FACULTY OF SCIENCE

SYLLABI

FOR

M.Sc. MICROBIAL BIOTECHNOLOGY

1st to 4th SEMESTER

EXAMINATION 2011-2012

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### M.Sc. 1st year (1st Semester)

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Course/Paper</th>
<th>Code</th>
<th>Theory</th>
<th>Practical</th>
<th>Credits</th>
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<td>Course No.</td>
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<tr>
<td>1.</td>
<td>Microbial Biodiversity and Physiology</td>
<td>MBT-101T</td>
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<td>MBT-101 P</td>
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<td>2.</td>
<td>Immunology and Immunotechnology</td>
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<td>Genetics and Recombinant DNA Technology</td>
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Total Credits = 30

Total Marks = 750

### M.Sc. 1st year (2nd Semester)

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<td>1.</td>
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<td>Industrial Microbiology-1 (Health, Food, Enzymes)</td>
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<td>Bioinformatics</td>
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<td>Intellectual Property Rights (IPR) &amp; Bioethics</td>
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Total Credits = 30

Total Marks = 750
### M.Sc. 2nd year (3rd Semester)

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<td>1.</td>
<td>Advances in Microbial Biotechnology (Genomics, Proteomics, Metabolomics)</td>
<td>MBT-301</td>
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<td>2.</td>
<td>Industrial Microbiology-II (Environment, Biofuels, Chemicals, Biomass)</td>
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<td>3.</td>
<td>Microbial Diagnostics and Nanobiotechnology</td>
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<td>4.</td>
<td>Bioinstruments and their Applications</td>
<td>MBT-304</td>
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<td>Entrepreneurship, Project Management and Quality Assurance</td>
<td>MBT-305</td>
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### M.Sc. 2nd year (4th Semester)

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<td>Research Methodology</td>
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<td>Seminars / Journal club / Invited Lectures</td>
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MBT-101: Microbial Biodiversity and Physiology

Total Marks: 100 (Exam-80 + Int. Asses.-20)

Objective: To expose the students to (i) the diversity of microbes, (ii) growth & nutrient requirements (iii) unique metabolic pathways.

Exam Pattern: Five questions to be attempted from a total of nine questions, which will be divided into five units. Each unit will comprise of two questions and students would be required to attempt one question from each unit. The last unit will comprise of objective type/short notes covering the complete syllabus.

Unit -I
1. Relevance of microbiology as a field of Biotechnology.
2. Historical milestones in Microbiology and Biotechnology
3. Structures and functions of *Escherichia*, *Staphylococci* & *Saccharomyces*.
4. Control of microbes by the use of physical and chemical agents.

Unit – II
5. Biodiversity of
   (a) Archaea
   (b) Bacteria
   (c) Fungi
   (d) Algae
   (e) Viruses
6. Microbial ecology: Biogeochemical cycling, Microbes in marine & freshwater environments, Microbes in terrestrial environment, Microbial interactions

Unit – III
7. Nutritional requirements of microbes
10. Mechanisms involved in transport of nutrients in microbes

Unit - IV
12. Unique pathways of microbial metabolism: ED, PK pathways; Respiration; Fermentations; Amphibolic pathways; Anaplerotic reactions.
13. Bacterial cell wall biosynthesis
14. Photoautotrophy, Chemolithotrophy, Methylotrophy, Calvin cycle
Practicals:

**Total Marks: 50**  
*Int. Asses.-10. Based on the performance of the students during the practical Exam. – 40 (Practicals - 20, Synopsis – 05, Notebook – 05, Viva voce – 10)*

1. Use of basic instruments in Microbiology (Light microscope, pH meter, Autoclave, Laminar flow chamber, Centrifuge, Spectrophotometer).
2. Staining of bacteria, yeast and fungi.
3. Purification of mixed cultures by streaking technique.
4. Determination of viable count.
5. Correlation of viable counting and optical density of cultures.
6. Isolation of microbes from environment.
7. Bacteriophage screening.
8. Preparation of complex and synthetic medium.
9. Sterilization of liquid and solid items.
10. Storage of microbes.

**Suggested readings:**

Objective: To expose the students to (i) the basics of immune system (ii) the response of humans to foreign bodies (iii) the techniques involved in immunoassays (iv) vaccines

Exam Pattern: Five questions to be attempted from a total of nine questions, which will be divided into five units. Each unit will comprise of two questions and students would be required to attempt one question from each unit. The last unit will comprise of objective type/short notes covering the complete syllabus.

Unit-I

1. Immune cells and immune organs, adaptive and innate immunity.
3. T cell biology: Development, thymic education, TCR rearrangement, basic functions of cells during immune response, T cells subsets.
4. Immunoglobulins: Structure and functions of Immunoglobulins, Immunoglobulin rearrangement, molecular genetics of BCR generation
5. Antigens complement system, haptens, adjuvants.

Unit-II

6. Antigen presenting cells (APCs): Dendritic cell (DC), importance of DCs in adaptive immune response, role of B cells and macrophages as APCs, non-professional APCs, cell biology of antigen processing and presentation.
8. Immune Homeostasis: Homeostasis, migration, tissue redistribution of lymphocytes, site specific immune response.
9. Chemokine, cytokine and cell signaling: Their roles in activation and differentiation of cells of immune system, importance in response to pathogens.
10. Nuclear receptors for macrophage and T cell plasticity, nuclear receptors and antigen processing and presentation, nuclear receptors and immune cell effector repertoire.

Unit-III

11. Antigen-antibody reactions, interaction, cross reactions, precipitation and agglutination.
12. Radioimmunoassay, ELISA, Western blotting.
13. Hybridomas and Monoclonal antibodies.
14. Recent advances in immunological tools for diagnosis of diseases.

Unit-IV

15. Tolerance and autoimmunity, allergy and hypersensitivity-mediated diseases.
16. Immune response to infectious diseases: Responses to different class of pathogens such as intracellular bacteria, viruses and extracellular and intracellular parasites.

17. Vaccines and their types: killed and live, sub unit, recombinant, multivalent, DNA, edible vaccines. Microbe-resistant transgenic plants

18. Antibodies as immunotherapeutic, cytokine therapy


Practicals:

Total Marks: 50   Int. Asses.-10. Based on the performance of the students during the practical

Exam. – 40 (Practical - 20, Synopsis – 05, Notebook – 05, Viva voce – 10)

1. Animal handling
2. Routes of injections
3. Drawing blood from animals
4. TLC and DLC for blood samples.
5. Determination of cell number (viable/non-viable).
6. Ficoll density gradient, separation of cell types.
7. Raising antibodies in animals.
8. Immunoassays

Suggested readings:

Objective: To expose the students to (i) genetics of microbes (ii) permanent changes in the genetic material (iii) techniques involved in the cloning of genetic elements

Exam Pattern: Five questions to be attempted from a total of nine questions, which will be divided into five units. Each unit will comprise of two questions and students would be required to attempt one question from each unit. The last unit will comprise of objective type/short notes covering the complete syllabus.

Unit-I
1. Significance of genetic recombination
2. Homologous genetic recombination (Transformation, Transduction, Conjugation)
3. Heterologous genetic recombination (IS, Tn, Mu phage)
4. Natural Plasmids and their types, Role of plasmids in transfer of genes

Unit II
5. Mutations: Fluctuation test, Replica plating
6. Physical and chemical mutagens
7. Types of mutations
8. DNA Repair mechanisms

Unit – III
9. Host restriction/modification, Enzymes involved in gene cloning
10. Plasmids as gene cloning vectors, Commercial vectors
11. Strategies involved in cloning of gene(s).
12. Construction of genomic, cDNA and meta-genomic libraries

Unit – IV
13. DNA sequencing
14. PCR and its applications and modifications
15. Phage display technology and its applications.
16. Yeast two-hybrid system, Combinatorial library

Practicals:

Total Marks: 50   Int. Asses.-10. Based on the performance of the students during the practical Exam. – 40 (Practical - 20, Synopsis – 05, Notebook – 05, Viva voce – 10)

1. Isolation of chromosomal DNA
2. Isolation of plasmid
3. Preparation of competent cells
4. Transformation and Electroporation
5. Restriction digestion (complete and partial) of DNA
6. Cloning and expression of a gene in E.coli
7. Amplification of DNA by PCR
Suggested readings:

MBT-104: Molecular Biology

Total Marks: 100 (Exam-80 + Int. Asses.-20)

**Objective:** To expose the students to the mechanism of (i) DNA replication (ii) DNA transcription (iii) protein synthesis (iv) regulation of gene expression (v) signal transduction

**Exam Pattern:** Five questions to be attempted from a total of nine questions, which will be divided into five units. Each unit will comprise of two questions and students would be required to attempt one question from each unit. The last unit will comprise of objective type/short notes covering the complete syllabus.

**Unit – I**

1. DNA and its various forms, super coiling of DNA, DNA melting, repetitive sequences, cot and rot curves, C value paradox, DNA protein interaction, DNA super coiling.
2. Unit of DNA replication, enzymes involved in replication, origin and replication fork, fidelity of replication.
3. Replication of bacterial chromosome
4. Replication of eukaryotic chromosomes.

**Unit-II**

5. RNA synthesis and processing: transcription factors and machinery, formation of initiation complex, transcription activator and repressor, RNA polymerases, capping, elongation, and termination, RNA processing, RNA editing, splicing, and polyadenylation, structure and function of different types of RNA, non coding RNA, RNA transport.

**Unit – III**

7. Control of gene expression at transcription and translation level:

**Unit – IV**

9. Role of microbes in cancer, apoptosis, antimicrobial peptides as cancer therapeutic.
10. Gene silencing strategies
Practicals:

Total Marks: 50  Int. Asses.-10. Based on the performance of the students during the practical
Exam. – 40 (Practical - 20, Synopsis – 05, Notebook – 05, Viva voce – 10)

1. Tm value of DNA
2. Spectrophotometric analysis of DNA
3. Protein purification by Gel exclusion chromatography
4. Protein purification by Ion-Exchange chromatography
5. Protein purification by Affinity chromatography
2. Separation of proteins on non-denaturing gels.

Suggested readings:

MBT-105: Bioprocess Engineering

Total Marks: 100 (Exam-80 + Int. Asses.-20)

Objective: To expose the students to the (i) bioreactor and its types (ii) production of bioactive molecules /cells in a bioreactor (iii) purification of bioactive molecules (iv) fermentation processes

Exam Pattern: Five questions to be attempted from a total of nine questions, which will be divided into five units. Each unit will comprise of two questions and students would be required to attempt one question from each unit. The last unit will comprise of objective type/short notes covering the complete syllabus.

Unit – I
2. Operation of bio-reactors.

Unit – II
3. Mass and Heat Transfer in Bioreactors: Aeration and Agitation in Bioreactors, Concept of mass transfer correlation and scale up.

Unit – III
5. Down Stream Process (DSP): Cell disruptions, Flocculation, Filtration, Ultra filtration, Centrifugation, Ultracentrifugation, Chromatographic methods, two phase aqueous separations, solvent – solvent extraction, centrifugation, pre treatment, crystallization etc.

Unit – IV
6. Fermentations and Fermentative processes like Submerged, Solid state, Batch, Fed Batch, Continuous system etc.
7. Hygiene and safety in fermentation laboratory/processes.

Practicals

Total Marks: 50 Int. Asses.-10. Based on the performance of the students during the practical Exam. – 40 (Practical - 20, Synopsis – 05, Notebook – 05, Viva voce – 10)

1. Components and Operation of a Bioreactor
2. Batch fermentation in conical flask
3. Production of the enzyme/s in shake flask
4. Solid state fermentation
Suggested readings:


Objective: To expose the students to (i) various types of diseases caused by microbial pathogens (ii) pathogenic mechanisms of microbes (iii) antimicrobial chemotherapy (iv) epidemiology of important diseases

Exam Pattern: Five questions to be attempted from a total of nine questions, which will be divided into five units. Each unit will comprise of two questions and students would be required to attempt one question from each unit. The last unit will comprise of objective type/short notes covering the complete syllabus.

Unit – I (Pathogenesis, Chemotherapy)

1. Overview of a) Normal microflora of humans and its importance, b) Specific and Non-specific defense mechanisms.
2. Pathogenesis of microorganisms: Host parasite relationships, pathogenesis of bacterial diseases, pathogenesis of viral diseases, toxigenesis, host defense against microbial invasion, microbial mechanism for escaping host defenses.
3. Antimicrobial chemotherapy: Characteristics of anti microbial drugs, determination of anti microbial activity, anti bacterial drugs, anti viral drugs, anti fungal drugs, anti protozoan drugs.

Unit – II (Bacterial infections)

5. Air-borne bacterial diseases (TB, Diphtheria, Pertusis, Streptococcal, etc.)
6. Food/Water – borne bacterial diseases (Botulism, Gastroenteritis, Cholera, Salmonellosis, Shigellosis, Traveler’s diarrhea; Sepsis and septic shock)
7. Direct - contact diseases (Gas gangrene, GBS, Conjunctivitis, Leprosy, Peptic ulcer, Staphylococcal, STB, Tetanus, Trachoma)
8. Arthropod - borne bacterial diseases (Typhus, Lyme, Plague, Q fever etc.); Zoonotic diseases (Anthrax, Brucellosis); Dental infections (Dental plaque, Dental Decay, Periodontal diseases.

Unit – III (Viral infections)

9. Air-borne viral diseases (Chicken pox, Small pox, Measles, Mumps, Influenza)
10. Direct - contact diseases (AIDS, Sores, Common cold, CMV, Genital herpes, Leukemia, Infectious mononucleosis, Hepatitis, Warts)
11. Food/Water – borne viral diseases (Gastroenteritis, Hepatitis, polio)
12. Zoonotic viral diseases; (Rabies, VHF); Arthropod - borne diseases (Encephalitis, RVF, Yellow fever); Prion diseases.
Unit – IV (Other infections, Epidemiology)

14. Brief introduction to discomforts caused by Algae
15. Epidemiological terminology, Morbidity rate, Mortality rate, Prevalence rate; Recognition of an infectious diseases in a population; Recognition of an epidemic; infectious disease cycle; Virulence and the mode of transmission
16. Emerging and reemerging infectious diseases/pathogens; Control of epidemics; Global travel and health considerations; Nosocomial infections.

Practicals:

Total Marks: 50    Int. Asses.-10. Based on the performance of the students during the practical Exam. – 40 (Practical - 20, Synopsis – 05, Notebook – 05, Viva voce – 10)

1. Collection, handling and storage of clinical samples
2. Culture identification of bacteria (E.coli, Salmonella, Shigella, Staphylococcus, Streptococcus)
3. Culture identification of fungi (Candida, Aspergillus)
4. Identification of pathogens by PCR technology
5. Antibiotic sensitivity of clinical pathogens

Suggested Readings:

**Objective:** To expose the students to (i) macromolecular interactions (ii) structure and functions of biomolecules (iii) enzymes: their functions, regulation and industrial applications

**Exam Pattern:** Five questions to be attempted from a total of nine questions, which will be divided into five units. Each unit will comprise of two questions and students would be required to attempt one question from each unit. The last unit will comprise of objective type/short notes covering the complete syllabus.

**Unit - I**

1. Buffers and physiological buffers.
2. Thermodynamics and Principles of thermodynamics, free energy, enthalpy and entropy.
3. Macromolecular interactions: van-der waal’s, hydrogen bonding, ionic, hydrophobic, covalent etc.
4. Structure and functions of Carbohydrates, Proteins, Lipids, Nucleotides, DNA, RNA, and Vitamins

**Unit – II**

5. Metabolism of Carbohydrates (Glycolysis, TCA, HMP, Gluconeogenesis)
6. Metabolism of Lipids (Fatty acid metabolism, Phospholipid metabolism, Cholesterol biosynthesis)

**Unit – III**

7. Metabolism of protein (Digestion of proteins, General reactions of amino acids, Fate of carbon skeletons of amino acids, Regulation of amino acid biosyntheses)
8. Electron transport chain, Oxidative phosphorylation

**Unit – IV**

9. Enzymes: General distinctive features, nomenclature and industrial applications
10. Enzyme kinetics
11. Allosteric enzymes
12. Feedback inhibition and Feedback repression mechanisms
13. Multienzyme complexes: advantage and examples
14. Biocatalysis-Definition, chirality, advantages/disadvantages of biocatalysis over chemical catalysis, different types of biocatalysis
Practicals:

Total Marks: 50  Int. Asses.-10. Based on the performance of the students during the practical Exam. – 40 (Practical - 20, Synopsis – 05, Notebook – 05, Viva voce – 10)

1. Qualitative and quantitative assay of Sugars
2. Qualitative and quantitative assay of Proteins
3. Qualitative and quantitative assay of Lipids
4. Qualitative and quantitative assay of Nucleic acids
5. Assay of enzymes
6. Substrate specificity and efficiency of enzymatic catalysis
7. Kinetics of enzyme catalyzed reactions
8. Effect of pH and temperature on enzyme activity
9. Enzyme immobilization

Suggested readings:

Objective: To expose the students to (i) Industrially important metabolites produce by microbes especially in the areas of health, food and enzymes (ii) immobilization of enzymes/cells

Exam Pattern: Five questions to be attempted from a total of nine questions, which will be divided into five units. Each unit will comprise of two questions and students would be required to attempt one question from each unit. The last unit will comprise of objective type/short notes covering the complete syllabus.

Unit I

1. Primary and Secondary metabolites of industrial importance.
2. Techniques involved in screening/detection of industrially important metabolites from microbes.
3. Pyruvate as the hub molecule

Unit II

4. Biosynthesis and fermentation process involved in
   (a) Health & Pharma- Antibiotics (Penicillin, Streptomycin,), Alkaloids (ergot, lysergic acid), Biotransformations (Steroids, chirals), Therapeutic proteins (Interferons, Insulin, Streptokinase, Erythropoietin).
   (b) Food and Beverages- Beer, Wine, Whisky, Vinegar, Probiotics, Traditional fermented foods, Food additives: Vitamins, Bioflavors

Unit – III

5. Microbial Enzymes - Pharma related enzymes, Detergent enzymes, Processing of starch and related carbohydrates, Fruit juice production, Textile & leather manufacture, Treatment of wood pulp, Organic synthesis, Diagnostics

Unit – IV

Practicals:

Total Marks: 50  Int. Asses.-10. Based on the performance of the students during the practical
Exam. – 40 (Practical - 20, Synopsis – 05, Notebook – 05, Viva voce – 10)

1. Screening of microbes for production of industrially important enzymes.
3. Wine fermentation
4. Purification of antimicrobial metabolites from a microbe.

Suggested readings:

MBT-204: Bioinformatics

Total Marks: 100 (Exam-80 + Int. Asses.-20)

Objective: To expose the students to (i) basic understanding of computers (ii) computational tools developed for understanding of genetic material and proteins

Exam Pattern: Five questions to be attempted from a total of nine questions, which will be divided into five units. Each unit will comprise of two questions and students would be required to attempt one question from each unit. The last unit will comprise of objective type/short notes covering the complete syllabus.

Unit – I (Computer skills)
1. Important components and functions of a computer.
2. Computer languages: History and generation of languages
3. Importance of Bioinformatics in microbiology/ biotechnology
4. Perl language and programming

Unit – II (Biological databases)
5. Database- introduction, Primary, Secondary and Tertiary databases. Type and kind of databases. Literature search (PUBMED and MEDLINE).
6. Nucleic acid (GenBank, EMBL etc.). Structural databases- PDB, PDBsum, NDB, CATH, SCOP etc. Motifs and Pattern Databases- PROSITE, Pfam, etc.
7. Protein databases (SWISS PROT, UNIPROT etc.). Structural databases- PDB, PDBsum, NDB, CATH, SCOP etc. Motifs and Pattern Databases- PROSITE, Pfam, etc.
8. Sequence retrieval (SRS, Entrez) and Data submission.

Unit – III (Sequence analysis)
9. Sequence alignment- introduction and concepts, Local and Global alignment concepts.
10. Similarity and Percent identity score (open, extended gap penalty). Multiple sequence alignment - introduction and concepts. Types of multiple sequence alignment techniques. Description of major softwares (MSA, CLUSTALW, PILEUP).
11. Database Scanning and Sequence similarity searches. Algorithm of FASTA. Description of BLAST algorithm. Various BLAST programs (BLASTP, BLASTN).
12. Protein Structure: Classification, Structure Analysis, Secondary structure predictions, Comparative modeling.

Unit – IV (Genome analysis)
16. Description of major gene prediction methods.
Practicals:

Total Marks: 50
Int. Asses.-10. Based on the performance of the students during the practical
Exam. – 40 (Practical - 20, Synopsis – 05, Notebook – 05, Viva voce – 10)

1. Sequence (DNA & Protein) alignments
2. Genome sequence studies
3. Designing ideal primers for amplification of genetic material
4. Deciphering 3-D structure of proteins.
5. Designing inhibitors of enzymes

Suggested readings:

**Objective:** To expose the students to (i) understanding of patents (ii) filing of a patents (iii) ethical and social issues in biotechnology

**Exam Pattern:** Five questions to be attempted from a total of nine questions, which will be divided into five units. Each unit will comprise of two questions and students would be required to attempt one question from each unit. The last unit will comprise of objective type/short notes covering the complete syllabus.

**Unit - I**

1. Introduction: General Introduction
2. Patent Claims, the legal decision-making process
4. Basic requirements of patentability, patentable subject matter, novelty and the Public Domain; Non-obviousness
5. Special issues in Biotechnology Patents: Disclosure Requirements, Collaborative research, competitive research, Plant Biotechnology

**Unit - II**

6. Foreign Patents
8. Recent Development in Patent System and Patentability of Biotechnology invention
9. IPR issues of the Indian Context
10. IT Act, 2000 : Aims and Objectives; Overview of the Act; Jurisdiction; Role of Certifying Authority; Regulators under IT Act; Cyber Crime-offences and Contraventions; Grey Areas on IT Act.

**Unit - III**

11. Public acceptance issues for biotechnology: Case studies/experiences from developing and developed countries.
13. The Cartagena protocol on biosafety

**Unit - IV**

14. Biosafety management: Key to the environmentally responsible use of biotechnology.
15. Ethical implications of biotechnological products and techniques.
16. Social and ethical implication of biological weapons
Practicals:

Total Marks: 50      Int. Asses.-10. Based on the performance of the students during the practical Exam. – 40 (Practical - 20, Synopsis – 05, Notebook – 05, Viva voce – 10)

1. Searching of National Patent databases
2. Drafting of National Patent applications
3. Searching of International Patent databases
4. Drafting of International Patent applications

Suggested readings:

Semester- III

MBT-301: Advances in Microbial Biotechnology (Genomics, Proteomics & Metabolomics)

1. Microbial genomics

**Unit–I**

i) Introduction to Microbial Genomes
ii) Recombinant-DNA technology and its involvement in microbial genomics
iii) Genome sequencing of different microbes and their importance
iv) Techniques for genome research
v) Application of microbial genomic variability for utilizing in human welfare (applications)
vi) Phylogenetic relationships between various genera of microbes
vii) Sequences as Biological Information - Cells Obey the Laws of Chemistry and Physics

**Unit–II**

viii) Evolution by Genome Expansion and Reduction
ix) Metagenomics
x) Methods to Compare Genomes
xi) Evolution by Genome Expansion and Reduction
xii) Archaeal Genomics
xiii) Microbial Genome Annotation
xiv) Genomics for pathogenic microbes – Search for better vaccines

**Unit–III**

2. Microbial proteomics

i) Introduction to microbial proteomics
ii) 2D gel profiling of various microbes
iii) Microbial pathogenesis at the proteome level researching drug resistance lecture
iv) Structural proteomics and computational analysis
v) Proteomics of Archaea
vi) Proteome research for novel drug targets
vii) Techniques for Proteome research
viii) High throughput proteomic screening for novel enzymes

**Unit–IV**

3. Microbial metabolic engineering

i) What is metabolic engineering
ii) Techniques for metabolic engineering
iii) Gene manipulation of useful microbes
iv) Production of valuable products by metabolic engineering
v) Strain improvement by metabolic engineering
vi) Applications of metabolic engineering

**Practicals:**

1. Operation of Gas chromatography
2. Operation of HPLC
3. Operation of Mass spectroscope
4. Operation of NMR.
5. Operation of HPLC, LCMS, Maldi-Tof
6. Setting up conditions for crystallization of proteins
7. X-Ray diffraction of crystals and data interpretation
8. Designing inhibitors of proteins

**Suggested readings:**


MBT-302: Industrial Microbiology-II (Environment, Biofuels, Chemicals, Biomass)

Unit–I

1. **Environment**: Waste water and effluent treatment, Composting, Biodegradation of xenobiotics, Bioremediation, Biomining,

Unit–II

2. **Biomass**: Baker’s yeast, SCPs, Mushrooms.

Unit–III


Unit–IV

4. **Biodegradable plastics**: Transgenic plants as Biocidal agents, Microbes as N and P Biofertilizers.

Suggested readings


MBT-303: Microbial Diagnostics and Nanobiotechnology

Biosensors

Unit–I
1. Importance of sensors in microbiology

Unit–II
2. Basic components of a sensor
3. Types of sensors and their applications.

Unit–III
4. Biosensors in industrial applications
5. Biosensors in research

Unit–IV
6. Biosensor in diagnostics
7. Futuristic biosensors

Nanobiotechnology:
1. Understanding Nanotechnology. Impact of Nanotechnology on biological systems esp. microbiology i.e. Nanobiotechnology
2. Cell-Nanostructure Interactions
3. Microbial Nanoparticle production
4. Protein based nanostructures
5. DNA-based nanostructures
6. Engineered nanopores
7. Nanoparticles for biological applications
8. Luminiscent quantum dots for biological labeling
9. Applications of Atomic Force Microscope (AFM) and Force Spectroscopy (FS) in biology Nanorobotic cells

Suggested readings:


**MBT-304: Bioinstruments and their Applications**

**Unit–I**

1. Microscopy: Light microscope, Field Microscope, Florescent microscope, Phase contrast microscope, AAS, AFM, SCM, TEM, and SEM.

2. Spectrophotometers: Colorimetry & UV/Visible spectrophotometer.

**Unit–II**

3. Mass spectroscopy, Infrared and Raman spectroscopy. CD spectroscopy, NMR, ESR.


**Unit–III**

5. Chromatography: GC, Paper Ch, TLC, HPLC, FPLC, GCMS, LCMS.

6. Protein purification workstation


**Unit–IV**


**Practicals:**

1. Operation of Microscopes: Florescent microscope, Phase contrast microscope, AFM, SCM, TEM, and SEM.

2. Rf value using TLC

3. Operation of Centrifuges (microfuge and high speed centrifuge and ultracentrifuge).

4. Operation of GC, HPLC

5. Operation of MS, LCMS, NMR.

6. Operation of Maldi-Tof

7. Setting up conditions for crystallization of proteins

**Suggested Readings:**


**MBT-305: Entrepreneurship, Project Management and Quality Assurance**

**Unit–I**

Forms of Project Organization, project planning, project control, human aspects of project management, pre-requisites for successful project implantation, project management, international project management. Network techniques for project management, development of project network, time estimation, determination of critical path, scheduling when resources are limited, PERT and CPM models, network cost-system.

**Unit–II**

Introduction to entrepreneurship and entrepreneurship. Barriers to entrepreneurship, community and entrepreneurship, functions of entrepreneurship, classification of entrepreneurship.

**Unit–III**


**Unit–IV**

Entrepreneurship-a function of innovation, the achievement motive in economic growth, theory of social change, family structure, migration & enterprise entrepreneurship.

**Suggested readings:**

SEMESTER- IV

MBT-401: Research Methodology
Planning and execution of an experiment. Report writing; manuscript writing, thesis writing. Presentation of a paper. General laboratory practices-Definition and procedures to be followed.

MBT-402: Dissertation
Each student will be given an independent research project.

MBT-403: Seminars / Journal clubs / Invited lectures
Students will be asked to deliver a talk on articles from Journals and Books, Manuals, Handbooks.

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