MASTER OF SCIENCE IN BOTANY

Semester I

BOT 101 - (CC) Paper I - Plant Diversity I (Algae, Fungi and Lichens)

BOT 102 - (CC) Paper II - Biomolecules and Metabolism

BOT 103 - (CC) Paper III - Cell Biology and Molecular Biology

BOT 104 - (CC) Paper IV - Genetics and Cytogenetics

BOT 105 - (DSE) Paper V - Bioinstrumentation and Biotechniques (DSE1)

/ Principles of Plant Pathology (DSE1)

BOT 106 - (CC) Paper VI - Practical I (Based on BOT 1 and BOT 2)

BOT 107 - (CC) Paper VII - Practical II (Based on BOT 3 and BOT 4)

BOT 108 - (CC) Paper VII – Seminar/Presentation

MASTER OF SCIENCE IN BOTANY

Semester I

Course Code: BOT-101 (CC)

Paper I - Plant Diversity I (Algae, Fungi and Lichens)

Credit: 4 **(Lectures: 60)**

Course Objective-

- The student will learn about organization and working mechanism of the cryptogams.
- Students will come to know about advancement of plant groups from lower to higher.
- Students get acquainted with economic importance, classification, detailed study on the representative ferns of major families with reference to their morphology, anatomy and reproduction.

Learning Outcomes-

On successful completion of the course, the students will be able to:

- Identify Algae, Fungi and Lichens
- Understand the structural organization of Algae, Fungi and Lichens
- Relate the structure and lifecycle patterns of Algae, Fungi and Lichens
- Appreciate the economic importance of Algae, Fungi and Lichens

Unit – I

Algae - Algae in diversified habitats (terrestrial, freshwater and marine), thallus organization, cell ultra- structure, reproduction (vegetative, asexual and sexual). Classification of algae based on pigments, cell wall composition, reserved food material and flagellation.

Salient features of Cyanophyta, Chlorophyta, Bacillariophyta, Xanthophyta, Pyrrophyta, Phaeophyta and Rhodophyta with special reference to *Spirulina, Scytonema, Dunaliella, Pinnularia, Gonyaulax, Laminaria, Gelidium and Batrachospermum, Acetabularia.*

Algal biofuels – algal biodiesel, bio-ethanol and biological hydrogen production, Algal biofertilizers**,** Algae in global warming – carbon capture by algae.

Unit –II

Fungi - General characters, substrate relationship, cell ultra-structure, thallus organization, cell wall composition, nutrition (saprobic, biotrophic and symbiotic), reproduction (asexual and sexual).

Homothallism and heterothallism in fungi. Homokaryon and Heterokaryon, Brachymeiosis, Para sexuality, Sex hormones in fungi. Ecological and Economic importance of fungi in industries, medicines and as food, fungi as biocontrol agents, poisonous fungi, mycorrhizae.

Unit-III

Phylogeny of fungi; General account of Mastigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina, Deuteromycotina with special reference *to Rhizopus, Perenospora, Neurospora, Polyporus, Drechslera and Collectotrichum*

Unit-4

Lichens: A general account of lichens with special reference to their mode of life. Gross and fine structure, nutrition, reproduction, classification; micro-chemical tests for their classification; their economic importance and ecological significance; role of lichens in biological estimation of pollution. Lichens -in vitro culture– a detailed study of one or two available species of lichens belonging to Ascolichen and Basidiolichen.

Suggested Practicals-

Morphological study of representative members of algae, fungi and lichens present in your locality in their natural habitat with special reference to:

- Algae*: Microcystis, Spirullina, Scytonema, Rivularia, Dunaliella, Aulosira, Spirogyra, Pediastrum, Hydrodictyon, Ulva, Pithophora, Stigeoclonium, Gelidium and Batrachospermum:* isolation and culture of Algae.
- Fungi*: Stemonites, Peronospora, Pythium, Albugo, Rhizopus, Pilobolus, yeast, Emericella, Chaetomium, Pleospora, Morchella, Melamsora, Phallus, polyporus, Drescslera, Curvularia, phoma, Penicillium, Aspergillus, Colletotrichum, fusarium and Alternaria.*
- Isolation and culture of fungi using moistened blotters, PDA and Sabouraud's Dextrose Agar media.
- Permanent slides of foliose, fruticose and crustose lichens.
- Field visit for 2 days for collection of specimens.
- Spotters related to theory

- **Suggested Readings –**

1. Bhatia, A. 1994. Treatise on Algae. S. Chand & Company. New Delhi.
2. Bold. H.C. & Wynne, M.J.1985. Introduction to the Algae. Prentice Hall of India. New Delhi.
3. Chapman. V.J. Chapman, D.J. 1975. The Algae. Macmillan India Ltd. Delhi.
4. Fritsch, F.E.1945. Structure and reproduction of Algae. Cambridge University Press
5. Hale, M.E.(Jr) 1983. The Biology of lichens. Edward Arnold. Maryland.
6. Lee, R.E. 2008. Phycology. Cambridge University Press, New York.
7. Lewin, R.A. (Ed.).1962. Physiology and Biochemistry of Algae. Academic Press.
8. Nash, T.H. 2008. Lichen Biology, Cambridge University Press, Cambridge.
9. Orlando Necchi Jr (Ed.). 2014. River Algae, Springer, Switzerland.
10. Pandey. B.P.1994. Algae. S. Chand & Company Ltd. New Delhi.
11. Roberts, P. Evans, S. 2014. The Book of Fungi: A Life-Size Guide to Six Hundred Species from around the World. University of Chicago Press,
12. Round. F.E.1984. The Ecology of Algae. Cambridge University Press.
13. Sharma, O.P.1998 Text book of Algae. Tata McGraw Hill. New Delhi.
14. Vashishta, B.R.1999. Algae. S.Chand & Company, New Delhi.
15. Webster, J. and Weber, R.W.S. 2007.Introduction to Fungi. Cambridge University Press, New York.
16. Watkinson, S.C., Boddy,L.& Money, N. 2016. The Fungi. Elsevier, London

MASTER OF SCIENCE IN BOTANY

Semester I

Course Code: BOT-102(CC)

Paper II - Biomolecules and Metabolism

Credit: 4 **(Lectures: 60)**

Course Objectives:

- To provide details about the importance of the biomolecules present in our system and the regulation of metabolic pathways.

Learning Outcomes-

On successful completion of the course, the students will be able to:

- Acquire knowledge about various biomolecules
- Define the structure, properties and significance of biomolecules
- Understand the metabolic pathways of biomolecules
- Discriminate the biomolecules from hormones and vitamins
- Describe the classification, mechanism of enzyme action and enzyme kinetics

Unit-I

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

Unit-II

Amino acids and Proteins: biosynthesis of amino acids: properties and chemical reaction concerned with amino acids: Proteins: primary, secondary, territory structure of protein, 3 D structure and protein folding, physiochemical properties of proteins.

Regulation of protein and enzyme synthesis (lac operon)

Unit-III

Biological Nitrogen fixation: Nitrogenase enzyme, substrates for nitrogenase, reaction mechanism, strategies to exclude oxygen and need to control hydrogen evolution.

Metabolism of Carbohydrates: chemical reactions & derivatives of monosaccharide: Glycolysis – T.C.A. Cycle. E.T Chain- ATP synthesis: Glycogenolysis – H.M.P. Pathway: Gluconeogenesis.

Unit-IV

Metabolism of Lipids: Oxidation of any one fatty acids and its bioenergetics: Biosynthesis of any one fatty acid: palmitic acid unsaturation: biosynthesis of cholesterol: Importance of cholesterol and plant lipids. Chemistry of vitamins, hormones and alkaloids : Vitamins as Co-enzymes : Chemistry and biosynthesis of hormones- thyroxin. Catecholamine's. steroidal hormones. Biologically important alkaloids: intermediary metabolism: integration of metabolic pathways.

Suggested Practicals-

- Introduction to various instruments and their working principles used in biochemistry laboratory.
- Preparation of buffers.
- To prepare the standard curve of protein, carbohydrates and amino acids.
- Qualitative estimation of amino acid and protein.
- Qualitative estimation of lipids.
- Qualitative estimation of carbohydrates.
- Quantitative estimation of protein by Lowry's method.
- Quantitative estimation of amino acid and phenols by using Spectrophotometer'
- Separation of various components in the different lipid fraction by thin layer chromatography.
- To study the effect of temperature on enzyme activity.
- Determination of water potential by various methods.
- Spectroscopic determination of chlorophyll a, chlorophyll b, and total chlorophyll, carotenoids and anthocyanins under varied environmental conditions.

- **Suggested Readings-**

  - Voet. D and Voet . J.G 1995. Biochemistry (2nd Ed.) John Wiley and Sons, Inc.
  - Deb.A.C. 2006. Concepts of Biochemistry (Theory and Practical). Books and Allied (P) Ltd., Kolkata.
  - Nelson, L. D. and M. M Cox Lehninger's Principle of Biochemistry: (5th ed. 2008), Macmillan, Worth Publication Inc
  - Berg J.M., TymoczkoJ.L. and Stryer.L.2007. Biochemistry (7th ed.) W.H.Freeman and Company, New York.
  - Buchanan B, Gruissem G and Jones R. (2000) Biochemistry and Molecular Biology of Plants, American Society of Plant Physiologists, USA.
  - Campbell, M.K.& Farrell, S.O. 2011. Biochemistry, 7th Reprint, Cengage Learning Publishers.
  - Conn. E.E. and stumpf P.K. 2009.
  - Outlines of Biochemistry. John Wiley and Sons, New Delhi
  - David T. Dennis and David H. Turupin (Eds.) 1993. Plant Physiology, Biochemistry and Molecular Biology. Longmann Scientific and Teachnical Singapore.
  - Fisher J. & Arnold,2003. BIOS Instant notes in chemistry for Biologists. Garland Science publications.
  - Goodwin and Mercer 1996. Introduction to plant Biochemistry. CBS Publishers and Distributors, New Delhi.
  - Hames, B.D. et. Al. 1999. Instant notes in Biochemistry. Viva books Pvt. Ltd., New Delhi
  - Dey, P. M. Harborne, J. B. 1997. Plant Biochemistry, Elsevier publications.
  - Jain J.L. 2000. Fundamentals of Biochemistry. S. Chand & co. New Delhi.
  - Plummer, D.T. 1996. An introduction to practical Biochemistry. McGraw Hill 10. Satyanarayana, U, 1999. Biochemistry. Books and Allied (P) Ltd. Calcutta.

MASTER OF SCIENCE IN BOTANY

Semester I

Course Code: BOT-103 (CC)

Paper III - Cell and molecular biology (CC)

Credit: 4 **(Lectures: 60)**

Course Objective-

- To provide the knowledge to the students about the basic and fundamental organization of life and genetic material and their applications in molecular aspects.
- The students will gain insight into the principal mechanisms of genome expression and its regulation.
- The students will learn about the methods of genetic recombination in bacteria.

Learning Outcomes:

On successful completion of the course, the students will be able to:

- Understand the structure and function of various cell organelles
- Understand the mechanism of cellular processes and cell cycle
- Recognize the structure and the functional significance of DNA and RNA
- Compare the mechanism of gene regulation in prokaryotes and eukaryotes.

Unit-I

Cell theory, Cell structure, prokaryotic and eukaryotic cells. Structure and functions of cytoplasmic organelles – Mitochondria and Chloroplast.

Golgi apparatus, Ribosomes, Lysosome, Glyoxysome and Vacuoles. Cytoplasm:

physicochemical properties and chemical composition.

Unit-II

Nucleus: Nuclear envelope, nuclear pore complex, trafficking between nucleus and cytoplasm.

Protein sorting: Targeting of proteins to organelles.

The cytoskeleton; organization and role of microtubules and microfilaments; motor movements;

implications in flagellar and other movements.

Unit – III

DNA/gene manipulating enzymes: Endonuclease, exonuclease, ligase, polymerase, phosphatase, transcriptase, transferase, topoisomerase

DNA replication types and mechanism. Difference between replication in prokaryotes and eukaryotes.

DNA damage and repair: Thymine dimer, 6-4 photoproducts, photo reactivation, excision repair

Unit-IV

Genetic recombination: Holliday, Potter & Dressler, Meselson and Radding and Szostak model of genetic recombination

Programmed cell death (PCD): Concept of PCD and its types in plants during vegetative and reproductive stages. Developmental and stress-induced PCD.

- **Suggested Practicals-**
  - Introduction to various instruments and their working principles used in Cell Biology laboratory.
  - Preparation of normal and moral solutions, buffers, pH setting etc.
  - Preparation and study of prefixatives, fixatives and stains.
  - To study various parts of microscope and demonstrate of microscopic techniques.
  - EM study of cell organelles.
  - Demonstration of Brownian movement.
  - Demonstration of tyndall effect.
  - Demonstration of plasmolysis and deplasmolysis in plant cell.
  - Demonstration of exosmosis and endosmosis in grapes and resins.
  - Study of structure of plant cell through temporary mounts.
  - To discriminate between viable and non-viable cells using staining techniques.
  - Effect of solution concentration on plant cells.
  - To study the structural diversity of fungi, algae and plant cells.
  - Cell division: Mitosis and meiosis in higher plants.
  - Study of various stages of mitosis using cytological preparation of onion root tips.
  - Microtomy
  - Histochemical techniques.
  - Organelle isolation, mitochondrion and chloroplast.
  - Fixation and maceration techniques, staining techniques of plant tissues.
  - Fluorescence staining with FDA for cell viability.
  - Cell wall staining with calcifluor white.
  - Histochemical localization of protein, carbohydrate, fats, starch, lignin, nucleic acids.
  - Isolation of mitochondria and activity of its marker enzyme, succinate dehydrogenase (SDH).
  - Demonstration of SEM and TEM.
  - Any other practical based on theory syllabus.

- **Suggested Readings-**

1. Alberts, B. and D. Bray, J. Lewis, M. Raff, K. Roberts and J. D. Watson. 1999. Molecular Biology of Cell. Garland Publishing, Inc., New York.

2. David Freifelder. 2008. Essentials of Molecular Biology. Narosa Publishing house. New Delhi.

3. Krishnamurthy, K. V. 2000. Methods in Cell Wall Cytochemistry. CRC Press, Boca Raton, Florida.

4. Lewin, B. 2000. Genes VII. Oxford University Press, New York.

5. Lodish, H. and A. Berk, S. L. Zipursky, P. Matsudaira, D. Baltimore, J. Darnell. 2000. Molecular Cell Biology. 4th Edition. WH Freeman and Co., New York.

6. Wolfe. S. L. 1993. Molecular and Cellular Biology. Wadsworth Publishing Co., California, USA.

7. Wayne M Becker, Lewis J Kleinsmith, Jeff Hardin (2007). The world of the cell (VI Edn). Pearson.

8. Geoffrey M Cooper, Robert E Hausman (2009). The Cell: A molecular approach (V Edn). Sinaeur.

9. Gerald Karp (2008). Cell and Molecular biology: Concepts and experiments (V Edn). John Wiley &Sons.

10.Allison.A. 2007. Fundamental Molecular Biology. Blackwell Publishing, UK.

11.H. Lodish et al. 2012. Molecular Cell Biology, 7th Ed. W.H Freeman and Company,

12.De Robertis& De Robertis, 2004. Cell and Molecular Biology. Williams and Wilkins. USA. 13.Freifelder, 1990. Molecular Biology, Narosa Publishing House, New Delhi.

14.Mary A. Schuler Raymond and E.Zrelinski, 2005. Methods in Plant Molecular Biology, Academic Press an imprint of Elsevier.

15.Peter Porella, 1998. Introduction to Molecular Biology, Mc Graw – Hill, New York.

16.Rastogi, S.C. 2010. Cell Biology. New age International Pub. New Delhi.

17.Watson Baker Bell, Gana Levine Losick, 2004. Molecular Biology of the gene, Pearson Education.

18.William D. Stansfield. Jaine S. Colone Raul J. Chand, 2004. Molecular and Cell Biology, Tata Mc Graw-Hill Publishing company, New Delhi.

19.Daniel L Hartl, Elizabeth W Jones (2012). Genetics: Analysis of genes and genomes (VII Edn). Jones and Bartlett publishers.

20.Geoffrey M. CooperandRobert E. Hausman2015. The Cell: A Molecular Approach. 7 thedn. Sinauer Associates is an imprint of Oxford University Press

MASTER OF SCIENCE IN BOTANY

Semester I

Course Code: BOT-104 (CC)

PAPER IV- Genetics and Cytogenetics (CC)

Credit: 4 **(Lectures: 60)**

Course Objectives:

- Provide an understanding of Inheritance and different aspects of genetics.
- The paper will deal with Mendelian and non-Mendelian inheritance, quantitative genetics, molecular markers and linkage mapping, prokaryotic and eukaryotic genome-structure, gene function and regulation, epigenetics, cytogenetics and crop evolution.

Course Outcomes:

Through this course students should be able to

- Summarize the principles underlying population genetics and Hardy-Weinberg Law.
- Restate Mendel's principles of inheritance and apply these to the problems of inheritance.
- Assemble genetic knowledge derived from different types of model organisms.
- Interpret complex modes of inheritance including multiple alleles and maternal inheritance.

Unit-I

Microbial Genetics: Viral and bacterial genomes and derived vectors; Recombination in viruses and bacteria (transformation, conjugation and transduction); Fine structure of gene; Prokaryotic gene regulation; Fungal genetics – mating types and genetic exchange, heterokaryosis, parasexual cycle. Mendelian and Non-Mendelian Inheritance: Meiosis; Chromosome theory of inheritance; Mendelian laws; Gene interactions; Organelle inheritance.

Unit –II

Eukaryotic Genome: Evolution, structure and organization; Gene regulation.

Recombination in Eukaryotes: Linkage and crossing over: basic concepts, linkage maps, correlation of genetic and physical maps, molecular markers and construction of linkage maps; Molecular mechanism of recombination; QTL mapping.

Unit-III

Mutation: Basic concept, spontaneous and induced mutations, allele theory, physical and chemical mutagens; Molecular basis of mutations; Transposons and their use in mutagenesis and gene tagging in plant systems; Oncogenes and cancer. Concepts in: Developmental genetics; Behavioural genetics; Population genetics and Quantitative genetics.

Unit-IV

Cytogenetics: Chromosome: Structure and nomenclature, centromere and telomere; Sex determination: mechanisms, sex chromosomes; Chromosomal aberrations: Duplications, 4 deficiencies/deletions, inversions, interchanges/translocations;

Role of chromosomal aberrations in crop evolution; Ploidy changes: Haploids, polyploids and aneuploids;

- **Suggested Practicals-**

- Study of problems on Mendelian Genetics, Gene interactions. Multiple allele and multiple gene inheritance.
- To test the genetics hypothesis by Chi-square Test and study goodness of fit.
- Preparation of Linkage Maps in Diploids using three points test cross method.
- Tetrad analysis and centromere mapping in ordered and unordered tetrads.
- Pedigree analysis.
- Problem relating to population genetics.
- Study of B chromosome in Maize/Drimia.
- Induction of polyploidy, using Colchicine.
- Study different stages of mitosis in root rips of Allium species.
- Study meiotic behaviour of chromosomes in Anthers of Allium.
- Solving problems related to monohybrid, dib rid crosses, Test cross, Multiple alleles.
- Solving problems related to gene interaction mentioned in the syllabus
- Calculating gene frequency using Hardy-Weinberg Law
- Chromosomal mapping
- Isolation and observation of genomic and plasmid DNA from microorganisms.
- Screening for amylase/ cellulase producing organisms.
- Transformation of E. coli.
- Study of mitosis - onion root tip squash for chromosomal examination – Haematoxylin staining 13. Study of meiosis – Tradescantia/Rheo for chromosomal examination – acetocarmine staining
- Molecular size determination of DNA samples by Agarose gel electrophoresis

- **Suggested Readings-**

- Karp, G., Iwasa, J. and Marshall, J. 2019. Karp's Cell and Molecular Biology, Wiley, 9th Edition.
- Hyde, D.R. 2010. Genetics and Molecular biology: With Fundamentals of Biostatistics. Special Indian edition, Tata Mc Graw Hill P.Ltd., New Delhi.
- Kleinsmith, L.J. and Kish,V.M. 1995. Principles of Cell and Molecular Biology (2ndedition). Harper Collins College Publishers, New York, USA.
- Raven, P. Johnson, G., Mason, K., Losos, J. and Duncan, T. 2020. Biology, Mc Graw Hill, 12th Edition.
- Rastogi, S.C. 2020. Cell and Molecular Biology, New Age International Publishers.
- Alberts, B., Johnson, A.D., Lewis, J., Morgan, D., Raff, M., Roberts, K. and Walter, P.2014. Molecular Biology of the Cell. Norton Publishers, 6th Edition.
- David Freifelder. 2008. Essentials of Molecular Biology. Narosa Publishing house. New Delhi.
- Krishnamurthy, K. V. 2000. Methods in Cell Wall Cytochemistry. CRC Press, Boca Raton, Florida.
- Krebs, J.E., Goldstein, E.S. and Kilpatrick, S.T. 2018. Lewin's Genes XII. Oxford University Press, New York, 12th Edition
- Lodish, H., Berk, A., Kaiser, C.A., Krieger, M., Bretscher, A., Ploegh, H., Amon, A. and Martin, K.C. 2016. Molecular Cell Biology. 4th Edition. WH Freeman and Co., 8 thEdition.
- Wolfe. S. L. 1993. Molecular and Cellular Biology. Wadsworth Publishing Co., California, USA.

MASTER OF SCIENCE IN BOTANY

Semester I

Course Code: BOT-105 (DSE1)

PAPER V- Bioinstrumentation and Biotechniques

Credit: 4 **(Lectures: 60)**

Objectives-

- To understand the knowhow's on principles and practical knowledge about the advanced instruments used in modern biology
- The aim of this course is to give the students essential knowledge pertaining to various tools and techniques used to gain insight into cell structure and biological processes.
- The focus is on studying the techniques used for isolation, purification and characterization of biomolecules.

Learning Outcomes:

- On successful completion of the course, the students will be able to:
  - Understand the basic principles and working mechanisms of various scientific instruments
  - Acquire hands-on training on different scientific instruments
  - Relate the importance and applications of various scientific instruments

Unit I:

Principle and uses of various microscopes: Simple, Compound, Phase Contrast, TEM, SEM, Atomic Force Microscope. Principles and applications of Micrometre, Haemocytometer and Microtome. Biological sample preparation techniques for microscopy.

pH meter – basic principles, Types of electrodes, Preparation of buffers. Centrifugation: Principle, Types of Rotors. Types of Centrifuges – Clinical, Refrigerated and Analytical centrifuges and their applications.

Unit II:

Blotting: Principles, types of blotting, immunoblotting - Southern, Northern, Western and Dot blots

DNA amplification and genome mapping: PCR, RT-PCR, RFLPs, RAPD, FISH, DNA sequencing: Various methods of DNA sequencing

Gene silencing: RNA interference (RNAi)

Unit III

Chromatography Gel filtration, ion exchange & affinity chromatography, TLC, HPLC, GC-basic concept

Electroporation – Principle, Procedure and application of AGE, SDS – PAGE separation of proteins. Blotting techniques – Principles and types (Northern, Western and Southern).

Spectroscopy: basic concept, NMR & ESR spectroscopy

Unit IV

Radiometry – Isotopes – Measurement of Radioactivity. Radioactive detectors: Scintillation and Geiger Mueller Counter. Autoradiography and its application.

Histochemical and Immunotechniques- Antibody generation, Detection of molecules using ELISA, RIA, western blot, immunoprecipitation, flowcytometry and immunofluorescence microscopy, detection of molecules in living cells, in situ localization by techniques such as FISH and GISH.

- **Suggested Practicals-**

  - Demonstration of the working mechanism of various instruments mentioned in the syllabus like -various microscopes: Simple, Compound, Phase Contrast, TEM, SEM**,** Micrometre, Haemocytometer, Microtome, Spectroscope PH meter, centrifuge, PCR and Gel Electrophoresis instrument etc
  - Spotters related to theory.
  - Calibration of stage and ocular micrometre
  - Measurement of PH of different solution
  - Preparation of buffer
  - Verification of Beer and Lamberts law using spectrophotometry.
  - Separation and identification and quantitative estimation of amino acids and phenols from plants using thin layer chromatography.
  - Separation of plant pigments using column chromatography.
  - Isolation of some natural products: Piperine, caffeine, flavone, coumarin, triterpenoids
  - Estimation of some natural products by TLC and UV spectrophotometry.
  - Preparation of stains.
  - Microtomy – Preparation of thin sections and permanent slides.
  - Staining starch, cell wall, lipids, proteins and nucleic acids using bright field dyes

- **Suggested Readings-**

  - Burdan R.H. Knippenberg RH. (editors). 1989, Techniques in Biochemistry and Molecular Biology, 2" ed, Elsevier.
  - Daphne. J. O and Micheal. B. J. 1989. Cell separation in plants physiology, Biochemistry and Molecular Biology. Springer-Verlag, Berlin.
  - Gahan, P.B. 1984. Plant Histochemistry and Cytochemistry. Academic Press, London. Gary, P. 1964.
  - Hand Book of Basic Micro technique. John Wiley & Sons, New York. Holcapek, M., Byrdwell, Wm. C. 2017.
  - Handbook of Advanced Chromatography /Mass Spectrometry Techniques, Elsevier. Jefrey. M., Backer el al., 1996.
  - Biotechnology- A Laboratory Course. Academic Press, New York. Johanson, DA. 1940.
  - Plant microtechniques. Mc Graw Hill. Johanson, W. A. 1982.
  - Botanical Histochemistry - Principles and Practice.Freeman & Co. Johanson, W. A. 1984.
  - Plant Microtechnique. Mc Graw Hill, New Delhi Kierman, J. A. 1909.
  - Histological and Histochemical Methods. ButterworthPublications, London. Mahiga, P. Klessing, D.F. Cashmore, A.R. Grinssen, W. and Varner, J.E. 1995.
  - Methods in Plant Molecular Biology - A Laboratory Course - Manual. CSHL Press. New York. Plummer, D.T. 1996.
  - An introduction to practical biochemistry. Tata Mc GrawHill. Robards, K., Jackson, P. E. & Haddad, P.R. 2012.
  - Principles and Practice of Modern Chromatographic Methods, Elsevier. Ruzin, Z. E. 1999.
  - Plant Micro technique and Microscopy. Oxford University Press, New York. Stock, R and Rice, C.B.F. 1980.
  - Chromatographic methods. Chapman and Hall. Yeung, E. C. T., Stasolla, C., Sumner, M.J., Huang, B.Q. 2015.
  - Plant Micro techniques and Protocols, Springer. Wilson, K. & Walker, J. 2010.
  - Principles and Techniques of Biochemistry and Molecular Biology (Seventh Edition). Cambridge University Press, Yow York.

MASTER OF SCIENCE IN BOTANY

Semester I

Course Code: BOT-105 (DSE2)

PAPER V-Principles of Plant Pathology

Credit: 4 **(Lectures: 60)**

Course Objective:

- The aim of this course is to give the students essential knowledge pertaining to various aspects of Plant Pathology like Symptomatology, Defence mechanisms, Host Parasite interactions, Role of enzymes and toxins in pathogenesis.
- It also aims to study the etiology, Epidemiology and Control of different plant diseases caused by Fungi and other micro-organisms.

Course outcomes:

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

- Understand the interaction between plant and pathogen in relation to the overall environment.
- Demonstrate an understanding of the principles of plant pathology and the application of these principles for the control of plant disease.
- Acquire physiology, photosynthesis, respiration, transpiration, translocation. Knowledge about cause of plant diseases and effect of microbial infections on plant.
- Demonstrate skills in laboratory and field related to plant pathology.

Unit I

Fundamentals of plant pathology: History of plant pathology; various levels of parasitism; classification of plant diseases. Pathogenesis: Penetration and entry of plant pathogens; development inside host tissue, Host – parasite Interactions: Alteration in plant physiological functions.

Unit II:

Agents of plant diseases: General characteristics and symptoms caused by – agents of infectious diseases (fungi, bacteria, mycoplasma, virus, MLOs, Spiro plasma.

Viroids, Mycoviruses and nematodes) and agents of non-infectious diseases (Air pollution, chemicals, minerals excesses, temperature). How pathogens attack plants: chemical weapons of pathogens (enzymes and toxins) Nutrition in Fungi.

Unit III

History, symptomology, causal organism, etiology and management of –

Algal Disease – Red Rust of Tea and Coffee

Fungal Diseases - Wheat – flag smut, Karnal bunt, Rust of Linseed, Tikka disease of Ground nut, Wilt Disease of Castor, Ergot disease of Bajra.

Bacterial Disease – Crown Gall of stone fruits, Black rot of crucifers.

Viral Diseases: Cadang- Cadang disease of coconut, Sandal Spike, Leaf curl / Necrosis disease of Black Gram

Nematode Disease – Root Knot of brinjal, Ear Cockle of Wheat

Non-Parasitic disease – Black Heart of Potato, Mango Necrosis

Unit IV

How plants defend themselves against pathogens: structural defence and biochemical defence. Plant disease epidemiology and plant disease forecasting: Importance of disease forecasting services, methods used in plant disease forecasting

Management of plant pathogens: cultural, chemical and biological methods. Detoxification of

pathogen toxin: Application of molecular biology in diseases control strategies, Plant quarantine.

- **Suggested Readings:**

1. Agrios, G.N., (2005), Plant Pathology, Acad. Press, Inc. California.

2. Bilgrami, K.S. and Dube, H.C., (1990), A Text Book of Modern Plant Pathology, Vikas Publishing House, New Delhi.

3. Mehrotra, R.S. and Aggarwal, A., (2013), Fundamentals of Plant Pathology, Tata Mc Graw Hill Publ. Ltd., New Delhi.

4. Mehrotra, R.S. and Ashok Aggarwal (2017): Plant Pathology, Tata Mc Graw Hill Publ. Ltd., New Delhi.

5. Singh, R.S., (2018), Plant Disease, 9th Edition, Oxford, IBH Publ., New Delhi.

6. Singh, R.S., (2017), Principles of Plant Pathology, 5th Edition, Medtech.

7. Recent and important review articles from scientific journals.

- **Suggested Practicals-**
  - Culture media for microorganisms.
  - Growth curve of bacteria
  - Gram staining
  - Virus indexing.
  - Isolation of pathogens from diseased tissues (leaf, stem and fruit) by serial dilution method.
  - To study the symptoms and diagnostic features of causal organisms of the following plant diseases: Wheat – flag smut, Karnal bunt, Rust of Linseed, Tikka disease of Ground nut, Wilt Disease of Castor, Ergot disease of Bajra.

Bacterial Disease – Crown Gall of stone fruits, Black rot of crucifers.

Viral Diseases: Cadang- Cadang disease of coconut, Sandal Spike, Leaf curl / Necrosis disease of Black Gram

Nematode Disease – Root Knot of brinjal, Ear Cockle of Wheat

Non-Parasitic disease – Black Heart of Potato, Mango Necrosis

- Collection and preservation of specimens from infected plants. Submit 5 herbarium sheets/live specimens along with a report.

Innovative and research oriented applied botany-

- ***Study on effect of water salinity on different plants and their growth.***
- ***Effect of vitamins on plant growth***
- ***Developing new plant species and varieties in new habitat by doing acclimatization experiments.***
- ***Study of micro flora on plant propagation materials and their control***
- ***To develop vegetable crop production without soil (Hydroponics)***
- ***Study of antimicrobial properties of water-fern Marsilea***

Semester II

BOT 201 - (CC) Paper I - Plant Diversity II (Bryophytes, Pteridophytes and Gymnosperms)

BOT 202 - (CC) Paper II - Plant Biotechnology

BOT 203 - (CC) Paper III - Recombinant DNA Technology and Molecular Pharming

BOT 204 - (CC) Paper IV- Plant Physiology

BOT 205 - (DSE) Paper V - Biodiversity and Evolutionary Biology (DSE2) / Biofertilizer (DSE2)

BOT 206 - (CC) Paper VI - Practical I (Based on BOT 201 and BOT 202)

BOT 207 - (CC) Paper VII - Practical II (Based on BOT 203 and BOT 204)

BOT 208- (CC) Paper VIII - Industrial Visit and Report Submission

MASTER OF SCIENCE IN BOTANY

Semester II

Course Code: BOT-201(CC)

Paper I- Plant Diversity II (Bryophytes, Pteridophytes and Gymnosperms)

Credit: 4 **(Lectures: 60)**

Course Objective-

- To familiarize students with the diversity of Bryophyte, Pteridophytes and Gymnosperms, their evolutionary history and origin
- Practicals and exposure of students to flora in the surrounding areas and botanical garden further add to their knowledge.

Learning Outcomes:

On successful completion of the course, the students will be able to:

- Understand and differentiate the structural organization and diversity of Bryophytes, Pteridophytes and Gymnosperms
- Appreciate the evolutionary trend in Bryophytes, Pteridophytes and Gymnosperms
- Trace the connecting links of fossil forms in Bryophytes, Pteridophytes and Gymnosperms
- Appreciate the economic importance of Bryophytes, Pteridophytes and Gymnosperms.

Unit -I

Bryophyta- Classification of Bryophytes, Comparative account of gametophyte structure, sporophyte structure and reproduction in Bryophytes.

Peristome structure and spore dispersal mechanisms in Bryophytes, spore germination patterns in Bryophytes.

General account of Marchantiales, Jungermaniales, Anthocerotales, Sphagnales, Funariales,and Polytrichales with special reference to *Plagiochasma, Notothylus, Sphagnum, Physcomitrella patens and Polytrichum.*

Fossil Bryophytes, evolutionary trends in bryophytes, economic importance of bryophytes, role of Bryophytes in plant succession

Unit II

Pteridophytes: Distribution, classification by International Committee of Botanical Nomenclature (ICBN), Economic importance of Pteridophytes. General account of fossil Pteridophytes; Introduction to Psilopsida, Lycopsida, Sphenopsida and Pteropsida classes.

Morphology, anatomy, reproduction, classification, life- history of: *Tmesipteris, Lycopodium, Glechenia, Isoetes, Ophioglossum and Azolla.*

Origin and evolution of stele, heterospory and seed habit.

Unit-III

Gymnosperms: Distribution, morphology, anatomy, reproduction,

Classification, life history and evolution. Cycadales *(zamia*), Ginkgoales (*Ginkgo)*, Coniferales *(Taxus, Araucaria and Biota*), Welwitschiales (*Welwitschia*), Gnetales *(Gnetum)*.

Unit-IV

History of Paleobotany, formation and types of fossils, techniques for study of fossils, Geological time scale. Brief account of pteridospermales (*Lygenopteris, Medullosa, Caytonia and Glossopteris*) Brief account of cydeoidales (*cycadeiodea*), cordaitales (*cordaites*)

Palaeobotany and evolution of vascular plants

Applied aspects of Palaeobotany, use in coal and petroleum exploration.

- **Suggested Practicals**-

  Morphological and anatomical study of representative members of Bryophytes, Pteridophytes and gymnosperms in their natural habitat found in your locality with special reference to the following material-

  - Bryophyta- *Plagiochasma, Pogonatum, Pellia, Notothylus, Andreaea and Polytrichum.*
  - Pteridophyta- *Lycopodium, Isoetes, Gleichenia, Ophioglossum and Azolla.*
  - Gymnosperms- *Zamia, Ginkgo, Taxus, Araucaria, Biota and Gnetum.*
  - Fossil study- *Lygenopteris, Medullosa, Caytonia and Glossopteris* , *Cycadeiodea* , *Cordaites* Spotters related to theory.
  - Field Trips to Mount Abu/ Kewra ki Naal Udaipur/ Darrah National Park, Kota/ Sariska National Park and Siliserh Lake, Alwar/ Ranakpur District to familiarize students with natural habitats, growth forms and diversity of Bryophytes, Pteridophytes and Gymnosperms.

- **Suggested Readings –**

- Bhatnagar, S. P. and Moitra, A.1996. Gymnosperms. New Age Int. Pvt. Ltd., New Delhi.
- Biswas, C. and Johri, B.M. 1999. The Gymnosperms. Narosa Publishing House, New Delhi. Chamberlain, C. J. 2000. Gymnosperms. C B S Publishers and Distributors, New Delhi.
- Chopra, R.N. and Kumra, P.K. 2005. Biology of Bryophytes. New Age Int. Pvt. Ltd., New Delhi.
- Parihar. N.S.1980. An Introduction to Embryophyta Vol. I. Bryophyta. Central Book Depot
- PremPuri, 1981. Bryophytes: Morphology, Growth and differentiation. Atma Ram and Sons. New Delhi.
- Rashicl, A. 1999. Pteridophyta. Vikas Publishing House Pvt. Ltd. New Delhi.
- Sharma. O.P. 1990. Textbook of Pteridophyta. Macmillan India Ltd. Delhi.
- Sporne, K. R.1986. Morphology of Gymnosperms. Hutchinson University Press.
- Sporne, K.R.1986. The morphology of Pteridophytes. Hutchinson University Press.
- SundaraRajan, S.1999. Introduction to Pteridophyta. New Age International Publishers, New Delhi. Vashishta, P.C. 1999. Bryophyta. S. Chand & Co. New Delhi.
- Vasishta, B. R., Sinha, A.K. & Kumar, A. 2011. Bryophyta (Revised Edition), S. Chand & Co. New Delhi.

MASTER OF SCIENCE IN BOTANY

Semester II

Course Code: BOT-202(CC)

Paper II- Plant Physiology (CC)

Credit: 4 **(Lectures: 60)**

Course Objectives:

- This course aims to educate student on concepts of proteins, enzymes, basic plant signalling mechanisms, sensory photobiology.
- The course further deals with physiology of nutrient uptake, photosynthesis and nitrogen metabolism.

Course Outcomes:

On successful completion of the course, the students will be able to:

- Understand the physiological pathways of plant systems
- Familiarize the factors influencing plant growth
- Understand the activity of hormones on plant growth and development
- Students will gain the knowledge on reproductive strategies in higher plants along with physiology of flowering, molecular and hormonal basis of flowering mechanism.

Unit I

Water relations of plants: Physicochemical properties of water, chemical potential and water potential in the plant.

Transport of water and solutes: Uptake of water, comparison of xylem and phloem transports, phloem loading and unloading, passive and active transports.

Transpiration: Types, cuticular, lenticular and stomatal. Factors affecting transpiration. Stomatal physiology and regulation.

Unit II

Photosynthesis: Photophysical and photochemical phase: light reactions, sequence of photosynthetic pathway – Electron Transport Chain, Photophosphorylation. Pathways of CO2 fixation in C3, C4 plants and CAM pathway. Glycolate pathway. Factors affecting photosynthesis

Signal Transduction: Overview, second messengers, receptors and G-proteins, phospholipid signaling, role of cyclic nucleotides, calcium-calmodulin cascade, diversity in protein kinases and phosphatases, specific signaling mechanisms and their regulation, e.g. simple and hybrid type of two-component sensor-regulator system in bacteria and plants (examples of chemotaxis, osmosensing, ethylene and cytokinin signaling), quorum sensing.

Unit III:

Respiration: Aerobic and Anaerobic, fermentation, respiratory quotient, Glycolysis, Kreb's cycle. Oxidative phosphorylation. Factors affecting respiration.

Photorespiration, pentose phosphate pathway, glyoxylate cycle.

Sensory Photobiology: Structure, function and mechanisms of action of phytochromes, cryptochromes and phototropins; stomatal movement; scotomorphogenesis and photomorphogenesis.

Unit IV

Nutrient Uptake: Apoplastic and symplastic transport mechanisms, role of aquaporins and transporter proteins, structure-function relationship of inward and outward ion channels, dual action of ATPases/pumps and modulation of their activity, specialized mechanisms for phosphorus and iron uptake, monitoring of ion channel activity;

Progammed cell death – Physiological and biochemical change. Water and salt stress.

- **Suggested Readings:**
  - Buchanan B, Gruissem G and Jones R. (2000) Biochemistry and Molecular Biology of Plants, American Society of Plant Physiologists, USA.
  - Davies P J. (2004) Plant Hormones: Biosynthesis, Signal Transduction, Action. 3rd Edition, Kluwer Academic Publisher, Dordrecht, The Netherlands.
  - Jordan BR. (2006) The Molecular Biology and Biotechnology of Flowering, 2nd Edition, CAB International, Oxfordshire, U.K.
  - Lehninger, A. L., Nelson, D. L. 1., & Cox, M. M. (2008). Lehninger principles of biochemistry (5th ed.). New York
  - Taiz, L. and Zeiger, E. (2010) Plant Physiology. 5th Edition
  - Hans-Walter Heldt Birgit Piechulla (2010) Plant Biochemistry
- **Suggested Practicals:**
  - Determination of water potential – plasmolytic, Chardkov's and Gravimetric method
  - Quantifications of non-photosynthetic figments (chla, chlb, chla+b)
  - Quantifications of photosynthetic fragments (Anthocyanin and flavones)
  - Absorption and Action spectra of Chlorophyll pigment
  - Effect of pH, temperature and detergents on membrane permeability
  - Effect of hormones on seed germination
  - Seed viability test (Tetrazoline blue dye reduction)
  - Smith's fermentation (Kuhn's fermentation tube)

MASTER OF SCIENCE IN BOTANY

Semester II

Course Code: BOT-203 (CC)

Paper-III Plant Biotechnology

Credit: 4 **(Lectures: 60)**

Course Objectives:

- This course is designed to provide a contextual and inquiry-based learning of modern-day advances in the field of recombinant DNA technology and proteomics.
- This course would provide students with an understanding of principles and techniques of plant tissue culture, concepts and methods associated with development and analysis of transgenic plants, and their applications in basic and applied research.

Course Outcomes:

The students will learn about

- Concepts, tools and techniques related to in vitro propagation of plants.
- Different methods used for genetic transformation of plants, use of Agrobacterium as a vector for plant transformation, components of a binary vector system.
- Various case studies related to basic and applied research in plant sciences using transgenic technology.
- Principles and methods used for phenotypic, genetic and molecular analysis of transgenic plants 5. Uses and current research paradigms in various plants of economic value.

Unit –I

Plant tissue culture – history; concepts of cell differentiation and totipotency; pathways for in vitro regeneration: organogenesis, somatic and gametic embryogenesis; protoplast isolation, culture and regeneration; somatic hybridization; Applications: micropropagation, meristem culture, embryo rescue, synthetic seed production, soma clonal and androclonal variations, cryopreservation and germplasm storage

Unit – II

Methods of gene delivery – Agrobacterium and CaMV mediated gene transfer; direct gene transfer using PEG, electroporation, biolistics, microinjection and liposome mediated. Transposons as vectors; use of mixed vectors, synthetic DNA vectors

Unit – III

Agro bacterium and genetic engineering in plants – Ti plasmid (Octopine and Nopaline) – Disarmed Ti plasmid vectors- Ri plasmid. Gene maps and expression of T-DNA. Incorpporation of T-DNA into the nuclear DNA of plant cells – role of virulent gene.

Unit- IV

Gene transfer in nuclear genome and chloroplasts; Agrobacterium-mediated gene transfer, direct gene transfer, antibiotic marker-free transgenics. Transgenic plants: insect resistance, virus resistance, abiotic stress tolerance, longer shelf life (including strategies for suppression of endogenous genes), male sterility, enhanced nutrition (golden rice), edible vaccines

- **Suggested Practicals:**
  - E. coli growth curve
  - Preparation of different types of standard tissue culture media.
  - Preparation of competent cells and transformation of E. coli (chemical/electroporation method)
  - Plasmid DNA isolation, quantification and agarose gel electrophoresis.
  - Restriction digestion, elution and cloning in E. coli.
  - Establishment of aseptic cultures following appropriate sterilization procedures using seeds.
  - PCR
  - ELISA
  - Southern Hybridization
  - RNA extraction and preparation of cDNA.
  - Preparation of competent cells and Agrobacterium transformation by electroporation.
  - Agrobacterium tumefaciens-mediated transformation of tobacco.

- **Suggested Readings:**

  - Buchanan B, Gruissem G and Jones R (2000). Biochemistry and Molecular Biology of Plants, American Society of Plant Physiologists, USA.
  - Harlow and Lane D (Eds.) (1988). Antibodies – A Laboratory Manual; Cold Spring Harbor Laboratory, USA.
  - Lieber DC (2006). Introduction to Proteomics: Tools for New Biology; Humana Press, NJ.
  - Pennington SR, Dunn MJ (Eds.) (2002). Proteomics: From Protein Sequence to Function, BIOS Scientific Publishers, United Kingdom.
  - Sambrook J and Russell DW (2001). Molecular Cloning – A Laboratory Manual, Vols I – III, Cold Spring Harbor Laboratory, USA.
  - Singer M and Berg P (1991). Genes and Genomes: A Changing Perspective; University Science Books, CA, USA.

MASTER OF SCIENCE IN BOTANY

Semester II

Course Code: BOT-204 (CC)

PAPER IV Recombinant DNA Technology and Molecular Pharming

Credit: 4 **(Lectures: 60)**

Course Objectives:

- This course is designed to provide a contextual and inquiry-based learning of modern-day advances in the field of recombinant DNA technology and proteomics.
- The aim of this course is to give the students essential knowledge pertaining to micropropagation, somatic embryogenesis, chromosome walking, somatic hybridization, DNA cloning etc.

Course Outcomes:

Students will acquire understanding of:

- Basic principles and modern age applications of recombinant DNA technology and proteomics.
- Learning molecular and technical skills along with applications of the instrumentation.
- Designing/conducting experiments and analysing experimental data.
- Ethics of Recombinant DNA Technology and proteomics.

Unit I

Basics of Recombinant DNA Cloning Introduction to purpose of cloning and concept of vector and insert, commonly used enzymes and their properties in RDT, principle of restriction digestion and its application in cloning.

Basic features of vectors (Promoters, terminators and sequences influencing gene expression, selectable markers and reporter genes, origin of replication).

- Vectors for cloning like plasmid, phage, phagemid, cosmid, BAC, PAC and YAC.

Unit II

Isolation of gene(s) of interest, isolation of specific genes from bacteria and higher plants; cloning; plant viruses, cDNA and genomic libraries; chromosome walking PCR and its applications; Principles of DNA sequencing.

Unit III

Micro propagation – Somatic hybridization, Cybrids, Artificial seeds and Soma clonal variation. Transgenic plants – Herbicide resistant plants. Virus resistant plants. Development of Bt cotton. Golden rice and Flavr SavrTamato.

Applications of rDNA technology – DNA finger printing – DNA vaccines – plants as edible vaccines – Hybridoma. Production of secondary metabolites, Cell immobilization, bio-reactor technology; conservation of germplasm in vitro strategies.

Unit IV

Molecular Pharming in Plants-Introduction and brief history of plant molecular pharming; Unique properties of host species for molecular pharming (tobacco, alfalfa, white clover, lettuce , spinach, dry seed crops, oil crops, fruit and vegetable crops), Types of plant expression systems for molecular pharming (stable nuclear transformation, plastid transformation system, virus infected plants, transiently transformed leaves, hydroponic cultures, hairy roots, shooty teratomas, suspension cell cultures, oleosin system); comparison, advantage and disadvantage of production system of molecular pharming (bacteria, yeast, transgenic animal, plant cell culture and transgenic plants).

Suggested Practicals:

- Isolation of Bacterial chromosomal DNA
- Isolation of plant chromosomal DNA
- Isolation of bacterial plasmid – Demonstration
- Agarose gel Electrophoresis and visualization of DNA
- Plant tissue culture, suspension culture induction – Demonstration
- Demonstration of regeneration from callus cultures
- Demonstration of isolation of plant protoplasts.
- Photographs of DNA on Agarose gel, Blue/white clones, plant tissue cultures, protoplasts, Transgenic plants.
- Diagram of vectors. Southern blot, Western blot setups.
- Amplification of DNA using PCR procedure – demonstration.
- Demonstration of protoplast isolation, culture and fusion.
- Demonstration of haploid plant production in Datura.
- Isolation of DNA and identification of DNA by AGE.
- Restriction digestion and estimation of the size of various DNA fragments
- Polymerase Chain Reaction amplification of DNA and analysis of the products

Suggested Readings:

- Brown, T.A. (2016) Gene Cloning and Analysis: An Introduction. Seventh edition. WileyBlackwell Publishing, UK.
- Dale J.W., Schantz M.V. and Plant N. (2011) From Genes to Genomes: Concepts and Applications of DNA Technology. Third edition. John Wiley & Sons, UK.
- Glick B.R., Pasternak J.J. and Patten C.L. (2010) Molecular Biotechnology: Principles and Applications of Recombinant DNA. Fourth edition. ASM Press, USA.
- Green M.R. and Sambrook J. (2012) Molecular Cloning: A Laboratory Manual. Fourth edition. CSHL Press, USA.
- Metzler, D.E. (2003) Biochemistry. Second edition. Academic Press, USA.

- Primrose, S.B. and Twyman, R.M. (2006) Principles of Genetic Manipulation and Genomics. Seventh Edition. Blackwell Publishing, UK.
- Voet, D., Voet, J.G. and Pratt C.W. (2012) Principles of Biochemistry. Fourth edition. John Wiley & Sons, UK.
- Wilson, K. and Walker, J. (2010) Principles and Techniques of Biochemistry and Molecular Biology, Seventh edition, Cambridge University Press, USA.
- Daniel, C Liebler (2002) Introduction to Proteomics-Tools for New Biology. Humana Press, Totowa, NJ.
- Twyman, R (2014) Principles of Proteomics. Second edition. Garland Science, Taylor and Francis group, UK
- Comai, L; Katz J and Mallick, P (2017) Proteomics-Methods and Protocols, Springer Protocols, Springer New York.

MASTER OF SCIENCE IN BOTANY

Semester II

Course Code: BOT-205 (DSE2)

PAPER V- Biodiversity and Evolutionary Biology

Credit: 4 **(Lectures: 60)**

Course Objectives:

- Patterns of biological variation and underlying processes responsible for these patterns.
- Evolutionary history and methods of study.
- Processes of evolution and methods of study.
- Tree thinking (in contrast to group thinking), skills in application.
- Population thinking (in contrast to typological thinking), skills in application.

Course Outcomes:

- On successful completion of the course, the students will be able to:
- Recall the Mendelian principles
- Interpret the concepts of linkage, crossing over and polyploidy
- Appreciate the evolutionary theories and variations in gene frequencies in a population.

Unit-I

Biodiversity definition, concept, scope, Levels of biodiversity Genetic, species and ecosystem diversity, Magnitude and distribution: Diversity gradients and related hypotheses, methods for biodiversity monitoring, megadiversity zones and hot spots ; Concept of Hot Spots, Keystone species, distribution of hotspots in India and the world, Measures of biodiversity – alpha, beta and gamma diversity .

Geological fundamentals. Phylogeny and the fossil record. Evolutionary trends. Rates of evolution. The geography of life. Major patterns of distribution. Historical biogeography, phytogeography. Genetic diversity: Genes, genomes, mutations, karyotypes. Sources of phenotypic variation. Genetic variation in populations. Variation among populations.

Unit- II

Causes and consequences of loss of biodiversity; Impact of exotic species on local biodiversity; extinction of species; Key stone species and their significance. Climate Change mediated Impacts on Biodiversity – El-Nino Southern Oscillation phenomenon (ENSO) and its impacts-sea surface water temperature (SST) elevation and coral reef bleaching, impacts of coral bleaching on coral biodiversity; Red Data Book and its importance.

Unit- III

Evolution: Various theories of Evolution – Lamarckism, Darwinism – Modern synthetic theories of Evolution – Natural selection and speciation Role of RNA in organic Evolution. Macroevolution: Inferring phylogenies. Gene trees, species trees. Patterns of evolutionary change. Adaptive radiation. Evolution and development.

Microevolution: Genetic drift, sampling, coalescence. Founder effects. Neutral theory of molecular evolution. Natural selection. Adaptation in action. Experimental studies. Levels of selection.

Unit- IV

Wildlife Conservation and management - need for conservation – in situ conservation; Sanctuaries, National parks, biosphere reserves – ex situ conservation, Zoological parks, gene banks and cryopreservation –Role of indigenous people in conservation – sacred species, sacred groves; role of remote sensing in biodiversity conservation; Biodiversity conservation – human animal conflicts.

Genetical theory of natural selection. Fitness, modes and models of selection. Evolution of phenotypic traits, Conflict and co-operation. Species and speciation. Reproductive success. Co-evolution.

- **Suggested Practicals-**
  - To find out species density, richness, abundance and frequency through plot method
  - To construct species-area curve for woody plant community
  - To find species and family important value indices for plant community/communities from grassland or forest
  - To estimate Shannon and Simpson diversity indices for plant community
  - To estimate Jaccard community coefficient index for determining the similarity among plant communities
  - To findthe population structure of woody plant community using basal area, tree size and density
  - To record diversity of woody plants in tropical dry forest located in your area.

Field visits/scientifictours

*Note: the students are expected to prepare a brief illustrated narrative of the field survey and scientific visits. After evaluation, the marks/grades awarded to students by teachers will be added to the final assessment of credits for Field study/tour.

- **Suggested Reading**

  - David Briggs, Stuart Max Walters (1997). Plant Variation and Evolution, Cambridge University Press
  - Douglas J. Futuyma (1998). Evolutionary Biology (3rd Edition), Sinauer Associates
  - Mark Ridley (2003) Evolution (3rd edition), Blackwell.
  - Roderic D. M. Page, Edward C. Holmes (1998). Molecular Evolution: A Phylogenetic Approach, Blackwell.
  - Scott R, Freeman and Jon C. Herron (2003). Evolutionary Analysis, Prentice Hall
  - Blackie, 1983. Evolutionary Principles. Oxford & 1BH, New Delhi.
  - Gadgil, M., Ghate, U, and Pramod, P.1996 Biodiversity resource materials, centre for ecological sciences. Indian Institute of Sciences, Bangalore and Biodiversity Unit, Jawaharlal Nehru, Centre for Advanced Scientific Research, Bangalore.
  - Gilson, L. 2015. Biodiversity Conservation and Environmental Change, Oxford University Press, Oxford.

- Krishnamoorthy, K.V. 2009. An advanced Text book on Biodiversity –Principles and practice, Oxford & IBH Publishing co, PVT. Ltd., New Delhi.
- Kumar, H.D. 1999. Biodiversity and sustainable conservation. Oxford and IBM publishing Company, New Delhi.
- Melchias, G.2001, Biodiversity and Conservation, Oxford and IBM publishing company Pvt., Ltd. New Delhi

MASTER OF SCIENCE IN BOTANY

Semester II

Course Code: BOT-205 (DSE2)

PAPER V- BIOFERTILIZERS

Credit: 4 **(Lectures: 60)**

Course Objectives:

- To acquaint the students with the preparation techniques and applications of biofertilizers.
- Students will come to know about benefits of micro-organisms.

Course Outcomes:

On successful completion of the course, the students will be able to:

Familiarize with the basic principle and techniques of Biofarming.

Appreciate the agronomic importance of beneficial micro-organisms

Formulate, produce and apply Biofertilizers in a pilot scale

Unit-I

Biofertilizers - Introduction, scope. A general account of plant growth promoters and regulators – Cyanobacterial Biofertilizer: Algalization – mass cultivation of cyanobacterial biofertilizers.

Unit-II

Nitrogen fixing Bacteria: Isolation, characterization, identification, mass cultivation and inoculation method of Rhizobium and Azospirillum. Mechanism of nitrogen fixation (free-living and symbiotic) - Biochemistry and molecular basis of nitrogen fixation.

Unit- III

Azolla – Structure and Morphology – Mass cultivation method and Application. Economic and Ecological importance of Azolla. Unit Phosphate solubilizing Bacteria: Isolation,

characterization, identification, mass cultivation and inoculation method of Phosphobacteria. Biochemistry of Phosphate solubilization and mobilization.

Unit- IV

Mycorrhizal fungi as biofertilizers - Introduction, scope. A general account of Ecto, Endo and Arbuscular mycorrhizae (AM). Isolation and method of inoculation of Arbuscular mycorrhizae (AM), Legume - AM interactions . Carrier based inoculum production methods and Field application

- **Suggested Practicals-**
  - To Evaluate Microbial Activity.
  - Detection of N-fixing activity.
  - Isolation of brady rhizobia from dried root nodules.
  - Isolation of spores from soils and their observation for identification.
  - Field study on application of biofertilizers.
- **Suggested Readings-**
  - A text book of microbiology, second reprint. S. Chand and Company• Ltd., New Delhi. Refernce Books Ann Larkin Hansen , 2010.
  - Dubey, R. C. 2008. A Textbook of Biotechnology. S. Chand & Co., New Delhi.
  - Kannaiyan, S. 2002 Biotechnology of Biofertilizers. Narosa publishing house, New• Delhi. Dubey, R.C. 2001.
  - Subba Rao, N. S. 2002. Soil Microbiology. 4th ed. Soil Microorganisms and Plant Growth. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
  - The Organic Farming Manual: A Comprehensive Guide to• Starting and Running a Certified Organic Farm. Storey Publishing LLC.
  - Niir Board, 2004. The Complete Technology Book On Bio-Fertilizer And Organic Farming, National Institute Of Industrial Research, Delhi

Innovative and research oriented applied botany-

- ***Low cost production of organic food and products***
- ***Increasing biomass of medicinally important plants***
- ***Increasing usage of plants in cosmetic and skincare industries***
- ***Effect of chemical industries' waste on surrounding plant growth and production***
- ***DNA extraction from plant cells by using chemicals present in surroundings***