant material.
6. To study plant vacuole in cells of onion leaf peel.
7. Restriction digestion of DNA samples using restriction endonucleases (RE).
8. To study the structure and organization of plant cell in various tissues of various plants (incl. leaf, stem and roots).

### **Suggested Readings/ Books**

1. Karp, G, Iwasa J, Marshall W. (2016) Karp's Cell and Molecular Biology (8<sup>th</sup> ed), Wiley
2. Watson JD. (2017) Molecular Biology of Gene. Pearson
3. Krebs JE, Goldstein ES, Kilpatrick, ST (2014) Lewin's Gene XI. John and Bartlett Learning.
4. Robertis EDP, Robertis EMF. (2011) Cell and Molceular Biology (8<sup>th</sup> ed). Lippincott.
5. Freifelder D (2004) Molecular Biology. Narosa Publishing
6. Verma PS, Agarwal VK (2010) Molecular Biology, S Chand Publisher
7. Kumar HD Molecular Biology (2<sup>nd</sup>ed), Vikas Publishing House Ltd.
8. Campbell NA and Reece JB (2008) Biology (8<sup>th</sup> ed), Pearson Publication

## Bryophytes, Pteridophytes and Gymnosperms

### **UNIT I**

Morphology, structure, reproduction and life history of Bryophytes. Classification of Bryophytes; General account of Marchantiales, Jungermaniales, Anthocerotales, Sphagnales, Funariales and Polytrichales. Life cycle of *Riccia*, *Marchantia*, *Anthoceros*, *Polytrichum*.

### **UNIT II**

Morphology, structure, reproduction and life history of Pteridophytes. Classification of Pteridophytes; Evolution of vascular system, heterospory and origin of seed habit. General account of Psilopsida, Lycopsida, Sphenopsida and Pteropsida. Life cycle of *Selaginella*, *Equisetum*, *Pteris*

### **UNIT III**

Morphology, structure, reproduction and life history of Gymnosperms. Classification of Gymnosperms (Morphology & Phylogeny based). Biogeography of Gymnosperms and their distribution in India. General account of Pteridospermales, Cycadeoidales and Cordaitales. Structure and reproduction of Cycadales. Life cycle of *Cycas*

### **UNIT IV**

Structure and reproduction of Ginkgoales. Life cycle of *Ginkgo biloba*. Structure and reproduction of Welwitschiales, Gnetales and Ephedrales. Life cycle of *Ephedra* and *Gnetum*.

### **UNIT V**

Structure and reproduction of Pinales, Araucariales, Cupressales. Life cycle of *Pinus*, *Taxus*.

Affinity of Gymnosperms with Pteridophytes and Angiosperms. Brief account of Fossil records of Gymnosperms in terms of geological time scale. Economic importance of Gymnosperms.

## MBOT201P

### Practical

1. To study the permanent slide of thallus structure of *Riccia* and *Marchantia* .
2. To study the permanent slide of *Polytichum* and draw well labelled diagram.
3. To study the preserved specimen of *Selaginella* and *Equisetum* and draw its diagram.
4. To study the permanent slide of stem of *Selaginella*.
5. To study the permanent slide of strobilus of *Selaginella*.
6. To study the permanent slide of strobilus of *Equisetum*.
7. To study the permanent slide of *Equisetum* stem.
8. To prepare hand sections of *Pinus* needle and draw labelled diagram of internal structure with the help of permanent slide.
9. To prepare hand sections of *Cycas* leaflet and draw labelled diagram of internal structure with the help of permanent slide.
10. To study the given permanent slides of *Pinus* male and female cone.
11. To study the given permanent slide of male and female strobilus of *Ephedra*.

### **Suggested Readings/ Books**

1. Vanderpoorten A Goffinet B (2002) Introduction to Bryophytes. Cambridge University Press
2. Malcolm B ( ) Mosses and other bryophytes-An
3. Goffinet B (2010) Bryophyte Biology (2<sup>nd</sup> ed), Cambridge University Press.
4. Watson EV (2015) The Structure and life of Bryophytes Scientific Publisher.
5. Goffinet B, Hollowell V, and Magill R (2004) Molecular Systematics of Bryophytes. Missouri Botanical Garden Press, St Louis
6. Sharma OP (2006) Pteridophyta MacMillan India Ltd.
7. Do N. Dai, Tran D. Thang et al. (2016) Bryophytes Pteridophytes and Gymnosperms. Intelliz Press
8. Johri RM, Lata S and Sharma S (2012) Textbook of Pteridophyta (2<sup>nd</sup> ed) Vedam eBooks P Ltd New Delhi
9. Johri BM and Biswas C ( ) The Gymnosperms. Narosa Publishing, New Delhi
10. Byng JW (2015) The Gymnosperm Handbook. Plant Gateway Ltd.
11. Bhatnagar SP and Moitra A (1996) Gymnosperms. New Age International Publisher

## Evolution, Taxonomy and Morphology of Angiosperms

### **UNIT I**

Evolutionary origin of Angiosperms; Unique features of Angiosperms in comparison to other land plants. Species concept, taxonomic hierarchy-species, genus, family order and other categories, delimitation of taxa and attribution of rank. Salient feature of International Code of Nomenclature for Algae, Fungi and Plants (ICN).

### **UNIT II**

Principles of Plant Systematics. Taxonomic evidence-morphology, anatomy, palynology, embryology, cytology, biochemical, molecular (DNA). Relevance of taxonomy in plant conservation. Taxonomic tools-herbarium, floras, histological, cytological, phytochemical, and molecular techniques and computer. Local plant diversity and its socio-economic importance.

### **UNIT III**

Historical account of Systems of Classification of Angiosperms. Recent phylogenetic classification of Angiosperms (APG). Merits and demerits of morphology based classification systems. Unique features of Monocots and Dicots. Endemism, Hot spots of diversity. Plant exploration: invasions and introduction. Centres of origin of crop plant diversity.

### **UNIT IV**

Plant Structure and Types-Habit, Plant Organs, Stem and Shoots, Leaves, Flowers, Perianth, Androecium, Nectaries, Gynaecium, Carpel, Pistil, Inflorescence, Fruits types

### **UNIT V**

Characteristic features of selected families of Angiosperms-  
MONOCOT-Poaceae, Polygonaceae, Musaceae DICOT-Arecaceae, Asteraceae (Compositae), Papaveraceae, Rosaceae, Brassicaceae, Cucurbitaceae, Solanaceae, Amarantaceae, Malvaceae(Hibiscus), Anacardiaceae (Mango), Cactaceae, Orchidaceae.

## **MBOT202P**

### **Practical**

1. Methods of non-destructive field collection and documentation.
2. Techniques of herbaria preparation.
3. Morphological characterization of selected families of dicots (10 families) and monocots (5 families) and identification upto families.
4. Preparation of artificial key (at least five) based on appropriate character combination.
5. Identification of genus and species from – (at least ten) Monocots and Dicots
6. Identification of given plant (at least six) up to species with the help of modern flora keys.
7. To study different types of leaves in plants available in Raipur.
8. To study different types of leaf arrangement in plants available in Raipur.
9. To study different types of fruits.
10. To study pollen morphology of different species of plants of University campus.
11. To visit any botanical garden situated in India, CSIR Lab Visit,
12. To perform 2 to 4 lab visit with student and try to discover floral character.

### **Suggested Readings/ Books**

1. Simpson MJ. (2019) Plant Systematics. Academic Press.
2. Soltis et al. (2018) Phylogeny and evolution of Angiosperms. University of Chicago Press.
3. Briggs D. (2016) Plant Variation and Evolution. Cambridge University Press.
4. Bhatnagar S.P. and Moitra A. 1996 Gymnosperms. New Age International Pvt New Delhi.
5. Singh H. 1978 Embryology of Gymnosperms , Encyclopedia of Plant Anatomy X Gebruder Bortraeger Berlin.
6. Spome K. R. 1991 : The Morphology of Gymnosperms; Hutchinson Univ. Library ,London .
7. Foster A.S. & Gifford E.M. Comparative morphology of vascular plants Vakils feffer & simons private Ltd. Bomay .
8. Chamberlain; Gymnosperms- Structure & Evolution CBS publishers & Distributors Delhi.
9. Shukla A.C. & Mishra S.P. Essentials of Paleobotany Vikas Publishing House Ptd. Delhi Bombay – 6 angalore – Calcutta – Kanpur.
10. Heywood & Moore, D.M. : 1984 : CWTent concept in plant Taxonomy Academic press.
11. Banson L.B. 1957: Plant classification . Health & Co. Boston.
12. Davis, P. R. & Heywood . V.H. 1973 : Principles of Angiosperms and Taxonomy , Robert E. Kreiger pub. Co. New York USA.
13. Eames , Al 1961: Morphology of Angiosperms , Mc- Graw Hill, New York.
14. Jeffery. C. ; 1968: An Introducaton to plant Taxonomy J & H Churchill Limited.
15. Lawrence , G. H. M. ; 1951 Taxonomy of Cascular plants Macmillan , New York.
16. Naik . V. K. 1984: Taxonomy of Angiosperms. Tata Mc – Graw Hill Pub. Co. Ltd. New Delhi.
17. Porter L.L. 1959: Taxonomy of Flowering plants . San Francisco. Radfor- AE. Dickinson
18. W.C. Massey J.R. and . Ben C.R. ; 1974 VQ- llar plant Systematics , Harper & Row , New

## **Plant Biochemistry and Biotechnology**

### **UNIT I**

Energetics of metabolic processes: Energy rich phosphate compounds, electron transport and phosphorylation,  $\beta$ -oxidation of lipids, Biological nitrogen fixation: Nitrogenase enzyme, substrates for nitrogenase, reaction mechanism, strategies to exclude oxygen and need to control hydrogen evolution

### **UNIT II**

Enzymology: General aspects, prosthetic groups and coenzymes, mechanism of catalysis, kinetics, Michaelis-Menten equation, bi-substrate reactions, active sites, factors contributing to the catalytic efficiency, enzyme inhibition, regulatory enzymes, ribozymes

### **UNIT III**

Phytochrome and cryptochrome mediated plant responses, Phototropins . Introduction Classification and Biosynthesis of Terpene, Alkaloid, Non Protein Amino Acid, Plant Phenolics, Flavonoids, Tannins, Lignin

### **UNIT IV**

Inorganic nitrogen and sulphur metabolism: Introduction, nitrate transport, nitrate and nitrite reductase, inhibitors of nitrate and nitrite reductases, localization and regulation of nitrate and nitrite reductases, sulphate uptake, activation and transfer, assimilatory pathways of sulphate reduction

### **UNIT V**

Biotechnology: PCR and its applications; principles of DNA sequencing, recombinant DNA technology: Gene transfer. Vectors of plant transformation. Genetic manipulation for pest resistance, improvement of crop yield and quality. Biocontrol of insect pests using microbes. GM crops-development, merits and demerits and public acceptance. Plant DNA fingerprinting - Hybridization and PCR based markers (RFLP, SSRs, RAPD, QTLS, SCARS, AFLP etc.). Applications of Plant Biotechnology.



## **MBOT203P**

### Practical

1. To study the permeability of plasma membrane using different concentrations of organic solvents.
2. To study the effect of temperature on permeability of plasma membrane.
3. To prepare the standard curve of protein and determine the protein content in unknown samples.
4. Separation of chloroplast pigments by solvent method.
5. Determining the osmotic potential of vacuolar sap by plasmolytic method.
6. Separation of amino acids in a mixture by paper chromatography and their identification by comparison with standards.
7. Enzymology: activity of catalase, invertase, amylase and urease, and effect of pH and temperature on enzyme activity.
8. Protein estimation in a given sample
9. Carbohydrate estimation
10. Nitrogenase activity.
11. Acid and alkaline acid phosphatase activity.
12. Separation of amino acid through paper and column chromatography.
13. Study of instruments and principle of TLC, HPLC and Centrifuge, Spectrophotometer .

### **Suggested Readings/ Books**

1. Hopkins, W.G. 1995. Introduction to Plant Physiology. John Wiley & Sons, Inc., New York, USA.
2. Lodish, H., Berk, A., Zipursky, S.L., Matsudaira, P., Baltimore, D. and Darnell, J. 2000. Molecular cell Biology (fourth edition). W.H. Freeman and Company, New York USA. Moore, T.C. 1989. Biochemistry and Physiology of Plant Hormones (second edition). Springer -Verlag, New York. USA.
3. Nobel, P.S. 1999. Physiochemical and Environmental Plant Physiology (second edition). Academic Press, San Diego, USA.
4. Salisbury FB and Ross CW 1991 Plant Physiology IV edition Wdsworth Publishing co. California usa.
5. Taiz I and Zeiger E 1998 Plant Physiology II Edition. Sinauer Associates Inc. Publisher MS. Dennis DT and Terpin DH Lefevere DD and Layzell DV 1997 Plant Metabolism II Ed. Longman England.
6. Hopkins, W.G. 1995. Introduction to Plant Physiology. John Wiley & Sons, Inc., New York, USA.
7. Lodish, H., Berk, A., Zipursky, S.L., Matsudaira, P., Baltimore, D. and Darnell, J. 2000. Molecular cell Biology (fourth edition). W.H. Freeman and Company, New York USA. Moore, T.C. 1989. Biochemistry and Physiology of Plant Hormones (second edition). Springer -Verlag, New York. USA.
8. Nobel, P.S. 1999. Physiochemical and Environmental Plant Physiology (second

- edition). Academic Press, San Diego, USA.
9. Salisbury FB and Ross CW 1991 Plant Physiology IV edition Wdsworth Publishing co. California usa.
  10. Taiz I and Zeiger E1998 Pant Pysiology II Edition. Sinauer Associates Inc. Publisher MS. Dennis DT and Terpin DH Lefevere DD and Layzell DV 1997 Plant Metabolism II Ed. Longman England.
  11. Glick, B.R. and Thompson, J.E. 1993. Methods in Plant Molecular Biology and Biotechnology. GRC Press, Boca Raton, Florida
  12. Glover, D.M. and Hames, B.D. (Eds), 1995. DNA Cloning 1 : A Practical Approach; Core Techniques, 2nd edition. PAS, IRL Press at Oxford University Press, Oxford
  13. Glick, B.R. and Thompson, J.E. 1993. Methods in Plant Molecular Biology and Biotechnology. GRC Press, Boca Raton, Florida

## Ecology & Biodiversity Conservation

### **UNIT I**

#### **The concept and scope of ecology**

Introduction, Plant interaction with abiotic factors such as climatic, edaphic and Topographic factors, Plant-plant interaction, concept of allelopathy Plant-animal interaction, herbivory, carnivorous plants , Plant- microbes interaction: Mutualism, parasitism, Ecological modelling.

### **UNIT II**

#### **Ecosystem ecology**

Organization of Ecosystem: biotic and abiotic components, Ecosystem types: Terrestrial, aquatic and artificial, Biomes of the world, Biomes of India – Case studies of terrestrial (forest, grassland) and aquatic (fresh water, marine, estuarine) ecosystems, Island biogeography.

### **UNIT III**

#### **Population and community ecology**

Habitat and niche, Characteristics of population: Distribution and size of the population, factors affecting population size, Ecological limits and the size of population, Life history strategies, r and k selection, C-S-R triangle, Concept of metapopulation, extinction events, population viability analysis

Community structure and species diversity, Diversity types and levels (alpha, beta and gamma), ecotone and edge effect.

### **UNIT IV**

#### **Ecosystem dynamics**

Energy flow models and mineral cycling, Ecosystem productivity- primary and secondary production, Plant succession: seral communities, xeric, aquatic, concept of climax, secondary succession on disturbed land, Resistance and resilience of ecosystem, homeostasis and homeorhesis

### **UNIT V**

Pollution & climate change- Air water and soil pollution; kinds, sources, quality parameters. Effects on structure & function of ecosystems; Management of pollution, Bioremediation; Climate changes sources, Trends & role of greenhouse gases, Effect of global warming on climate, ecosystem processes and biodiversity. Ozone layer & Ozone hole. Resource monitoring- Remote sensing concepts & tools, satellite remote sensing, basics sensors, visual & digital interpretation EMR bands and their applications Indian remote sensing program (IRS); Thematic mapping of resources and application of remote sensing in ecology & forestry.

## **MBOT204P**

### **Practical**

1. To determine the minimum area of quadrat for phytosociological analysis of grassland.
2. To determine frequency, density and abundance of different species in the grassland.
3. To determine minimum number of quadrats for sampling of grassland.
4. To compare community structure of different forest.
5. To determine the pH & Dissolve Oxygen of water sample.
6. To determine homogeneity and heterogeneity of grassland vegetation.
7. To determine the trophic state of alkalinity/ salinity of water body.
8. To determine the pH of soil samples.
9. To calculate Simpson's indices of diversity of grassland vegetation.
10. To calculate Shannon-Wiener indices of diversity of grassland vegetation.
11. To determine water holding capacity of the soil.

### **Suggested Readings/ Books**

1. Smith R.L. 1996; Ecology and Field Biology , Harper Collins New York.
2. Muller Dombois . D. and Ellenberg H. 1974 Aims and methods 01 Vegetation Ecology Wiley New York.
3. Begon M. Harper J. L. And Townsend C.R. 1996 . Ecology. Blackwell Science Cambridge , Ludwig.J. and Reynolds J.F. 1988 Statistical Ecology John Wiley & Sons.
4. Odum E. P. 1971. Fundamentals of Ecology. Saunders Philadelphia.
5. Odum. E. P. 1983 . Basic Ecology Saunders Philadelphia.
6. Barbour M.G. Burk J.H. and pitts W.O. 1987 Terrestrial plant Ecology cummings publication company California.
7. Kormondy E.J. 1996 Concepts of Ecology , Pentice Hall of India pvt Ltd. New Delhi .
8. Chapman J.L.and Reiss M.J. 1988 Ecology principles and Applications t:: ambridge University press Cambridge U.K.
9. Moldan B. and Billharz S. 1997 . Sustainability Indicators John wiley & Sons New York.
10. Treshow M. 1985 Air pollution and plant fife wiley Interscience.
11. Heywood , V, H, and Watson R.T. 1995 Global Biodiversity Assessment. Cambridge University Press.
12. Mason C.F. 1991 . Biology of freshwater pollution. Longman
13. Hill M.K. 1997 Understanding Environmental Pollution Cambridge University press.
14. Brady N.C. 1990 The Nature and Properties of Soils MacMillan.
15. Mohdan B. and Billharz S. 1997 Sustainability Indicators John wiley & sons New Youk.
16. Treshow M. 1985 Air Pollution and plant Life Wiley Interscience.
17. Heywood V.H. and Watson R.T. 1995 Global Biodiversity Assessment Cambridge University press.
18. Mason C.F. 1991 Biology of freshwater pollution Longman.
19. Kothari A 1997 Understanding Biodiversity Life Sustainability and Wquity Orient Longmen.

## Anatomy, Development, Reproduction and Embryology of Angiosperms

### **Unit: I**

Unique features of plant development differences between animal and plant development. Organization of shoot apical meristem (SAM) control of tissue differentiation especially xylem and phloem; secretory ducts and laticifers wood development in relation to environmental factors.

### **Unit: II**

Leaf Growth and differentiation. Organization of root apical meristem (RAM) cell fates and lineages vascular tissue differentiation lateral roots root hairs microbe interaction. Vegetative options and sexual reproduction flower development genetics of flower development genetics of floral organ differentiation homeotic mutants in *Arabidopsis* and *Antirrhinum* sex determination .

### **Unit: III**

Structure of anthers microsporogenesis role of tapetum pollen development and gene expression. Male sterility pollen germination pollen tube growth and guidance. pollen storage, pollen allergy and pollen embryos

### **UNIT IV**

Ovule development, megasporogenesis organization of embryo sac. Structure of embryo sac cells. Flora characteristics; pollination mechanisms and vectors breeding system structure of pistil pollen stigma interactions sporophytic and gametophytic self incompatibility. Double fertilization, Endosperm development during early maturation and desiccation stages. Embryogenesis; storage proteins of endosperms and embryo. Polyembryonic, apomixes. Dynamics of fruit growth biochemistry and molecular biology of fruit maturation.

## MBOT301P

### Practical

1. Effect of gravity, unilateral light and plant growth regulators on the growth of young seedling.
2. Study of living shoot apices by dissections using aquatic plants such as *Ceratophyllum* and *Hydrilla*.
3. Study of monocot and dicot stem.
4. Examinations of shoot apices in monocotyledons in both T.S. and L.S. to show the origin and arrangement of leaf primordia.
5. Microscopic examination of vertical section of leaves such as Cannabis, Tobacco, Nerium, Maize and wheat to understand the internal structure of leaf tissues and trichomes, glands etc.
6. Study the C3 and C4 leaf anatomy of plants.
7. Study of whole roots in monocots and dicots.
8. Study of microsporogenesis and gametogenesis in sections of anthers.
9. Examination of modes of anther dehiscence and collection of pollen grains for microscopic examination
10. Pollen germination using hanging drop and sitting drop cultures, suspension culture and surface culture.
11. Estimating percentage and average pollen tube length in vitro.
12. Study of ovule in cleared preparations, study of monosporic, bisporic and tetrasporic types of embryo sac development through examination of permanent, stained serial sections.
13. Field study of several types of flower with different pollination mechanisms (wind pollination thrips pollination bee/butterfly pollination, bird pollination).
14. Study of seed dormancy and methods to break dormancy.

### **Suggested Readings/ Books**

1. Johri BM (1982) Experimental Embryology of Angiosperms. Springer, Berlin
2. Rost . T et al 1998 plant Biology wadsworth publishing con California USA
3. Krishanmurthy K.V. 2000 Methods in cell wall cytochemistry CRC press Boca Roton Florida USA
4. Buchanan B.B. Groissem w. And jones RL 2000 Biochemistry And molecular biology of plants American society of plant physiologists Maryland USA.
5. De. D.N. 2000 Plant cell vacuoles An Introduction CSIRO Publication Collij18W Australia.
6. Bhojwani S.S. and Bhathagar S.P. 2000 . The Embryology of Angiosperms ( 4<sup>th</sup> revised and enlarged edition) vikas publishing House New Delhi.
7. Burgess J. 1985 : An Introduction to plant cell Development Cambridge University press Cambridge.
8. Fageri K. and Van der Piji L 1979 . The Principles of Pollination Ecology . Pergamon Press Oxford.

9. Fahn . A 1982 Plant Anatomy (3<sup>rd</sup> edition) pergamon press Oxford.
10. Fosket D.E. 1994 Plant Growth and Development . A Molecular Approach . Academic Press san Diego .
11. Howell S.H. 1998 Molecular Genetics of Plant Development Cambridge . J Cramer Germany.
12. Lyndon R.F. 1990 Plant Development . The Cellular Basis Unin Hyman . London
13. Murphy . T. M. and Thompson W.E. 1988 Molecular plant Development . Prentice Hall New Jersey.
14. Proctor M. And Yeo P. 1973. The Pollination of Flowers . William Collins Sons London .
15. Raghvan V. 1997 Molecular Embryology of Flowering Plant Cambridge University Press Cambridge.
16. Raghvan V. 1999 Development Biology of Flowering P. Jants Springer Verlag

## **Cytogenetics and Plant Breeding**

### **UNIT-I**

Mendelian and Non-Mendelian Inheritance: Meiosis; Chromosome theory of inheritance; Mendelian laws; Gene interactions; Organelle inheritance.

### **UNIT-II**

Molecular Cytogenetics: Nuclear DNA content, C-value paradox, Cot curve and its Significance, restriction mapping - concept and techniques, multigene families and their evolution, in situ hybridization and techniques, chromosomes micro dissection and micro cloning, flow cytometry and confocal microscopy and karyotype analysis.

### **UNIT-III**

Gene structure and expression: fine structure of gene, Cis-trans test, fine structure analysis of eukaryotes, introns and their significance. RNA splicing, regulation of gene expression in prokaryotes and eukaryotes. • Protein sorting: Targeting proteins to organelles.

### **UNIT-IV**

Mutation: Spontaneous and induced mutation, physical and chemical mutagens molecular basis of gene, transposable elements in prokaryotes and eukaryotes, mutation induced by transposones, site directed mutagenesis, inherited human diseases and defects in DNA repair, translocation, intersect Robertsonian translocation.

### **UNIT- V**

Plant breeding and crop improvement: Objectives and scope of plant breeding, hybridization in self- and cross-pollinated crops, genetic basis of inbreeding depression and heterosis, breeding for disease and insect resistance, transgenes and transgenic plants. Physical and genetic mapping using molecular markers



## MBOT302P

### Practical

1. Preparation of mitotic and meiotic spreads and analysis of various stages of cell division (*Phlox*, *Allium* and *Rhoeo*).
2. Extraction of genomic DNA from plants by CTAB method.
3. Analysis of molecular polymorphism in parental lines and derived mapping population using different types of molecular markers.
4. Mutagenesis experiments in *E. coli*.
5. Studying pea plant as tool for investigating Laws of Inheritance.
6. Demonstration of Mendel's Law of segregation.
7. Demonstration of Mendel's Law of Independent Assortment.
8. Studying deviations from Mendel's laws and applying statistics.
9. Studying *Drosophila* as a model organism.
10. Familiarizing students with lab equipments
11. Study of different type of chromosomes
12. Preparation of karyograms using camera lucida
13. Induction of polyploidy using colchicines
14. Induction of polyploidy using colchicine

### **Suggested Readings/ Books**

1. Alberts, B. Bray, D. Lewis, J. Raff: M. Roberts, K. and Watson, J. D. 1989 Molecular Biology of the Cell (2nd edition). Garland Publishing Inc., New York. U. S. A.
2. Atherly, AG. Girton, J.R and Mc Donald, J.E. 1999. The Science of Genetics: Saunders College Publishing, Fort Worth, U.S.A.
3. Burnham, C.R 1962. Discussions in Cytogenetics, Burgess Publishing Co. Minnesota.
4. Busch. H. and Rothblum. L. 1982. Volume X. The Cell Nucleus rDNA Part A. Academic Press.
5. Hartl, D.L. and Jones, E. W. 1998. Genetics: Principles and Analysis (4th edition). Jones & Bartlett Publishers, Massachusetts, USA
6. Khush, G.S. 1973. Cytogenetics of Aneuploids. Academic Press, New York, London.
7. Karp, G. 1999 Cells and Molecular Biology: Concepts and Experiments John Wiley & Sons, U S A
8. Lewin: B. 2000 Gene VII. Oxford University Press, New York, U.S.A
9. Lewis, R. 1997. Human Genetics: Concepts and Applications. (2nd edition). McGraw Hill, U.S.A
10. Malacinski, G. M. and Freifelder, D. 1998. Essentials of Molecular Biology (3rd edition). Jones and Bartlett Publishers, Inc. London.
11. Russel, P.J. 1998. Genetics (5th edition). The Benjamin / Cummings Publishing Company Inc., U. S. A
12. Snustead, D. P. and Simmons, M. J. 2000. Principles of Genetics (2nd edition). John Wiley & Sons, U.S.A
13. Lewin, B. 2000, Genes VII, Oxford University Press, New York.
14. Kleinsmith, L.J. and Kish, V.M. 1995. Principles of Cell and Molecular Biology (2nd Edition). Harper Collins College Publishers, New York, USA
15. Pollard, T. S. and Ewald, W. C. 2002 Cell Biology. Saunders, Philadelphia, U.S.A Twyman, R. M. 2003. Advanced Molecular Biology. Viva Books Private Ltd. New Delhi.
16. Gardner, M. J. Simmons, D. P. Snustad (2006) Principles of Genetics. John Wiley and Sons.
17. Sybenga J Cytogenetics and Plant Breeding. Springer Verlag.

## **Plant Physiology & Metabolism**

### **Unit -I**

Plant-water relation, mechanism of water transport through xylem, root microbe interaction in facilitating nutrient uptake. Comparison of xylem and phloem transport, phloem loading and unloading, passive and active solute transport, membrane transport system.

### **Unit –II**

Photosynthesis: Properties of light and absorption of light by photosynthetic pigments, Composition and characterization of photo systems I and II, Photo-oxidation of Water, mechanism of electron & proton transport, Photo-phosphorylation. A brief description of C3, C4 and CAM plants, photorespiration.

### **Unit –III**

Respiration: General aspects, Glycolysis, TCA Cycle, Electron transport and ATP synthesis and alternate Oxidase system. Pentose Phosphate pathway and its significance. Glyoxylate cycle.

### **Unit –IV**

Physiology of Floral Induction: Photoperiodism and its significance, role of Vernalization, Phytochrome – structure and function. Physiology and biochemistry of seed dormancy and germination: Causes of dormancy and methods of breaking dormancy, Biochemical changes accompanying seed germination.

### **Unit –V**

Plant Growth Regulators: Structure, metabolism and physiology effect of auxins, gibberellins, cytokinins, ethylene and abscisic acid. Stress physiology: Plant responses to biotic and abiotic stress, mechanism of biotic and abiotic stress tolerance, oxidative stress.

## **MBOT303P**

### **Practical**

1. To study the effect of temperature on permeability of plasma membrane.
2. To prepare the standard curve of protein and determine the protein content in unknown samples.
3. Separation of chloroplast pigments by solvent method.
4. Determining the osmotic potential of vacuolar sap by plasmolytic method.
5. Determining the water potential of any tuber.
6. Separation of amino acids in a mixture by paper chromatography and their identification by comparison with standards.
7. Study of Salt stress, acid stress, drought stress.
8. Isolation and identification and interaction of rhizospheric microorganism.
9. Comparison of the rate of respiration of various plant parts
10. Isolation and identification of Rhizobium from different plants.
11. Study of instruments and principle of TLC, HPLC and Centrifuge, Spectrophotometer

### **Suggested Readings/ Books**

1. Hopkins, W.G. 1995. Introduction to Plant Physiology. John Wiley & Sons, Inc., New York, USA.
2. Moore, T.C. 1989. Biochemistry and Physiology of Plant Hormones (second edition). Springer-Verlag, New York. USA.
3. Nobel, P.S. 1999. Physiochemical and Environmental Plant Physiology (second edition). Academic Press, San Diego, USA.
4. Salisbury FB and Ross CW 1991 Plant Physiology IV edition Wdsworth Publishing co. California usa.
5. Taiz I and Zeiger E 1998 Plant Physiology II Edition. Sinauer Associates Inc. Publisher MS. Dennis DT and Terpin DH Lefevre DD and Layzell DV 1997 Plant Metabolism II Ed. Longman England.
6. Hopkins, W.G. 1995. Introduction to Plant Physiology. John Wiley & Sons, Inc., New York, USA.
7. Lodish, H., Berk, A., Zipursky, S.L., Matsudaira, P., Baltimore, D. and Darnell, J. 2000. Molecular cell Biology (fourth edition). W.H. Freeman and Company, New York USA. Moore, T.C. 1989. Biochemistry and Physiology of Plant Hormones (second edition). Springer-Verlag, New York. USA.
8. Nobel, P.S. 1999. Physiochemical and Environmental Plant Physiology (second edition). Academic Press, San Diego, USA.
9. Salisbury FB and Ross CW 1991 Plant Physiology IV edition Wdsworth Publishing co. California usa.
10. Taiz I and Zeiger E 1998 Plant Physiology II Edition. Sinauer Associates Inc. Publisher MS. Dennis DT and Terpin DH Lefevre DD and Layzell DV 1997 Plant Metabolism II Ed. Longman England.

## **ELECTIVES**

### **MBOT-304A**

External Term: 70  
Internal Marks: 30

## **Biostatistics and Computer Application**

### **UNIT – I**

Importance and scope of statistics in experimentation, Measure of central tendency Arithmetic, Geometric and Harmonic means, Measure of dispersion variance, Standard deviation, Coefficient of variation, Confidence limits of population mean.

### **UNIT – II**

Elements of probability, Statistical and Mathematical definitions, Probability distribution function: Normal, Binomial and Poisson distribution.

### **UNIT – III**

Tests of significance, Hypothesis and errors, 't' test, Population mean equals a specified value, Test of the equality of two means ( Independent samples & Equal variances), Test of the equality of two means ( Paired samples), 'F'- test, One way analysis of variance ( Sample sizes, Equal and Unequal).

### **UNIT – IV**

Chi-square statistics, Test of goodness of fit and test of independence of factors, Simple correlation coefficient,

### **UNIT -V**

Significance tests, linear regression equation and diagram, regression coefficient, Standard error, Significance tests.

## MBOT304A-P

### Practical

1. To find out the average length of the mango leaf by arithmetic, harmonic and geometric mean.
2. To find out the standard deviation and coefficient of variation of the length of leaf.
3. To find out the confidence limit of the length of the leaf.
4. To find out the probability of getting head in 10, 20, 30, 40 & 50 tosses of a fair coin.
5. To test the hypothesis that average pulse rate of biostatistics class students is 72 beats per minute.
6. To calculate the correlation coefficient between length and weight of 10 different pieces of *Parthenium* stem.
7. To find out the prediction or regression equation of the *Parthenium* stem.
8. To calculate correlation co-efficient of two plant variables (leaf number and plant height).

### **Suggested Readings/ Books**

1. Ronald Forthofer Eun Lee Mike Hernandez Biostatistics -A Guide to Design, Analysis and Discovery 2nd Edition, Academic Press.
2. Lee CP and Eberly LE Introductory Biostatics. 2<sup>nd</sup> edition. Wiley.
3. Agarwal BL Basic Biostatics. 6<sup>th</sup> edition. New Age International Publishers.
4. BL Agarwal and SP Agarwal. Statistical Analysis of Quantitative Genetics. . New Age International Publishers
5. Veer Bala Rastogi Biostatics. 3<sup>rd</sup> editon.
6. Belavendra Antonisamy Premkumar PS, Christopher S (2017) Principles and Practice of Biostatistics. Elsevier
7. Trudy A. Watt, Robin H. McCleery, Tom Hart. (2007) Introduction to Statics for Biology 3<sup>rd</sup> edition. Chapman and Hall
8. Finny, D. J. (1980) Statistics for Biologists. Springer.

## **ELECTIVES**

### **MBOT-304B**

## **Herbal Medicine**

External Term: 70  
Internal Marks: 30

#### **Unit-I**

Medicinal plant: research scenario in India. Diagnostic features, bioactive molecules and therapeutic value of some common medicinal plants

#### **Unit-II**

Standardization of herbal drugs, Commercial cultivation of medicinal plants; conservation of medicinal plants

#### **Unit-III**

Neutraceuticals and medicinal foods. Bioprospecting, biopiracy and protection of traditional medicinal knowledge (IPR) Pharmacopoeia, Sources of impurities in medicinal agents, limit tests.

#### **Unit-IV**

Use of pesticides and plant growth regulators. Methods of harvesting and storing plant drugs. Basics of commerce of herbal drugs, Methods of cultivating medicinal plants.

#### **Unit-V**

Ethnomedicine: Definition, history and scope. Collection of ethnic information. Importance of medicinal plants: Role in human health care. Introduction to basic concepts of folk medicine and Ayurveda, Naturopathy and Yoga: methods of disease diagnosis and treatment. Important ethnomedicines of Madhya Pradesh and Chhattisgarh

## **MBOT304B-P**

### **Practical**

1. To prepare crude drug from plant parts.
2. Isolation, purification of crude drug from plant parts.
3. To perform antibiotic assay using extracted drug.
4. Estimation of Alkaloid and Phenolics content from plant parts.
5. To perform antifungal assay using plant extracts.
6. To perform antibacterial assay using plant extracts.
7. Determination of phytochemicals in crude plant extracts.

### **Recommended books**

1. A Class Book of Botany. A.C. Dutta. Oxford University Press.
2. Pharmacognosy -G. E. Trease and W.C. Evans. Saunders Edinburgh, New York
3. Textbook of Pharmacognosy by T.E. Wallis.
4. Cultivation of Medicinal Plants by C.K. Atal & B.M. Kapoor.
5. Aniszewski T, (2015) Alkaloids (2<sup>nd</sup> Edition) Chemistry, Biology, Ecology and Application< Elsevier Science.
6. Cooper R and Nicola G (2014) Natural Products Chemistry. CRC Press, Taylor & Francis Group, USA.

## **ELECTIVES**

### **MBO-304C**

External Term: 70

Internal Marks: 30

## **Applied Microbiology**

Unit 1- Microbes as tools for understanding the biological processes: Physiology, biochemistry, genetics, molecular biology, genomics, proteomics. Microbes and environment: Pollution abatement, bio indicators, restoration of degraded ecosystems, biodegradation, bioremediation, biogenic gases, microbes in biological warfare

Unit2- Application of microbes in fermentation processes: Types, design and maintenance of bioreactors, application of fermentation technology in industry

Medical microbiology: Microbes as causal agents of human and animal diseases;

Immunology: basic concepts, vaccines, immunotherapy

Unit 3- Role of microbes in relation to agriculture: Nitrogen economy, plant health, biological control.

Unit4- Symbiotic associations: Concepts, types and applications . Microbes in food and dairy industry: Mushrooms, fermented foods, microbial spoilage of food and dairy products, toxins

Unit-5 Extremophiles and their biotechnological applications, Microbial technology: Biosensors, bio molecules, enzymes



## MBOT304C-P

### Practical

1. Basic techniques in microbiology.
2. Cultivation of Different type of mushroom.
3. Isolation of Lipolytic microorganism from butter.
4. Isolation of Antibiotic producing microorganism from soil.
5. Detection of number of bacteria in mil by breed count.
6. Enzyme production and assay –cellulase, protease and amylase.
7. Alcohol production.
8. Visit and observe an industry unit pertaining to microbiological products manufacturing.

### **Suggested Reading and Books**

1. A Textbook of Basic and Applied Microbiology” by K R Aneja published by New Age International, 2008
2. Applied Microbiology” by J P Simon and A Durieux by springer
3. Advances in Applied Microbiology” by Allen I Laskin and Geoffrey M Gadd
4. Applied Microbiology and Biotechnology” by Dean Watson *Publisher: Syrawood Publishing House (May 23, 2016);*
5. Baltz R.H., Demain A.L. and Davies J.E. (2010) Manual of Industrial Microbiology and Biotechnology, ASM Press.
6. Flickinger M.C. and Drew S.W. (1999) Encyclopedia of Bioprocess Technology: Fermentation, Biocatalysis and Bioseparation, (Vol 1-5), Wiley publishers
7. Stanbury P.T.,Whitaker A. and Hall S. (2016) Principles of Fermentation Technology, Butterworth-Heinemann.
8. Waites M.J. Morgan N.L.,Rockey J.S. and Higton G. (2011) Industrial Microbiology.An Introduction, Paperback, WB Publishers.
9. Patel A.H. (2016) Industrial Microbiology, 2ndEdn. Laxmi Publications.

## **Plant Cell, Organ & Tissue Culture**

### **UNIT-I**

Plant cell and tissue culture: general introduction, history, scope, concept of cellular differentiation and totipotency. Tissue culture media, Techniques of tissue culture. Callus culture, Cell suspension culture, Organ culture . meristem, anther and embryo culture. Clonal propagation, Organogenesis and embryogenesis.

### **UNIT-II**

Somatic embryogenesis and androgenesis, Protoplast isolation, fusion and culture, Somatic Hybridization and cybrids, Somaclonal variation and its significance, Production of Secondary metabolites.

### **UNIT-III**

Cryopreservation and Germplasm storage: Raising sterile tissue cultures, Addition of cryoprotectants and pretreatment, freezing, storage, thawing, determination of survival viability. Plant growth and generation, verification, encapsulation and dehydration. Slow growth method, Applications. Intellectual Property Rights: Possible ecological risks and ethical concerns.

### **UNIT- IV**

Transgenic Plants-Genetic engineering of plants, aims, strategies for development of transgenics (with suitable examples); *Agrobacterium* . the natural genetic engineer; T-DNA and transposon mediated gene tagging . Plant cloning vectors: Ti and Ri plasmid and viral vectors (CaMV based vectors, Gemini virus, TMV based vectors). Mechanism of DNA transfer.

### **UNIT- V**

Biological nitrogen fixation and biofertilizer, molecular mechanism of nitrogen fixation, genetics of *nif* gene. Plant DNA fingerprinting - Hybridization and PCR based markers (RFLP, SSRs, RAPD, QTLs , SCARS , AFLP etc.) Application of Plant Biotechnology.

## **MBOT401P**

### **Practical**

1. Introduction and awareness of lab safety measures.
2. Study of sterilization of explants and working place.
3. Demonstration of androgenesis in *Datura*.
4. Study of Organogenesis.
5. Somatic embryogenesis using appropriate explants.
6. Preparation of artificial seed.
7. Familiarizing students with lab set up and instrumentation.
8. Growth characteristics of *E. coli* using plating and turbidimetric methods.
9. Isolation of plasmid from *E. Coli* by alkaline lysis method and its quantification spectrophotometrically
10. Restriction digestion of the plasmid and estimation of the size of various DNA fragments.
11. Cloning of a DNA fragments in a plasmid vector, transformation of the given bacterial population and selection of recombinants.
12. Demonstration of siderophore production by microbes.
13. Demonstration of Phosphate solubilizing activity of microbes.
14. Isolation, culture of Rhizobia and demonstration of their nodulation and nitrogen fixing potential.

### **Suggested Readings/ Books**

1. Butenko, R.G. 2000. Plant Cell Culture. University Press of Pacific.
2. Collin, H.A. and Edwards, S. 1998. Plant Cell Culture. Bios Scientific Publishers, Oxford, UK.
3. Dixon, R.A. (Ed.) 1987. Plant Cell Culture: A Practical Approach. IRL Press, Oxford.
4. Gelvin, S.B. and Schilperoort, R.A. (Eds), 1994. Plant Molecular Biology Manual, 2nd edition, Kluwer Academic Publishers, Dordrecht, The Netherlands.
5. George, E.F. 1993. Plant Propagation by Tissue Culture. Part 1. The Technology, 2nd edition. Exeg.etics Ltd., Edington, UK.
6. George, E.F. 1993. Plant Propagation by Tissue Culture. Part 2. In Practice, 2nd edition. Exegetics Ltd., Edington UK.
7. Glick, B.R. and Thompson, J.E. 1993. Methods in Plant Molecular Biology and Biotechnology. GRC Press, Boca Raton, Florida.
8. Glover, D.M. and Hames, B.D. (Eds), 1995. DNA Cloning 1 : A Practical Approach; Core Techniques, 2nd edition. PAS, IRL Press at Oxford University Press, Oxford.
9. Gelvin, S.B. and Schilperoort, R.A. (Eds), 1994. Plant Molecular Biology Manual, 2nd edition, Kluwer Academic Publishers, Dordrecht, The Netherlands.
10. Glick, B.R. and Thompson, J.E. 1993. Methods in Plant Molecular Biology and

Biotechnology. GRC Press, Boca Raton, Florida.

11. Glover, D.M. and Hames, B.D. (Eds), 1995. DNA Cloning 1 : A Practical Approach; Core Techniques, 2nd edition. PAS, IRL Press at Oxford University Press, Oxford.
12. Brown, T.A. 1999. Genomes. John Wiley & sons, Singapore
13. Callow, J.A., Ford-Lloyd, B.V. and Newbury, H.J. 1997. Biotechnology and Plant Genetic Resources: Conservation and Use. CAB International, Oxon, UK.
14. Jolles, O. and Jornvall, H. (eds.) 2000. Proteomics in Functional Genomics. Birkhauser Verlag, Basel, Switzerland.
15. Primrose, S.B. 1995. Principles of Genome Analysis. Blackwell Science Ltd., Oxford, UK

## Biochemical, Molecular Techniques and Bioinformatics

### **UNIT I**

Electrophoresis: Polyacrylamide gel electrophoresis (PAGE), agarose gel electrophoresis, native PAGE, SDS-PAGE, 2D electrophoresis, mass spectrometry, Isolation and purification: Genomic and plasmid DNA; RNA; proteins.

### **UNIT II**

Isoelectric focusing (IEF): Principles, kinds of pH gradients used in IEF- free carrier ampholytes, Immobilized pH gradients, blotting: Principles, types of blotting, immunoblotting - Southern, Northern, Western and Dot blots

### **UNIT III**

DNA amplification and genome mapping: PCR, RT-PCR, RFLPs, RAPD, FISH; Genome expression analysis: Microarray, EST, SAGE, DNA sequencing: Various methods of DNA sequencing, Gene silencing: RNA interference (RNAi)

### **UNIT IV**

Chromatography: Gel filtration, ion exchange & affinity chromatography, TLC, HPLC, GC-basic  
Concept, Spectroscopy: basic concept, NMR & ESR spectroscopy, Microscopy: Phase contrast, confocal, fluorescence, Scanning Electron Microscopy & Transmission Electron Microscopy (TEM).

### **UNIT V**

Bioinformatics: Database (NCBI, EMBL, DDBJ, Genbank, Pubmed), sequence analysis using online tools-BLAST, Methods of phylogeny analysis (Neighbour Joining, Maximum Parsimony and Maximum Likelihood), Phylogenetic inference packages, sites and centres.

## MBOT402P

### Practical

1. Extraction of total proteins from soybean seeds.
2. To perform SDS-PAGE of proteins isolated from soybean seeds.
3. To isolate DNA from spinach leaves and quantify using spectrophotometer.
4. To perform agarose (0.8%) gel electrophoresis of DNA sample.
5. To perform PCR of ITS region.
6. To perform agarose (1.2) gel electrophoresis of PCR product
7. To perform thin layer chromatography of amino acids.
8. To study protozoan diversity in a water sample using a light and phase contrast microscope.
9. To carry out BLAST (NCBI) analysis of the given DNA sequence.
10. To download DNA sequences (ITS region) from Genbank and align them using MEGA software and manual editing.
11. To construct phylogenetic tree of the aligned sequences using various phylogenetic methods given in MEGA software.

### **Suggested Readings/ Books**

1. Anna Tramontano Introduction to Bioinformatics The Ten Most Wanted Solutions in Protein Bioinformatics, CRC Press
2. Hooman Rashidi, Lukas K. Bioinformatics Basics: Applications in Biological Science and Medicine Buehler Publisher: CRC Press/Taylor & Francis Group
3. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins By: Andreas D. Baxevanis (Ed), B. F. Francis Ouellette (Ed)
4. Bioinformatics in the Post-Genomic Era: Genome, Transcriptome, Proteome, and Information-Based Medicine By: Jeffrey Augen Publisher: Addison-Wesley
5. Bioinformatics: Genes, Proteins and Computers C. A. Orengo, D. T. Jones, J. M. Thornton (Ed), D. T. Jones (Ed) Edition: 1st edition, May 2003, Publisher: Routledge
6. Introduction to Bioinformatics: A Theoretical and Practical Approach, By: Stephen A. Krawetz, David D. Womble Edition: 1st, Book & CD-ROM edition, May 2003, Publisher: Humana Press
7. Discovering Genomics, Proteomics, and Bioinformatics By: A. Malcolm Campbell, Laurie J. Heyer Edition: Book and CD-ROM edition, September 2002 Publisher: Benjamin/Cummings
8. Lehninger Principles of Biochemistry by Albert L. Lehninger, David L. Nelson, and Michael M. Cox Seventh Edition Published by Macmillan Learning, 2017
9. Rajan Katoch (2011) Analytical Techniques in Biochemistry and Molecular Biology, Springer
10. K. Wilson and J. Walker Principles and Techniques in Biochemistry and Molecular Biology. 7<sup>th</sup> edition. Cambridge University Press.

11. RC Gupta and S Bhargava Practical Biochemistry 5<sup>th</sup> edition. CBS Publisher and Distributers.
12. D Rickwood and BD Hames Gel Electrophoresis of Nucleic Acids- A Practical Approach. IRL Press
13. D Rickwood and BD Hames Gel Electrophoresis of Proteins- A Practical Approach. IRL Press
14. Suzanne Bell, Keith Morris (2009) Introduction to Microscopy. CRC Press.
15. Baxenavis AD and Ouellette BFF. Bioinformatics- A Practical guide to analysis of Genes and Proteins (Student edition). Wiley Publication.

## **ELECTIVES**

### **MBOT-403A**

External Term: 70

Internal Marks: 30

## **Plant Pathology**

### **Unit-I**

Historical development and present status of phytopathology, Concept of plant disease, Classification of plant diseases, Pathogenesis and disease development; role of enzymes and toxins in pathogenesis, Host-pathogen interaction, Pathogenesis and disease development; role of enzymes and toxins in pathogenesis

### **Unit-II**

Viral disease of plant, Life cycle of TMV, Gemini Virus, viral diseases symptoms, transmission, Isolation and purification of virus, Multiplication. Basic control measures and production of virus-free plants. Yellow vein mosaic of bhindi

### **Unit-III**

Bacterial diseases of plant symptoms and transmission, Plant responses against bacterial infection, Study of citrus canker, Bacterial leaf blight on wheat, Crown gall diseases caused by Agrobacterium, bacterial blight of rice, Ear cockle of wheat-Anguina tritici, Root knot of vegetables-Meloidogyne incognita, M. javanica, M. arenaria ; little leaf of brinjal

### **Unit-IV**

Fungal diseases- Symptoms and transmission-; Rusts, Smuts and powdery mildews; damping-off of seedlings, late blight of potato, red rot of sugarcane. Integrated pest disease management

The effect of weather on pathogenic agents- Insect pest, fungi, bacteria and viruses, combating plant diseases, natural and artificial methods, the integrated campaign (IPM), insect against insects, Bacteria and Bacilli against insect, Virus against Insects, effect of weather on the host.

### **Unit-V**

Host-pathogen interaction. Plant disease diagnosis; Koch's postulates with special reference to parasitism. Defense mechanism in host, effect of infection on host physiology, Dissemination of plant disease; disease forecasting and management plant disease. Post harvest diseases and mycotoxins.



## **MBOT403A-P**

### **Practical**

1. Isolation of fungal Pathogen from leaves
2. Extraction of Cellulase enzyme from diseased plant (*In vivo*)
3. Demonstration of Koch's Postulates for a Fungal Pathogen
4. Isolation of Plant Pathogen Bacteria
5. Identification and study of Citrus canker and other bacterial diseases,
6. Identification of fungal diseases- *Fusarium*, White blister, late blight of Potato.
7. Study of infected plant material for rust and smut disease.
8. Study of plant material infected with powdery mildew disease.
12. Effect of antifungal agents on selected fungi

### **Suggested Readings/ Books**

1. Agrios G. Plant Pathology (5<sup>th</sup> edition). Academic Press.
2. Mehrotra RS Plant Pathology. Tata McGraw Hill.
3. Bonnie H. Ownley, Robert N. Trigiano (2016) Plant Pathology Concepts and Laboratory Exercises. CRC Press
4. Singh RS Introduction To Principles Of Plant Pathology, 5<sup>th</sup> edition. MedTech
5. Stephen Burchett and Sarah Burchett. Plant Pathology. CRC Press
6. Sharma PD (2013) Plant Pathology. Deep and Deep Publications
7. Cooke, B. Michael, Jones, D. Gareth, Kaye, Bernard (2006) The Epidemiology of Plant Diseases. Springer, Netherlands

## **ELECTIVES**

### **MBOT-403B**

External Term: 70

Internal Marks: 30

## **Limnology**

### **Unit: I**

Introduction: Definition and Scope of Limnology; Water in the Biosphere; Classification and origin of Lakes.

### **Unit: II**

Chemical properties: Hydrogen-ion concentration, Dissolved gases in freshwater- Nitrogen and Phosphorus cycles in freshwater lakes.

### **Unit: III**

Ecological classification of freshwater organisms: Nature and distribution of Phytoplankton, Macrophytes and Zooplankton communities.

### **Unit: IV**

Concept of Productivity: Seasonal variation, Primary productivity in freshwater lakes, Estimation of Primary Productivity.

### **Unit: V**

Food Chains, Food webs, Trophic levels and Energy flow in freshwater ecosystems. Eutrophication : Causes, mechanism and significance, Management of freshwater bodies.

**Practical**

**Suggested Laboratory Exercises**

1. Construction of morphometric maps of aquatic systems.
2. Measurement of transparency and temperature.
3. Analysis of different dissolved gases: Dissolved oxygen and Carbondioxide.
4. Analysis of lake water for bicarbonates, carbonates, total alkalinity, chlorides etc.
5. Sampling of phytoplankton and their qualitative and quantitative analysis.
6. Sampling of periphytes and macrophytes, and their qualitative and quantitative analysis.
7. Sampling of Zooplankton and their qualitative and quantitative analysis.
8. Primary production: Experiment-*in-situ* by light and dark bottle method.
9. Short term productivity experiments for the understanding of diel variation in aquatic ecosystems.
10. Analysis of sediments for benthic fauna and flora.

**Suggested Readings/ Books**

1. Adoni, A.D. et al. 1985. Workbook on Limnology. Pratibha Pub. Sagar 216 p.
2. APHA 1981. Standard Methods for the Examination of Water and Waste water. American Public Health Association, Washington.
3. Arber, A. 1920. Water Plants. Cambridge University Press.
4. Barnes, A.K. and K.H. Mann, 1980. Fundamentals of Aquatic Ecosystems. Blackwell Scientific Publication, Oxford.

## **ELECTIVES**

### **MBOT 403C**

External Term: 70

Internal Marks: 30

## **Forest Ecology**

### **Unit: I**

Introduction, Importance of forest resources, forest communities of different climatic zones, Methods of studying structure and composition of forest communities. Forest types of India and M.P.

### **Unit: II**

Classification of forest biomes, World distribution, Classification of forests of India, Tropical forest, Subtropical forests, Temperate forest, Alpine vegetation of Himalayas. Differences between true temperate and Indian temperate forests.

### **Unit: III**

Phenomenon of succession in forest, Nature of climax, Role of grazing and anthropogenic factors, Forest environment, climatic factors governing forest distribution.

### **Unit: IV**

Methods of studying environmental factors in forests. Microclimate of forest, Forest soils of India, Forest Natural regeneration, Joint Forest management concept and practice.

### **Unit: V**

Wildlife conservation and related legislation, Seed biology, Forest Influences, Organic matter dynamics and annual budget sheets.

**Practical**

**Suggested Laboratory Exercises**

1. A survey and reconnaissance of a nearby forest to have an idea of various herb, shrub and tree species.
2. Sampling of the forest vegetation by quadrat method for determining density, frequency and basal area of different tree species.
3. Studying forest natural regeneration.
4. Study of climatic factors inside and outside a forest.
5. Visits to forest of different edapho-climatic zones.
6. Excursions to places of importance to forestry research, such as IIFM – Bhopal, SFRI and TFRI Jabalpur, FRI Dehra Dun etc.

**Suggested Readings/ Books**

1. Prasad, R. and A.K. Kandya (1992). Handling of forestry seeds in India. Associated Publ. Co. Delhi.
2. Tiwari, D.N. (1995). Marketing and trade of forest produce. International book distributors, Dehra Dun.
3. Dwivedi, A.P. (1993). Forestry in India. International book distributors, Dehra Dun. Negi, S.S. (1998). Forest tree seeds. International book distributors, Dehra Dun.
4. Negi, S.S. (2000). Joint Forest management and Peoples participation. International book distributors, Dehra Dun.
5. Pandeya, S.C., G.S. Puri and J.S. Singh (1985). Methods in ecological researches.
6. Tiwari, D.N. (1992). Tropical forestry in India. International book distributors, Dehra Dun.
7. Kittredge, J. (1994). Forest influences.
8. Gulati, N.K. (1992). A glossary of forestry terms. International book distributors, Dehra Dun.
9. Negi, S.S. (1986). A handbook of forestry. International book distributors, Dehra Dun. Suri, R.K. (1984). Recent trends in forest utilization.

**MBOT 404**

External Term: 100  
Internal Marks: 50

## Project Work

Project based on any of the above subject courses.  
Viva-vice, Presentation,  
Submit two copy of project report in the department.