M.Sc. BIOTECHNOLOGY
SEMESTER-I

COURSE TITLE: CELL BIOLOGY

Course code: PSBTTC101
Duration of Examinations
Minor Test1: 1 hour
Minor Test2: 1 hour
Major Test: 2.5 hours

Contact hours: 48
Credits: 4
Max. Marks: 100
Minor Test1: 20
Minor Test2: 20
Major Test: 60
Total: 100

Syllabi for the examinations to be held in the years Dec 2018, Dec 2019 & Dec 2020

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, exocytosis, and endocytosis, Membrane pumps; Na^+, K^+, Ca^{2+} pumps.
iv. Cell wall and ECM, Cell motility; cilia, flagella of eukaryotes and prokaryotes.

UNIT - II: CELL ORGANELLES

i. Cellular organelles; Structure and function of endoplasmic reticulum, golgi bodies, lysosomes, endosome, Mechanism of vesicular transport.
ii. Mitochondria, chloroplast and peroxisomes.
iii. Nucleus; nuclear envelope, NPC, nucleolus, nuclear matrix.
iv. Chromosomes and chromatin, centromeres, telomeres, nucleosome, Hetero- and euchromatin, 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, protein-kinase linked cell surface receptors, signal transduction pathways; Ras/MAPK' Pathways, second messengers.
ii. Cell signaling in micro-organisms; bacterial chemotaxis, quorum sensing.
iii. General principle of cell communication, cell-cell interaction, structural and functional significance of plasmodesmata.
iv. Cellular junction and adhesion; role of different adhesion molecules, gap junction.

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

i. Biology of cancer; Cancer Genes (Oncogenes and Tumor Suppressor Genes), retinoblastoma and E2F proteins.
ii. Introduction to growth control and cell cycle; Mitotic Spindle, Microtubules, checkpoints.
iii. Regulators of cell cycle progression; role of cyclin and cyclin dependent kinases.
iv. Apoptosis and cell death; program cell death, extrinsic and intrinsic pathways

UNIT –V: **DEVELOPMENT BIOLOGY**

i Cellular basis of differentiation and development- mitosis, gametogenesis and fertilization.
ii Development of *Drosophila*- early drosophila development, pattern formation, maternal and gap genes, pair rule and segmentation genes, nervous system and eye development, Homeotic genes and their role in development.
iii Development of *C. elegans*-Introduction, life cycle, organogenesis (vulva formation).
iv Morphogenesis and organogenesis in *Arabidopsis thaliana* as model plant- shoot and root development, leaf and floral 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.
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. BIOTECHNOLOGY
SEMESTER-I

COURSE TITLE: GENERAL AND APPLIED MICROBIOLOGY

Course code: PSBTTC102 **Contact hours**: 48
Duration of Examinations **Credits**: 4
Minor Test1: 1 hour **Max. Marks**: 100
Minor Test2: 1 hour **Minor Test1**: 20
Major Test: 2.5 hours **Minor Test2**: 20
Major Test: 60
Total: 100

Syllabi for the examinations to be held in the years Dec 2018, Dec 2019 & Dec 2020

Objectives: In today's scientific world, microbiological studies have enriched knowledge of Molecular Biology and Biotechnology. This course has been designed to provide insight to students into the structure and function of microorganisms, microbial taxonomy, microbial genetics and application of microbial technology in food, medicine, environment, agriculture and industry.

UNIT – I: INTRODUCTORY MICROBIOLOGY

i. History and development of Microbiology, Methods in Microbiology, Pure culture techniques
ii. Culture collection and maintenance of cultures
iii. Theory and practice of sterilization; Principles of microbial nutrition
Construction of culture media
iv. Enrichment culture techniques for isolation of Chemo–autotrophs, Chemo – heterotrophs and photosynthetic microorganisms
v. Microbial growth: batch and continuous culture; Factors affecting growth.

UNIT – II: MICROBIAL DIVERSITY, SYSTEMATICS AND METABOLIC DIVERSITY -I

i. Prokaryotic cell structure and function; Flagella and motility; cell inclusions like endospores, gas vesicles.
ii. Eukarya : Overview of Algae, Fungi, Slimemolds and Protozoa.
iii. Microbial taxonomy, Nomenclature and Bergey's manual.
iv. Prokaryotic diversity: Protobacteria, Cyanobacteria, Chlamydias, Cytophaga, Gram positive bacteria, Green sulphur bacteria, Green non-sulphur bacteria, Spirochaetes, Deinococci.

UNIT – III: MICROBIAL DIVERSITY, SYSTEMATICS AND METABOLIC DIVERSITY -II

i. Methods for determining evolutionary relationships. Ribotying and Ribosomal RNA sequencing.
ii. Metabolic diversity: Overview of basic metabolism. an overview of Phototrophy, Chemolithotrophy

iii. Anaerobic respiration, Fermentation and Syntrophy, Hydrocarbon oxidation, Nitrogen fixation.

UNIT – IV: MICROBIAL DIVERSITY, SYSTEMATICS AND METABOLIC DIVERSITY - III

i. Archaea as earliest life forms, Halophiles, Methanogens, Hyperthermophilic Archea, Thermoplasma.
ii. Viruses: Discovery, Classification and Structure of Viruses.
iii. Viruses of Prokaryotes and Eukaryotes. Examples of Herpes, Pox, Adenoviruses, Retroviruses, Viriods and prions.
iv. Overview of important microbial diseases

UNIT-V: APPLIED MICROBIOLOGY

i. Industrial microorganisms and product formation: Major Industrial products for health industry Antibiotics, Vitamins, Aminoacids, Steroids, Enzymes
ii. Major Industrial Products for food and Beverage industry: Alcohol and Alcoholic beverages, Vinegar, Citric acid and other organic acids.
iii. Yeast as a food and food supplement, Mushrooms as a food source.
iv. Microbes as used in Genetic Engineering: Insulin, Protein Products, Recombinant Vaccines, Plants and Animals.

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 Wiley-Liss a John Wiley and sons, Inc. Publication.
2. Stainer, R.Y., Ingraham, J.L., Wheelis, M. L. and Painter, P.R.(1991) General Microbiology. The MacMillan press.
3. Madigan, M.T., Martinko, J.M. and Parker, J. (2007). Brock Biology of Microorganisms. J. Prentice Hall. 11th ed.
4. Pelczar, M. J., Chan, E.C.S. and Kreig, N.R. (1998) Microbiology. McGraw Hill.
5. Maloy, S. R., Cronan, J. E. and Freifelder, D. Microbial Genetics. Jones Barlett Publishers.
6. Cappuccino,J. G. and Sherman, N. (2003). Microbiology – A Laboratory Manual. Addison Wesley..

7. Tortora, G.J., Funke, B.R. and Case (2007). Microbiology: An Introduction. Benzamin Cummings. 2nd edition.
8. Prescott, L. M., Harley, J.P. and Klein, D. A. (2002) Microbiology. W.C.B. Oxford.
9. Atlas, R. M. (2004), Microbiology: Fundamentals and Applications. Macmillan Publishing Co. New York. 2nd edition.
10. Salkia,R., Bora,C. and Bezbamah,K.L.(2008). Microbial Biotechnology. New India Publishing Agency.

M.Sc. BIOTECHNOLOGY
SEMESTER - I

COURSE TITLE: BIOCHEMISTRY AND METABOLISM

Course code: PSBTTC103 **Contact hours**: 48
Duration of Examinations **Credits**: 4
Minor Test1: 1 hour **Max. Marks**: 100
Minor Test2: 1 hour **Minor Test1**: 20
Major Test: 2.5 hours **Minor Test2**: 20
Major Test: 60
Total: 100

Syllabi for the examinations to be held in the years Dec 2018, Dec 2019 & Dec 2020

Objectives: 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.
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.

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 tests per day should be conducted and no preparatory holiday shall be given.

BOOKS RECOMMENDED

1. Voet, D . and Voet, J.G. (2007) Biochemistry. John Wiley and Sons inc. USA. 4th ed.
2. Stryer, L. (2004). Biochemistry. W.H. Freeman & Company, New York. 4th ed.
3. Lehinger, A.L. (2006). Principles of Biochemistry. CBS Publishers & Distributors, New Delhi.
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. (2003). Harper's Biochemistry. Appleton, Lange Publishers, CT. 6th 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. Voet, D and Voet, J.G. (1995),Biochemistry, John Wiley and Sons, Inc.USA. 2nd edition.

M. Sc. BIOTECHNOLOGY
SEMESTER - I

COURSE TITLE: MOLECULAR BIOLOGY

Course code: PSBTTC104
Duration of Examinations
Minor Test1: 1 hour
Minor Test2: 1 hour
Major Test: 2.5 hours

Contact hours: 48
Credits: 4
Max. Marks: 100
Minor Test1: 20
Minor Test2: 20
Major Test: 60
Total: 100

Syllabi for the examinations to be held in the years Dec 2018, Dec 2019 & Dec 2020

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, FUNCTION AND REPLICTION

i. 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
ii. DNA structures; Primary, secondary, tertiary and quartenary DNA structure; Function of alternate forms and structure of DNA
iii. Denaturation analysis of DNA; denaturation curve and assessement of GC % and Tm, Hyper and hypochromic effect of DNA
iv. Replication of DNA, Replication of core genome and replication of extrachromosomal DNA, Elements and factors required for replication of core genome in eukaryotes, prokaryotes and viruses taking *E.coli, S. cerevisae* and phi X174 as models

UNIT-II: RNA STRUCTURE FUNCTION AND REPLICATION

i. RNA Structure; Physical and chemical structure and Function. Secondary structures of RNA, RNA as genetic material; RNA genomes; Denaturation analysis of RNA
ii. Linear and circular RNA genomes. Single stranded as well as double stranded genomes. Replication of RNA genomes + sense, -ve sense, ambi-sense and dsRNA genomes.
iii. RNA as a structural molecule transfer and ribosomal RNA, RNA as a information molecule messenger RNA, RNA as an biocatalyst, Ribozymes, RNA as a regulatory molecule; RNAi and Antisense RNA

iv. Introduction to various types of small nuclear, small nucleolar, small cytoplasmic Mi and Si RNA molecules and their role in cell.

UNIT-III: GENE EXPRESSION - TRANSCRIPTION

i. Mechanism of transcription in prokaryotes: Elements and factors involved in prokaryotes; Promoter sequences and regulatory factors,
ii. Operon concept; Inducible and repressible operons in prokaryotes. Attenuation, antitermination, auto- regulation of gene expression. Negative and positive control of gene expression
iii. Mechanism of transcription in Eukaryotes: Gene activation in eukaryotes, Basal transcription apparatus, Eukaryotic promoter sequences, enhancers and silencers and general and specific factors.
iv. Initiation, elongation and termination of transcription in Eukaryotes. Comparison of basic transcription and regulation of transcription in Prokaryotes and eukaryotes

UNIT-IV: GENE EXPRESSION - TRANSLATION

i. Genetic Code; Universality and degeneracy of code and exceptions to code, Wobble hypothesis, Codon usage bias.
ii. Mechanism of translation in prokaryotes: Elements and factors required for translation, Co-transcriptional- translation,
iii. Initiation, elongation and termination of translation in prokaryotes. Non- ribosomal peptide synthesis.
iv. Mechanism of translation in Eukaryotes: Elements and factors required for translation, Initiation, elongation and termination of translation in eukaryotes.

UNIT V: REGULATION OF REPLICATION, TRANSCRIPTION, TRANSLATION

i. Regulation of DNA replication, Origin of replication and regulatory factor, Relation between origin, regulatory factors and copy number
ii. Regulation of transcription in eukaryotes; Post transcriptional regulation: mRNA processing capping and polyadenylation.
iii. mRNA splicing and editing, nucleo-cytoplasmic mRNA transport, mRNA stability, degradation and half life period .
iv. Regulation of translation, co- and post translational modification of peptides, role of molecular chaperons.

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. Watson G.D (2008). Molecular biology of the gene. Cold spring habor Ltd Press.
2. Burton E (2008). Molecular Biology: gene to protein. Jones & Bartlett.
3. Clark & Pazdernik (2009).Biotechnology: applying the genetic revolution. Academic Press.
4. Hartwell(2004). Genetics from genes to genomes. Macgrawhill.
5. Russell (2006). Genetic: molecular Approaches. Pearson Press.
6. Lewin (2011). GenesX. Jones & Bartlett.

M.Sc. BIOTECHNOLOGY
SEMESTER-II

COURSE TITLE: GENETIC ENGINEERING

Course code: PSBTTC201
Duration of Examinations
Minor Test1: 1 hour
Minor Test2: 1 hour
Major Test: 2.5 hours

Contact hours: 48
Credits: 4
Max. Marks: 100
Minor Test1: 20
Minor Test2: 20
Major Test: 60
Total: 100

Syllabi for the examinations to be held in the years May 2019, May 2020 & May 2021

Objectives: 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: FUNDAMENTALS OF GENETIC ENGINEERING

i. Scope of Genetic Engineering; Genetic Engineering guidelines. *E.coli* as model organism.
ii. Concept of cloning; Gene centric cloning and genome centric cloning, concept of isolation and identification of gene
iii. 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: TECHNIQUES IN GENETIC ENGINEERING

i. Isolation, purification, quantitation and electrophoresis of genomic and extra genomic DNA.
ii. Isolation, purification, quantitation and electrophoresis of nuclear, organelles and cytoplasmic RNA.
iii. Size standards for DNA and RNA. Enrichment of RNA molecules for studying gene expression
iv. Southern, Northern and Western blotting; Preparation of labeled DNA probes- radioactive and non- radioactive labeling,

UNIT-III: GENE CLONING

i. Construction of genomic. 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, Cloning differentially active genes. Subtractive hybridization
iii. Screening and analysis of genomic and cDNA library by function and sequence based methods.
iv. Expression strategies for hetrologous genes; vector engineering and codon optimization, host engineering, Expression in eukaryotic and prokaryotic systems.

UNIT-IV: ALTERNATE WAYS OF GENE CLONING AND MODIFICATION

i. Polymerase chain reaction, nucleic acid amplification, primer design and programming. Modifications of basic PCR
ii. Site directed mutagenesis and protein engineering; methods, strategies and applications.
iii. Cloning interacting genes; two and three hybrid system, RNase protection assay and reporter assay,
iv. Phage display, Gene tagging, Transposon tagging. *In vitro* transcription and translation, methods and application

UNIT-V: ADVANCED TECHNIQUES IN GENETIC ENGINEERING

i. DNA sequencing; Sanger's Chain termination methods, next generation sequencing methods ,
ii. Nucleic acid micro arrays; method and applications. RNA antisense, ribozyme and interference; methods and applications.
iii. Gene Knock out technology; method and applications: Chromosome engineering; method and application.
iv. Genetic engineering in molecular diagnostics, 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 test per day should be conducted and no preparatory holiday shall be given.

BOOKS RECOMMENDED

1. William, W. et al. (1997). Methods in Gene Technology. Bios Scientific Publications.
2. Glick, B.R. and Pasternack, J. J. (2007). Molecular Biotechnology: Principles and applications of recombinant DNA. ASM Press.
3. Miesfeld, R.J. (1999). Applied Molecular Genetics . John Wiley and sons Inc. Publications.

4. Ream, W. and Field, K. G. (2003). Molecular Biology Techniques. An intensive Laboratory Course. Academic Press.
5. Sambrook, J. et al.(2005). Molecular cloning: A Laboratory Manual. Cold Spring Harbour Laboratory Press , New York.
6. Primrose,S. (2007). Gene Manipulation: an embracing techniques. Blackwell Science pub.6th ed.
7. Brown, T. A. (2004). The Basic Principles of Gene cloning and DNA analysis. Blackwell science pub. IV ed.

M.Sc. BIOTECHNOLOGY
SEMESTER-II

COURSE TITLE: ENZYMOLOGY

Course code: PSBTTC202
Duration of Examinations
Minor Test1: 1 hour
Minor Test2: 1 hour
Major Test: 2.5 hours

Contact hours: 48
Credits: 4
Max. Marks: 100
Minor Test1: 20
Minor Test2: 20
Major Test: 60
Total: 100

Syllabi for the examinations to be held in the years May 2019, May 2020 & May 2021

Objectives: The course is structured to provide the students insight into protein/ enzyme structure, enzyme kinetics and mechanism & control of enzyme action, enzyme folding, enzyme purification and enzymes characterization. It also aims at acquainting students with clinical and industrial applications of enzymes.

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 cofactor, coenzyme, 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;

UNIT-III: KINETICS OF ENZYME CATALYSED REACTIONS

i. Principles of bioenergetics, basis of kinetics of enzyme catalysed reactions

ii. Steady state vs equilibrium assumption, Henri and Michaelis-Menten equations, Michaelis-Menten equation for uni-substrate enzyme catalysed reactions and its significance,

iii. Kinetic parameters V_{max}, K_m , Lineweaver-Burk plots, Eadie-Hofstee and Hanes plots,

iv. Factors affecting enzyme activity: enzyme/substrate concentration, pH and temperature dependence of enzymes,

v. Enzyme inhibitions: Reversible and irreversible inhibition, types of enzyme inhibitions, and determination of K_i.

UNIT-IV: REGULATORY ENZYMES

i. Enzymes in regulation of metabolic pathways, Covalent and noncovalent modification of enzymes,

iii. Allosteric enzymes, sigmoidal kinetics and its physiological significance,

iv. General mechanisms of enzyme regulation: Feedback inhibition, Feedback repression, induction, Partial Proteolysis;

v. Covalent modification of enzymes-reversible covalent modification.

vi. Phosphorylation, adenylylation, uridylation, ADP-ribosylation, methylation, disulphide reduction as means of regulation.

UNIT-V: ENZYME TECHNOLOGY

i. Strategies for bulk enzyme production, sources of enzyme isolation,

ii. Enzyme purification, criteria and aim for purification, techniques /steps involved

iii. Chromatography, ion exchange, adsorption, hydrophobic, and gel filteration; salting out;

iv. Ascertaining purity level of enzyme, specific activity; criteria of enzyme purity, characterization of an enzyme, determination of the molecular weight (Mr)

v. Industrial applications of enzymes- in diagnosis, therapy, brewery, dairy, food processing, detergent, textile; enzyme immobilization and its industrial importance; protein engineering, enzyme inhibitors and drug design.

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. BIOTECHNOLOGY
SEMESTER – II

COURSE TITLE: GENETICS

Course code: PSBTTC203 | **Contact hours**: 24
Duration of Examinations | **Credits**: 2
Minor Test1: 1 hour | **Max. Marks**: 50
Major Test2: 2.5 hours | **Minor Test1**: 10
Major Test: 40
Total: 50

Syllabi for the examinations to be held in the years May 2019, May 2020 & May 2021

Objectives: 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 pro- and eukaryotes. Besides, the molecular approach is being adopted in altering genotype and tailoring plants and animals to answer human needs. This course will introduce student to the basic concepts of genetics and prepare him to appreciate the boom of biotechnology and participate in the on going revolution.

UNIT-I: GENETICS-I

i. Mendelian genetics, Crossing over and Linkage, molecular mechanism of crossing over, Holliday model of recombination
ii. Bacterial genetic system; transformation, transduction, conjugation and F mediated sexduction, Site specific recombination.
iii. Concept of molecular markers, genetic mapping, Physical mapping, Chromosome walking
iv. Reverse genetics: Tilling, Gene silencing, RNA inference

UNIT-II: GENETICS-II

i. Mutation: Physical and Chemical mutagens, induction of mutations; molecular basis of mutations; detection of mutations
ii. Transposons; molecular characteristics of transposable elements in bacteria, Mechanism of transposition, Transposable elements in eukaryotes and prokaryotes
iii. Introduction to human genetics, Role of genetics in medicine, Patterns of single gene inheritance -autosomal recessive; Autosomal dominant
iv. Human pedigrees; X linked inheritance, Sex influenced and sex limited expression.

UNIT- III: GENETICS-III

i. Multiple alleles, Non disjunction; Dosage compensation.
ii. Sex determination; Role of Y chromosome; Genetic recombination; Maternal inheritance.
iii. Molecular cytogenetics: Fluorescence in situ hybridization (FISH); Genomic in situ hybridization (GISH), Comparative Genomic Hybridization (CGH).

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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. Lewin, B., (2008) Gene IX, John and Batleh, 9th Ed.
2. Gardner, E.J., Simmons, M.J. and Snustad, D. P. (1991). Principles of genetics. John Wiley and sons, New York.
3. Kurt, W. Hide, N. Kirsten, W. and Wieland, M. (1994). DNA Fingerprinting in plants and fungi. CRC Press, Boca Raton.
4. Hughes, M.A. (1996). Plants and Molecular genetics. Addison Wesley Longman Ltd., U.K.
5. Stainsfield, W.D.(1991).Theory and Problems of Genetics. McGraw Hill, USA.
6. Watson, J.D., Hopkins, H.N., Roberts, W.J., Sleitz, J.A. and Weiner, M.A. (2007). Molecular biology of gene. The Benjamin/ Cumming Publishing Company, Inc. USA.
7. Cronk, N., Bateman, P., and Hawkins, A. (2008). Developmental Genetics and Plant Evolution. Taylor & Francis Pub.
8. Ruthwell, N. V. (2008),. Understanding Genetics : A molecular approach. Wiley-liss Pub.

M.Sc. BIOTECHNOLOGY
SEMESTER – II

COURSE TITLE: MOLECULAR VIROLOGY

Course code: PSBTTC204 **Contact hours**: 24
Duration of Examinations **Credits**: 2
Minor Test1: 1 hour **Max. Marks**: 50
Major Test2: 2.0 hours **Minor Test1**: 10
Major Test: 40
Total: 50

Syllabi for the examinations to be held in the years May 2019, May 2020 & May 2021

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, diagnoses and treatment will remain the main learning objectives of this course.

UNIT-I: INTRODUCTION TO MOLECULAR VIROLOGY

i. Mechanisms of viral entry and Spread of Infection/ viral pathogenesis;

ii. Host Resistance to Viral Infections;

iii. Cellular receptors and virus entry. Definition, structure and methods of discovery of viral receptors (polio, herpes, HIV).

iv. Cellular interactions-clathrin coated pits, lipid rafts

v. Virus uncoating mechanisms, virus -cytoskeletal interactions, chaperons.

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 measle 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

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.

RECOMMENDED BOOKS

1. S. J. Flint, V. R. Racaniello, L. W. Enquist, V. R. Rancaniello, A. M. Skalka (2003) Principles of Virology: Molecular Biology, Pathogenesis, and Control of Animal Viruses. Publisher: American Society Microbiology.

2. Alan J. Cann (2000) DNA Virus Replication. Publisher: Oxford University Press.

3. Alan J. Cann (2005) Principles of Molecular Virology. Publisher: Elsevier Science & Technology Books.

4. Stephen K. Tyring. (2004) Field Virology Vol.1 and 2. Antiviral Agents, Vaccines, and Immunotherapies. Publisher: Marcel Dekker.

5. Paul F. Torrence. (2005) Antiviral Drug Discovery for Emerging Diseases and Bioterrorism Threats. Publisher: Wiley, John & Sons, Incorporated.

6. Stanley A. Plotkin, Walter A. Orenstein (2008) Vaccines. Publisher: Elsevier Health Sciences.

M.Sc BIOTECHNOLOGY
SEMESTER-II

COURSE TITLE: IMMUNOLOGY

Course code: PSBTTC205 **Contact hours**: 48
Duration of Examinations: **Credits**: 4
Minor Test1: 1 hour **Max. Marks**: 100
Minor Test2: 1 hour **Minor Test1**: 20
Major Test: 2.5 hours **Minor Test2**: 20
Major Test: 60
Total: 100

Syllabi for the examinations to be held in the years May 2019, May 2020 & May 2021

Objectives: 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
i. 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.
ii. Nature and Biology of antigens and super antigens, Antibody structure and function, antibody mediated effector functions, antibody classes and biological activity
iii. 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
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.

BOOKS RECOMMENDED

1. Goldsby, R. A., Kindt, T.J. and Osborne,B.A. (2002).Kuby Immunology. W.H. Freeman and company, New York.
2. Coleman, R.M., Lombard, M.F. and Sicard, R.E.(1992).Fundamental Immunology. Wm.C.Brown publishers,USA.

3. Roitt,I., Brostoff, J. and Male,D. (1999). Immunology. Hartcourt Brace and Company , Asia Pte.Ltd.
4. Benjamini,E.,Coico,R., and Sunshine, G. (2000). Immunology – a short course. John Wiley and Sons. Inc., New York.
5. Davies,H. (1997). Introductory Immunology. Chapman and Hall, New York
6. Bratke & Myrtek (2007). Immunology : The experimenter series.Elsener Pub.
7. Wood, Peter (2008). Understanding Immunology Elseiver Pub. 2nd edition.

M.Sc BIOTECHNOLOGY
SEMESTER-III

COURSE TITLE: PLANT BIOTECHNOLOGY

Course code: PSBTTC301
Duration of Examinations
Minor Test1: 1 hour
Minor Test2: 1 hour
Major Test: 2.5 hours

Contact hours: 48
Credits: 4
Max. Marks: 100
Minor Test1: 20
Minor Test2: 20
Major Test: 60
Total: 100

Syllabi for the examinations to be held in the years Dec 2019, Dec 2020 & Dec 2021

Objectives: Plant Biotechnology is increasingly being used to produce therapeutic medicines, plastics for industry etc. as well as for raising disease and stress resistant crop for agriculture. This course is intended to introduce some of these new and exciting areas to beginners in plant biotechnology.

UNIT-I: INTRODUCTION TO CELL AND TISSUE CULTURE

i. History of Plant Tissue Culture, Requirements for a Tissue Culture lab, Nutrient media, explants selection and technique of culturing the same.

ii. Micropropagation, Multiplication, transfer and establishment of whole plants in soil, applications

iii. Initiation and maintenance of callus and suspension culture; single cell clone, organogenesis, somatic embryogenesis

vi. Shoot-tip culture; virus-free plants; Embryo culture and embryo rescue, wide hybridization

ix. Anther, pollen and ovary culture for production of haploid plants and homozygous lines

UNIT-II: SOMATIC HYBRIDIZATION AND CRYOPRESERVATION

i. Protoplast isolation: mechanical and enzymatic method, purification, culture and regeneration of plants.

ii. Techniques of protoplast fusion; selection of hybrid cells and regeneration of hybrid plant.

iii. Advantages of somatic hybridization, its applications, Cybrids.

iv. Cryopreservation, types and role of cryoprotectants, Freezing and storage, Thawing.

v. DNA banking for germplasm conversation, freeze preservation and slow growth cultures.

UNIT-III: GENE TRANSFER IN PLANTS

i. Plant Transformation technology : The basis of tumour formation, hairy root, features of T1 and R1 plasmids.
ii. Mechanisms of DNA transfer, role of virulence genes, use of T1 and R1 as vectors, binary vectors.
iii. Promoters, use of 35S and other promoters, genetic markers, use of reporter genes, viral vectors and their applications, multiple gene transfers.
iv. Vectorless or direct DNA transfer, particle bombardment, electroporation, microinjection.
v. Transformation of monocots; Transgene stability and gene silencing; In plant transformation.

UNIT-IV: TRANSGENIC PLANTS

i. Application of plant transformation for productivity and performance; herbicide resistance, phosphoinothricin, glyphosate; sufonyl urea, atrazine, insect resistance.
ii. Bt. Genes, non-Bt like protease inhibitors, alpha amylase inhibitor, virus resistance, coat protein mediated, nucleocapsid gene.
iii. Disease resistance, chitinase, 1-3 beta-glucanase, antifungal proteins, thionines, PR proteins, nematode resistance, abiotic stress.
iv. Post- harvest losses, long shelf life of fruits and flowers, use of ACC synthase and ACC oxidase.
v. Male sterile lines, bar and barnase systems, carbohydrate composition and storage, terminator gene technology.

UNIT-V: APPLICATIONS OF PLANT BIOTECHNOLOGY

i. Chloroplast transformation: Advantages, vectors, success with tobacco and potato.
ii. Plant secondary metabolites, phenylpropanoid pathway; alkaloids, industrial enzymes.
iii. Biodegradable plastics. Polyhydroxybutyrate, therapeutic proteins, edible vaccines, vaccines for Hepaptitis B.
iv. Transgenics for antibodies, Transgenics for Biopharmaceuticals, Production of Hirudin, Biofortification.
v. Molecular marker-aided breeding: RFLP, RAPD, AFLP and microsatellite markers, QTL, map-based cloning

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. Winnaker, E.L. (1987). From genes to clones: Introduction to Gene Technology. VCH, Germany.
2. Old, R.N. and Primose, S.B. Principles of Gene manipulation
3. Razdan,M.K. (2005). An introduction to plant tissue culture, Oxford and IBH.
4. Chawla, H.S. (2003). Biotechnology in Crop Improvement. International book Distributing Co. Lucknow.
5. Glick, B.R. and Pasternak, J.J. (2007). Molecular Biotechnology: principles and applications of recombinant DNA. ASM press, Washington.
6. Hammond, J., Mcgarvey, P. and Yusibow, V. (2000). Plant Biotechnology: New product and applications. Spinger, Berlin.

M.Sc. BIOTECHNOLOGY
SEMESTER-III

COURSE TITLE: BIOPROCESS ENGINEERING

Course code: PSBTTC302
Duration of Examinations
Minor Test1: 1 hour
Minor Test2: 1 hour
Major Test: 2.5 hours

Contact hours: 48
Credits: 4
Max. Marks: 100
Minor Test1: 20
Minor Test2: 20
Major Test: 60
Total: 100

Syllabi for the examinations to be held in the years Dec 2019, Dec 2020 & Dec 2021

Objectives: 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.

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, Types of fermentation processes: 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 BIOMASS IMMOBILIZATION

i. Bioreactors, typical design of stirred tank reactor, nonagitated bioreactors, Specialized bioreactors-packed bed, fluidized bed
ii. Concept of Scale up, scale up paradox, Bioprocess economics,
iii. Process monitoring and control of bioprocess parameters, sensors, Role of computers in process control
iv. Biomass immobilization, approaches, merits, limitations, and Industrial Applications,
v. Use of Microorganisms in mineral beneficiation and oil recovery.

UNIT-III: BIOPROCESS BASED INDUSTRIAL PRODUCTION OF CHEMICALS

i. Alcohol (ethanol), bioethanol- Biofuel from lignocellulosic biomass,

ii. Acids (citric, acetic and gluconic)
iii. Solvents (glycerol, acetone, butanol),
iv. Antibiotics (penicillin, streptomycin, teracycline),
v. Aminoacids (lysine, glutamic acid), Single Cell Protein.

UNIT-IV: DOWNSTREAM PROCESSING AND EFFLUENT TREATMENT

i. Downstream processing, DSP, Criteria, steps involved in DSP
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

UNIT-V: FOOD TECHNOLOGY

i. Introduction to food technology,
ii. Sterilization and Pasteurization of food products
iii. Elementary idea of canning and packing
iv. Technology of Typical Food/Food products (bread, cheese, idli)
v. Food preservation and hygiene, Hurdle concept, HACCP System.

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. 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., (2007). 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. BIOTECHNOLOGY
SEMESTER - III

COURSE TITLE: BIOINFORMATICS

Course code: PSBTTC303
Duration of Examinations
Minor Test1: 1 hour
Minor Test2: 1 hour
Major Test: 2.5 hours

Contact hours: 48
Credit: 4
Max. Marks: 100
Minor Test1: 20
Minor Test2: 20
Major Test: 60
Total: 100

Syllabi for the examinations to be held in the years Dec 2019, Dec 2020 & Dec 2021

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: Bionomial, 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: FUNDAMENTALS OF COMPUTERS

i. Introduction to digital computers; organization, binary number system, flow chart and programming techniques
ii. MS OFFICE software covering word processing, spreadsheets and presentation software
iii. Types of networks, data transmission methods, communication protocols.
vii. Internet- Evolution and its Uses, Intranet Protocols, Concepts of Internet, URL, Domain Names, E-mail concepts, FTP & its usages.

UNIT-III: INTRODUCTION TO BIOLOGICAL DATABASES

i. Internet and the biologist, Scope of Bioinformatics, Biological Databases; Primary, Secondary & Composite databases.
ii. Nucleotide Sequence Databases; GenBank, EMBL, DDBJ, NCBI Data Model.
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)
v.

UNIT-IV: INFORMATION RETRIEVAL & SEARCHING OF BIOLOGICAL DATA

i. Retrieval Systems: SRS, ENTREZ, GQuery: Global cross database NCBI Search, DBGET Search, LinkDB: Database of link information
ii. Sequence Similarity Search: BLAST, FASTA, CLUSTALW.
iii. Sequence submission tools: BankIt, Sequin, Webin, SAKURA.
iv. Retrieval of Structural Data from PDB, MMDB, CDD, Protein Visualization Software: RASMOL, Cn3D, JMol., PyMol, Swiss-PDB (SPDBV)

UNIT-V: COMPUTATIONAL ANALYSIS OF BIOLOGICAL DATABASES

i. Analysis of DNA and protein sequences, ESTs, SAGE and Gene prediction
ii. Definition of Genome, Introduction to Human Genome Project, Genome Sequencing, Genome Maps & their uses.
iii. Sequence assembly, Genome analysis, Phylogenetic analysis.
iv. Currently existing biological databases (Summary) ACEDB: A database for genome information.

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. Baxevanis, A.D. and Francis Onellete, B.F. (2001). Bioinformatics. Wiley Interscience. John Wiley and Sons Inc. New York.
2. Attwood, T.K. and Parry-Smith, D.J. (1999). Introduction to Bioinformatics. Pearson Education Ltd., Singapore.
3. Mueller, J.P. and Sheldon, T. (1998). Internet information server 4. Tata McGraw Hill Publishing Company Ltd., New Delhi.
4. Curtin, D.P. et al. (1999). Information Technology. Tata McGraw-Hill Publishing Company Ltd., New Delhi.
5. Dhar, M.K. and Kaul, S. (1997). Statistics in Biology. Malhotra Brothers, Jammu.
6. Snedecor, G.W. and Cochran, W.G. (1989). Statistical methods. Iowa State University Press, Ames.
7. Steel, R.G.D. and Torrie, J.H. (1981). Principles and procedures of statistics: A Biometrical approach. McGraw-Hill Book Company, Singapore.
8. Ye, Q. S. (2008). Bioinformatics: A practical approach. Champman & Hall/ CRC.
9. Noah, H. (2008) Bioinformatics Genomics and postgenomics. Wiley.
10. Tramontano Anna (2008). Int. to Bioinformatics. Chapman & hall/ CRC.

M.Sc BIOTECHNOLOGY
SEMESTER-III

COURSE TITLE: IPRs AND ENTREPRENEURSHIP DEVELOPMENT IN BIOTECHNOLOGY

Course code: PSBTTC304 **Contact hours**: 24
Duration of Examinations **Credits**: 2
Minor Test1: 1 hour **Max. Marks**: 50
Major Test2: 2.0 hours **Minor Test1**: 10
MajorTest: 40
Total: 50

Syllabi for the examinations to be held in the years Dec 2019, Dec 2020 & Dec 2021

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 biotech 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 based industries (agri/pharma).

UNIT-I: INTELLECTUAL PROPERTY

i. Role of IPRs in Biotechnology, types of IPRs, patent protection in the constitutions, Purpose of a Patent
ii. Material transfer Agreements, Promoting Technological Advancement. Patentable Inventions, Biotechnology Patents, Patent Requirements, Patent Application, Patenting Organisms, Patent Licensing.
iii. Research and IP, Major treaties that govern IP; Introduction to Indian and US patent offices.
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. Stem Cells, Cloning, Food and Agriculture, Use of animals in research,

UNIT-III: ENTREPRENEURSHIP IN BIOTECHNOLOGY BASED INDUSTRIES

i. Introduction to social and business entrepreneurship; basic characteristics, developing entrepreneurship through training and motivation.
ii. Concept of enterprise, importance of spotting the opportunity, leveraging resources and creating value.

iii. Customer needs and market segmentation; categories of value: enhancements, extensions and specializations.
iv. Entrepreneurial opportunities in Biotechnology; Structure of the industry: companies working in different areas of specialization (agri-biotech, pharmabiotech etc.) and different stages (R&D, manufacture, sales and marketing); the changing nature of the phama-biotech industry; policy making relevant to the biotech industry.

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.

SUGGESTED READINGS:

1. Philippe Cullet; (2005) Intellectual Property Rights and Sustainable Development, Lexis, Nexis, New Delhi.
2. Arthur William *et al*.; (2005) Expanding Horizons in Bioethics, Springer.
3. Prabuddha Ganguli; (2001) Intellectual Property Rights, Unleashing the Knowledge Economy, Tata Mc Graw Hill, New Delhi.
4. Venkatratnam J.B (2009) Entrepreneurship Development, Heritage Printers, Hyderabad
5. Patzelt, Holger; Brenner, Thomas (2008), Handbook of Bioentrepreneurship, Springer Publications
6. S. Mitra; (2009) Entrepreneur Journeys Vol. 1, Hachette Publishing Group.
7. R.D. Hisrich; (2006) Entrepreneurship, Tata McGraw-Hill Publishing Co Ltd, 6th Edition.
8. D.F. Kuratko, H.P. Welsch; (2001) Strategic Entrepreneurial Growth, Harcourt College Publishers.
9. P. Ganguli; (2009) Intellectual Property Rights, Tata Mcgraw Hill Publishing Co Ltd.
10. M.B. Rao; (2008) Biotechnology, IPRs and biodiversity, Pearson Publications.

M.Sc BIOTECHNOLOGY
SEMESTER-III

COURSE TITLE: TECHNIQUES IN BIOTECHNOLOGY

Course code: PSBTTE307 **Contact hours**: 48
Duration of Examinations **Credits**: 4
Minor Test1: 1 hour **Max. Marks**: 100
Minor Test2: 1 hour **Minor Test1**: 20
Major Test: 2.5 hours **Minor Test2**: 20
Major Test: 60
Total: 100

Syllabi for the examinations to be held in the years Dec 2019, Dec 2020 & Dec 2021

Objective: The course is designed to give students a sound and basic exposure to Biotechnology. This course offers a very robust and forward-looking programme in the theory and techniques of Biotechnology. The course gives exposure to the various basic techniques of biotechnolgy used in molecular biology, enzymology, plant and animal tissue culture and immunology.

UNIT I: BASIC TECHNIQUES IN MOLECULAR BIOLOGY

i. Nucleic acid structure and types, Isolation of nucleic acids from microbes, plants and animals, methods and principles.
ii. Eletrophoretic analysis of nucleic acids (DNA, RNA) by Agrose gel electrophoresis, Molecular weight determination.
iii. Spectrophotometric analysis of DNA, RNA, Estimation of concentration and purity, Introduction to PCR.
iv. Cloning, Genomic DNA and cDNA library construction, DNA fingerprinting, molecular markers

UNIT II: BASIC TECHNIQUES IN ENZYMOLOGY AND BIOPROCESSING

i. General characteristics of Enzymes, biocatalysts vs chemical catalysts, Basis of Nomenclature and classification of enzymes, Enzyme activity, enzyme action, Nature of active sites, Enzyme substrate complex, Types of enzymes.
ii. Approaches for enzyme assays, Units of enzyme activity, specific activity, kinetics of enzyme catalyzed reactions, enzymes in regulation of metabolism,
iii. Industrial application of enzymes. Fundamentals of bioprocess development, products based on bioprocessing, growth and product synthesis kinetics
iv. Upstream and downstream processing, process optimization, scale up paradox, effluent treatment.

UNIT III: BASIC TECHNIQUES IN GENOMICS AND BIOINFORMATICS

i. Restriction mapping, nucleic acid hybridization and Microarray
ii. DNA sequencing, Maxam and Gilbert's degradation method and Sanger's dideoxynucleotide synthetic method
iii. Introduction to Bioinformatics, biological databases: Primary and secondary databases, structural databases.
iv. Sequence analysis at Nucleotide and protein level, Database retrieval systems, SRS, ENTREZ, NCBI datamodel, Database searching: BLAST, FASTA

UNIT IV: BASIC TECHNIQUES IN PLANT AND ANIMAL BIOTECHNOLOGY

i. Plant tissue culture, culture media, Establishment of cultures, acclimatization to field conditions and their applications
ii. Gene transfer in plants, vector mediated and vectorless methods, applications with reference to BT cotton and Golden rice
iii. Primary and established cell lines, mono-layer and suspension culture, cryopreservation
iv. Stem cells and therapy, three dimension culture, useful products from transgenic animals.

UNIT V: BASIC TECHNIQUES IN IMMUNOLOGY

i. Hematopoiesis and cell of immune system, T-cell subsets and surface markers, Immunogloublins – classes, structures and functions

ii. Antigen-Antibody interaction, Affinity and avidity, Recognition of antigen by T-cells and role of MHC, Structure of T and B cell receptors.
iii. Immuno-diffusion and Immuno-electrophoresis, Immuno-blot, ELISA, RIA,

iv. Introduction to Monoclonal antibodies, production and application.

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. Primrose, S.B. (1994). Molecular Biotechnology, 2nd edition, Blackwell Scientific Publishers.Oxford.

2. Berger, S.L and Kimmel, A.R (1996). Methods in Enzymology, Guide to Molecular Cloning Techniques, vol. 152, Academic Press Inc., San Diego.
3. Bhojwani S.S. and Razdan M.K. (2005) Plant tissue culture: Theory and practice. Elsevier Science, New Delhi.
4. J. Reinert and Y. P. S. Bajaj Applied and Fundamental Aspects of Plant Cell, Tissue, and Organ Culture . Springer-Verlag, Berlin, New York
5. Karl-Hermann Neumann, Ashwani Kumar, Jafargholi Imani: Plant Cell and Tissue Culture - A Tool in Biotechnology: Basics and Application (Principles and Practice). Springer-Verlag, Berlin, New York
6. Keshavachandran and Peter, KV (2008): Plant Biotechnology: Methods in Tissue Culture and Gene Transfer. Orient Blackswan
7. Sambrook, J. Fritsch, E.F. and Maniatis, T. (2001). Molecular Cloning. A Laboratory Manual 2nd ed., Cold Spring Harbor Laboratory Press.
8. Kuby, J. (2007), Immunology. 6th Edition. W.H. Freeman and company, New York.
9. Satyanarayana, U. (2005). Biotechnology. Books and Allied (P) Ltd, (Kolkatta) India
10. Nicholas, P, Stevans, L. Fundamental of Enzymology (1999). Oxford University Press, New York.
11. Tripathi, G. (1999). Enzyme Biotechnology. Technoscience Publications, Jaipur, India.
12. Palmer T. The Chemical Nature of Enzyme Catalysis, Enzymes: Biochemistry, Biotechnology and Clinical Chemistry. Horwood Publishing Limited, Coll House, Westergate, England, 2001.
13. Stanbury, P. F., Whitaker, A., Hall, S. J., Principles of Fermentation Technology, Butterworth-Heinemann, UK 1995.
14. Creuger W and Crueger A (1991) Biotechnology: Text Book of industrial microbiology and Biotechnology. Sinauer Associatesw Inc. Sundarland , MA.
15. Molecular cloning: A laboratory manual, 3 volumes by Green & sambrook. 4th edition, cold spring. Harbor laboratory press, 2012.
16. Gene cloning & DNA analysis : An introduction by T.A.Brown, 6th edition , wiley-Blackwell,2010.
17. Recombinant DNA principles & methodologies edited by James.J.Greeene & venigalla.B.Rao, CRC press, 2009.
18. Essentials of molecular biology by David Freifelder & George.M.Malacinski ; 2nd edition, panama publishing corporation.reprinted 1996.

M.Sc. BIOTECHNOLOGY
SEMESTER- IV

COURSE TITLE: ENVIRONMENTAL BIOTECHNOLOGY

Course code: PSBTTC404 | **Contact hours**: 48
Duration of Examinations | **Credits**: 4
Minor Test1: 1 hour | **Max. Marks**: 100
Minor Test2: 1 hour | **Minor Test1**: 20
Major Test: 2.5 hours | **Minor Test2**: 20
Major Test: 60
Total: 100

Syllabi for the examinations to be held in the years May 2020, May 2021 & May 2022

Objective: The objective of this course is to familiarize the students with various problems concerning environment and their possible solutions employing the biotechnological approaches.

UNIT- I: ENVIRONMENT: BASIC CONCEPTS AND ISSUES

i. Environment: Basic concepts and issues
ii. Environmental pollution: Types and causes
iii. Global environmental problems: their impact and biotechnological approaches for management
iv. Ozone depletion, Ultra Violet radiations, Green-house effect and acid rain

UNIT-II: ENVIRONMENTAL BIOTECHNOLOGY-I

i. Air pollution and Water pollution - causes and control
ii. Eutrophication: types and control
iii. Waste water treatment-physical, chemical and biological treatment processes
iv. Energy resources: conventional and renewable energy resources. Wastes as renewable source of energy

UNIT-III: ENVIRONMENTAL BIOTECHNOLOGY-II

i. Microbiology of waste water treatments: Aerobic process: Activated sludge, Oxidation ditches, Trickling filter
ii. Towers, Rotating discs, Rotating drums, Oxidation ponds
iii. Anaerobic processes: Anaerobic digestion, anaerobic filters
iv. Upflow anaerobic sludge blanket reactors

UNIT-IV: ENVIRONMENTAL BIOTECHNOLOGY-III

i. Treatment schemes for waste waters of dairy, distillery and antibiotic industries.

ii. Solid waste and Soil pollution management: Treatment and disposal of Solid waste.
iii. Aerobic (composting and vermiculture)
iv. Anaerobic treatment of solid waste and biogas generation.
v. Soil erosion and its control

UNIT-V: BIOREMEDIATION AND BIODEGRADATION

i. Bioremediation : principle, concept and process.
ii. Bioremediation of contaminated soils and waste land, Spilled Hydrocarbons.
iii. Biodegradation of Organic pollutants, Pesticides and Xenobiotics.
iv. Biopesticides and Integrated Pest management.
v. Biopollution, Biopolymers, Bioplastics and Biomining.

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. Tchobanoglous, G., Franklin, B. and Stensel, H. D. (1991)Wastewater Engineering – Treatment, Disposal and Reuse, Tata McGraw Hill, New Delhi
2. M.Moo-Young (2007) Comprehensive Biotechnology, Pergamon Press, Oxford
3. De, A. K. (2003) Environmental Chemistry Wiley Eastern Ltd., New Delhi
4. Allsopp, D. and Seal, K. J. (2004) Introduction to Biodeterioration, ELBS/Edward Arnold,
5. Ahmed, N., Qureshi, F. M. and Khan, O. Y. (2001) Industrial and Environmental Biotechnology. Horizon.
6. Kumar, A. (2004) Environmental Biotechnology. Daya publishing house.
7. Goel P.K. and Pathade G.R. (2004) Biotechnological applications in Environment and Agriculture. ABD Publishers.
8. Goel, P.K. (2003) Advances in industrial waste water treatment. ABD Publishers.
9. Cutter, S. L. (2003) Environmental risks and Hazards. Prentice Hall.
10. Ignacimuthu, S. (2003) Environmental Science. Phoenix Publishing house.
11. Pathade, G. R. and Goel, P.K. (2003) Biotechnology in Environmental Management. ABD Publications.

M.Sc. BIOTECHNOLOGY
SEMESTER- IV

COURSE TITLE: ANIMAL BIOTECHNOLOGY

Course code: PSBTTC403
Duration of Examinations
Minor Test1: 1 hour
Minor Test2: 1 hour
Major Test: 2.5 hours

Contact hours: 48
Credits: 4
Max. Marks: 100
Minor Test1: 20
Minor Test2: 20
Major Test: 60
Total: 100

Syllabi for the examinations to be held in the years May 2020, May 2021 & May 2022

UNIT 1: FUNDAMENTALS OF CELL CULTURE

i Introduction, importance and history of cell culture development; Cell culture equipment and aseptic conditions
ii Different tissue culture techniques including primary and secondary cultures; Monolayer and Suspension cultures
iii Different types of cell culture media, serum and serum free media
iv Behavior of cells in cell culture conditions, division, their growth pattern and estimation of cell number.

UNIT –II: ANIMAL CELL CULTURE AND ITS TYPES

i Continuous cell lines; Transformed cell lines (phenotypic properties of transformation); development, characterization and maintenance of cell lines, common cell culture contaminants
ii Cell synchronization, measurement of cell viability and cytotoxicity
iii Scale-up in monolayer and suspension culture; cryopreservation
iv Organ, Organotypic and Histotypic culture; three dimension culture; concept and importance of Tissue engineering; Stem cell culture and its applications.

UNIT- III: APPLICATION OF ANIMAL CELL CULTURE

i Conventional methods of animal vaccine production, recombinant approaches to vaccine production
ii Application of animal cell culture for *in vitro* testing of drugs; production of pharmaceutical proteins
iii Somatic cell cloning and hybridization; transfection and transformation of cells

iv Micro-organisims and proteins used as probiotics (lactic acid bacteria); application of probiotics for humans, farm animals and poultry.

UNIT- IV: ANIMAL REPRODUCTIVE BIOTECHNOLOGY

i Structure of sperms and ovum, Cryopreservation of sperms and ova of livestock, Artificial insemination, *in vitro* fertilization, culturing and cryopreservation of embryos
ii Micromanipulation of animal embryos; *in-situ* and *ex-situ* preservation of germplasm
iii Animal cloning - basic concept, cloning from embryonic cells and adult cells, cloning of different animals
Iv Transgenic animal production, animals as bioreactors and application in expression of therapeutic proteins

UNIT- V: ANIMAL GENOMICS AND BIOETHICS

i Introduction to animal genomics; Different methods for characterization of animal gnomes- SNP, STR, QTLS, RFLP, RAPD
ii Gene-knock out technology and animal models for human genetic disorders
iii Ethical issues in animal cloning; using animals for research and testing
iv Ethical concerns in embryonic stem cell research; Risks versus benefits of animal 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.

SUGGESTED READINGS:

1. Freshney, R.I (2007) Culture of animal cells: A manual of Basic Technique. Jonh Wiley and Sons Inc., USA.
2. Gordon I. 2005. Reproductive Techniques in Farm animals. CABI.
3. Portner R. 2007. Animal Cell Biotechnology. Humana Press.
4. Spinger TA. 1985. Hybridoma Technology in Biosciences and Medicine. Plenum Press.
5. Barry R Bloom, Paul- Henri Lambert 2002. The Vaccine Book. Academic press.

6. Blackwell. Kannaiyan S and Gopalam A. 2007. Biodiversity in India: issue and Concerns.APC
7. Huffnagle GB & Wernick S. 2007. The probiotics Revolution: The Definitive Guide to Safe Natural Health. Banatm Books.
8. Krishna VS. 2007. Bioethics and bioethics in biotechnology. New Age International (P) Limited., India.

M.Sc BIOTECHNOLOGY
SEMESTER-IV

COURSE TITLE: ESSENTIALS IN MICROBIOLOGY AND BIOCHEMISTRY

Course code: PSBTTE405 **Contact hours**: 48
Duration of Examinations **Credits**: 4
Minor Test1: 1 hour **Max. Marks**: 100
Minor Test2: 1 hour **Minor Test1**: 20
Major Test: 2.5 hours **Minor Test2**: 20
Major Test: 60
Total: 100

Syllabi for the examinations to be held in the years May 2020, May 2021, May 2022

Objective: The basic goal of this course is to determine how the collections of inanimate molecules that constitute living organisms, interact with each other and show an exciting excursion into human metabolism and life. 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: INTRODUCTORY MICROBIOLOGY

i. Methods in Microbiology, Pure culture techniques; culture collection and maintenance of cultures; Theory and practice of sterilization;
ii. Principles of microbial nutrition, Construction of culture media.
iii. Microbial growth: batch and continuous culture; Factors affecting growth;
iv. Prokaryotic cell structure and function; Flagella and motility; cell inclusions like endospores, gas vesicles.

UNIT II: MICROBIAL DIVERSITY

i. Microbial taxonomy, Methods for determining evolutionary relationships Prokaryotic diversity: Protobacteria, Cyanobacteria, Chlamydias, Cytophaga, Gram positive bacteria, Green sulphur bacteria, Green non-sulphur bacteria, Spirochaetes, Deinococci
ii. Archaea as earliest life forms, Halophiles, Methanogens, Hyperthermophilic Archea, Thermoplasma.
iii. Eukarya: Overview of Algae, Fungi, Slimemolds and Protozoa.
iv. Viruses: Discovery, Classification and Structure of Viruses. Viruses of Prokaryotes and Eukaryotes. Examples of Herpes, Pox, Adenoviruses, Retroviruses, Viriods and prions.

UNIT III: INTRODUCTORY BIOCHEMISTRY

i. General concepts

ii. Thermodynamics, reaction kinetics, equilibrium,
iii. water, pH, buffers, solubility,
iv. Bioenergetics, biocatalysis.

UNIT IV: CARBOHYDRATE AND LIPIDS

i. Structure and function of Carbohydrates, monosaccharides, disaccharides, polysaccharides,
ii. Glycolysis, Kreb's cycle, Gluconeogenesis, Pentose Phospahte Pathway
iii. Electron Transport chain, Chemiosmotic theory for ATP synthesis, regulation of ATP production; Photosyntheis and respiration concept.
iv. General concept of lipids, Phospholipids, glycolipids, sphingolipids, steroids and functions of lipids, biosynthesis of fatty acids and catabolism of lipids: β - oxidation of fatty acids

UNIT V: PROTEINS AND NUCLEIC ACIDS

i. Introduction to types of proteins, primary secondary and tertiary and quartenary structures, globular and fibrous proteins and function of proteins
ii. Enzymes, regulatory enzymes, essential amino acids, glucogenic, ketogenic, urea cycle
iii. Structure and function of nucleic acids: DNA (A, B and Z types) and RNA (rRNA, tRNA and mRNA) and their role
iv. Ribose, deoxyribose sugars, Nucleotides and nucleosides, Purines and pyrimidines

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. Voet, D . and Voet, J.G. Biochemistry. John Wiley and Sons inc. USA.
2. Stryer, L. Biochemistry. W.H. Freeman & Company, New York.
3. Lehinger, A.L. Principles of Biochemistry. CBS Publishers & Distributors, New Delhi.
4. Ritter, P. Biochemistry: A foundation. Books/ cole Publishers.
5. Murray, R.K., Granner, D.K., Mayes, P.A. and Rodwell, V.W. Harper's Biochemistry. Appleton, Lange Publishers, CT. 6th edition.

6. Moat, A.G., Foster, J.W. and Spector, M K. (2002) Microbial Physiology Wiley- Liss a John Wiley and sons, Inc. Publication.
7. Stainer, R.Y., Ingraham, J.L., Wheelis, M. L. and Painter, P.R.(1991) General Microbiology. The MacMillan press.
8. Madigan, M.T., Martinko, J.M. and Parker, J. (2007). Brock Biology of Microorganisms. J. Prentice Hall. 11th ed.
9. Pelczar, M. J., Chan, E.C.S. and Kreig, N.R. (1998) Microbiology. McGraw Hill.
10. Maloy, S. R., Cronan, J. E. and Freifelder, D. Microbial Genetics. Jones Barlett Publishers.
11. Cappuccino,J. G. and Sherman, N. (2003). Microbiology – A Laboratory Manual. Addison Wesley..
12. Tortora, G.J., Funke, B.R. and Case (2007). Microbiology: An Introduction. Benzamin Cummings. 2nd edition.
13. Prescott, L. M., Harley, J.P. and Klein, D. A. (2002) Microbiology. W.C.B. Oxford.
14. Atlas, R. M. (2004), Microbiology: Fundamentals and Applications. Macmillan Publishing Co. New York. 2nd edition.
15. Salkia,R., Bora,C. and Bezbamah,K.L.(2008). Microbial Biotechnology. New India Publishing Agency.