# Department of Bioscience and Biotechnology

## M. Sc. Bioscience (BOTANY STREAM)

### 1st Semester
- **BSB-411** Cell Biology 4CH
- **BSB-412** Microbiology 4CH
- **BSB-413** Biomolecules & Enzymology 4CH
- **BSB-414** Biostatistics & Computer Application 4CH
- **BSB-415** Practical 8CH

### 2nd Semester
- **BSB-421** Genetics & Molecular Biology 4CH
- **BSB-422** Immunology 4CH
- **BSB-423** Environmental Biology & Biodiversity 4CH
- **BSB-424** Bio techniques & Instrumentation 4CH
- **BSB-425** Practical 8CH

### 3rd Semester
- **BSB-531** Plant Morphology & Systematic 4CH
- **BSB-532** Angiosperms and Plant Anatomy 4CH
- **BSB-533** Plant Physiology 4CH
- **BSB-534** Choice Base Credit Paper 4CH
- **BSB-535** Practical 8CH
  - Non credit course on Fakir Mohan Studies

### 4th Semester
- **BSB-541** Plant Development 4CH
- **BSB-542** Special Paper-I 4CH
- **BSB-543** Special Paper-II 4CH
- **BSB-544** Dissertation (Project work) 8CH
- **BSB-545** Dissertation Presentation, Seminar & Grand Viva-Voce 4CH

### Special Papers
1. Microbiology
2. Molecular Physiology
3. Molecular Genetics
1st Semester

BSB-411                               CELL BIOLOGY       4CH

Unit-I: Diversity of cell, sizes & shapes, Cell theory, Structure of prokaryotic and eukaryotic cells, Cellular organelles - Structural organization and function of plasma membrane, cell wall, Transport of nutrients, ions and macromolecules across membranes, Cell motility – cilia, flagella of eukaryotes and prokaryotes.

Unit-II: Organization of genes and chromosomes: Operon, unique and repetitive DNA, heterochromatin, euchromatin, Cellular energy transactions – role of mitochondria and chloroplasts, Cell cycle-molecular events and model systems, Mitosis & Meiosis, Cellular responses to environmental signals in plants and animals – mechanism of signal transduction.

Unit-III: Metabolite pathways and their regulation, Biosynthesis of proteins in eukaryotic cell, co and post translational modification, intracellular protein traffic, Protein localization, synthesis of secretory and membrane protein, import into nucleus, mitochondria, chloroplast and peroxysomes, receptor mediated endocytosis.

Unit-IV: Cellular basis of differentiation and development – gametogenesis and fertilization, Development in Drosophila and Arabidopsis, Brief introduction to the life cycle and molecular biology of some important pathogens of AIDS, Malaria, Hepatitis and Tuberculosis.

Books
3. Developmental Biology, Gilbert SF, Sinauer Assoc. Inc.
Unit-I: Introductory Microbiology: History, Microbial evolution, modern approaches in taxonomy, ribotyping, ribosomal RNA sequencing; taxonomic nomenclature and Bergen’s manual role of micro-organisms; sterilization techniques; principles of microbial nutrition; culture media for different micro-organisms, culture collection and maintenance of cultures.


Unit-III: Diversity of Bacteria, mycoplasma, Archea as the earliest life forms, Eukarya, viruses, Microbial Diseases caused by bacteria and viruses and pathogenic fungi, emerging and resurgent infectious diseases. Host-parasite relationship: microflora of skin; oral cavity; gastrointestinal tract; entry of pathogens into the host; genesis.


Books
Unit-I: Chemical foundations of Biology: pH and buffers, Principles of thermodynamics, Heterocyclic compounds and secondary metabolites in living systems – nucleotides, pigments and isoprenoids, Analytical techniques in biophysics and biochemistry for small molecules and macromolecules for quantification.


Unit-III: Enzyme: Chemical nature, Nomenclature, Classification, Mechanism of enzyme catalysis, Activation energy, Enzyme specificity, Enzyme substrate interaction, factors affecting enzyme activity, Enzyme kinetics, Michaelis – Menton’s Equation, Lineweaver – Burk plot, kinetics of multi-substrate reaction, Different types of enzyme inhibitions.

Unit-IV: Regulatory enzyme, covalent modulation and non-covalent modulation of regulatory enzyme, Aspartate transcarbmylase, glycogen phosphorylase, Models of enzyme catalysis, chymotrypsin, hexokinase, carbonic anhydrase, restriction enzyme, ribozymes, isozymes.

Books
1. Essentials of Molecular Biology, David Friefilder, Jones and Bartlett Publications.
9. Protein Structure, Max Peruz.
Unit-I: Brief description and tabulation of data and its graphical representation. Measure of central tendency and dispersion; mean, median, mode, range, standard deviation, variance. Idea of two types of errors and level of significance, tests of significance (F, Z and t-test); chi-square tests, Simple linear regression and correlation.

Unit-II: Introduction of digital computers; organizations; low-level and high level languages, the binary number system. Flow charts and programming techniques. Microsoft software (presentation software, word, excel), Introduction to programming in basic C and C++.

Unit-III: Computer – oriented statistical techniques: Computation of mean, variance and standard deviation, t-test, correlation coefficient.

Unit-IV: Introduction to Bio-informatics and different tools, Introduction to data structures and database concepts, Biological sequence analysis, pair wise and multiple sequence alignment, Phylogenetic analysis of protein and genes, Homology modelling and docking, Protein structure prediction.

Books
1. Fundamentals of Biostatistics by Veer Bala Rastogi
2. Basic Biostatistics by G B N Chainy, P. K. Mohanty and G. Mishra
3. Fundamentals of Biostatistics by Bernard Roser
5. Computer Fundamentals by Anita Goel
6. The C++ Programming language by Bjarne Stroustrup
1. Microscopy
2. Microtomy.
3. Mitosis and meiosis.
4. Preparation of liquid and solid media for the growth of micro-organisms.
5. Isolation and maintenance of organisms by plating, streaking, and serial dilution methods, slants and stab cultures, storage of microorganisms.
6. Isolation of pure cultures of bacteria from soil and water.
8. Microscopic examination of bacteria, yeast and moulds and study of organisms by Gram stain, acid fast stain and staining for spores.
10. Bacterial transformation.
11. Biochemical characterization of selected microbes.
12. Transduction.
15. Quantitative estimation of Protein, Sugars, Lipids by spectrophotometer.
17. Determination of activity of different enzymes.
18. Preparation of Buffers.
19. Karyotyping
20. Practical related to Biostatistics and computer application.
2nd Semester

BSB-421 Genetics & Molecular Biology 4CH

Unit-I: Introduction to Genetics. An overview on Mendelian & Non-Mendelian inheritance, Linkage & crossing over, sex linked inheritance, gene mapping (in E.Coli & Drosophilae), Mutation- types and significance, Structure & numerical variation in chromosomes, meiotic behaviour and genetic consequences in structural heterozygotes, Polygenic inheritance, multiple alleles, evidences of DNA as genetic material, Gene concept, and one gene-one polypeptide hypothesis.

Unit-II: Introduction to Molecular Biology, DNA Replication: Prokaryotic and Eukaryotic DNA replication, Transcription: Prokaryotic transcription, Eukaryotic transcription, RNA polymerase, General and specific transcription factors, mechanisms of transcription regulations, transcriptional and post-transcriptional modifications, gene silencing, Translation: Prokaryotic and Eukaryotic translation, the translation machinery, mechanisms of initiation, elongation and termination, regulation of translation, co-and post-translation modifications of proteins.


Unit-IV: Antisense and Ribozyme Technology: Molecular mechanism of antisense molecules, inhibition of splicing, polyadenylation and translation, disruption of RNA structure and capping, biochemistry of ribozyme; hammerhead, hairpin and other ribozymes, strategies for designing ribozymes, applications of antisense and ribozyme technology.

Books
BSB-422  Immunology  4CH

Unit-I: Introduction, Phylogeny of immune system, Innate and acquired immunity, Clonal nature of immune response, Organization and structure of lymphoid organs, Cells of the immune system : Hematopoiesis and differentiation, lymphocyte trafficking, B- lymphocytes, T-lymphocytes, macrophages, dendritic cells, natural killer and lymphokine activated killer cells, eosinophil, neutrophils and mast cells.

Unit-II: Nature and biology of antigens and super antigens, Antibody structure and function, Antigen-antibody interactions, Major histocompatibility complex, BCR and TCR generation of diversity, Complement system. Regulation of immune response, Antigen processing and presentation, generation of humoral and cell mediated immune responses, Activation of B and T – lymphocytes, Cytokines and their role in immune regulation, T-cell regulation, MHC restriction, Immunological tolerance.

Unit-III: Cell – mediated cytotoxicity: Mechnism of T cell and NK cell mediated lysis, antibody-dependent cell-mediated cytotoxicity, macrophage mediated cytotoxicity, Hypersensitivity, Autoimmunity.

Unit-IV: Transplantation, Immunity to infectious agents (intracellular parasites, helminthes and viruses), Tumour immunology, AIDS and other immune-deficiencies, Hybridoma technology and monoclonal antibodies.

Books
3. Fundamentals of Immunology, William Paul.
4. Immunology by Roist and others.


Unit-III: Concept of population and population attributes: Biotic potentiality and natality, mortality, survivorship curves, life table, age structure, population growth forms, concept of carrying capacity and environmental resistance, Life history strategies, r and k selection. Population fluctuation and population interaction: Extrinsic and intrinsic factors associated with population fluctuation, abiotic, biotic, density dependent and independent factors. Community: Concept of habitat and niche, types of niches; spatial, trophic and hypervolume niche; ecological equivalents, community organization, types of communities, community structure (analytical and synthetic), qualitative features of community (Composition, stratification, Physiognomy, dispersion, sociability, vitality etc), quantitative characteristics of community (frequency, density, cover dominance and diversity, important value index), Ecotone and edge effect. Community dynamics and succession: Ecological succession (Hydrosere, Lithosere and Xerosere)

Unit-IV: Biodiversity- Concept of Biodiversity ($\alpha, \beta, \gamma$) Significant of biodiversity, Status of Biodiversity at global and National level. Biodiversity hot spots and megadiversity countries. Assessment of Biodiversity (Species Richness, dominance and Diversity Indices, Similarity index etc.). Principle of conservation of Biodiversity (Ex Situ and In Situ). Strategies for Biodiversity conservation and salient features of biodiversity Act.

BOOKS
1. Fundamentals of ecology by Prof. M.C. Dash
BSB-424  Bio techniques & Instrumentation  4CH

Unit-I pH measurements by method of pH indicators and potentiometric methods, Centrifugation Techniques: Principle and application of High speed centrifuges, Continuous flow centrifuge, Density gradient centrifuge, Analytical ultracentrifugation.

Unit-II Spectroscopic methods: The principle, instrumentation and application of the ultraviolet and visible spectrometry, Fluorescence Photometry, Infra-red-spectroscopy. Atomic Absorption Spectroscopy (AAS): The principle, differences, instrumentation and application of Flame emission spectroscopy and Absorption spectroscopy.

Unit-III Chromatography Techniques: The principle, experimental techniques, qualitative and quantitative analysis, applications of Adsorption Chromatography, Ion exchange chromatography, Paper chromatography, Thin layer chromatography (TLC), Gas liquid chromatography (GLC), High performance liquid chromatography (HPLC).

Unit-IV Electrophoresis Techniques: Principle, methods of measurement and applications of paper and cellulose Acetate electrophoresis, Thin layer Electrophoresis, Polyacrylamide Gel Electrophoresis (PAGE) and Agarose Gel Electrophoresis. Bomb Calorimetry: Principle, experimental arrangement and its application. Radioactivity and instruments for measurement of radiation such as Geiger–Müller counter & Liquid Scintillating counter.

BOOKS
i. Instrumental methods of analysis  by Willard et al.
ii. Practical Biochemistry: Principles and Techniques by Wilson and Walker
iii. Principles and Techniques of Biochemistry and Molecular Biology By Wilson and Walker
BSB-425 Practical 8CH

1. Isolation of genomic DNA
2. Southern blotting
3. RFLP analysis
4. Isolation of RNA
5. Northern blotting
6. Metabolic labeling of proteins and immunoprecipitation
8. Lymphoid organs and their microscopic organization.
10. Double diffusion and immuno-electrophoresis.
11. Radial immuno diffusion
12. Purification of IgG from serum.
14. Western-blotting
15. ELISA
17. Immunodiagnostics (demonstration using commercial kits).
18. Calculation of Important Value Index (IVI) of grassland ecosystem.
19. Determination of primary productivity
20. Homozygote and heterozygote determination by Hardy-Weinberg’s equation.
THIRD SEMESTER

**BSB-531**  
Plant Morphology & Systematic  

**Unit-I**  
**Algae:** Range of thallus organization and reproduction in chlorophyceae, Thallus organization, reproduction and life cycle of Phaeophyceae, Thallus organization, reproduction and life cycle in Rhodophyceae.

**Fungi:** Sexual and asexual reproduction in Phycomycetes, Mode of ascus formation and degeneration of sexuality in Ascomycetes, Somatic structure and Basidium formation in Basidiomycetes.

**Unit-II**  
**Bryophytes:** Evolution of sporophytes in Marchantiales, Anthocerotales as the connecting link between Pteridophytes and Bryophytes, Mosses as the most advanced bryophytes, Comparative study of Marchantiales, Anthoceratales, Sphagnales and Funariales.

**Unit-III**  
**Pteridophytes:** Origin and evolution in Pteridophytes, Telome theory, apogamy and apospory, heterospory and seed habit, Filicales as the advanced Pteridophytes, Fossil and Fossilization process, A brief account of the following fossils: Rhynia, Psilophyton and Lepidodendron, Economic importance of Pteridophytes.

**Unit-IV**  
**Gymnosperms:** Origin and outline classification, Cycadofilicales as intermediate between Petridophytes and Gymnosperms, Cycadales as the relic of ancient Gymnosperms, Phylogenetic position of Ginkgoales, Gnetum as the advanced Gymnosperms, Evolution of ovules in Gymnosperms.

**BSB-532**  
Angiosperms and Plant Anatomy  

**Unit-I**  
Origin and evolution in Angiosperm, Classification schemes for Angiosperms, Natural, artificial and phylogenetic classification with examples, Botanical nomenclature: International code of Botanic Nomenclature; principles: Rules and recommendations; priority; typification; Rules of effective and valid publications; Numerical taxonomy, Chemotaxonomy.

**Unit-II:**  
Diagnostic characteristics, systematic phylogeny and economic importance of families: Magnoliaceae, Rosaceae, Apocynaceae, Asclepiadaceae, Convolvulaceae, Bignoniaceae, Lamiaceae, Euphorbiaceae, Orchidaceae, Zingiberaceae, Cyperaceae and Poaceae, Embryology and Palynology in relation to taxonomy.

**Unit-III**  
Molecular approaches to plant taxonomy: Application of DNA markers in angiosperm taxonomy; molecular phylogeny. Apomixis: Adventive embryony, diplospory, apospory, Polyembryony.

**Unit-IV**  
Secondary growth and its abnormalities in Angiosperms, Significance of anomalous secondary growth, Structural anatomy of wood and its variation in Angiosperms,
Meristem and its organization, types and significance in Angiosperms, Special features of apical meristem.

**BSB-533**  
**Plant Physiology**  
**4CH**

**Unit-I** Water relation in plants: Diffusion and water potential, osmosis, Ascent of sap, Transpiration, stomatal movement mechanism. Solute transport; phloem loading and unloading, partitioning and control mechanisms.

**Unit-II**: Mineral nutrition: Methods of studying plant nutrition, Nitrogen and Sulphur metabolism, Mechanism of nitrogen fixation in free living and symbiotic organisms, Assimilation of nitrate and sulphate, Physiological responses to abiotic stresses: Responses to the abiotic factors, light, temperature, water and salts; acclimation of physiological processes under abiotic stresses, Calmodulin i) Structure ii) Function iii) Protein phosphorylation

**Unit-III** Respiration and Respiratory quotient, Alternative pathways of electron transport and significance of Oxidative phosphorylation, Energetics of respiration, lipids as respiratory substrates, Cyanide – resistant respiration.

**Unit-IV** Photosynthesis and photosynthetic pigments, Carbon fixation (C3, C4 and CAM pathway), Photorespiration, Synthesis of sucrose and starch.

**Books**  
i. Plant Physiology by Taiz & Zaiger

**BSB-534**  
**Choice Base Credit Paper**  
**4CH**

**BSB-535**  
**PRACTICAL**  
**4CH**

1. Description and identification of Angiosperms at family, genus and species levels using Floras.
2. Identification of key characters in a group of species of a genus and construction of keys.
5. Collection and identification of algae occurring in and around University / College Campuses.
6. Morphology and anatomy of vegetative and reproductive organs using cleared whole mount, sections macerations and permanent preparations Bryophytes and Pteridophytes.
8. Determination of chlorophyll a, chlorophyll b and total chlorophylls in C3 and C4 plants.
11. Record and collections (Herbarium)

FOURTH SEMESTER

BSB-532  Plant Development  4CH

Unit-I  Molecular and cytological analysis: Male & female Gametophytes, Fertilization, Endosperm, Different types of embryo, Apomixis, Polyembryony, Parthenogenesis & Parthenocarpy.

Unit-II  Hormones and growth regulators: Auxins, Cytokinins, Gibberllins, Ethylene, Abscisic Acid and other compounds, and their mechanism of action, Biological clock.

Unit-III  Flowering and senescence: Photoperiodism signals involved in flowering, Gene regulation of floral development. Programmed cell death, Types of senescence, significance and regulation of leaf senescence by genes, Photoreceptors: Phytochromes, Cytochromes, UV-B and their role in regulation of plant morphogenesis.

Unit-V  Germination and Greening: Pattern formation in plants: Molecular analysis of shoot apical meristem, Root apical meristem, and Leaf growth, Physiological & molecular changes associated with germination, Vascular tissue differentiation, Homeotic mutants in Arabidopsis and Antirrhinum, Biosynthesis of chlorophylls, LHC.

Books
i. Plant development by Srivastava

BSB-542  Special Paper-I  4CH
BSB-543  Special Paper-II  4CH
BSB-544  Dissertation (Project work)  8CH
BSB-545  Dissertation Presentation, Seminar & Grand Viva-Voce  4CH

Special Papers:  Student has to select any one of the following papers:

1. Microbiology
2. Molecular Physiology
3. Molecular Genetics