M.Sc. Microbiology
SEMESTER I

Syllabi for the examinations to be held in the years Dec. 2022, Dec. 2023 & Dec. 2024

COURSE TITLE: Cell Biology

Course code: PSMBTC101 **Contact hours**: 48
Duration of Examinations **Credits**: 4
Minor Test1: 1.5 hour **Max. Marks**: 100
Minor Test2: 1.5 hour **Minor Test1**: 20
Major Test: 3.0 hours **Minor Test2**: 20
Major Test: 60
Total: 100

Course objectives: Cell is the basic unit of life. Therefore knowledge concerning it is important for the pursuit of other branches in life sciences. The course has been designed to provide insight to students into the structures of cell and constituents, and to some extent their functioning, which will serve as the edifice for subsequent learning.

UNIT - I: CELL STRUCTURE AND DIVERSITY

i. Universal Properties of Cell; cell theory, diversity of the cell size and shape, different classes of cells
ii. Preliminary methods used in cell biology, Microscopic techniques for study of cells; Sub-cellular fractionation.
iii. Membrane structure and function; Transport of nutrients, ions and macromolecules across membranes, Membrane pumps; Na^+, K^+, Ca^{2+} pumps.
iv. Cytoskeletal systems, Motor proteins, Motility, Cilia and flagella

UNIT - II: CELL ORGANELLES

i. Cellular organelles; Mitochondria, chloroplast, endomembrane system; endoplasmic reticulum, golgi bodies, lysosomes and peroxisomes
ii. Membrane Trafficking; transport vesicles, endocytosis and exocytosis
iii. Nucleus; nuclear envelope, Nuclear pore complex, export and import of proteins
iv. Chromosomes and chromatin, centromeres, telomeres, types of chromosomes and alterations.

UNIT - III: CELL SIGNALING AND CELL COMMUNICATION

i. Cell signaling- signaling molecules, cell surface receptor, G- protein linked cell-surface receptors, signal transduction pathways; Ras/MAPK' Pathways, second messengers
ii. Cell signaling in micro-organisms; bacterial chemotaxis and quorum sensing, signaling in plants
iii. Cellular communication: General principle of cell communication, extra cellular matrix, cell adhesions molecules
iv. Cell-cell interaction; Cell junctions: tight junction, desmosome, hemidesmosome and gap junctions, plant cell wall

M.Sc. Microbiology
SEMESTER I

Syllabi for the examinations to be held in the years Dec. 2022, Dec. 2023 & Dec. 2024

COURSE TITLE: Cell Biology

Course code: PSMBTC101 **Contact hours**: 48
Duration of Examinations **Credits**: 4
Minor Test1: 1.5 hour **Max. Marks**: 100
Minor Test2: 1.5 hour **Minor Test1**: 20
Major Test: 3.0 hours **Minor Test2**: 20
Major Test: 60
Total: 100

UNIT - IV: CELL CYCLE, GROWTH, DIVISION AND REGULATION

i. Cell cycle; Phases of cell cycle. Interphase and M phase (mitosis and meiosis), checkpoints in cell cycle.
ii. Regulators of cell cycle progression; role of cyclin and cyclin dependent kinases.
iii. Apoptosis, program cell death, extrinsic and intrinsic pathways.
iv. Cell transformation and cancer, oncogenes and proto-oncogenes, tumor suppressor genes, metastasis.

UNIT - V: **DEVELOPMENT BIOLOGY**

i. Basic concept of development- gametogenesis, fertilization and early development
ii. Development of *Drosophila*- early drosophila development, pattern formation, maternal and gap genes, pair rule and segmentation genes, Homeotic genes and their role in development.
iii. Development of *C. elegans*-Introduction, life cycle, organogenesis
iv. Morphogenesis and organogenesis in *Arabidopsis thaliana* as model plant- shoot, root, leaf and flower development.

NOTE FOR PAPER SETTING AND COURSE EVALUATION

Minor test 1 should cover upto 20% of syllabus. Minor test II should cover 21%- 40% of syllabus. Major test should cover 41% -100% of syllabus. Major test will have 7 questions each of 15 marks. One question will be very short answer type of multiple parts compulsory spread over entire syllabus. The remaining 6 questions will be from remaining 41%-100% part of the syllabus and the candidate will have to attempt any three of them. The major test should test both the subjective and objective aptitudes of the student. Minor test 1 will be held after 3-4 weeks of teaching and Minor test II will be held 8-9 weeks after the start of session. Two minor tests per day should be conducted and no preparatory holiday shall be given.

BOOKS RECOMMENDED

1. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K. and Walsh, P. (2006) Molecular Biology of the Cell. Garland Science, USA. . 4th edition.
2. Alberts, B., Bray, J.L., Roberts, K. and Watson, J.D. (2008). Molecular Biology of the Cell. Garland Publishing House, New York. 2nd ed.
3. Du Praw, E.J. (1968). Cell and Molecular Biology. Allyn & Bacon, Boston, USA.
4. Dyson, R.D. (1975). Essentials of Cell Biology. Allyn & Bacon, Boston, USA.

M.Sc. Microbiology
SEMESTER I

Syllabi for the examinations to be held in the years Dec. 2022, Dec. 2023 & Dec. 2024

COURSE TITLE: Cell Biology

Course code: PSMBTC101 **Contact hours**: 48
Duration of Examinations **Credits**: 4
Minor Test1: 1.5 hour **Max. Marks**: 100
Minor Test2: 1.5 hour **Minor Test1**: 20
Major Test: 3.0 hours **Minor Test2**: 20
Major Test: 60
Total: 100

5. Swanson, C.P. and Webster, P. (2006). The Cell. Prentice – Hall, Englewood Cliffs, USA.
6. De Robertis, E. D. P. and De Robertis, E.M.F. (2001) Cell and Molecular Biology. Lippincott Williams and Wilkins, Philadelphia, USA. .8th ed.
7. Karp, G (2007) Cell and Molecular Biology : Concepts and Experiments. John Wiley Inc. New York. 5th ed.
8. Szallasi, Z., Stelling, J., and Periwal,V.(2007). System Modelling in Cellular Biology, Prentice Hall, India.

M.Sc. Microbiology
SEMESTER I
Syllabi for the examinations to be held in the years Dec. 2022, Dec. 2023 & Dec. 2024

COURSE TITLE: BIOCHEMISTRY AND METABOLISM
Course code: PSMBTC103

Contact hours: 48

Duration of Examinations
Minor Test1: 1.5 hour
Minor Test2: 1.5 hour
Major Test: 3.0 hours

Credits: 4
Max. Marks: 100
Minor Test1: 20
Minor Test2: 20
Major Test: 60
Total: 100

Course Objective: The basic goal of this course is to determine how the collections of inanimate molecules that constitute living organisms, interact with each other to maintain and perpetuate the living state. Biochemistry yields important insights and practical application in medicine, agriculture, nutrition and industry, but its ultimate concern is with the wonder of life and living things.

UNIT-I: CARBOHYDRATE METABOLISM

i. Occurrence, classification, structure of disacharrides and polysacharrides, properties and biological importance of carbohydrates, Stereochemistry of carbohydrates
ii. Metabolic pathways; glycolysis, aerobic and anaerobic glycolysis, oxidation of Pyruvate to Acetyl Co A
iii. Citric acid cycle and its regulation, Glyoxylate cycle; Gluconeogenesis.
iv. The pentose-phosphate reductive pathway, uronic acid pathway and their significance

UNIT-II: PROTEIN CHEMISTRY AND METABOLISM

i. Proteins: Structure, classification and functions. Structure and classification of amino acids
ii. Titration curves; Metabolism of simple, branched and aromatic amino acids; Biosynthesis of essential amino acid.
iii. Degradation of different amino acids to TCA Cycle intermediates; glucogenic and ketogenic amino acids metabolism; Allosteric regulation of amino acid biosynthesis.
iv. Urea cycle; Inborn errors of amino acid metabolism, Aminoaciduria.

UNIT-III: PHOTOSYNTHESIS AND ATP SYNTHESIS

i. Photosynthesis: concept and significance, Z scheme of photophosphorylation; C3 and C4 pathways, their nature and regulation.
ii. ATP cycle; bioenergetics; concept of entropy; free energy.
iii. Electron transport chain, substrate- level and oxidative phosphorylation.
iv. Chemiosmotic theory for ATP synthesis, regulation of ATP production; Glycerol 3 P shuttle and Malate Aspartate shuttle system.

M.Sc. Microbiology

SEMESTER I

Syllabi for the examinations to be held in the years Dec. 2022, Dec. 2023 & Dec. 2024

COURSE TITLE: BIOCHEMISTRY AND METABOLISM

Course code: PSMBTC103

Contact hours: 48

Duration of Examinations

Minor Test1: 1.5 hour

Minor Test2: 1.5 hour

Major Test: 3.0 hours

Credits: 4

Max. Marks: 100

Minor Test1: 20

Minor Test2: 20

Major Test: 60

Total: 100

UNIT-IV: LIPID CHEMISTRY AND METABOLISM

i. Fatty acids as building blocks of most lipids, major classes of lipids and their role.

ii. Biosynthesis of even-Chain, odd-Chain, saturated and unsaturated- fatty acids.

iii. Biosynthesis of fats, phospholipids, glycolipids and sphingolipids, prostaglandins and cholesterol.

iv. Oxidation of fatty acids, α- β- and ω oxidation; Ketogenesis and its regulation.

UNIT-V: NUCLEIC ACID CHEMISTRY AND METABOLISM

i. Nucleic acid chemistry and structure of DNA and various RNAs.

ii. Metabolism of purine- and pyrimidine- nucleotides; biosynthesis of pyrimidine nucleotides; their regulation, catabolism of pyrimidines.

iii. Purine salvage pathway, Pathway of de novo purine biosynthesis from ribosephosphate and ATP, their regulation, catabolism of purines.

iv. Regulation of biosynthesis by feedback control; Genetic disorders and hyperuricemia.

NOTE FOR PAPER SETTING AND COURSE EVALUATION

Minor test 1 should cover upto 20% of syllabus. Minor test II should cover 21%- 40% of syllabus. Major test should cover 41% -100% of syllabus. Major test will have 7 questions each of 15 marks. One question will be very short answer type of multiple parts compulsory spread over entire syllabus. The remaining 6 questions will be from remaining 41%-100% part of the syllabus and the candidate will have to attempt any three of them. The major test should test both the subjective and objective aptitudes of the student. Minor test 1 will be held after 3-4 weeks of teaching and Minor test II will be held 8-9 weeks after the start of session. Two minor test per day should be conducted and no preparatory holiday shall be given.

BOOKS RECOMMENDED

1. Voet, D . and Voet, J.G. (2016) Fundamentals of Biochemistry. John Wiley and Sons inc. USA. 5th ed.

2. Stryer, L. et al. (2019). Biochemistry. Macmillan. 9th ed.
3. Nelson DL and Cox M (2021). Lehinger Principles of Biochemistry. CBS Publishers & Distributors, New Delhi.

M.Sc. Microbiology

SEMESTER I

Syllabi for the examinations to be held in the years Dec. 2022, Dec. 2023 & Dec. 2024

COURSE TITLE: BIOCHEMISTRY AND METABOLISM

Course code: PSMBTC103

Contact hours: 48

Duration of Examinations

Minor Test1: 1.5 hour

Minor Test2: 1.5 hour

Major Test: 3.0 hours

Credits: 4

Max. Marks: 100

Minor Test1: 20

Minor Test2: 20

Major Test: 60

Total: 100

4. Seage, S.L and Slabaugh, M.R. (1997). Organic and Biochemistry for Today. 3rd edition. Brooks/ cole Publishers.
5. Ritter, P. (1996). Biochemistry: A foundation. Books/ cole Publishers.
6. Murray, R.K., Granner, D.K., Mayes, P.A. and Rodwell, V.W. (2018). Harper's Biochemistry. Appleton, Lange Publishers, CT. 31st edition.
7. Burtis, C.A., Ashwood, E. R. (2007). Clinical Chemistry. Elsener Publishers. 5th edition.
8. Luxton, B. and Pallister, K. (2007). Clinical Biochemistry. Butterworth Heinemann Publishers.
9. Makowski GS (2021) Advances in clinical biochemistry. Academic Press,

M. Sc. MICROBIOLOGY
SEMESTER - I
Syllabi for the examinations to be held in the years Dec. 2022, Dec. 2023 & Dec. 2024

COURSE TITLE: MOLECULAR BIOLOGY

Course code: PSMBTC109
Duration of Examinations
Minor Test1: 1.5 hour
Minor Test2: 1.5 hour
Major Test: 3 hours

Contact hours: 48
Credits: 4
Max. Marks: 100
Minor Test 1: 20
Minor Test 2: 20
Major Test: 60
Total: 100

Objectives: In today's scientific world no biological study is complete till it is studied at the molecular level. This course will guide students about the basic background (physical and chemical) of molecular biology. The primary objective is to make students achieve a simple, comprehensive and interested view of basic composition of nucleic acids, their structure and their mode of replication. The study deals with conversion of genetic information coded in DNA to cellular macromolecules. The contents cover important aspects like, synthesis, modification and regulation of important cellular macromolecules, namely RNA and Protein.

UNIT-I: DNA STRUCTURE AND FUNCTION

i. Techniques to study nucleic acids; centrifugation, crystallography, electron-microscopy, spectroscopy and chromatography.
ii. DNA as a genetic material, DNA Structure and function: Physical and chemical structure of DNA, Alternate forms of DNA A,B,Z; Alternate DNA structure H-, G-; DNA loops; D-loop, R-loop, cruciforms, hairpin loops
iii. DNA structures; Primary, secondary, tertiary and quaternary DNA structure; Function of alternate forms and structures of DNA, Topography and superhelicity of DNA.
iv. Denaturation analysis of DNA; denaturation curve and assessment of GC% and Tm, Hyper and hypochromic effect of DNA

UNIT-II: DNA REPLICATION AND INTRODUCTION TO RNA

i. Interaction of DNA with proteins; role of these interactions on the function of DNA, e.g. Zn finger , lucine zipper, helix turn helix and helix-loop -helix proteins
ii. Replication of DNA, Replication of core genome and replication of extrachromosomal DNA, Elements and factors required for replication of core genome in eukaryotes, prokaryotes
iii. Chromosomal replication with chromosomal replication in *E.coli* and *S. cerevisae*, as reference.
iv. Extra chromosomal elements replication with phi X174, Plasmid and mitochondrial replication as reference

UNIT-III: GENE EXPRESSION I - TRANSCRIPTION

i. RNA structure and function. RNA as a structural molecule: transfer and ribosomal RNA, RNA as information molecule: messenger RNA,
ii. Mechanism of transcription in prokaryotes; Elements and factors involved in prokaryotes; Promoter sequences and regulatory factors,

M. Sc. MICROBIOLOGY
SEMESTER - I
Syllabi for the examinations to be held in the years Dec. 2022, Dec. 2023 & Dec. 2024

COURSE TITLE: MOLECULAR BIOLOGY

Course code: PSMBTC109 **Contact hours**: 48
Duration of Examinations **Credits**: 4
Minor Test1: 1.5 hour **Max. Marks**: 100
Minor Test2: 1.5 hour **Minor Test1**: 20
Major Test: 3 hours **Minor Test2**: 20
Major Test: 60
Total: 100

iii. Operon concept; Inducible and repressible operons in prokaryotes. Attenuation, anti-termination, auto-regulation of gene expression. Negative and positive control of gene expression.
iv. Mechanism of transcription in Eukaryotes: Gene activation in eukaryotes, Basal transcription apparatus, Eukaryotic promoter sequences, enhancers, silencers, general and specific factors. Initiation, elongation and termination of transcription in Eukaryotes.

UNIT-IV: GENE EXPRESSION II- TRANSCRIPTION/TRANSLATION

i. Post transcriptional regulation: mRNA processing capping and polyadenylation. mRNA splicing and editing, nucleo-cytoplasmic mRNA transport, mRNA stability, degradation and half life period. Differential gene expression
ii. Genetic Code: Universality and degeneracy of code and exceptions to code, Wobble hypothesis, Codon usage bias.
iii. Mechanism of translation in prokaryotes: Elements and factors required for translation, Co-transcriptional- translation regulation of prokaryotic translation.
iv. Initiation, elongation and termination of translation in prokaryotes. Non- ribosomal peptide synthesis.

UNIT V: GENE EXPRESSION III- TRANSLATION AND DNA DAMAGE AND REPAIR.

i. Mechanism of translation in Eukaryotes: Elements and factors required for translation, Initiation, elongation and termination of translation in eukaryotes.
ii. Regulation of eukaryotic translation. Non ribosomal translation and its importance
iii. DNA Damage: radiation damage, alkylation damage, mutagen and carcinogen damage, oxidative damage and instability in water
iv. DNA repair: direct reversal of damage, base excision repair, nucleotide excision repair, mismatch repair and SOS repair

NOTE FOR PAPER SETTING AND COURSE EVALUATION
Minor test 1 should cover upto 20% of syllabus. Minor test II should cover 21%- 40% of syllabus. Major test should cover 41% -100% of syllabus. Major test will have 7 questions each of 15 marks. One question will be very short answer type of multiple parts compulsory spread over entire syllabus. The remaining 6 questions will be from remaining 41%-100% part of the syllabus and the candidate will have to attempt any three of them. The major test should test both the subjective and objective aptitudes of the student. Minor test 1 will be held after 3-4 weeks of teaching and Minor test II will be held 8-9 weeks

M. Sc. MICROBIOLOGY
SEMESTER - I
Syllabi for the examinations to be held in the years Dec. 2022, Dec. 2023 & Dec. 2024

COURSE TITLE: MOLECULAR BIOLOGY

Course code: PSMBTC109 **Contact hours**: 48
Duration of Examinations **Credits**: 4
Minor Test1: 1.5 hour **Max. Marks**: 100
Minor Test2: 1.5 hour **Minor Test1**: 20
Major Test: 3 hours **Minor Test2**: 20
Major Test: 60
Total: 100

after the start of session. Two minor tests per day should be conducted and no preparatory holiday shall be given.

BOOKS RECOMMENDED

1. 1Watson J.D (2017). Molecular biology of the gene. Pearson Education.
2. Burton E (2011). Molecular Biology: genes to proteins. Jones & Bartlett Publishers, Inc.
3. Clark &Pazdernik (2009).Biotechnology: applying the genetic revolution. AcademicPress.
4. Hartwell L (2010). Genetics from genes to genomes. Macgraw-hill Education.
5. Russell (2016). iGenetics: A molecular approach. Pearson Education.
6. Krebs J.E , Goldstein E.S, Kilpatrick S.T (2017). Lewin'sGenesXII. Jones & Bartlett.

M.Sc. MICROBIOLOGY
SEMESTER I

Syllabi for the examinations to be held in the years Dec. 2022, Dec. 2023 and Dec. 2024

COURSE TITLE: BACTERIOLOGY AND VIROLOGY

Course code: PSMBTC110 **Contact hours**: 48
Duration of Examinations **Credits**: 4
Minor Test1: 1.5 hour **Max. Marks**: 100
Minor Test2: 1.5 hour **Minor Test 1**: 20
Major Test: 3.0 hours **Minor Test 2**: 20
Major Test: 60
Total: 100

Course Objective: A microbiologist must be acquainted did many biological disciplines and with all major groups of micro organisms. Bacteria and viruses have a great impact on fields such as medicines, agricultural and food sciences, ecology, genetics, bio chemistry and molecular biology. The course on Bacteriology and Virology would provide a balanced introduction of these areas to the students of microbiology.

UNIT - I: GENERAL BACTERIOLOGY

i. Morphology and ultrastructure of bacteria. Cell Wall of Archaebacteria, Gram negative, and Gram positive bacteria, L-Form cell wall synthesis.
ii. Structure, composition and function of: cell membranes, flagella, cilia, pili, inclusion bodies, nucleoid.
iii. Antigenic properties of capsule, Chemotaxis and Endospore.
iv. Cell division.

UNIT - II: BACTERIAL GROWTH AND KINETICS

i. Culture media- types and composition. Methods of preservation of microbial cultures.
ii. Growth Kinetics; Batch and Continuous culture, Synchronous, Asynchronous.
iii. Growth measurement, Factors affecting growth. Control of bacterial growth, Physical and chemical agents.
iv. Basis of microbial classification, classification and silent features of bacteria according to the Bergey's manual of determinative bacteriology

UNIT - III: METHODS OF ASSESSING MICROBIAL DIVERSITY

i. **Culture based approach**: Isolation & cultivation, cultivation of aerobic and anaerobic bacteria
ii. Bacterial identification: Morphology, microscopy, biochemical characterization and molecular characterization
iii. **Cultivation independent approach**: Metagenomic DNA extraction, gene targeted metagenic approach (Metabarcoding, 16S rRNA, housekeeping genes)
iv. Cloning dependent and cloning independent (Next generation sequencing) metabarcoding approach

UNIT - IV: GENERAL VIROLOGY

i. Discovery, nomenclature, classification of animal and plant viruses, distinctive properties and cultivation of viruses.
ii. Morphology and ultrastructure; Capsid, and their arrangements, Types of envelopes and their composition. Viral genome; types and structure.

iii. Virus related agents; viroids and prions.

M.Sc. MICROBIOLOGY
SEMESTER I

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COURSE TITLE: BACTERIOLOGY AND VIROLOGY

Course code: PSMBTC110 **Contact hours**: 48
Duration of Examinations **Credits**: 4
Minor Test1: 1.5 hour **Max. Marks**: 100
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Major Test: 3.0 hours **Minor Test2**: 20
Major Test: 60
Total: 100

iv. Bacteriophage structural organization, Life cycle; lysogenic and lytic. Bacteriophage typing and its application in bacterial genetics. Brief details on M13, Mu, T-even, T-odd and lambda P1.

UNIT - V: TYPES OF VIRUSES

i. Viruses of Animals, DNA (Pox, Herpes, Adeno) and RNA (Picorna, Ortho-myxo, Para-myxo) Viruses,
ii. Viruses of Plant, Life cycle of TMV, Cauliflower mosaic virus, potato mosaic virus.
iii. Viruses of Cyanobacteria, algae and fungi.
iv. Arthopod viruses (Rhabdo, Rota, and other Oncogenic viruses).

NOTE FOR PAPER SETTING AND COURSE EVALUATION:

Minor test 1 should cover upto 20% of syllabus. Minor test II should cover 21%- 40% of syllabus. Major test should cover 41% -100% of syllabus. Major test will have 7 questions each of 15 marks. One question will be very short answer type of multiple parts compulsory spread over entire syllabus. The remaining 6 questions will be from remaining 41%-100% part of the syllabus and the candidate will have to attempt any three of them. The major test should test both the subjective and objective aptitudes of the student. Minor test 1 will be held after 3-4 weeks of teaching and Minor test II will be held 8-9 weeks after the start of session. Two minor tests per day should be conducted and no preparatory holiday shall be given.

BOOKS RECOMMENDED

1. Moat,A.G., Foster, J.W. and Spector, M.K.(2002) Microbial physiology. Wileyliss a John Wiley and sons, Inc. Publication.
2. Pelczar, M.J., Chan, E.C.S.,Kraig N.R., (2002). Microbiology, Mc Graw Hills.
3. Balows, A.G.Thuper, M. Dworkin. W. Harder, K. Springer Verlag (1991). The Prokaryotes.
4. Microbiology: An Introduction, 13th Edition, Gerard J. Tortora, Bergen Community College; Berdell R. Funke, North Dakota State University; Christine L. Case, Skyline College 13th edition. ©2019 |Pearson
5. Brock, Biology of Microorganisms, 16th Edition by Michael T. Madigan, John M. Martinko, Kelly S. Bender, Daniel H. Buckley, David A. Stahl, Thomas Brock ©2021 Pearson
6. Willey, J.M, Sherwood, L.M, and Woolverton, C.J. (2011) Prescott's Microbiology McGraw Hill Eighth International Edition.
7. Sneath, P.H.A., Elizebeth, S.N.M. (2001) Bergeys manual of systemic Bacteriology.
8. Cappuccino,J.G and Shreman, N. (2005) Microbiology- A Laboratory Manual Addison Weseley
9. Saravanan,P. (Virology) 2007 (MJP Pub.)

10. Dimmock N.J., Easton A.J., & Leppard K.N. (2007) (An introduction to modern Virology) Blackwell pub. 5th ed.

M. Sc MICROBIOLOGY
SEMESTER-II

Syllabi for the examinations to be held in the years May 2023, May 2024 and May 2025

COURSE TITLE: ENZYMOLOGY
Course code: PSMBTC202

Contact hours: 48

Duration of Examinations
Minor Test 1: 1.5 hour
Minor Test 2: 1.5 hour
Major Test: 3.0 hours

Credits: 4
Max. Marks: 100
Minor Test 1: 20
Minor Test 2: 20
Major Test: 60
Total: 100

Course objective: The course is structured to provide the students insight into protein/ enzyme structure, folding, functional mechanisms, enzyme kinetics and regulation of enzyme action, purification and characterization, and bulk production of enzymes. The course also aims to acquaint students with application potential of enzymes for wide range industries.

UNIT-I: INTRODUCTION TO ENZYMES

i. General characteristics of enzymes, nature of enzymatic and non-enzymatic catalysis, Enzyme specificity, biocatalysts vs chemical catalysts
ii. Criteria for Nomenclature and IUB classification of enzymes, significance of nomenclature and classification of enzymes; significance of numbering system,
iii. Holoenzyme, apoenzyme cofactors, coenzymes, prosthetic group
iv. Basis of enzyme assays, Units of enzyme activity- IU, katal, turn over number and specific activity;
v. Structure of enzyme proteins, N and C terminal amino acid determination, sequencing of polypeptides, protein folding, amino acid side chains and their influence on preferred folding; other catalytic bio-molecules.

UNIT-II: MECHANISM OF ENZYME ACTION

i. Enzyme catalysis; effect of enzyme on the rate and equilibrium of a reaction;
ii. Specificity of enzyme action: type of specificity, lock and key, induced fit hypothesis,
iii. Chemical mechanisms involved in biocatalysis, proximity and orientation effect, acid/base catalysis covalent catalysis, strain and distortion theory;
iv. Active (catalytic) site, elucidation of amino acids involved in active site, identification of functional groups at active sites;
v. Mechanism of action of chymotrypsin, carboxypeptidase, ribonuclease and lysozyme;

M. Sc MICROBIOLOGY
SEMESTER-II

Syllabi for the examinations to be held in the years May 2023, May 2024 and May 2025

COURSE TITLE: ENZYMOLOGY
Course code: PSMBTC202

Contact hours: 48

Duration of Examinations
Minor Test 1: 1.5 hour
Minor Test 2: 1.5 hour
Major Test: 3.0 hours

Credits: 4
Max. Marks: 100
Minor Test 1: 20
Minor Test 2: 20
Major Test: 60
Total: 100

UNIT-III: ENZYME KINETICS AND REGULATORY ENZYMES

i. Principles of bioenergetics, basis of kinetics of enzyme catalyzed reactions
ii. Steady state vs equilibrium assumption, Henri and Michaelis-Menten equations, Michaelis-Menten kinetics and its limitations, Lineweaver-Burk plots, Eadie-Hofstee and Hanes plots.
iii. Factors affecting enzyme activity: enzyme/substrate concentration, pH and temperature dependence of enzymes, Enzyme inhibition kinetics, Reversible and irreversible inhibition kinetics.
iv. General Mechanisms for enzyme based regulation of metabolic pathways, covalent and noncovalent modification of enzymes, feedback inhibition and repression, partial proteolysis
v. Allosteric enzymes, sigmoidal kinetics, importance of allosteric enzymes in physiology and metabolism

UNIT-IV: PRODUCTION, PURIFICATION AND IMMOBILIZATION OF ENZYMES

i. Strategies for bulk industrial enzyme production, scale up and optimization, sources of enzyme isolation
ii. Enzyme purification, criteria, aim and importance of purification, general techniques /steps involved
iii. Salt precipitation of enzymes, salting-in and out, Chromatography, ion exchange, adsorption, hydrophobic, and gel filtration; affinity chromatography, SDS/Native/2D PAGE, Zymography
iv. Approaches for ascertaining the purity level of enzyme, specific activity; criteria of enzyme purity, characterization of a purified enzyme, molecular weight (Mr) assay
v. Enzyme immobilization, techniques and principles, industrial significance of immobilized enzymes

UNIT-V: ENZYME TECHNOLOGY

i. Industrial applications of enzymes, Desirable characteristics of enzymes for industrial applications, significance of using enzymes for industrial processes

M. Sc MICROBIOLOGY
SEMESTER-II

Syllabi for the examinations to be held in the years May 2023, May 2024 and May 2025

COURSE TITLE: ENZYMOLOGY
Course code: PSMBTC202

Contact hours: 48

Duration of Examinations
Minor Test 1: 1.5 hour
Minor Test 2: 1.5 hour
Major Test: 3.0 hours

Credits: 4
Max. Marks: 100
Minor Test 1: 20
Minor Test 2: 20
Major Test: 60
Total: 100

ii. Enzymes for food processing, dairy, brewery, winery, and for production of industrial products, biofuels.
iii. Applications of enzymes in detergent, textile, leather industries
iv. Enzymes for diagnosis of diseases/disorders, and enzymes as therapeutic agents
v. Enzyme inhibitors as drugs; Enzyme engineering and design, new enzyme discovery.

NOTE FOR PAPER SETTING AND COURSE EVALUATION

Minor test 1 should cover upto 20% of syllabus. Minor test II should cover 21%- 40% of syllabus. Major test should cover 41% -100% of syllabus. Major test will have 7 questions each of 15 marks. One question will be very short answer type of multiple parts compulsory spread over entire syllabus. The remaining 6 questions will be from remaining 41%-100% part of the syllabus and the candidate will have to attempt any three of them. The major test should test both the subjective and objective aptitudes of the student. Minor test 1 will be held after 3-4 weeks of teaching and Minor test II will be held 8-9 weeks after the start of session. Two minor tests per day should be conducted and no preparatory holiday shall be given.

BOOKS RECOMMENDED:

1. Segal, L.H. (1975). Enzyme Kinetics. Wiley Interscience, USA.
2. Walsh, C. (1979). Enzymatic reaction mechanism. Freeman and company, USA.
3. Gerhartz, W. (1990). Enzyme in Industry, Production and application VCH.
4. Shultz, A.R. (1994). Enzyme Kinetics. Cambridge Press.
5. Fresht (1995) 2nd Ed. Enzyme structure and mechanism. Freeman and company.
6. Trevor, P. (2002) 4th Ed. Understanding Enzymes. Prentice Hall/Ellis, Harwood, England.
7. Dixon, M. and Webb,E.C. (1997). Enzymes, 3rd Ed. Academic Press, New York.
8. Nicholas, C. Price and Lewis Stevens (2007). Fundamentals of Enzymology. 6th edition.
9. Biotol, P. (2008). Principles of Enzymology for technological Applications. Elsevier Pub

M.Sc. MICROBIOLOGY
SEMESTER - II
Syllabi for the examinations to be held in the years May 2023, May 2024 and May 2025

COURSE TITLE: MOLECULAR VIROLOGY
Course code: PSMBTC204

Contact hours: 24	**Credits: 2**
Duration of Examinations:	**Max. Marks: 50**
Minor Test 1: 1 hour	**Minor Test 1: 05**
Minor test 2: 1 hour	**Minor Test 2: 05**
Major Test: 2.5 hours	**Major Test: 40**
	Total: 50

Objectives: This course has been designed to develop broad understanding of molecular virological strategies, mechanisms and their relationship to current paradigms in virus pathogenesis. Also, it will provide theoretical knowledge of virus groups which are pathogens, including analyses of emerging infections, through an in depth study of selected viruses. Study of antiviral activities along with their application and relevance in current research, diagnosis and treatment will remain the main learning objectives of this course.

UNIT-I: INTRODUCTION TO MOLECULAR VIROLOGY

i. Overview of the mechanism/Stages of viral pathogenesis
ii. Viral entry: Adsorption, Cellular receptors, penetration, uncoating mechanisms, and Cellular interactions (clathrin coated pits, lipid rafts)
iii. Multiplication of virus, protein synthesis, intracellular trafficking, viral assembly, maturation and release. Case study: Polio, Covid-19, HIV.
iv. Virus–Host Interactions and Host response to viral infection, Host immune responses to virus infections and evasion of Immune Responses by Viruses.

UNIT-II: DNA AND RNA VIRUSES

i. Types of Viruses, Animal viruses, Oncogenic viruses (tumor viruses),
ii. DNA containing oncogenic viruses, human adenovirus,
iii. RNA containing oncogenic viruses, retroviruses (Onco RNA viruses), AIDS virus.
iv. Viral diseases: Description and pathology of diseases caused by myxo and paramyxo viruses (influenza and measles virus); viruses affecting nervous system (poliomyelitis virus), enterovirus (Coxsackie), viral hepatitis.

UNIT-III: VIRUS CONTROL

i. Viral Vaccine: Conventional vaccines- killed and attenuated, modern vaccines recombinant proteins, subunits, DNA vaccines, vaccine delivery and adjuvants.
ii. Antivirals: Interferons, designing and screening for antivirals, mechanisms of action,
iii. Antiretrovirals—mechanism of action and drug resistance.
iv. Modern approaches of virus control: Anti-sense RNA, siRNA, ribozymes

M.Sc. MICROBIOLOGY
SEMESTER – II

Syllabi for the examinations to be held in the years May 2023, May 2024 and May 2025

COURSE TITLE: MOLECULAR VIROLOGY
Course code: PSMBTC204

Contact hours: 24	**Credits: 2**
Duration of Examinations:	**Max. Marks: 50**
Minor Test 1: 1 hour	**Minor Test 1: 05**
Minor test 2: 1 hour	**Minor Test 2: 05**
Major Test: 2.5 hours	**Major Test: 40**
	Total: 50

NOTE FOR PAPER SETTING AND COURSE EVALUATION:

Minor test 1 should cover upto 20% of the syllabus. Minor test II should cover 21% - 40% of the syllabus. Major test should cover 41% - 100% of the syllabus. Major test will have 5 questions. One question of 10 marks will be very short answer type of multiple parts and is compulsory spread over entire syllabus. The remaining 4 questions will be from remaining41% - 100% part of the syllabus of 15 marks each and the candidate will have to attempt any two of them. The major test should test both the subjective and objective aptitudes of the student. Minor test 1 will be held after 3-4 weeks of teaching and Minor test II will be held 8-9 weeks after the start of session.

RECOMMENDED BOOKS:

1. Riedel S, Hobden JA, Miller S, Morse S A., Mietzner T A., Detrick B, Mitchell T G., Sakanari J A., Hotez P, Mejia R (2019) Medical Microbiology. McGraw-Hill Education. 28th edition
2. Flint S.J., Racaniello V.R., Enquist L.W., Rancaniello V.R., Skalka A.M. (2020) Principles of Virology: Molecular Biology, Pathogenesis, and Control of Animal Viruses. 5th Edition. Publisher: American Society Microbiology.
3. Adoga M.P (2017). Molecular Virology. 7th edition. Publisher: Intech
4. Carter J., Saunders V. (2013). Virology: Principles and Applications. 2nd edition, Wiley.
5. Alan J. Cann (2000) DNA virus Replication. Publisher: Oxford University Press.
6. Alan J. Cann (2005) Principles of Molecular Virology. Publisher: Elsevier Science and Technology Books.
7. Stephen K. Tyring. (2004) Field Virology Vol.1 and 2. Antiviral Agents, Vaccines, and Immunotherapies. Publisher: Marcel Dekker.

M. Sc MICROBIOLOGY

SEMESTER-II

Syllabi for the examinations to be held in the years May 2023, May 2024 & May 2025

COURSE TITLE: IMMUNOLOGY
Course code: PSMBTC205
Contact hours: 48
Duration of Examinations **Credits: 4**
Minor Test1: 1.5 hour **Max. Marks: 100**
Minor Test2: 1.5 hour **Minor Test1: 20**
Major Test: 3.0 hours **Minor Test2: 20**
Major Test: 60
Total: 100

Course objective: This course introduces students to molecular and cellular immunology, including antigen and antibody structure and function, major histo-compatibility complexes, B- and T- cell receptors, antibody formation and immunity and regulation of immune system. The course will also provide birds eye view of the applied aspects of the immunology.

UNIT - I: INTRODUCION TO THE IMMUNE SYSTEM

i. Introduction to immune system, Innate and acquired immunity, clonal nature of immune response; Organization and structure of lymphoid organs
iv. Cells of the immune system: Hematopoiesis and differentiation, B- lymphocytes, T- lymphocytes, Macrophages, Dentritic cells, Natural killer and Lymphokine activated killer cells, Eosinophils, Neutrophils and Mast cells.
v. Nature and Biology of antigens and super antigens, Antibody structure and function, antibody mediated effector functions, antibody classes and biological activity
vi. Antigenic determinants on immunoglobulins, Immunoglobulin superfamily, BCR & TCR, generation of antibody diversity.

UNIT - II: HUMORAL AND CELL MEDIATED IMMUNITY

i. Regulation of immune response, Antigen processing and presentation, generation of humoral and cell mediated immune responses, Activation of B- and T- lymphocytes,
ii. Complement System: components of complement, complement activation, complement cascade, regulation of complement System
iii. Cytokines, cytokines receptors, cytokines antagonists, role of cytokines in T_H1/T_H2 subset development and their role in immune regulation, MHC: MHC molecules and genes, MHC restriction,
iv. Cell-mediated cytotoxicity: Mechanism of T cell and NK cell mediated lysis, Antibody dependent cell mediated cytotoxicity, macrophage mediated cytotoxicity.

UNIT - III:
IMMUNOLOGICAL DISORDERS

i. Autoimmunity and auto immune disorders: organ specific and systemic autoimmune diseases, animal models for autoimmune diseases and the molecular mechanism, immunodeficiency disorder- AIDS

ii. Hypersensitivity: IgE mediated Hypersensitivity, Antibody mediated cytotoxic Hypersensitivity, Immune comlex- mediated Hypersensitivity, Delayed type Hypersensitivity

M. Sc MICROBIOLOGY
SEMESTER-II
Syllabi for the examinations to be held in the years May 2023, May 2024 & May 2025

COURSE TITLE: IMMUNOLOGY
Course code: PSMBTC205
Contact hours: 48
Duration of Examinations **Credits: 4**
Minor Test1: 1.5 hour **Max. Marks: 100**
Minor Test2: 1.5 hour **Minor Test1: 20**
Major Test: 3.0 hours **Minor Test2: 20**
Major Test: 60
Total: 100

iii. Transplantation immunology: Immunological basis of graft rejection, clinical manifestation of graft rejection, general immunosuppressive therapy, specific immunosuppressive therapy, immune tolerance to allografts
iv. Immunological tolerance: central tolerance, peripheral tolerance, component of peripheral tolerance

UNIT IV: IMMUNODIAGNOSTIC PROCEDURES

i. Antigen- Antibody interactions and Techniques – ELISA and its variants, ELISPOT, Radio immunoassay, Immunofluorescence, Flow cytometry and Fluorescence, Immunoelectron microscopy
ii. Agglutination and haemagglutination assays
iii. Types of immundiffusion and immunoelectrophoretic procedures, isolectric focusing
iv. Affinity chromatographic methods and Immunoblotting.

UNIT - V: IMMUNOBIOTECHNOLOGY

i. Hybridoma Technology and Monoclonal antibodies detection and application of monoclonal antibodies;
ii. lymphokines: production and applications, Interleukine therapy
iii. Vaccines: History of vaccine development, introduction to the concept of vaccine, Active and passive immunization, Designing vaccines for active immunization: Conventional vaccines, subunit vaccines, conjugate vaccines, DNA vaccines, Recombinant vector vaccines
iv. Cell culture and maintenance of cell lines

NOTE FOR PAPER SETTING AND COURSE EVALUATION

Minor test 1 should cover upto 20% of syllabus. Minor test II should cover 21%- 40% of syllabus. Major test should cover 41% -100% of syllabus. Major test will have 7 questions each of 15 marks. One question will be very short answer type of multiple parts compulsory spread over entire syllabus. The remaining 6 questions will be from remaining 41%-100% part of the syllabus and the candidate will have to attempt any three of them. The major test should test both the subjective and objective aptitudes of the student. Minor test 1 will be held after 3-4 weeks of teaching and Minor test II will be held 8-9 weeks after the start of session. Two minor tests per day should be conducted and no preparatory holiday shall be given.

M. Sc MICROBIOLOGY

SEMESTER-II

Syllabi for the examinations to be held in the years May 2023, May 2024 & May 2025

COURSE TITLE: IMMUNOLOGY
Course code: PSMBTC205
Contact hours: 48
Duration of Examinations **Credits: 4**
Minor Test1: 1.5 hour **Max. Marks: 100**
Minor Test2: 1.5 hour **Minor Test1: 20**
Major Test: 3.0 hours **Minor Test2: 20**
Major Test: 60
Total: 100

BOOKS RECOMMENDED

1. Kuby Immunology, Eighth Edition 2019 by **Jenni Punt; Sharon Stranford; Patricia Jones; Judy Owen**
2. Janeway's Immunobiology by Kenneth Murphy, Casey Weaver (2017). Ninth edition New York: Garland Science.
3. Basic Immunology: Functions and Disorders of the Immune System by Abul K. Abbas, Andrew H. H. Lichtman, Shiv Pillai (2019)
4. Roitt's Essential Immunology by Peter J. Delves, Seamus J. Martin, Dennis R. Burton, Ivan M. Roitt (2017). Thirteenth edition
5. Brostoff, J., Seaddin, J. K., Male, D., & Roitt, I. M. (2002). Clinical Immunology. London: Gower Medical Pub.
6. Paul, W. E. (2012). Fundamental Immunology. New York: Raven Press.
7. Goding, J. W. (1996). Monoclonal Antibodies: Principles and Practice: Production and Application of Monoclonal Antibodies in Cell Biology, Biochemistry, and Immunology. London: Academic Press.
8. Parham, P. (2005). The Immune System. New York: Garland Science.
9. Relevant review articles/research papers/handouts provided in the course

M.Sc MICROBIOLOGY
SEMESTER-II
Syllabi for the examinations to be held in the years May. 2023, May 2024 and May 2025

COURSE TITLE: GENETIC ENGINEERING

Course code: PSMBTC210	**Contact hours: 48**
Duration of Examinations	**Credits: 4**
Minor Test1: 1.5 hour	**Max. Marks: 100**
Minor Test2: 1.5 hour	**Minor Test1: 20**
Major Test: 3.0 hours	**Minor Test2: 20**
	Major Test: 60
	Total: 100

Course objective: The aim of the course is to extend the student's understanding of new concepts and expertise in molecular biology and fundamentals of recombinant DNA technology.

UNIT-I: TOOLS AND TECHNIQUES USED IN GENETIC ENGINEERING

i. Isolation, purification, quantification and electrophoresis of nuclear and cytoplasmic DNA and RNA.
ii. Isolation, purification, quantification and electrophoresis of environmental DNA and RNA
iii. Size standards for DNA and RNA. Molecular tools and their uses; enzymes used in genetic engineering: restriction endonucleases, Ligases, Kinases, Phosphatases, Polymerases, terminal transferases
iv. Gene cloning vectors: plasmids, bacteriophages, cosmids and artificial chromosomes

UNIT-II: GENE/s CLONING TECHNIQUES

i. Construction of genomic library. Preparation of vector and insert for cloning and construction of recombinant DNA molecule. Transformation of E.coli with recombinant DNA.
ii. Construction of cDNA library, RNA enrichment techniques. Cloning differentially active genes. Subtractive hybridization.
iii. Polymerase chain reaction, nucleic acid amplification, primer design and programming. modifications of basic PCR.
iv. Southern, Northern and Western blotting; Preparation of labeled DNA probes- radioactive and non- radioactive labeling,

UNIT-III: GENE/s EXPRESSION TECHNIQUES

i. Gene centric cloning and genome centric cloning, Isolation, identification and characterization of gene.
ii. Screening and analysis of genomic and cDNA library by function and sequence based methods.
iii. Identification of interacting genes; two and three hybrid system, RNase protection assay and reporter assay
iv. Expression strategies for heterologous genes; vector engineering and codon optimization, host engineering, Expression in eukaryotic and prokaryotic systems; In vitro transcription and translation, methods and application, Phage display.

M.Sc MICROBIOLOGY
SEMESTER-II
Syllabi for the examinations to be held in the years May. 2023, May 2024 and May 2025

COURSE TITLE: GENETIC ENGINEERING

Course code: PSMBTC210	**Contact hours: 48**
Duration of Examinations	**Credits: 4**
Minor Test1: 1.5 hour	**Max. Marks: 100**
Minor Test2: 1.5 hour	**Minor Test1: 20**
Major Test: 3.0 hours	**Minor Test2: 20**
	Major Test: 60
	Total: 100

UNIT-IV: ADVANCED TECHNIQUES IN GENETIC ENGINEERING

i. DNA sequencing: Sanger's Chain termination methods, next generation sequencing (NGS) methods,
ii. Targeted sequencing and whole genome sequencing methods using NGS
iii. Genome engineering: Genome/gene editing methods, strategies and applications
iv. Introduction to synthetic biology; chemical synthesis of nucleic acids, methods, strategies and applications, Gene circuits.

UNIT-V: APPLICATION OF GENETIC ENGINEERING

i. Protein engineering by directed mutagenesis e.g. site directed mutagenesis, strategies for protein engineering
ii. Genetic engineering in molecular diagnostics, Nucleic based diagnostics and protein based diagnostics
iii. Artificial intelligence and Machine learning in recombinant DNA technology and its application. Production of genetically engineered drugs and vaccines, industrial products of genetically modified organisms.

NOTE FOR PAPER SETTING AND COURSE EVALUATION

Minor test 1 should cover upto 20% of syllabus. Minor test II should cover 21%- 40% of syllabus. Major test should cover 41% -100% of syllabus. Major test will have 7 questions each of 15 marks. One question will be very short answer type of multiple parts compulsory spread over entire syllabus. The remaining 6 questions will be from remaining 41%-100% part of the syllabus and the candidate will have to attempt any three of them. The major test should test both the subjective and objective aptitudes of the student. Minor test 1 will be held after 3-4 weeks of teaching and Minor test II will be held 8-9 weeks after the start of session. Two minor tests per day should be conducted and no preparatory holiday shall be given.

BOOKS RECOMMENDED

1. Brown, T. A. (2020) Gene Cloning and DNA Analysis: An Introduction. Wiley-Blackwell Publishing, UK.

SEMESTER-II

Syllabi for the examinations to be held in the years May. 2023, May 2024 and May 2025

COURSE TITLE: GENETIC ENGINEERING

Course code: PSMBTC210	**Contact hours: 48**
Duration of Examinations	**Credits: 4**
Minor Test1: 1.5 hour	**Max. Marks: 100**
Minor Test2: 1.5 hour	**Minor Test1: 20**
Major Test: 3.0 hours	**Minor Test2: 20**
	Major Test: 60
	Total: 100

2. Glick B. R and Patten C. L. (2017) Molecular Biotechnology: Principles and Applications of Recombinant DNA. ASM Press, USA.
3. Green M. R. and Sambrook J. (2012) Molecular Cloning: A Laboratory Manual. CSHL Press, USA.
4. Primrose, S. B. and Twyman, R. M. (2006) Principles of Genetic Manipulation and Genomics. Blackwell Publishing, UK.
5. Voet, D., Voet, J. G. and Pratt C. W. (2018) Voet’s Principles of Biochemistry. John Wiley & Sons, UK.
6. Andreas Hofmann and Samuel Clokie (2018) Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology. Cambridge University Press.

M. Sc MICROBIOLOGY
SEMESTER-II
Syllabi for the examinations to be held in the years May 2023, May 2024 & May 2025

COURSE TITLE: MICROBIAL GENETICS AND GENOMICS
Course code: PSMBTC211

Contact hours: 48	**Credits: 4**
Duration of Examinations:	**Max. Marks: 100**
Minor Test 1: 1.5 Hours	**Minor Test 1: 20**
Minor Test 2: 1.5 Hours	**Minor Test 2: 20**
Major Test: 3 hours	**Major Test: 60**
	Total: 100

Course objective: In recent years, genetics and related sciences have grown explosively, generating large body of new information regarding the fine structure of gene and gene expression in prokaryotes. Besides, the molecular approach is being adopted in altering genotype and tailoring of microbial world to answer human needs. This course will introduce students to the basic concepts of genetics and genomics and prepare them to appreciate the boom of biotechnology and their participation in the on-going revolution.

Unit-I: BACTERIAL GENETICS

i. Fundamentals of Bacterial Genetics: Identification and selection of mutants; plasmids types, detection, replication, partitioning, copy-number control and transfer
ii. Properties of some known plasmids; genetic rearrangements and their evolutionary significance
iii. Recombination in Bacteria and its significance, Transformation: mechanism of transformation;
iv. Conjugation-Unidirectional gene transfer –F+ and F- ; High frequency recombination;

Unit-II: Viral Mediated transduction in Bacteria

i. Biology and genetics of Bacteriophage - virulent phage (T4) and temperate phage (lambda); hostparasite relationship, Lytic cycle and Lysogenic cycle of bacteriophage,
ii. Transduction: Generalized transduction, Co-transduction and Linkage,
iii. Specialized transduction – Formation of specialized transducing particle, Specialized transduction from λ gal and λ bio,abortive transduction
iv. Site specific recombination (lambda); biology of Phage Mu, Mu as a genetic tool

Unit- III: Genetics of Eukaryotic Viruses and Yeast

i. General features of Eukaryotic viruses, DNA viruses (Adeno viruses, Herpes, SV40, Papilloma viruses, Baculo viruses) and RNA viruses (Retro viruses – Rous Sarcoma viruses and HIV viruses; Polio viruses and Rio viruses)
ii. Regulation of gene expression by viruses in prokaryotic and eukaryotic host, case study
iii. Yeast genetics- life cycles, nuclear and organellar genomes, making mutants and analyzing genetic interactions in yeast
iv. Heterothallism and mating type switches, gene disruption plasmids, YACs

M. Sc MICROBIOLOGY
SEMESTER-II
Syllabi for the examinations to be held in the years May 2023, May 2024 & May 2025

COURSE TITLE: MICROBIAL GENETICS AND GENOMICS
Course code: PSMBTC211

Contact hours: 48	**Credits: 4**
Duration of Examinations:	**Max. Marks: 100**
Minor Test 1: 1.5 Hours	**Minor Test 1: 20**
Minor Test 2: 1.5 Hours	**Minor Test 2: 20**
Major Test: 3 hours	**Major Test: 60**
	Total: 100

UNIT- IV: GENOMICS I

i. DNA fingerprinting-principles and applications, various types of markers used for microbial fingerpeinting, Community fingerprinting
ii. Gene mapping by transformation, Mapping by Co- transduction and high frequency recombination
iii. Transposons; insertional and composites, prokaryotic transposons (Bacteria, Phage and animal viruses) and mechanism of transposition
iv. Microbial genome projects, understanding Bacterial, Bacteriophage and virus genomes, Yeast nuclear and organellar genomes

UNIT- V: GENOMICS II

i. Microbial comparative genomics: method and applications, collinearity among the genomes
ii. Microbial DNA microarrays: Concept, microbial cDNA and oligonucleotide-based microarrays, limitations and applications
iii. iii Microbial synthetic biology: role of synthetic biology in Metabolomics, predictive model building (metabolomes)
iv. Synthetic microbial genomes, synthetic bacterium, Mycoplasma laboratorium and others

NOTE FOR PAPER SETTING AND COURSE EVALUATION

Minor test 1 should cover upto 20% of syllabus. Minor test II should cover 21%- 40% of syllabus. Major test should cover 41% -100% of syllabus. Major test will have 7 questions each of 15 marks. One question will be very short answer type of multiple parts compulsory spread over entire syllabus. The remaining 6 questions will be from remaining 41%-100% part of the syllabus and the candidate will have to attempt any three of them. The major test should test both the subjective and objective aptitudes of the student. Minor test 1 will be held after 3-4 weeks of teaching and Minor test II will be held 8-9 weeks after the start of session. Two minor tests per day should be conducted and no preparatory holiday shall be given.

RECOMMENDED BOOKS

1. Microbial Genetics (1994); 2nd edition By Stanley and others

M. Sc MICROBIOLOGY
SEMESTER-II
Syllabi for the examinations to be held in the years May 2023, May 2024 & May 2025

COURSE TITLE: MICROBIAL GENETICS AND GENOMICS
Course code: PSMBTC211

Contact hours: 48	**Credits: 4**
Duration of Examinations:	**Max. Marks: 100**
Minor Test 1: 1.5 Hours	**Minor Test 1: 20**
Minor Test 2: 1.5 Hours	**Minor Test 2: 20**
Major Test: 3 hours	**Major Test: 60**
	Total: 100

2. Prescotts Microbiology (2019); 11thedition, By Joanne M Willey
3. Microbiology: An Introduction (2015), 12thedition; By Tortora and others
4. Genetic Analysis (2005); By Griffith and others
5. Microbiology: Concepts and Applications; By John Wiley
6. Microbiology (2020); 3rd edition; By Dave Wessner and others
7. Bacterial genetics and genomics (2020); 1st edition; By Lori A. S. Snyder

M.Sc MICROBIOLOGY
SEMESTER-III

Syllabi for the examinations to be held in the years Dec. 2023, Dec. 2024 & Dec. 2025

COURSE TITLE: MYCOLOGY AND PHYCOLOGY

Course code: PSMBTC301 **Contact hours**: 48
Duration of Examinations **Credits**: 4
Minor Test1: 1.5 hour **Max. Marks**: 100
Minor Test2: 1.5 hour **Minor Test1**: 20
Major Test: 3.0 hours **Minor Test2**: 20
Major Test: 60
Total: 100

Course objective: The course on Mycology and Phycology has been designed for the students who need an orderly presentation of certain fundamental facts on the structure and classification of fungi and algae. With the recent studies in the genetics and the biochemistry of fungi, and with the realization of the role which fungi play in the causation of allergies and parasitic diseases of man, the need for such a course is envisaged.

UNIT- I: INTRODUCTION TO FUNGI

i. Historical introduction to mycology, Importance of studying fungal diversity, distribution of fungi, Nutrition in fungi
ii. Thallus organization, Cell structure and cell differentiation.
iii. Reproduction: asexual, sexual and parasexual
iv. Nomenclature and Classification; Systems of classification: (Alexopoulos, Ainsworth, Alexopoulos and mims; Modern method of classification

UNIT - II: LOWER FUNGI

i. Division myxomycota; Acrasiomycetes, Hydromyxomycetes, Plasmo- diophoromycetes
ii. Zoosporic fungi; Chytridiomycetes, Hypochytridiomycetes, Oomycetes,
iii. Zygomycotina- Zygomycetes, Trichomycetes.
iv. Evolutionary tendencies in lower fungi. Evolution of Asexual Apparatus (Conidium) from a Sporangium in the Mucorales.

UNIT - III: HIGHER FUNGI

i. Ascomycotina; Hemiascomycetes, Plectomycete, Pyrenomycetes,
ii. Discomycetes, Laboulbeniomycetes, Loculoascomycetes.
iii. Basidiomycotina; Teliomycetes, Hymenomycetes (Gasteromycetes)
iv. Deuteromycotina; Hyphomycetes, Coelomycetes, Blastomycetes.Heterothalism, Sex hormones in fungi, Physiological Specialization.

UNIT - IV: FUNGI AND ECOSYSTEM

i. Lichens: ascolichens, basidiolichens, deuterolichens
ii. Mycorrhiza: ectomycorrhiza, endomycorrhiza, vesicular arbuscular mycorrhiza, fungi.
iii. Fungal diseases; mycoses systemic and subcutaneous, candidiasis, Pneumocystis, blastomycoses, dermatophytosis.

iv. Economic importance of fungi, Fungi and bioremediation, Fungi as biocontrol agents

UNIT - V: ALGAE

i. Distribution of algae, classification of algae, algal nutrition, algal thallus, algal reproduction.
ii. Green algae, diatoms, euglenoids, Brown Rhodophyta, Pyrrophyta.
iii. Algal Bloom and Algal Biofertilizers
iv. Algal ecology and algal biotechnology.

NOTE FOR PAPER SETTING AND COURSE EVALUATION

Minor test 1 should cover upto 20% of syllabus. Minor test II should cover 21%- 40% of syllabus. Major test should cover 41% -100% of syllabus. Major test will have 7 questions each of 15 marks. One question will be very short answer type of multiple parts compulsory spread over entire syllabus. The remaining 6 questions will be from remaining 41%-100% part of the syllabus and the candidate will have to attempt any three of them. The major test should test both the subjective and objective aptitudes of the student. Minor test 1 will be held after 3-4 weeks of teaching and Minor test II will be held 8-9 weeks after the start of session. Two minor tests per day should be conducted and no preparatory holiday shall be given.

BOOKS RECOMMENDED:

1. Mehrotra, R.S. and K.R. Aneja (2015), An introduction to Mycology, New Age International publishers.
2. Alexopoulos, C.J. and C.W. Mims (2007), Introduction to Mycology. Wiley Eastern Ltd. New Delhi. (4^{th} ed.).
3. Subbalis, G.(2004) The Fungi. Narosa Publishing House, N.Delhi.
4. Stainer, R.Y., Ingrahm, J.L., Wheelis, M.L. and Painter, P.R.(1991) General Microbiology. The MacMillian Press.
5. Michael J. Pelczar JR, E.C. S.Chan, Noel R. Krieg. (2021) Microbiology. Mc Graw Hills
6. Balows, A.G.Thuper, M. Dworkin. W. Harder, K. Springer Verlag (1991). The Prokaryotes.
7. Madigan, M.T.,Martinko, J.M. and Parker, J. (2008).Brock Biology of microorganisms (14 th ed.)
8. Cappuccino, J.G. and Shreman, N. (2005) Microbiology :- A Laboratory Manual. Addison Wiley.
9. Tortora, G.J., Funke, B.R. and Case (2008) Microbiology: An introduction 9^{th} ed. Ed., Benzamin Cummings.

M.Sc MICROBIOLOGY
SEMESTER-III

Syllabi for the examinations to be held in the years Dec. 2023, Dec. 2024 & Dec. 2025

COURSE TITLE: FOOD MICROBIOLOGY

Course code: PSMBTC302 **Contact hours: 24**
Duration of Examinations: **Credits: 2**
Minor Test 1: 1 hour **Max. Marks: 50**
Minor Test 2: 1 hour **Minor Test1: 05**
Major Test: 2.5 hours **Minor Test2: 05**
Major Test: 40
Total: 50

Course objective: While microorganisms are increasingly being used for food production or augmentation, these are also responsible for food spoilage and considerable losses. Huge inputs are required to preserve the foods against microbial invasion and above all these are major cause of the most horrible diseases outbreaks.

UNIT - I: INTRODUCTION TO FOOD MICROBIOLOGY

i. Food as a substrate for microorganisms, microorganisms important in food microbiology, Brief account of moulds, yeast and bacteria,
ii. Factors affecting microbial growth- intrinsic and extrinsic factors
iii. General characteristics and importance, principles of food preservation, asepsis, removal of microorganisms, anaerobic conditions, high and low temperatures, drying; Chemical preservatives and food additives.
iv. Microbiology of fermented milk, meat, vegetable and cereal products (Vinegar, wine, Sauerkraut, Pickles, cheese, yogurt)

UNIT - II: FOOD SPOILAGE and MICROBIAL DIAGNOSTICS

i. Food spoilage and food-borne infections, general principle underlying food spoilage and contamination.
ii. Spoilage of canned foods, fermented foods, dairy and poultry products, and oriental fermented foods.
iii. HACCP concept for foods production, storage and transport, Hurdle technology.
iv. Microbial diagnostics in food – Conventional and New methods (Molecular and Immunological methods)

UNIT - III: FOOD BORNE INFECTIONS AND INTOXICATIONS

i. Bacterial and non bacterial food borne infections and intoxification- *Brucella, Bacillus, Clostridium, Escherichia, Salmonella, Shigella, Staphylococcus, Vibrio, Yersinia.*
ii. Nematodes, algae, fungi and viruses in food borne infection and intoxications.

M.Sc MICROBIOLOGY
SEMESTER-III

Syllabi for the examinations to be held in the years Dec. 2023, Dec. 2024 & Dec. 2025

COURSE TITLE: FOOD MICROBIOLOGY

Course code: PSMBTC302 **Contact hours: 24**
Duration of Examinations: **Credits: 2**
Minor Test 1: 1 hour **Max. Marks: 50**
Minor Test 2: 1 hour **Minor Test1: 05**
Major Test: 2.5 hours **Minor Test2: 05**
Major Test: 40
Total: 50

iii. Food borne outbreaks- laboratory testing; prevention measures- food sanitation in manufacture and retailing.

iv. Food control agencies their rules and regulations, plant sanitation- worker's health standards, quality control, waste disposal.

NOTE FOR PAPER SETTING AND COURSE EVALUATION

Minor test 1 and Minor test II should cover upto 20% of syllabus from Unit 1. Major test will have three questions. One question of 20 marks will be of short answer type of multiple parts compulsory spread over entire syllabus. The remaining two questions will be from Unit II and Unit III of the syllabus of 10 marks each and the candidate will have to attempt two questions, selecting one from each unit.

BOOKS RECOMMENDED:

1. Modi, H.A (2007), (Introductory Food Microbiology). Aavishkar Pub. Distributors. Jaipur.
2. Khatkar, Singh Bhupendra (2007), (Food sciences tech.) (Daya Pub. House).
3. Doyle.P and Bucchat larry, (2008). Food Microbiology. ASM publications. (3rd ed).
4. Arnold L Demain, Julia E Davis (1999) Mannual of Industrial Microbiology and Biotechnology, ASM press.
5. Whataker and P.F. Stanbury (1995) Principles of Fermentation Technology. Butterworth-Heinemann.
6. William,s C, Frazier and Dennis Westhoff (2014) Food Microbiology. McGraw Hill Inc., New York.
7. Bibek Ray and Arun Bhunia (2013) Fundamental Food Microbiology (Fifth edition). CRC Press
8. Montville J. Thomas and karl R. Mathews (2008), (Food Microbiology). An introduction; ASM Press.

M.Sc MICROBIOLOGY
SEMESTER-III

Syllabi for the examinations to be held in the years Dec. 2023, Dec. 2024 & Dec. 2025

COURSE TITLE: BIOPROCESS ENGINEERING

Course code: PSMBTC303 **Contact hours**: 48

Duration of Examinations **Credits**: 4

Minor Test1: 1.5 hour **Max. Marks**: 100

Minor Test2: 1.5 hour **Minor Test1**: 20

Major Test: 3.0 hours **Minor Test2**: 20

Major Test: 60

Total: 100

Course objective: This course is to introduce students to the engineering aspects of microbial processes and help them to develop understanding of design, operation and optimization of bioprocess systems for production of products of industrial significance.

UNIT - I: INTRODUCTION TO BIOPROCESS ENGINEERING

i. Introduction to bioprocess engineering and technology, Concept of fermentation vs bioprocess
ii. Bioprocess based products of industrial importance
iii. Kinetic of microbial growth and death, Methods for growth assay, Types of fermentation/bioprocesses: batch, Fed-batch and continuous bioprocesses,
iv. Industrially important microorganisms, Isolation, Preservation and Maintenance of Industrial microorganisms
v. Media for industrial Fermentation, Sterilization of air and media,

UNIT-II: BIOREACTORS, BIOPROCESS MONITORING AND CONTROL

i. Bioreactors, typical design of stirred tank reactor, nonagitated bioreactors, Specialized bioreactors-packed bed, fluidized bed
ii. Mass transfer, Gas-liquid mass transfer, Oxygen uptake in cell cultures.
iii. Bioprocess monitoring, and control for various process parameters, sensors, Role of computers in process monitoring, and control.
iv. Concept of scale up. Practical aspects and issues of process scale up, Bioprocess economics
v. Use of Microorganisms in mineral beneficiation and oil recovery.

UNIT-III: BIOPROCESS BASED INDUSTRIAL PROUDCTS

i. Alcohol (ethanol), bioethanol- Biofuel from sugary and non-sugary (starches, lignocelluloses) sources,
ii. Organic Acids (citric, acetic and gluconic), Solvents (glycerol, acetone, butanol),
iii. Industrial enzymes (amylases, proteases, cellulases); Antibiotics (penicillin, streptomycin, teracycline),
iv. Aminoacids (lysine, glutamic acid), Single Cell Protein, Probiotics, and prebiotics.
v. Biomass immobilization, approaches, merits, limitations, and Industrial Applications

M.Sc MICROBIOLOGY
SEMESTER-III

Syllabi for the examinations to be held in the years Dec. 2023, Dec. 2024 & Dec. 2025

COURSE TITLE: BIOPROCESS ENGINEERING

Course code: PSMBTC303 **Contact hours**: 48
Duration of Examinations **Credits**: 4
Minor Test1: 1.5 hour **Max. Marks**: 100
Minor Test2: 1.5 hour **Minor Test1**: 20
Major Test: 3.0 hours **Minor Test2**: 20
Major Test: 60
Total: 100

UNIT-IV: DOWNSTREAM PROCESSING AND EFFLUENT TREATMENT

i. Downstream processing (DSP), Criteria, steps involved in typical DSP operation
ii. Removal of microbial cells and solid matter, foam separation, Precipitation, filtration, centrifugation
iii. Methods for cell disruptions, liquid-liquid extraction, chromatography, Membrane process, Drying and Crystallization
iv. Effluent treatment: B.O.D and C.O.D, treatment and disposal of effluents.
v. Types of reactors used for effluent treatment

UNIT-V: FOOD TECHNOLOGY

i. Introduction to food technology,
ii. Sterilization and Pasteurization of food products,
iii. Elementary idea of canning and packing,
iv. Food preservation and hygiene, Hurdle concept, Hazard Analysis Critical Control Point (HACCP) System.
v. Technology of Typical Food/Food products (bread, cheese, idli), Probiotics/prebiotics supplemented foods

NOTE FOR PAPER SETTING AND COURSE EVALUATION

Minor test 1 should cover upto 20% of syllabus. Minor test II should cover 21%- 40% of syllabus. Major test should cover 41% -100% of syllabus. Major test will have 7 questions each of 15 marks. One question will be very short answer type of multiple parts compulsory spread over entire syllabus. The remaining 6 questions will be from remaining 41%-100% part of the syllabus and the candidate will have to attempt any three of them. The major test should test both the subjective and objective aptitudes of the student. Minor test 1 will be held after 3-4 weeks of teaching and Minor test II will be held 8-9 weeks after the start of session. Two minor test per day should be conducted and no preparatory holiday shall be given.

SEMESTER-III

Syllabi for the examinations to be held in the years Dec. 2023, Dec. 2024 & Dec. 2025

COURSE TITLE: BIOPROCESS ENGINEERING

Course code: PSMBTC303 **Contact hours**: 48

Duration of Examinations **Credits**: 4

Minor Test1: 1.5 hour **Max. Marks**: 100

Minor Test2: 1.5 hour **Minor Test1**: 20

Major Test: 3.0 hours **Minor Test2**: 20

Major Test: 60

Total: 100

BOOKS RECOMMENDED

1. Aiba, S.,Humphrey, A.E. and Millis (1973). Biochemical Engineering, N.F. Univ. of Tokyo Press, Tokyo.
2. Atkinson, B.,(1991). Biochemical Engineering, Pion Ltd. London.
3. Baily, J.E. and Ollis, D.F.(1986). Biochemical Engineering Fundamentals, McGraw- Hill Book Co. New York
4. Rehm H.J. and Reed G. (1993). Biotechnology Vol. 1-12 VCH, Weinheim.
5. Murray Moo-Young (2004). Comprehensive Biotechnology Vol 1-4 KTH, Stockholm, Bioprocess Technology: Fundamentals and Applications
6. Jachson, A.T., Process Engineering in Biotechnology. Prentice Hall, Engelwood Cliffs, Shuler, M.L. and Kargi, F. (2003). Bioprocess Engineering: Basic concepts Prentice Hall, Engelwood Cliffs.
7. Stanbury, P.F. and Whitaker, A., (2016). Principles of Fermentation Technology Pergamon Press, Oxford,
8. Lee, J.M., Biochemical Engineering, Prentice Hall Inc. Crueger, W. and Crueger, A. (2002). Biotechnology: A text book of industrial Microbiology, Science Tech Inc. Publishers.

M.Sc MICROBIOLOGY
Semester-III
Syllabi for the examinations to be held in the years Dec. 2023, Dec. 2024 & Dec.2025

Course Title: IPRs, BIOETHICS AND ENTREPRENEURSHIP DEVELOPMENT

Course code: PSMBTC308	**Contact hours**: 24
Duration of Examinations	**Max. Marks :** 50
Credits: 2	**Minor Test1**:05
Minor Test1: 1 hour	**Minor Test2**:05
Minor Test2: 1 hour	**Major Test**:40
Major Test : 2.5 hours	**Total**:50

Objectives: This course will cater to various aspects of IPR like procedure, limit and variety of patent laws. Further it will also address bioethical concerns arising from the commercialization of biological products, GM foods, stem cell research, organ transplantation etc. The course will also provide the concept of enterprise, generating ideas, financial and legal issues of entrepreneurship in Biotechnology/Microbiology/Biochemistry based industries (agri/pharma).

UNIT-I: INTELLECTUAL PROPERTY

i. Role of IPRs in Biotechnology/Microbiology/Biochemistry, types of IPRs, Purpose of a Patent
ii. Material transfer Agreements, Promoting Technological Advancement. Patentable Inventions, Biological Patents, Patent Requirements, Patenting Organisms
iii. Research and IP, Patent Application, Introduction to Indian and US patent offices, Patent Licensing
iv. TRIPS and various provisions in the TRIPS Agreement, Benefits of securing IPRs; Indian legislations for the protection of various types of IPs; National Biodiversity protection initiatives

UNIT-II: BIOETHICS

i. Traditional knowledge and bioethics, bioactivities, Ethical Issues, Statement of Bioethical Principles
ii. Gene Therapy, Germ line Gene therapy Moratorium.
iii. Medical Privacy and Genetic Discrimination
iv. Ethical issues: Stem Cells, Organ Transplantation, Animal Cloning, GM foods; Use of animals in research

UNIT-III: ENTREPRENEURSHIP DEVELOPMENT

i. Introduction to social and business entrepreneurship; Basic characteristics, Developing entrepreneurship through training and motivation
ii. Concept of enterprise, Leveraging resources and creating value categories of value: Enhancements, Extensions and Specializations

M.Sc MICROBIOLOGY
Semester-III
Syllabi for the examinations to be held in the years Dec. 2023, Dec. 2024 & Dec.2025

Course Title: IPRs, BIOETHICS AND ENTREPRENEURSHIP DEVELOPMENT

Course code: PSMBTC308 **Contact hours**: 24
Duration of Examinations **Max. Marks :** 50
Credits: 2 **Minor Test1**:05
Minor Test1: 1 hour **Minor Test2**:05
Minor Test2: 1 hour **Major Test**:40
Major Test : 2.5 hours **Total**:50

iii. Entrepreneurial opportunities in Biotechnology/Microbiology/Biochemistry; Structure and different stages of companies working in different areas of specialization (agri-based, pharma -based etc.). Policy making relevant to the Biotechnology/Biochemistry/Microbiology industry
iv. Concept of startups and challenges, incubation center, various schemes supporting startups in Biotechnology/ Microbiology/ Biochemistry

NOTE FOR PAPER SETTING AND COURSE EVALUATION:

Minor test 1 and Minor test II should cover upto 20% of syllabus from Unit 1. Major test will have three questions. One question of 20 marks will be of short answer type of multiple parts compulsory spread over entire syllabus. The remaining two questions will be from Unit II and Unit III of the syllabus of 10 marks each and the candidate will have to attempt two questions, selecting one from each unit.

SUGGESTED READINGS:

1. Ahmetoglu et al., (2017) The Wiley handbook of entrepreneurship, John Wiley and sons, UK.
2. Ahuja VK; (2015) Intellectual Property Rights in India Lexis, Nexis, and New Delhi.
3. Arthur William *et al*.; (2005) Expanding Horizons in Bioethics, Springer.
4. Craig S; (2020) Biotechnology entrepreneurship, Academic Press (Elsevier), UK.
5. Ganguli P.; (2006) Intellectual Property Rights, Tata Mcgraw Hill Publishing Co Ltd.
6. Padma N; (2017) An introduction to Ethical, Safety and intellectual property rights issues in Biotechnology, Academic press (Elsevier), UK.
7. Patzelt, H, Brenner T; (2008) Handbook of Bioentrepreneurship, Springer Publications.
8. Rao MB; (2008) Biotechnology, IPRs and biodiversity, Pearson Publications.
9. Singh HB, Jha A and Keswani C; (2016) Intellectual property issues in Biotechnology, CABI, UK.
10. Hopkins T and Perui O (2019) The smart start up, Jaico publishing house, Mumbai
11. Venkatratnam JB (2009) Entrepreneurship Development, Heritage Printers, Hyderabad.
15. Zaware N; (2018) Entrepreneurship development and start up management, Educreation publishing, New Delhi
16. Castle D (2009) The Role of Intellectual Property Rights in Biotechnology Innovation, Edward Elgar, publishing, UK.

M.Sc. MICROBIOLOGY
SEMESTER – III

Syllabi for the examinations to be held in the years Dec 2023, Dec 2024 & Dec 2025

COURSE TITLE: BIOINFORMATICS and BIOSTATISTICS
Course code: PSMBTC310

Contact hours: 24	**Credits: 2**
Duration of Examinations:	**Max. Marks: 50**
Minor Test 1: 1 hour	**Minor Test 1: 05**
Minor test 2: 1 hour	**Minor Test 2: 05**
Major Test: 2.5 hours	**Major Test: 40**
	Total: 50

Objectives: - The last decade has seen veritable explosion in of information generated by molecular biologists. To come in grips with the cascade of information knowledge of computers and their applications has become very important. Bioinformatics, loosely defined as interaction of molecular and computational biology, has to do this and to unravel more of nature's secrets. The present course has been designed to provide the students basic knowledge about genomics, proteomics and bioinformatics.

UNIT-I: BASIC STATISTICS

i. Measures of central tendency and measures of dispersion, probability and its types: permutation, combination, probability computations
ii. Theoretical distributions: Binomial, Poisson and Normal, hypothesis testing; two types of errors
iii. Tests of significance; t-test, chi-square test, one way and two way analysis of variance
iv. Simple correlation and regression.

UNIT-II: INTRODUCTION TO BIOINFORMATICS AND BIOLOGICAL DATABASES

i. Internet and the biologist, Scope of Bioinformatics, Biological Databases; Primary, Secondary & Composite databases.
ii. Nucleotide Sequence Databases; GenBank, EMBL, DDBJ
iii. Protein Sequence Databases; SWISS-PROT protein sequence database, Translated EMBL (TrEMBL), UniProt, PROSITE, Pfam, OWL: A composite protein sequence database.
iv. Structural Databases; Protein Data Bank (PDB), Molecular Modelling Database (MMDB), Nucleic Acid Database (NDB), SCOP (Structural Classification of Protein), CATH (Class Architecture Topology Homology)

UNIT-III: INFORMATION RETRIEVAL, SEARCHING AND COMPUTATIONAL ANALYSIS OF BIOLOGICAL DATABASES

i. Retrieval Systems: SRS (Sequence Retrieval System) for flat file format libraries, ENTREZ Global Query for NCBI Search, DBGET/LinkDB: Database of link information
ii. Sequence Similarity Search: BLAST, FASTA, CLUSTALW.
iii. Sequence submission tools: BankIt, Sequin, Webin, SAKURA.

SEMESTER – III

Syllabi for the examinations to be held in the years Dec 2023, Dec 2024 & Dec 2025

COURSE TITLE: BIOINFORMATICS and BIOSTATISTICS
Course code: PSMBTC310

Contact hours: 24	**Credits: 2**
Duration of Examinations:	**Max. Marks: 50**
Minor Test 1: 1 hour	**Minor Test 1: 05**
Minor test 2: 1 hour	**Minor Test 2: 05**
Major Test: 2.5 hours	**Major Test: 40**
	Total: 50

iv. Introduction to Human Genome Project, Genome Sequencing, Genome Maps & their uses.
v. Sequence assembly, Genome analysis, Phylogenetic analysis.
vi. Comparative genomics: cluster of orthologous groups(COGs), Homologene at NCBI

NOTE FOR PAPER SETTING AND COURSE EVALUATION

Minor test 1 should cover upto 20% of syllabus. Minor test II should cover 21%- 40% of syllabus. Major test should cover 41% -100% of syllabus. Major test will have 5 questions each of 15 marks. One question will be very short answer type of multiple parts compulsory spread over entire syllabus. The remaining 4 questions will be from remaining 41%-100% part of the syllabus and the candidate will have to attempt any two of them. The major test should test both the subjective and objective aptitudes of the student. Minor test 1 will be held after 3-4 weeks of teaching and Minor test II will be held 8-9 weeks after the start of session.

BOOKS RECOMMENDED

1. Lesk, A. M. (2002). Introduction to Bioinformatics. Oxford: Oxford University Press.
2. Mount, D. W. (2001). Bioinformatics: Sequence and Genome Analysis. Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press.
3. Baxevanis, A. D., & Ouellette, B. F. (2001). Bioinformatics: a Practical Guide to the analysis of Genes and Proteins. New York: Wiley-Interscience.
4. Pevsner, J. (2015). Bioinformatics and Functional Genomics. Hoboken, NJ.: Wiley-Blackwell.
5. Bourne, P. E., & Gu, J. (2009). Structural Bioinformatics. Hoboken, NJ: Wiley-Liss.
6. Lesk, A. M. (2004). Introduction to Protein Science: Architecture, Function, and Genomics. Oxford: Oxford University Press.
7. Baxevanis, A.D. and Francis Onellete, B.F. (2001). Bioinformatics. Wiley Interscience. John Wiley and Sons Inc. New York.
8. Attwood, T.K. and Parry-Smith, D.J. (1999). Introduction to Bioinformatics. Pearson Education Ltd., Singapore.
9. Mueller, J.P. and Sheldon, T. (1998). Internet information server 4. Tata McGraw Hill Publishing Company Ltd., New Delhi.
10. Curtin, D.P. et al. (1999). Information Technology. Tata McGraw-Hill Publishing Company Ltd., New Delhi.
11. Dhar, M.K. and Kaul, S. (1997). Statistics in Biology. Malhotra Brothers, Jammu.

12. Snedecor, G.W. and Cochran, W.G. (1989). Statistical methods. Iowa State University Press, Ames.
13. Steel, R.G.D. and Torrie, J.H. (1981). Principles and procedures of statistics: A Biometrical approach. McGraw-Hill Book Company, Singapore.
14. Ye, Q. S. (2008). Bioinformatics: A practical approach. Champman & Hall/ CRC.
15. Noah, H. (2008) Bioinformatics Genomics and postgenomics. Wiley.
16. Tramontano Anna (2008). Int. to Bioinformatics. Chapman & hall/ CRC.

SEMESTER – III

Syllabi for the examinations to be held in the years Dec 2023, Dec 2024 & Dec 2025

COURSE TITLE: BIOINFORMATICS and BIOSTATISTICS (Practical)
Course code: PSBTPC311/ PSMBPC313/ PSBCPC315

Contact hours: 3hrs/week	**Credits: 2**
Duration of Examinations:	**Max. Marks: 50**
Internal exam: 3 hour	**Internal exam: 25**
External exam: 3 hour	**External exam: 25**
	Total: 50

Course Objectives: The aim of this course is to provide practical training in bioinformatic methods including accessing major public sequence databases, use of different computational tools to find sequences, analysis of protein and nucleic acid sequences by various software packages. Student Learning Outcomes On completion of this course, students should be able to describe contents and properties of most important bioinformatics databases, Perform text- and sequence-based searches and analyze and discuss results in light of molecular biological knowledge, Explain major steps in pairwise and multiple sequence alignment and Predict secondary and tertiary structures of protein sequences.

List of practicals:

1. Using NCBI and other web resources.
2. Introduction and use of various biological databases.
3. Sequence information resource: Using NCBI, EMBL, Genbank, Entrez, Swissprot/ TrEMBL, UniProt.
4. Similarity searches using tools like BLAST and interpretation of results.
5. Multiple sequence alignment using ClustalW.
6. Phylogenetic analysis of protein and nucleotide sequences.
7. Use of different gene prediction methods
8. Using RNA structure prediction tools.
9. Use of various primer designing and restriction site prediction tools.
10. Use of different protein structure prediction databases (PDB, SCOP, CATH).
11. Construction and study of protein structures using Deepview/PyMol.
12. Homology modelling of proteins.
13. Use of tools for mutation and analysis of the energy minimization of protein structures.
14. Use of miRNA prediction, designing and target prediction tools.

M.Sc. MICROBIOLOGY
SEMESTER -III

Syllabi for the examinations to be held in the years Dec. 2023, 2024 & 2025

COURSE TITLE: Nanotechnology in Biology

Course code: PSMBTC317 **Contact hours**: 24
Duration of Examinations **Credits**: 2
Minor Test: 1 hour **Max. Marks**: 50
Major Test: 2.5 hours **Minor Test1**: 10
Minor Test 2: 10
Major Test: 30
Total: 50

Course Objectives: Understanding and applied prospective of nanoscience in biological system

UNIT- I: INTRODUCTION

i. Introduction to History of nanotechnology - Origin and fundamental concepts
ii. Types of nanomaterials and their classifications Definition of a Nano system - Types of Nanocrystals-One Dimensional (1D)-Two Dimensional (2D) -Three Dimensional (3D)
iii. Basic properties of nanomaterials- mechanical, thermal, optical and electrical properties
iv. Different formats of nanomaterials and applications, Cellular Nanostructures; Nanopores; Biomolecular motors; Bio-inspired Nanostructures

UNIT - II: SYNTHESIS AND CHARACTERIZATION

i. Different types of Nanomaterials and synthesis (bottom up and top down methods), Biogenic synthesis of nanoparticles, Growth and stabilization, self assembling.
ii. Characterization of Nanomaterial: Size (particle size analyzer), Electron microscopy and its modifications: TEM, SEM, EDS, cryo Electron microscopy
iii. Technique and principle of FT-IR and UV-VIS, basics of X-Ray diffraction (XRD), TGA, BET etc.
iv. Nanoparticles for drug delivery, concepts and advantages

UNIT- III: NANOTECHNOLOGY AND ITS APPLICATION

i. Nanotechnology in food industry, food packaging, overview of Nanotoxicology
ii. Nanotechnology in Agriculture, Precision farming, Smart delivery system
iii. Nanotechnology in health, drug delivery, biomedical applications and
iv. Nanotechnology application in energy and environment

NOTE FOR PAPER SETTING AND COURSE EVALUATION

Minor test 1 should cover upto 20% of syllabus. Major test will have 5 questions. One question of 10 marks will be very short answer type of multiple parts compulsory spread over entire syllabus. The remaining 4 questions will be from remaining 21%-100% part of the

M.Sc. MICROBIOLOGY
SEMESTER -III

Syllabi for the examinations to be held in the years Dec. 2023, 2024 & 2025

COURSE TITLE: Nanotechnology in Biology

Course code: PSMBTC317 **Contact hours**: 24
Duration of Examinations **Credits**: 2
Minor Test: 1 hour **Max. Marks**: 50
Major Test: 2.5 hours **Minor Test1**: 10
Minor Test 2: 10
Major Test: 30
Total: 50

syllabus of 15 marks each and the candidate will have to attempt any two of them. The major test should test both the subjective and objective aptitudes of the student. Minor test 1 will be held after 3-4 weeks of teaching.

BOOKS RECOMMENDED:

1. Nano: The Essentials, T.Pradeep. Tata McGraw Hill, New Delhi, 2007.
2. Bharat Bhusan, "Springer Handbook of Nanotechnology", springer, Newyork, 2007.
3. Instrumental Methods of Analysis, Willard. Merritt, Dean & Settle, CBS Publications, 6th Edition, 2000.
4. Nalwa HS. 2005. Handbook of Nanostructured Biomaterials and Their Applications in Nanobiotechnology. American Scientific Publ.
5. Niemeyer CM & Mirkin CA. 2005. Nanobiotechnology. Wiley Interscience.
6. Vinod Saharan and Ajay Pal 2016. Chitosan Based Nanomaterials in Plant Growth and Protection,springerbrief
7. Fundamental Properties of Nanostructured Materials, Fiorani. D., Sberveglieri, G, World Scientific, 1994.
8. Challa Kumar (Ed) – Biological and Pharmaceutical Nanomaterials, Wiley – VCH Verlag , Weinheim, 2006
9. Ralph. S. Greco, Fritz B. Prinz and R. Lane Smith (Eds) - Nanoscale Technology in Biological Systems, CRC Press, 2005.
10. Challa Kumar(Ed) - Nanomaterials for Medical Diagnosis and Therapy, Wiley-VCH, 2006.
11. A. S. Edelstin and R. C. Cammarata - Nanomaterials: Synthesis, Properties and Applications, Taylor & Francis, 1996.
12. Plant Nanotechnology: Principles and Practices. 2016. Chittaranjan Kole, D. Sakthi Kumar, Mariya V. Khodakovskaya. (Eds.) Springer-Verlag, New York, USA ISBN 978-3-319-42152-4. 383 p.
13. Nano: The essentials understanding nanoscience and Nano- T.Pradeep - 2009 – Mc Graw Hill.
14. Nanotechnology Applications in Agriculture – C.R. Chinnamuthu, B.Chandrasekaran and C. Ramasamy – 2008.
15. Bionanotechnology: Lessons from Nature by David S. Goodsell 2. Nanomedicine, Vol. IIA: Biocompatibility by Robert A. Freitas

16. Handbook of Nanostructured Biomaterials and Their Applications in Nanobiotechnology - Hari Singh Nalwa
17. Nanobiotechnology; ed. C.M.Niemeyer, C.A. Mirkin.
18. Cancer Nanotechnology, eds. H. S. Nalwa and Thomas Webster, American Scientific Publishers, 2007, ISBN: 1- 58883-071-3
19. Biomedical Nanotechnology Editor: Neelina H. Malsch Publisher: CRC Press ISBN: 0- 8247-2579-4.

M.Sc. MICROBIOLOGY
SEMESTER-IV
Syllabi for the examinations to be held in the years May 2024, May 2025 & May 2026

COURSE TITLE: MEDICAL MICROBIOLOGY

Course code: PSMBTC404	**Contact hours: 48**
Duration of Examinations	**Credits: 4**
Minor Test1: 1.5 hour	**Max. Marks: 100**
Minor Test2: 1.5 hour	**Minor Test 1: 20**
Major Test: 3.0 hours	**Minor Test 2: 20**
	Major Test: 60
	Total: 100

Objectives: We are in contact of myriad of organisms in the environment and also with an enormous number that inhabit out bodies. Human kind has long been beset by diseases that may spread with devastating effects. The study in medical microbiology has practical benefits by an understanding to explore the cause and control of these diseases.

UNIT - I: PRINCIPLES OF MEDICAL MICROBIOLOGY

i. Early discovery of pathogenic microorganisms; development of bacteriology as scientific discipline; contribution made by eminent scientists
ii. Classification of medically important microorganisms
iii. Normal microbial flora of human body; role of the resident flora; normal flora and the human host.
iv. Opportunistic pathogens and true pathogens. Exogenous infection, mode of spread of infection.

UNIT - II: MECHANISMS OF BACTERIAL PATHOGENESIS

i. Microbial pathogenecity; transmission, infectivity and virulence.
ii. Establishment, spreading: invasiveness, tissue damage: Toxigenicity and anti-phagocytic factors.
iii. Mechanism of bacterial adhesion, colonization and invasion of mucous membrane of respiratory enteric and urogenital tracts.
iv. Role of aggressins, coagulase, fibrinolysin or kinase, Depolymerizing enzymes

UNIT - III: MICROBIAL AGENTS OF BACTERIAL DISEASES

i. Classification of pathogenic bacteria, *Staphylococcus, Streptococcus, Neisseria*.
ii. *Corynebacterium, Bacillus, Clostridium,* Non sporing anaerobes (*Actinomyces, Propionibacterium.*)
iii. Organisms belonging to Enteriobactericeae *(Escherichia, Klebsiella, Enterobacter),* Vibrios.

M.Sc. MICROBIOLOGY
SEMESTER-IV

Syllabi for the examinations to be held in the years May 2024, May 2025 & May 2026

COURSE TITLE: MEDICAL MICROBIOLOGY

Course code: PSMBTC404	**Contact hours: 48**
Duration of Examinations	**Credits: 4**
Minor Test1: 1.5 hour	**Max. Marks: 100**
Minor Test2: 1.5 hour	**Minor Test 1: 20**
Major Test: 3.0 hours	**Minor Test 2: 20**
	Major Test: 60
	Total: 100

iv. Non fermenting gram negative Bacilli *(Bacteroides)*, *Haemophylius, Bordetella, Brucella, Mycobacterium*.
v. *Treponema*, Rickettsia, *Chlamydiae*.

UNIT - IV: MICROBIAL AGENTS OF VIRAL DISEASES

i. General properties, of viruses, virus- host interaction
ii. Pox viruses, Herpes viruses, Adenoviruses, Arboviruses
iii. Picarno viruses, Orthomyxoviruses Rhabdoviruses, Oncogenic viruses
iv. Hepatitus viruses, Human Immuno Deficiency viruses (AIDS), Corona viruses, preparing for future viral pandemics

UNIT - V: MICROBIAL AGENTS OF FUNGAL DISEASES AND LABORATORY DIAGNOSIS

i. Description and classification and their laboratory diagnosis: Dermatophytes, dimorphic fungi and opportunistic fungal pathogens.
ii. Laboratory control of antimicrobial therapy: various methods of drug susceptibility testing, antibiotic assay in body fluids.
iii. Brief account of available vaccines and schedules, passive prophylactic measures,
iv. Noscomial infection, common types of hospital infections: their diagnosis and control.

NOTE FOR PAPER SETTING AND COURSE EVALUATION

Minor test 1 should cover upto 20% of syllabus. Minor test II should cover 21%- 40% of syllabus. Major test should cover 41% -100% of syllabus. Major test will have 7 questions each of 15 marks. One question will be very short answer type of multiple parts compulsory spread over entire syllabus. The remaining 6 questions will be from remaining 41%-100% part of the syllabus and the candidate will have to attempt any three of them. The major test should test both the subjective and objective aptitudes of the student. Minor test 1 will be held after 3-4 weeks of teaching and Minor test II will be held 8-9 weeks after the start of session. Two minor test per day should be conducted and no preparatory holiday shall be given.

M.Sc. MICROBIOLOGY
SEMESTER-IV

Syllabi for the examinations to be held in the years May 2024, May 2025 & May 2026

COURSE TITLE: MEDICAL MICROBIOLOGY

Course code: PSMBTC404	**Contact hours: 48**
Duration of Examinations	**Credits: 4**
Minor Test1: 1.5 hour	**Max. Marks: 100**
Minor Test2: 1.5 hour	**Minor Test 1: 20**
Major Test: 3.0 hours	**Minor Test 2: 20**
	Major Test: 60
	Total: 100

BOOKS RECOMMENDED

1. Ananthanarayan, R and Jayaram, C.K, (2020) Textbook of microbiology. Orient longman.
2. Murray PR, Rosenthal KS, Pfaller MA (2020) Medical Microbiology. Elsevier
3. Livingstone, Churchill. (1996) vol. I Microbial infection. Mackie and McCartney.
4. Livingstone, Churchill. (1996) vol.II Practical Medical microbiology, Mackie and McCartney.
5. Jawetz Melnick & Adelbergs Medical Microbiology, 27th Edition. Geo. Brooks, Karen C. Carroll, Janet Butel and Stephen Morse Copyright © 2016 by McGraw-Hill Education.
6. Shanson, D.C. Wright, P.S.G. (1995) Microbiology in clinical practice.
7. Tille P (2021). Bailey and Scott's Diagnostic Microbiology.
8. Engelkirk, PG, Engelkirk, JD, Fader RC (2020). Burtons Microbiology for Health Sciences. Jones and Bartletts learning

M.Sc. MICROBIOLOGY
SEMESTER-IV

Syllabi for the examinations to be held in the years May 2024, May 2025 & May 2026

COURSE TITLE: ENVIRONMENTAL MICROBIOLOGY

Course code: PSMBTC406 **Contact hours: 24**
Duration of Examinations **Credits: 2**
Minor Test 1: 1 hour **Max. Marks: 50**
Minor Test 2: 1 hour **Minor Test1: 05**
Major Test: 2.5 hours **Minor Test2: 05**
Major Test: 40
Total: 50

Objectives: The aim of the course is to introduce the students to the growing environmental problems due to ever increasing industrialization and civilization and how the microbes can play vital role in circumventing some of the problems.

UNIT-I: AEROBIOLOGY, AQUATIC AND SOIL MICROBIOLOGY

i. Aerobiology and Aquatic; Air borne microorganisms. Fresh water (ponds, lakes, streams), marine (Estuaries, mangroves, deep sea), classification of soil, microflora of various soil types, rhizosphere, phyllosphere.
ii. Dispersal of airborne microorganisms; Droplet nuclei and aerosol Water zonation, upwelling, eutrophication and potability of water. Major biogeochemical cycles and the organisms: carbon, nitrogen, Phosphorous and Sulphur cycles
iii. Assessment of air quality, Microbial assessment of water quality and Biological nitrogen fixation-nitrogenase enzyme, nif genes, symbiotic nitrogen fixation and non symbiotic nitrogen fixation.
iv. Air borne disease caused by bacteria, fungi, virus -their symptoms and preventive measures. Brief account of water borne diseases and preventive measure. Rumen microbiology.

UNIT-II: WASTE TREATMENT

i. Waste -types (solid, Liquid) and characterization of wastes.
ii. Waste treatment; Primary secondary and tertiary treatments. Physical, chemical and biological treatment of wastes, activated sludge, oxidation ponds.
iii. Solid waste treatment-saccharification, gasification, composting, effluent treatment, BOD, COD.
iv. Utilization of solid waste-food, fuel (ethanol, methane), fertilizer (composting).

UNIT-III: BIODEGRADATION AND BIODETERIORATION

i. Biodegradation of recalcitrant compounds. Bioaccumulation of metals and detoxification, biopesticides.
ii. Biodeterioration of paper, leather, wood, textile- modes of deterioration and organisms involved.

M.Sc. MICROBIOLOGY
SEMESTER-IV

Syllabi for the examinations to be held in the years May 2024, May 2025 & May 2026

COURSE TITLE: ENVIRONMENTAL MICROBIOLOGY

Course code: PSMBTC406 **Contact hours: 24**
Duration of Examinations **Credits: 2**
Minor Test 1: 1 hour **Max. Marks: 50**
Minor Test 2: 1 hour **Minor Test1: 05**
Major Test: 2.5 hours **Minor Test2: 05**
Major Test: 40
Total: 50

iii. Bioremediation of contaminated soils and wastelands; Microbial services in green house gases mitigation
iv. Impact of Genetically modified organisms on environment

NOTE FOR PAPER SETTING AND COURSE EVALUATION

Minor test 1 and Minor test II should cover upto 20% of syllabus from Unit 1. Major test will have three questions. One question of 20 marks will be of short answer type of multiple parts compulsory spread over entire syllabus. The remaining two questions will be from Unit II and Unit III of the syllabus of 10 marks each and the candidate will have to attempt two questions, selecting one from each unit.

Books Recommended:

1. Pepper, I. L., Gerba, C., Brusseau, M. L. (2019). Environmental and Pollution Science. Netherlands: Elsevier Science
2. Ramesh, K. V. (2019). Environmental Microbiology. India: MJP Publishers.
3. Baker, K.H. and Herson, D.S. (1994) Bioremediation. McGraw Hill Inc., New York.
4. Bagyaraj and Rangasamy (2009) Agricultural Microbiology. PHI learning.
5. Martin Alexander (1999) Biodegradation and Biodeterioration. Academic Press.