Sinhgad Technical Education Society's
SINHGAD COLLEGE OF SCIENCE
Department of Computer Science
(Affiliated to University of Pune, ID No. PU/PN/SC/162/2001, **NAAC Accredited**: 'B' + **Grade.**)
S.No. 9/1/5 & 9/2/4, off West Bypass Highway, Ambegaon (Bk), **PUNE**–411046.
: (020) 2434 1730, 24100171/262, 24356798, E-mail: principal.scos@sinhgad.edu, Website: http://scos.sinhgad.edu

M. Sc. Microbiology (NEP-2023)

PROGRAMME OBJECTIVES (PO)

PO1: Academic competence:

i. Describe microbial processes that can be used for the development of biochemical and immunological tools to improve the quality of human life.
ii. Study the cytology, biochemistry, growth as well as application of environmentally and industrially important microbes with a specific emphasis on improving environmental sustainability and human health.
iii. Describe and understand the concepts of role of microorganisms in geochemical processes like leaching of metals and bioremediation methods.

PO2: Personal and Professional competence:

i. Apply tools of molecular taxonomy and bioinformatics to the study of diverse microbial groups.
ii. Evaluate industrially important microbial products in terms of their purity, safety and ethically acceptable application for the benefit of mankind.
iii. Combine public presentation skills of effective articulation and nonverbal communication with a sound understanding of microbial science to effectively communicate ideas.

PO3: Research Competence

i. Validate scientific hypothesis and editorialize experimental scientific data by using statistical tools applicable to biological sciences.
ii. Integrate principles of biology and physical sciences to standardize detection and quantification methods using sophisticated techniques.

PO4: Entrepreneurial and Social Competence:

i. Employ skill sets related to Quality assurance and testing of pharmaceutically important products in accordance with internationally accepted standards.
ii. Evaluate the importance of new groups of consumer goods such as prebiotics, probiotics and nutraceuticals.
iii. Apply the concepts of microbial interactions in basic and advanced treatment of waste water treatment processes.

COURSE OUTCOME (CO)

CO1:

i. Define species concept in prokaryotes and eukaryotes.
ii. List measures and indices of diversity.
iii. Define "unculturable" bacteria and list culture-independent molecular methods for identifying unculturable bacteria.
iv. List different molecular methods used in microbial taxonomy.
v. Know the differences between the six classes of fungi.

CO2:

I. Explain the 5-Kingdom and 3-Domain classification systems and facets of microbial diversity.
II. Understand molecular evolution.
III. Explain socio-biology, Lamarckism, Darwinism, Neo-Darwinism, and understand Game Theory, as well as r and k selection.

CO3:

i. Apply the use of molecular clocks in taxonomy.
ii. Summarize various theories of evolution.

Course Outcomes for M. Sc. Microbiology First Part I

SEMESTER I

MB 511 MJ - Microbial Systematics

CO1: Define species concepts in prokaryotes and eukaryotes.

CO2: Explain the Five-Kingdom and Three-Domain classification systems.

CO3: Differentiate between fungal classes and describe fungal systematics.

CO4: Illustrate determinative and systematic bacteriology, including phenetic and phylogenetic approaches.

CO5: Apply polyphasic approaches and molecular clocks in microbial taxonomy.

CO6: Discuss facets of microbial diversity, including morphological, structural, metabolic, and ecological aspects.

CO7: Measure species divergence and microbial diversity indices (alpha, beta, gamma).

CO8: Explain the concept of unculturable bacterial diversity.

CO9: Apply culture-independent molecular methods (PCR, RFLP, DGGE, etc.) for identifying unculturable bacteria.

CO10: Extract total bacterial DNA and conduct metagenome analysis.

CO11: Summarize the history and development of evolutionary theories (Lamarckism, Darwinism, Neo-Darwinism).

CO12: Explain socio-biology, kin selection, and evolutionary stability.

CO13: Discuss molecular evolution, including the origin of life and evolutionary trade-offs.

MB 512 MJ - Biochemistry, Cell and Developmental Biology

CO1: Understand the structural features and classification of amino acids and proteins.

CO2: Apply Henderson-Hasselbalch equations for buffer formulation.

CO3: Analyse the conformational properties of polypeptides using Ramachandran plots.

CO4: Describe nucleic acid structures, tautomeric forms of bases, and DNA forms.

CO5: Differentiate between carbohydrates, including mono-, di-, and polysaccharides.

CO6: Classify lipids based on their chemical structure and explain their functions.

CO7: Explain concepts of commitment, determination, and differentiation in development.

CO8: Understand morphogen gradients and their role in gastrulation and axis formation.

CO9: Describe plant morphogenesis, including root and shoot development.

CO10: Explore the ultrastructure and functions of cellular organelles.

CO11: Describe protein trafficking and targeting to specific organelles.

CO12: Analyse cell cycle regulation and apoptosis.

MB 513 MJ - Basic Quantitative Biology

CO1: Explain basic statistical terms, variables, and measurement scales.

CO2: Perform data collection, organization, and graphical representation.

CO3: Apply measures of central tendency and dispersion to biological data.

CO4: Understand concepts of probability distributions (binomial, normal, Poisson).

CO5: Analyse biological data using parametric and non-parametric tests.

CO6: Formulate and test hypotheses using t-tests and z-tests.

MB 514 MJP - Practicals Based on MB 511, MB 512 and MB 513

CO1: Follow laboratory safety protocols and prepare biological buffers.

CO2: Perform data visualization using software for statistical analysis.

CO3: Apply microbiological techniques for isolation and identification of bacteria.

CO4: Observe mitosis and polyploidy in onion root tips.

CO5: Mount fruit fly embryos at various developmental stages.

CO6: Extract microbial biomolecules like proteins and polysaccharides.

CO7: Perform spectrophotometric estimations of extracted biomolecules.

MB 510 RM - Research Methodology

CO1: Understand types of research and problem formulation.

CO2: Conduct literature reviews and define research objectives.

CO3: Design research using various methods (qualitative, quantitative, mixed).

CO4: Prepare scientific presentations and posters.

CO5: Write research reports, abstracts, and project proposals.

CO6: Address ethical issues in research, including plagiarism and copyrights.

MB 510 RMP - Research Methodology Practicals

CO1: Use search engines and reference management tools for scientific research.

CO2: Analyse statistical data using software.

CO3: Prepare graphical abstracts and present scientific findings.

ELECTIVE THEORY AND PRACTICAL PAPERS

Group I – MB 515 MJ: Microbial Extremophiles

CO1: Study the diversity, properties, and adaptation mechanisms of extremophiles.

CO2: Understand applications of thermophiles, acidophiles, and other extremophiles.

CO3: Isolate and identify extremophilic microbes from natural samples.

CO4: Develop identification keys for extremophiles.

Group II – MB 516 MJ: Microbial Communication and Signal Transduction

CO1: Explain quorum sensing in bacteria and biofilm dynamics.

CO2: Explore signal transduction pathways and membrane transport mechanisms.

CO3: Study quorum sensing signals and biofilm formation.

CO4: Analyse chemotaxis and osmosis using artificial membranes.

Group III – MB 517 MJ: Advanced Quantitative Biology

CO1: Analyse relationships between independent and dependent variables.

CO2: Evaluate data using statistical techniques for categorical variables.

CO3: Use statistical tools to interpret data from biological experiments.

SEMESTER II

MB 521 MJ - Molecular Biology I

CO1: Describe the structure and functions of DNA.

CO2: Explain DNA replication mechanisms and its regulation in prokaryotes and eukaryotes.

CO3: Understand transcription processes in prokaryotes and eukaryotes.

CO4: Differentiate between various RNA types and their processing.

CO5: Explain the genetic code and protein synthesis mechanisms.

CO6: Analyse the role of ribosomes, tRNAs, and associated factors in translation.

CO7: Discuss operon models like *Lac, Trp* and *Ara* in prokaryotes.

CO8: Analyse gene regulatory mechanisms in eukaryotes, including epigenetics.

MB 522 MJ - Enzymology, Bioenergetics and Metabolism

CO1: Explain enzyme classification, structure, and catalysis.

CO2: Analyse enzyme kinetics, including Michaelis-Menten and Lineweaver-Burk plots.

CO3: Explore the principles of thermodynamics in biological systems.

CO4: Understand ATP synthesis through substrate-level phosphorylation and oxidative phosphorylation.

CO5: Describe glycolysis, TCA cycle, and electron transport chain.

CO6: Analyse the energy yield and regulation of these pathways.

CO7: Understand gluconeogenesis, lipid biosynthesis, and nitrogen assimilation.

CO8: Explore integration and regulation of metabolic pathways.

MB 523 MJ - Laboratory Techniques and Instrumentation

CO1: Understand the principles of UV-Vis, IR, and fluorescence spectroscopy.

CO2: Apply chromatographic techniques like HPLC and GC for separation and purification.

CO3: Conduct experiments using PAGE and agarose gel electrophoresis.

CO4: Understand the principles and applications of ultracentrifugation.

MB 524 MJP - Practicals Based on MB 521, MB 522 and MB 523

CO1: Isolate DNA and RNA from microbial cells.

CO2: Perform PCR amplification and analyse results using gel electrophoresis.

CO3: Conduct enzyme assays and study enzyme kinetics.

CO4: Analyse metabolic intermediates using spectrophotometric methods.

CO5: Perform separation of biomolecules using HPLC.

CO6: Conduct experiments using spectroscopic and centrifugation techniques.

MB 520 OJT - Internship / On-Job Training

CO1: Gain practical exposure to microbiological techniques in industrial or academic settings.

CO2: Develop analytical and problem-solving skills through real-world applications.

CO3: Apply theoretical knowledge to practical challenges.

CO4: Develop teamwork, communication, and project management skills.

CHOICE-BASED OPTIONAL PAPERS

Group I – MB 525 MJ: Molecular Biology Tools and Applications

CO1: Understand the principles of genetic engineering and cloning.

CO2: Apply PCR-based techniques for diagnostics and research.

CO3: Perform electrophoresis and DNA fingerprinting.

CO4: Demonstrate plasmid isolation and restriction digestion.

Group II – MB 526 MJ: Nitrogen Metabolism, Respiration and Photosynthesis

CO1: Understand biological nitrogen fixation and ammonium assimilation.

CO2: Explain nitrate and nitrite reduction mechanisms.

CO3: Differentiate between oxygenic and anoxygenic photosynthesis.

CO4: Analyse the role of pigments in photosynthesis.

CO5: Conduct experiments on nitrogen metabolism and photosynthesis.

CO6: Analyse enzyme activities involved in nitrogen fixation.

Group III – MB 527 MJ: Molecular Biophysics

CO1: Explore principles of NMR, X-ray crystallography, and spectroscopy.

CO2: Study macromolecular interactions using biophysical methods.

CO3: Analyse data from techniques like HPLC and UV spectroscopy.

CO4: Conduct structural studies using protein modelling tools.

Group IV – MB 528 MJ: Bioinformatics

CO1: Use computational tools for analysing biological data.

CO2: Perform sequence alignment and phylogenetic analysis.

CO3: Perform PCR amplification of 16S rRNA genes.

CO4: Use bioinformatics software like BLAST and MEGA for phylogenetic studies.

M. SC. MICROBIOLOGY PART II

Semester III

MB 601 MJ - Immunology

CO1: Define immune receptor-ligand interactions, tumour immunology, and lymphoid tumours.

CO2: Explain signal transduction pathways, immune activation mechanisms, and tumour escape strategies.

CO3: Apply biological response modifiers (BRMs) in cancer therapy.

CO4: Compare complement system pathways and tumour antigens.

CO5: Understand immunotherapy approaches to treat cancers and infections.

CO6: Summarize network theory in immunology.

MB 602 MJ - Molecular Biology II

CO1: Understand genomics, sequencing technologies, and epigenetics.

CO2: Explore genomic variations, SNPs, and gene editing techniques.

CO3: Apply gene therapy principles and GMO-related issues.

CO4: Describe mobile genetic elements and their evolutionary roles.

CO5: Understand proteomics and metabolomics in microbial studies.

MB 603 MJ - Clinical Microbiology

CO1: Understand medical microbiology concepts, including bacterial pathogenicity.

CO2: List and describe medically significant microorganisms.

CO3: Study bacterial, viral, and fungal pathogens' epidemiology, diagnosis, and treatment.

CO4: Understand chemotherapeutic agents and their modes of action.

MB 604 MJP - Practicals Based on MB 601, MB 602, MB 603

CO1: Perform immunological techniques (e.g., immunodiffusion, immunoelectrophoresis).

CO2: Visualize RNA using gel electrophoresis and perform plasmid transformations.

CO3: Conduct primer design for genetic studies.

CO4: Isolate and identify pathogenic microbes.

CO5: Understand genomics and proteomics databases for microbial research.

Group I: MB 610 MJ - Cell Culture Techniques

CO1: Gain awareness about cell culture technology.

CO2: Learn cell culture media, types, and equipment.

CO3: Understand lymphoid culture preparation techniques.

MB 610 MJP - Practicals Based on Cell Culture Techniques

CO1: Perform primary and secondary cell cultures.

CO2: Analyse cell cultures using software tools.

Group II: MB 611 MJ - Bioremediation and Biomass Utilization

CO1: Differentiate bioremediation, biodegradation, and bioaugmentation.

CO2: Understand microbial pathways for xenobiotic degradation.

CO3: Apply biomass utilization for ecosystem and industrial purposes.

MB 611 MJP - Practicals Based on Bioremediation and Biomass Utilization

CO1: Perform biodegradation experiments using microbial cultures.

CO2: Analyse bioremediation effectiveness using case studies.

Semester IV

MB 651 MJ - Pharmaceutical Microbiology

CO1: Understand drug discovery and pharmaceutical microbiology principles.

CO2: Explore antimicrobial agents and their mechanisms.

CO3: Learn about regulatory standards in pharmaceutical microbiology.

MB 652 MJ - Bioprocess Technology

CO1: Apply principles of fermentation technology.

CO2: Understand microbial bioconversion processes.

CO3: Learn scale-up, downstream processing, and industrial applications.

MB 653 MJP - Practicals Based on MB 651 and MB 652

CO1: Perform assays for drug evaluation and microbial quality control.

CO2: Conduct fermentation and downstream processing experiments.

Group I: MB 660 MJ - Quality Assurance and Validation in Pharmaceuticals

CO1. Understand pharmaceutical quality control and validation processes.

CO2. Explore the role of plant-derived anti-infectives.

MB 660 MJP - Practicals Based on Quality Assurance and Validation

CO1. Conduct validation experiments for pharmaceutical processes.

CO2. Analyse plant-derived compounds for antimicrobial activity.