M. Sc. BIOTECHNOLOGY

DEPARTMENT OF BIOTECHNOLOGY

PROGRAMME SPECIFIC OUTCOMES (PSOs)

After successful completion of the M. Sc. programme in Biotechnology students will:

PSO 1. Understand the fundamental concepts of biotechnology and allied disciplines.

PSO 2. Be able to design, conduct experiments, analyze and interpret data for investigating problems in biotechnology and allied fields.

PSO 3. Be able to pursue higher studies (M. Phil., Ph. D.) in order to attain research positions.

PSO 4. Be eligible and equipped for appearing in various examinations such as CSIR-NET, ARS-NET, GATE, ICMR, DBT and many others for promising careers in research.

PSO 5. Be qualified to work in entrepreneurship ventures such as consultancies and training centres, in pharmaceutical industries, drug and food processing companies, in marketing division for boosting company business and absorbed by institutions as teaching faculties.

PSO 6. Have an understanding of the potential and impact of biotechnological innovations and inventions on the environment, health sector, agriculture, etc., and hence can contribute on spreading awareness and finding sustainable solutions for implementation.

B. Sc. BIOTECHNOLOGY

DEPARTMENT OF BIOTECHNOLOGY

PROGRAMME SPECIFIC OUTCOMES (PSOs)

Successful completion of the B. Sc. programme in Biotechnology will enable students to:

PSO 1. Understand the basic principles, practices and emerging concepts in Biotechnology, enabling their applications in industry, medicine and research.

PSO 2. Develop strong skills for the analysis and interpretation of problems and information in modern biology. Technical and laboratory hands-on training will be provided that will help the students excel in research and get better job opportunities.

PSO 3. Create awareness of the importance of ethics and IPR in research and industries. The students will be inculcated to adhere to ethical principles and to have a sense of responsibility.

PSO 4. Successfully compete in various exams and competitions at the national and international level.

B. Sc. BIOCHEMISTRY

DEPARTMENT OF BIOCHEMISTRY

PROGRAMME SPECIFIC OUTCOMES (PSOs)

Successful completion of the B. Sc. programme in Biochemistry will enable students to:

PSO 1. Understand the nature and basic concepts of Biochemistry, their biomolecules and their techniques used.

PSO 2. Analyse the importance of thermodynamics, its membrane biophysical features and the need of statistical analyses in biology.

PSO 3. Have an in-depth understanding of proteins and the usefulness of enzymes in biochemistry.

PSO 4. Understand the nature and basic concepts of cell biology and physiology of prokaryotic and eukaryotic cells in plants, animals and microbes.

PSO 5. Explore the intermediary metabolism of all the biomolecules involved in living organisms for a clear concept in the basis of biochemistry.

PSO 6. Analyse the nutritional and clinical aspects of biomolecules in humans.

PSO 7. Understand the features, importance and basic concepts of molecular biology and its application.

M. Sc. BIOTECHNOLOGY

DEPARTMENT OF BIOTECHNOLOGY

COURSE OUTCOMES (COs)

SEMESTER I

Course: BIT C 101 – Cell Biology and Genetics (Theory)

After successful completion of the course, students will be able to:

CO 1. Understand the basic structure/function of cell organelles and organization and function of cell wall.

CO 2. Describe the mechanisms of electron transport system, oxidative phosphorylation and photophosphorylation.

CO 3. Describe the structure and composition of nucleus, mechanism of cell cycle and cell division.

CO 4. Understand cell signaling and mechanism of signal transduction in animal and *Rhizobium*-legume symbiosis.

CO 5. Understand microbial genetics with emphasis on different mechanisms of genetic transfer processes.

CO 6. Understand extranuclear inheritance by studying the maternal effects in snail coiling and mitochondrial genetic defects.

CO 7. Understand the basic concepts of human genetics, Mendelian pedigree pattern and polygenic inheritance.

CO 8. Understand chromosome abnormalities, genome instability and sex-determination.

Course: BIT C 102 – Biomolecules (Theory)

After successful completion of the course, students will be able to:

CO 1. Learn in detail the types of chemical bonds and the nature of interaction.

CO 2. Understand the law of thermodynamics in biological systems; relevance of Gibbs free energy, entropy and enthalpy.

CO 3. Learn in detail the structures, functions & applications of nucleotides, flavonoids, alkaloids, pigments, phenolic, terpenoids, carbohydrates, proteins and lipids.

CO 4. Understand the concept of secondary metabolites, its relevance & applications.

CO 5. Understand the concept of hetrocyclic compounds & its applications.

CO 6. Learn the conformational properties of biomolecules and the mathematical models to study protein folding.

CO 7. Describe the role of chaperones and chaperonins.

CO 8. Learn the basic principles and applications of important techniques for analyzing carbohydrate and protein.

Course: BIT C 103 – Microbiology (Theory)

After successful completion of the course, students will be able to:

CO 1. Describe the history of discovery of microorganisms, controversy over spontaneous generation, and interaction of microorganisms with the environment.

CO 2. Understand basic concepts of microbial nutrition and growth, construction and types of culture media, culture techniques, influence of environmental factors on growth and culture collection and its maintenance.

CO 3. Learn the metabolic diversity of microorganisms; photosynthesis, chemolithotrophy, hydrogen-iron-nitrite oxidation, nitrate and sulfate reduction, methanogenesis, acetogenesis, fermentation and nitrogen.

CO 4. Learn the physiological diversity of bacteria, archaea and eukarya.

CO 5. Learn the discovery and classification of viruses, cultivation, maintenance and handling practices.

CO 6. Learn microbial diseases and their methods and modes of transmission.

CO 7. Understand the interaction between parasites and their host, mechanism of virulence and pathogenesis.

CO 8. Describe the types of antimicrobial substances.

CO 9. Understand the mechanism of microbial resistance to antibiotics.

Course: BIT C 104 – Laboratory I (Practical)

Students will learn how to:

CO 1. Learn the principles and applications of bright field, phase contrast and fluorescence microscopy.

CO 2. Prepare subcellular fractionation of mitochondria and chloroplast.

CO 3. Prepare chromosome from mice bone marrow and root tip for examination of metaphase.

CO 4. Study meiosis in grasshopper tetstes and flower bud

CO 5. Study cell cycle from flow cytometry analysis

CO 6. Culture lymphocyte and prepare chromosome from human.

CO 7. Perform human karyotyping from well spread metaphase photograph.

CO 8. Perform quantitative reactions of amino acids, sugars, proteins and nucleic acids.

CO 9. Perform microscopic examination of microorganisms and effects of environmental factors on bacterial growth.

CO 10. Isolate and culture microorganisms and perform antibiotic assay.

CO 11. Study sister chromatid exchanges and chromosomal aberrations.

SEMESTER II

Course: BIT C 201 – Molecular Biology (Theory)

After successful completion of the course, students will be able to:

CO 1. Describe the detail structure of DNA and its physico-chemical properties.

CO 2. Understand the important aspects of eukaryotic and prokaryotic replication, transcription, post transcriptional modification, translation and repair of DNA damage.

CO 3. Learn the salient features of genetic code, regulation of prokaryotic and eukaryotic gene expression and translation.

CO 4. Learn the underlying mechanisms of base and nucleotide excision repair, mismatch repair and DNA double strand break repair.

CO 5. Understand the inducible and repressible regulation of prokaryotic gene expression.

CO 6. Understand the regulatory mechanisms of chromatin remodeling in eukaryotes.

CO 7. Understand the importance of epigenetics and regulatory RNAs.

CO 8. Learn the importance of human genome projects, structural genomics, functional genomics and analysis of knock-out mutants.

Course: BIT C 202 – Immunology (Theory)

After successful completion of the course, students will be able to:

CO 1. Understand the basic concepts of immune responses, classification and types of immune responses and structure/organization of lymphoid organs.

CO 2. Understand the concepts of immunogens, antigens ,haptens&adjuvents and their roles in immune response

CO 3. Learn the nature and biology of T-dependent, T-independent and superantigens.

CO 4. Understand the antigen-antibody interaction and MHC structure and function.

CO 5. Understand the mechanism of activation of T & B lymphocytes and their role in the regulation of immune system.

CO 6. Understand the role of cytokines and MHC restriction.

CO 7. In depth understanding of autoimmunity, hypersensitivity, immunomodulation: - its mechanisms and significance.

CO 8. Understand the complement system and its pathways-Regulation & applications

CO 9. Understand the mechanism of immune response to microbes and pathogens.

CO 10. Understand the mechanism of immunity to tumor and the development, problem and prospect of vaccines against AIDS, cancer and malaria.

Course: BIT C 203 – Laboratory II (Practicals)

Students will learn how to:

CO 1. Extract genomic DNA and RNA.

CO 2. Study semi-conservative replication in mammalian cells

CO 3. Perform polymerase chain reaction (PCR) of human/mouse genomic DNA.

CO 4. Perform agarose gel electrophoresis of DNA.

CO 5. Perform restriction endonuclease digestion of DNA.

CO 6. Separate mononuclear cells by Histopaque.

CO 7. Isolate and identify macrophages.

CO 8. Count WBCs.

CO 9. Raise antiserum in mouse/rabbit and perform immunodiffusion in agar gels.

CO 10. Study antigen-antibody interaction in *in vitro* double immunodiffusion.

CO 11. Perform ELISA.

CO 12. Staining of splenocytes with antibodies and flow cytometric analysis.

Course: BIT O 204 – Microbial Technology (Theory)

After successful completion of the course, students will be able to:

CO 1. Explain the mechanism to regulate and manipulate gene expression in prokaryotes.

CO 2. Learn the techniques to increase protein expression in *E. coli.*

CO 3. Describe the construction of plasmids, antibiotic resistance and their role in *E. coli* transformation.

CO 4. Explain the mode of synthesis and significance of polysaccharides, steroids and sterols produced by microorganisms.

CO 5. Describe the roles of microorganisms in waste management and industrial production of food and beverages.

CO 6. Explain the metabolic pathways of microbial production of amino acids, antibiotics, enzymes, and organic acids.

CO 7. Describe the methods for strain selection, improvement, preservation and production of probiotics.

CO 8. Explain the role of microorganisms in farm animals and transgenic plants.

CO 9. Describe the diagnostic and clinical methods for infectious diseases.

CO 10. Understand endophytes and their role in novel metabolite production.

Course: BIT O 205 – Microbial Technology (Laboratory Work)

Students will learn how to:

CO 1. Enumerate microbial population.

CO 2. Identify unknown bacteria.

CO 3. Isolate genomic DNA from *E. coli.*

CO 4. Perform polymerase chain reaction (PCR) of bacterial DNA.

CO 5. Perform electrophoretic separation of bacterial DNA in agarose gel.

CO 6. Produce alcohol, citric acid, amylase and antibiotics from microorganisms.

SEMESTER III

Course: BIT C 301 – Computer applications, Bioinformatics & Biostatistics (Theory)

After successful completion of the course, students will be able to:

CO 1. Describe the role of computer applications in bioinformatics.

CO 2. Classify the different types of biological database with examples

CO 3. State the importance of using a database.

CO 4. Explain the different types of nucleotide databases.

CO 5. Explain the different types of protein databases.

CO 6. Explain the different types of protein structure databases.

CO 7. Define sequence alignment and classify the different types of sequence alignment.

CO 8. Explain the sequence alignment algorithm – Dot matrix analysis, pairwise alignment using dynamics programming and Bayesian method.

CO 9. Differentiate between local alignment and global alignment.

CO 10. Differentiate between pairwise alignment and multiple sequence alignment.

CO 11. Explain the different types of BLAST programs and its applications.

CO 12. Explain the different types of FASTA programs and its applications.

CO 13. Differentiate between BLAST and FASTA programs.

CO 14. Differentiate between motifs and domains.

CO 15. Define regulatory networks and its concept.

CO 16. Define phylogenetic analysis and its application in evolutionary relationships.

CO 17. Differentiate and explain the tree building methods – UPGMA, NJ, Maximum Parsimony, Maximum Likelihood and Bayesian inference.

CO 18. Explain how bootstrap provides a confidence limit in building a phylogenetic tree.

CO 19. Explain comparative genome analysis.

CO 20. Explain how metabolic pathway of newly sequenced genome is constructed.

CO 21. Describe the computational tools are used for expression analysis.

CO 22. Define drug designing and explain the computational steps involved in drug design.

CO 23. Define molecular docking and explain the different docking algorithms and scoring function.

CO 24. Explain QSAR and its importance in structure – activity relationship.

CO 25. Explain the methods used to build 2D and 3D QSAR models.

CO 26. Explain the different advances in QSAR – GQSAR, 3D, 4D, 5D and 6D.

CO 27. Define homology modelling and explain the steps involved in modelling a three-dimensional structure of a protein.

CO 28. Explain energy minimisation and state its importance.

CO 29. Explain molecular dynamics simulation and why it is important.

CO 30. Explain the applications of molecular dynamics simulation in biomolecules.

CO 31. Define computer networks and elaborate the different topologies of computer networks with examples.

CO 32. Describe the basics of the different computer operation system – Windows, Linux and MacOS.

CO 33. Describe the various characteristics and attributes of HTML.

CO 34. Create a web page using suitable HTML tags.

CO 35. Explain the basic concept of PERL programming.

CO 36. Describe the applications of PERL programming in biological data.

CO 37. Explain the basic concept of SQL.

CO 38. Explain the importance of SQL in creating a database.

CO 39. Describe and calculate mean, median, mode, range, standard deviation and variance.

CO 40. Calculate the level of significance of the tabulated data.

CO 41. Describe and calculate the statistical significance using F and t test.

CO 42. Describe and calculate Chi – square test.

CO 43. Describe and calculate linear regression and correlation.

CO 44. Describe and calculate the probability tests using – random experiment, sample point, sample space, exclusive and exhaustive events.

Course: BIT C 302 – Genetic Engineering and Plant Biotechnology (Theory)

After successful completion of the course, students will be able to:

CO 1. Explain the modes of action and applications of restriction enzymes and modifying enzymes.

CO 2. Understand the features of cloning vectors and their role in recombinant DNA cloning.

CO 3. Describe molecular techniques such as S1 mapping, RNase protection assay and reporter assay.

CO 4. Describe the strategies to express heterologous genes in bacteria, yeast, mammalian and plant cells.

CO 5. Describe high throughput sequencing technique, creation of knock-out mutations and functional proteomics and genomics of yeast and *Arabidopsis*.

CO 6. Explain the basic concept of totipotency in plants, plant regeneration methods, culture methods, micropropagation, and acclimatization.

CO 7. Describe anther culture, embryo culture, embryo rescue and conservation of plant resources.

CO 8. Describe the role of DNA markers.

CO 9. Describe the transformation methods in plants, monocots and chloroplast.

CO 10. Understand the benefits of transgenic plants in fruit yield and performance under biotic and abiotic stresses.

CO 11. Understand the basic rights of breeders and farmers.

Course: BIT C 303 – Laboratory – III (Practicals)

Students will learn how to:

CO 1. Isolate plamid DNA.

CO 2. Perform polymerase chain reaction (PCR) of plant DNA.

CO 3. Perform DNA restriction digestion and agarose gel electrophoresis.

CO 4. Prepare competent cells and perform bacterial transformation.

CO 5. Propagate callus and organogenesis.

CO 6. Perform anther culture for the production haploid plants.

CO 7. To retrieve a nucleotide sequence and a protein sequence from NCBI

CO 8. To retrieve a research article from NCBI PubMed

CO 9. To perform NCBI BLAST to search for similar sequences based on homology.

CO 10. To retrieve a nucleotide sequence from DDBJ

CO 11. To retrieve a protein sequence from Swissprot/Uniprot

CO 12. To retrieve a biological pathway from KEGG

CO 13. To retrieve a protein structure and analyse using Rasmol

CO 14. To perform a multiple sequence alignment using Clustal Omega

CO 15. Perform statistical analysis of biological data.

Course: BIT O 304 – Applied Molecular Genetics (Theory)

After successful completion of the course, students will be able to:

CO 1. Explain the mechanism of protein-DNA interaction and regulation of transcription and translation.

CO 2. Describe gene silencing and gene therapy.

CO 3. Learn the molecular diagnosis of cancer and cell cycle control.

CO 4. Understand gene expression and the formation of fruiting body in *Dictyostellium*.

CO 5. Learn the different prenatal diagnosis techniques and their significance.

CO 6. Learn the role of hox genes in body pattern in *Drosophila* and humans.

CO 7. Understand the developmental biology of root, shoot, flower development and seed formation.

CO 8. Understand about genetic disorders in haemoglobin and learn the types of mutations and structural defects of enzymes and proteins.

CO 9. Learn about the genes involved in neurodegenerative disorders in humans.

CO 10. Understand the genetic basis of plant-pathogen interactions and the role of R genes.

CO 11. Understand genome projects of *Saccharomyces cerevisiae, Schizosaccharomyces pombe,Candida albicans,Caenorhabditis elegans, Arabidopsis thaliana* and *Oriza sativa*.

CO 12. Learn about genome instability: molecular causes and their mechanisms.

CO 13. Understand molecular cytogenetic techniques and their applications: chromosome banding, chromosome painting, FISH, GISH and CGH-analysis.

Course: BIT O 305 – Applied Molecular Genetics (Laboratory Work)

Students will learn how to:

CO 1. Perform polymerase chain reaction (PCR) of DNA repair/tumor suppressor genes.

CO 2. Perform reverse-transcription polymerase chain reaction (RT-PCR).

CO 3. Perform western blot of regulatory protein of cell cycle/apoptosis.

CO 4. Prepare metaphase chromosomes from cultured lymphocytes and cell lines.

CO 5. Determine genetic fidelity of tissue culture plants with RAPD markers.

Course: BIT O 306 – Bioinformatics in Molecular and Cell Biology (Theory)

After successful completion of the course, students will be able to:

CO 1. Explain the role of computer applications in bioinformatics.

CO 2. Classify the different types of biological database with examples

CO 3. State the importance of using a database.

CO 4. Explain the different types of nucleotide databases.

CO 5. Explain the different types of protein databases.

CO 6. Explain the different types of protein structure databases.

CO 7. Define sequence alignment and classify the different types of sequence alignment.

CO 8. Explain the sequence alignment algorithm – Dot matrix analysis, pairwise alignment using dynamics programming and Bayesian method.

CO 9. Differentiate between local alignment and global alignment.

CO 10. Differentiate between pairwise alignment and multiple sequence alignment.

CO 11. Explain the different types of BLAST programs and its applications.

CO 12. Explain the different types of FASTA programs and its applications.

CO 13. Differentiate between BLAST and FASTA programs.

CO 14. Explain the statistical importance of sequence alignments.

CO 15. Explain how insertions and deletions affect the alignment of the sequences.

CO 16. Explain how a gene is predicted using different methods.

CO 17. Explain how repetitive elements are detected in a DNA sequence using CENSOR program.

CO 18. Describe the detection of functional sites in DNA sequence using PromoterScan.

CO 19. Understand concept of functional SNPs and explain how they are identified using in silico analysis.

CO 20. Explain the different methods and computational tools used for analysis of functional SNPs.

CO 21. Understand a scoring matrix and describe the various protein scoring matrices.

CO 22. Elaborate the use of the scoring matrices when two protein sequences are aligned.

CO 23. Differentiate between PAM and BLOSUM and elaborate on its types.

CO 24. Explain how a domain pattern is detected using different computational tools – PROSITE, BLOCKS and PRINTS.

CO 25. Differentiate between motifs and domains.

CO 26. Enumerate the significance of DNA – protein interaction.

CO 27. Explain the methods used to evaluate DNA – protein interaction.

CO 28. Enumerate the significance of protein – ligand interaction.

CO 29. Explain theexperimental methods used to evaluate protein – ligand interaction.

CO 30. Define drug designing and explain the computational steps involved in drug design.

CO 31. Define molecular docking and explain the different docking algorithms and scoring function.

CO 32. Explain Bragg’s Law with example.

CO 33. Explain the steps in X – ray crystallography of proteins.

CO 34. Describe the ideal characteristics of a protein crystal.

CO 35. Define PDB. Explain how protein structures stored in PDB.

CO 36. Explain the insilico approach to classify a protein structure using CATH and SCOP.

CO 37. Explain pairwise alignment of protein structures using DALI.

CO 38. Explain how protein structure is aligned to sequences of homologues and a sequence profile characteristic of the family using HSSP.

CO 39. Explain the computational methods to study interactomes.

CO 40. Explain the methods used to evaluate protein – protein interaction.

CO 41. Explain how secondary structures of a protein sequence are predicted.

CO 42. Explain in details the different secondary structures prediction methods.

CO 43. Explain how charge and hydrophobicity profile help in identifying a transmembrane segment.

CO 44. Explain how transmembrane segments in a protein sequence are predicted using computational tools.

CO 45. Explain how protein structures are analysed and summaries using PDBsum

CO 46. Define molecular markers and explain how they are used to analyse genetic diversity.

CO 47. Define SNP genotyping and discuss the hybridisation based method.

CO 48. Define VNTRs and explain in details.

CO 49. Define 23SrRNA.

CO 50. Explain the methodology and applications of AFLP.

CO 51. Explain the methodology and applications of RAPD.

CO 52. Define microarray and explain in details.

CO 53. Describe the factors affecting microarray data.

CO 54. Enumerate the problems that may appear with microarray.

CO 55. Define ESTs and explain in details.

CO 56: Understand the concepts of molecular markers and types.

CO 57. Learn the molecular tools (microarray, transcriptome, expressed sequence tags) to analyze gene expression.

CO 58. Understand the mechanism of transcription regulation.

Course: BIT O 307 – Bioinformatics in Molecular and Cell Biology (Practicals)

Students will learn how to:

CO 1. Retrieve a nucleotide and a protein sequence from NCBI.

CO 2. Retrieve a research article from NCBI PubMed.

CO 3. Perform NCBI BLAST to search for similar sequences based on homology.

CO 4. Retrieve a nucleotide sequence from DDBJ.

CO 5. Retrieve a protein sequence from Swissprot/Uniprot.

CO 6. Retrieve a biological pathway from KEGG.

CO 7. Retrieve a protein structure and analyse using Rasmol.

CO 8. Perform a multiple sequence alignment using Clustal Omega.

CO 9. Retrieve information from TAIR database for *Arabidopsis thaliana.*

CO 10. Predict a transmembrane region of a protein sequence using TMHMM.

CO 11. Search for a protein family and domain using ScanProsite.

CO 12. Classify a protein structure using CATH.

CO 13. Classify a protein structure using SCOP.

CO 14. Analyse the DNA sequence for restriction enzymes using NEB cutter.

CO 15. Search and predict a gene sequence from a DNA sequence using GenScan.

CO 16. Search and predict PCR primers for a DNA sequence using Primer 3.

CO 17. Visualise genome maps using NCBI viewer.

SEMESTER IV

Course: BIT C 401 – Animal Science and basic Enzymology (Theory)

After successful completion of the course, students will be able to:

CO 1. Explain the basic concepts of animal cell structure and organization.

CO 2. Explain the concept of cell lines and types.

CO 3. Describe the composition of culture media and the chemical, physical and metabolic functions of the media constituents.

CO 4. Describe the basic techniques of *in vitro* mammalian cell culture, maintenance, cell synchronization, growth parameters, cell viability measurement and cytotoxicity.

CO 5. Understand the concepts of organ and histotypic cultures.

CO 6. Learn about the techniques of cell cloning, micromanipulation and transformation.

CO 7. Describe the applications of animal cell culture, stem cell culture, embryonic culture and cell culture based vaccines.

CO 8. Understand interspecific somatic cell genetics and application in human chromosome mapping.

CO 9. Understand the concept of system biology and the application of computational biology approaches to digestive, respiratory, nervous and circulatory systems.

CO 10. Learn enzymes: classification, properties and denaturation.

CO 11. Explain the mechanism of enzyme action and energetic of enzyme catalyzed reactions.

CO 12. Understand the regulatory role of isoenzymes, co-factors and co-enzymes.

CO 13. Learn enzyme kinetics and the derivation of Michaelis-Menten equation.

CO 14. Explain the significance of Vmax, Kcat and enzyme inhibition.

CO 15. Learn about ribozymes, catalytic antibodies, multienzyme systems and their applications.

Course: BIT C 402 – Bioprocess Engineering and Technology (Theory)

After successful completion of the course, students will be able to:

CO 1. Describe the techniques to isolate, preserve and maintain the industrial microorganisms.

CO 2. Describe important aspects of microbial cultures: kinetics of growth and death, biomass estimation, open/closed system and product formation.

CO 3. Describe the different types of bioreactors and analysis of the reactions, microbial populations and reactor stability.

CO 4. Explain the working principle of bioreactor and the control parameters for the reaction and management of substrates and products.

CO 5. Explain the importance of enzyme and cell immobilization.

CO 6. Describe the role of microorganisms in mineral beneficiation and oil recovery.

CO 7. Understand the essential biosynthetic pathways for production of alcohols (ethanol), acids (citric, acetic and gluconic), solvents (glycerol, acetone, butanol), antibiotics (penicillin, streptomycin and tetracycline) and amino acids (lysine and glutamic acid).

CO 8. Describe the basic procedure of canning and packing of food products.

CO 9. Explain food preservation processes such as sterilization and pasteurization.

CO 10. Describe fermented foods and probiotics.

Course: BIT C 403 – Environmental Biotechnology, IPR, Biosafety and Bioentrepreneurship (Theory)

After successful completion of the course, students will be able to:

CO 1. Understand the concepts, structure and function of environment, ecology and ecosystems.

CO 2. Explain the damages caused to the environment by soil/air/water pollution, ozone depletion, green house gases and land degradation.

CO 3. Describe the importance of genetically modified microorganisms (GEMs) in the environment.

CO 4. Understand the process of remediation and its types.

CO 5. Describe microbial treatment of contaminated ground water, phytoremediation of soil metals and microbial degradation of xenobiotics.

CO 6. Describe the techniques to assess, treat and manage of sewage and waste water.

CO 7. Explain the role of microorganisms in the control of air pollution and production of biofuels.

CO 8. Learn about Biosafety and its relevance.

CO 9. Describe the terms GMOs, LMOs and their significance and relevance in the field of research.

CO 10. Understand in detail the concepts of containment, Risk and hazard: Its significance in the field of Recombinant DNA research.

CO 11. Understand the concept and types of IPR; should be able to draft an IP.

CO 12. Analyse various types of IP.

CO 13. Understand bioentrepreneurship: ventures, financial assistance, budget planning and cash flow management.

CO 14. Describe the basic features of accounting practices: assessment of market demand, market conditions, prediction of market changes, market linkages and distribution channels.

Course: BIT C 404 – Laboratory – IV (Practicals)

Students will learn how to:

CO 1. Perform trypsinization of monolayer and subculturing.

CO 2. Perform cryopreservation and thawing of cell lines.

CO 3. Prepare metaphase chromosomes from cultured cell.

CO 4. Isolate industrially important microorganisms.

CO 5. Determine thermal death point (TDP) and thermal death time (TDT) microorganisms required for the design of a sterilizer.

CO 6. Determine Km and Vmax of urease/arginase activity by by M. M. and L. B. plots respectively.

CO 7. Determine Ki of urease/arginase by M. M. and L. B. plots respectively.

CO 8. (a) Determine growth rate of a given microorganism and to determine substrate degradation profile.

(b) Compute specific growth rate (m) and growth yield (Yx/s) from (a).

CO 9. Determine and compare the production of ethanol by using different substrates.

CO 10. Produce and assay alkaline protease.

CO 11. Detect coliforms and determine the purity of potable water.

CO 12. Determine dissolved oxygen concentration of water sample by Winkler's method.

CO 13. Determine the biological oxygen demand (BOD) and chemical oxygen demand (COD) of sewage water.

CO 14. Test aromatic degradation of hydrocarbons by bacteria.

CO 15. Estimate nitrate in drinking water.

CO 16. Field/study tour report submission (visits to Biotechnology department, institute and industrial firms).

B. Sc. BIOTECHNOLOGY

DEPARTMENT OF BIOTECHNOLOGY

COURSE OUTCOMES (COs)

SEMESTER I

Course: Paper I T – Cell Biology and Genetics (Theory)

After successful completion of the course, students will be able to:

CO 1. Define and understand the functions of a cell and its organelles.

CO 2. Learn about the contributors of the Cell Theory.

CO 3. Describe the different theories of origin of life.

CO 4. Understand the development of the first cell and the evolution of metabolism.

CO 5. Describe the structure, composition and general functions of the various parts of a cell.

CO 6. Learn about the shape and structure of different chromosome types with diagrams.

CO 7. Understand the role of sex chromosome in sex determination.

CO 8. Learn about cell cycle and their different checkpoints, mitosis and meiosis

CO 9. Learn the basic concepts of genetics and terminologies, Mendel's experiments and the deviations.

CO10. Understand multiple alleles, multifactorial inheritance, types of gene interactions with examples.

CO 11. Learn about genetic linkage and linked genes, coupling and repulsion theory, and cis and trans configuration.

CO12. Compare crossing over and genetic recombination, and calculate recombination frequency, genetic distance and linear order of the genes.

CO 13. Learn the basic concepts of cytoplasmic inheritance (infective particles inheritance in *Paramecium.*

CO 14. Understand maternal inheritance and its effect on shell coiling in *Lymnaea*.

CO 15. Classify and describethe various types of mutations with examples.

CO 16. Learn about the isolation of auxotrophic, conditional and resistant bacterial mutants.

CO 17. Describe the methods for the detection of recessive mutations in the autosomes and X chromosomes of *Drosophila*.

CO 18. Learn about human genetics, human pedigrees and inheritance pattern of genetic disorders in humans.

Course: Paper I P – Laboratory

The students will learn how to:

CO 1. Prepare and study the mitotic stages from onion root tip cells.

CO 2. Prepare and study the different stages of meiosis in male grasshopper.

CO 3. Prepare polytene chromosomes in Dipteran larvae.

CO 4. Extract mitochondria and chloroplast.

CO 5. Prepare human karyotyping usinga photograph of a randomly scattered human metaphase spread.

SEMESTER II

Course: Paper II T – Biological Chemistry (Theory)

At the end of the course, students will be able to:

CO 1. Learn about composition of matter, ionisation of water, pH, pK and buffer systems.

CO 2. Derive the Hendersen-Hesselbach equation.

CO 3. Understand the concepts of entropy, free energy, electrical properties of biological components, electro-chemical gradients, membrane potential and chemiosmotic hypothesis.

CO 4. Classify and learn the structures of carbohydrates, amino acids, proteins and fats.

CO 5. Understand oxidative phosphorylation and the mechanism of ATP synthesis.

CO 6. Describe the electron transport chain in bacteria, plants and animals.

CO 7. Learn the basic concepts of metabolism and the terminologies.

CO 8. Describe glucose and glycogen breakdown, synthesis and their regulation.

CO 9. Learn about the diseases involved with deficiency of hormones in regulation on blood glucose level.

CO 10. Learn about fermentation, pentose phosphate pathway and fatty acid breakdown and generation of ATP.

CO 11. Describe CO_2-fixation, C-reduction cycles and photorespiration.

CO 12. Classify enzymes and learn about their and nomenclature.

CO 13. Understand the role of enzymes in catalysis, enzyme kinetics and its regulation.

CO 14. Learn how to isolate and purify enzymes.

Course: Paper II P – Laboratory

The students will learn how to:

CO 1. Prepare buffers.

CO 2. Estimate proteins, carbohydrates and lipids.

CO 3. Perform paper chromatography of amino acids.

CO 4. Determine the K_m and V_{max} of salivary amylase.

SEMESTER III

Course: Paper III T- Biostatistics and Biological Techniques (Theory)

At the end of the course, students will be able to:

CO 1. Understand the concepts of biostatistics, sample and population, collection of data and sampling techniques.

CO 2. Learn about processing and presentation of data.

CO 3. Learn the applications, merits and demerits of measures of central tendency and measures of dispersion.

CO 4. Understand the concepts of probability and conditional probability, correlation and regression analysis.

CO 5. Understand different types of theoretical distributions and their properties.

CO 6. Learn the meaning of significance, hypothesis testing and student's t-test.

CO 7. Understand the basics, working principles, types and applications of microscopy, colorimetry, spectrophotometry, fluorimetry, chromatography, electrophoresis, electrofocussing and centrifugation.

CO 8. Learn about nucleic acid hybridization, FISH, PCR, Southern blot, northern blot, western blot and ELISA.

Course: Paper III P – Laboratory

The students will learn how to:

CO 1. Verify Beer-Lambert's law

CO 2. Understand the parts and working principles of simple, compound, phase contrast and fluorescence microscope.

CO 3. Perform paper chromatography of carbohydrates.

CO 4. Estimate ascorbic acid.

CO 5. Quantify DNA using spectrophotometer.

CO 6. Calculate mean, standard deviation, frequency distribution, Chi-square test, and student's t-test for paired data.

SEMESTER IV

Course: Paper IV T – Molecular Biology and Immunology (Theory)

At the end of the course, students will be able to:

CO 1. Learn about the DNA and RNA structures and their roles.

CO 2. Describe the features of genome of virus, prokaryotes, and eukaryotes.

CO 3. Understand melting temperature and buoyant density of DNA and its relationship with DNA content.

CO 4. Learn about semiconservative DNA replication and the Meselson-Stahl experiment.

CO 5. Understand and compare the mechanism of DNA replication in prokaryotes and eukaryotes.

CO 6. Understand and compare the mechanism of transcription in prokaryotes and eukaryotes.

CO 7. Learn about reverse transcriptase and reverse transcription.

CO 8. Understand eukaryotic post-transcriptional processing of RNA

CO 9. Understand the genetic code and its properties.

CO 10. Understand the mechanism of translation in prokaryotes.

CO 11. Learn about the regulation of gene expression in prokaryotes.

CO 12. Understand the concept of immunology, innate, adaptive immunity, active and passive immunity.

CO 13. Learn about cells, organs and other components of the immune system.

CO 14. Learn about immunogens, antigens, haptens and adjuvents and their roles in immune response.

CO 15. Describe the structure and functions of antibody and its types.

CO 16. Learn about monoclonal antibody production and its application.

CO 17. Understand the antigen-antibody interactions and its applications.

CO 18. Describe antigen processing presenting pathways.

CO 19. Describe the complement system and its activation.

Course: Paper IV P – Laboratory

The students will learn how to:

CO 1. Isolate genomic DNA, followed by its quantification and ascertaining its purity.

CO 2. Perform agarose gel electrophoresis of the isolated DNA.

CO 3. Determine the T_m of DNA.

CO 4. Prepare a blood smear and identify leucocytes.

CO 5. Study antigen-antibody specificity by ODD.

CO 6. Determine their blood group (ABO blood grouping).

SEMESTER V

Course: Paper V T – Recombinant DNA technology (Theory)

After successful completion of the course, students will be able to:

CO 1. Understand the safety measures in rDNA technology and biosafety levels.

CO 2. Learn about major events in the development of rDNA technology.

CO 3. Learn abouthost cells - *Escherichia coli*strains, *Saccharomyces cerevisiae, Aspergillus,*mammalian cell lines - their nomenclature and general properties.

CO 4. Learn about the tools and techniques in rDNA technology.

CO 5. Learn about the different types of vectors and their applications.

CO 6. Describe the production of define DNA fragments, insertion of DNA into a vector and detection of recombinants.

CO 7. Understand gene cloning and expression in prokaryotic and eukaryotic systems.

CO 8. Describe the methods of gene delivery in plants and animals.

CO 9. Describe different transgenic organisms, the methods for creating them, their advantages and disadvantages, the ethics involved and the latest developments.

CO 10. Learn about the types of gene therapy, advantages, disadvantages and recent developments in the field.

Course: Paper V P – Laboratory

The students will learn how to:

CO 1. Isolate plasmid DNA, followed by its quantification.

CO 2. Perform agarose gel electrophoresis of the isolated plasmid DNA.

CO 3. Perform restriction digestion of bacteriophage λ DNA using Hind III enzyme, followed by agarose gel electrophoresis.

CO 4. Perform polymerase chain reaction (PCR), followed by analysis of the amplicons.

Course: Paper VI T – Microbiology and Environmental Biotechnology (Theory)

At the end of the course, students will be able to:

CO 1. Learn about the history and development of microbiology.

CO 2. Learn about the concepts and methods of sterilization.

CO 3. Learn about microbial growth curve and the factors affecting microbial growth.

CO 4. Describe and nutritionally classify the various forms of microorganisms.

CO 5. Learn about the isolation of microorganisms and pure culture techniques.

CO 6. Understand spontaneous and induced variations in microbial populations.

CO 7. Describe genetic recombination in microbes and strain improvement.

CO 8. Learn about symbiosis, antibiosis and N-fixation.

CO 9. Learn about modern fuels and their environmental impacts.

CO 10. Understand treatment of waste and effluents, and degradation of pesticides and toxic chemicals.

CO 11. Learn about limiting factors of the environment, energy transfer and biochemical cycling.

CO 12. Learn about environmental problems, GEMS in the environment and biopesticides.

CO 13. Learn about the bio-assessment of environment quality.

CO 14. Understand the role of the biotechnology in management of environmental problems.

Course: Paper VI P – Laboratory

The students will learn how to:

CO 1. Prepare media, cotton plugs and sterilization.

CO 2. Isolate microorganisms from water and soil samples.

CO 3. Isolate pure cultures by colony streaking and pour plate methods.

CO 4. Perform antibiotic sensitivity test.

CO 5. Perform Gram staining.

CO 6. Perform BOD and COD.

SEMESTER VI

Course: Paper VII T – Animal and Plant Biotechnology (Theory)

After successful completion of the course, students will be able to:

CO 1. Identify the four primary tissue types and discuss the structure, relevant features and function of each.

CO 2. Identify the various types of tissue membranes and the unique qualities of each.

CO 3. Understand the basic concepts in animal cell culture.

CO 4. List and explain the different ways in which a cell line can become established.

CO 5. Learn about stem cells and their applications.

CO 6. Understand tissue engineering and *in vitro* fertilization.

CO 7. Learn about Dolly the cloned sheep and the importance of cloning.

CO 8. Understand the problems and ethics in genetic engineering.

CO 9. Learn about the scope and history of plant biotechnology.

CO 10. Describe plant tissue culture tools and techniques, culture media, sterilization, callus and suspension cultures.

CO 11. Learn about embryogenesis, organogenesis and different modes of plant regeneration.

CO 12. Describe the methods employed for production of haploid plants.

CO 13. Learn about micropropagation of elite species.

CO 14. Explain the various methods of protoplast isolation, fusion and regeneration.

CO 15. Learn about the different methods to test the genetic fidelity of tissue culture raised plants.

CO 16. Learn about marker-assisted selection.

CO 17. Describe the production of transgenic plants with success stories.

CO 18. Understand intellectual property rights (IPR) and related issues.

Course: Paper VII P – Laboratory

The students will learn how to:

CO 1. Prepare media, culture animal cells and maintain them.

CO 2. Prepare plant culture media, initiate and maintain callus.

CO 3. Perform micropropagation of ornamental plants by auxillary bud proliferation.

Course: Paper VIII T – Genomics, Proteomics and Computer Application

After successful completion of the course, students will be able to

CO 1. Learn about the objectives, goals and findings of the Human Genome Project and the *Arabidopsis* Genome Initiative.

CO 2. Understand the term genomics and also to differentiate between functional and structural genomics with suitable examples.

CO 3. Describe the role of Sequence Tagged Sites (STSs) in human genomics.

CO 4. Understand the concept of proteomics, structural organisation of proteins and protein structure and function relationship.

CO 5. Learn about the basic concepts of Operating Systems, programming language (C+,C++), algorithm and flow-chart.

CO 6. Understand batch online and real-time data processing in industries and bioreactors.

CO 7. Learn about internet applications and the concept of data mining.

CO 8. Explain the role of computer science in bioinformatics.

CO 9. Classify the different types of biological database with examples

CO 10. State the importance of using a database.

CO 11. Explain the different biological data formats that can be used to store data in the biological database.

CO 12. Describe the different types of BLAST programs and its applications.

CO 13. Learn the application of bioinformatics in various fields and at different cellular levels

CO 14. Explain the role of genomics, transcriptomics and proteomics in bioinformatics.

Course: Paper VIII P – Laboratory

The students will learn how to:

CO 1. Retrieve a nucleotide sequence and a protein sequence from NCBI

CO 2. Retrieve a research article from NCBI PubMed

CO 3. Perform NCBI BLAST to search for similar sequences based on homology.

CO 4. Retrieve a nucleotide sequence from DDBJ and EMBL.

CO 5. Retrieve a protein sequence from Swissprot/Uniprot

CO 6. Retrieve a biological pathway from KEGG

CO 7. Visit to educational institute/biotech firms and submit the report

B. Sc. BIOCHEMISTRY

DEPARTMENT OF BIOCHEMISTRY

COURSE OUTCOMES (COs)

SEMESTER I

Course: Paper I T – Biomolecules and Biophysical Techniques (Theory)

After successful completion of the course, students will be able to:

CO 1. Describe molecular structure, the hydrogen bonds involved and physical properties of water.

CO 2. Understand pH, pK and buffers in laboratory and biological system.

CO 3. Identify and understand the properties, structure and classification of monosaccharides (glucose & fructose), disaccharides (sucrose, maltose and lactose) and polysaccharides (dextrins, starch, glycogen and cellulose).

CO 4. Understand mechanism of stereochemistry of sugars: chiral carbon, epimers, anomers, mutarotation, chair and boat forms, glycosides, glycopyranoseandfructopyranose.

CO 5. Describe alpha amino acids: structure and properties of amino acids; proteins: primary structure (structure of peptide bond-restricted rotation, cis/trans); secondary structure (α, β and super secondary structures); tertiary structure - protein folding; and quaternary structure of proteins.

CO 6. Explain the importance of fatty acids its nomenclature and chemical properties

CO 7. Classify lipids and understand the general structure and function of the major lipid subclasses like acylglycerols, phosphoglycerides, sphingolipids, waxes and terpenes, steroids and prostaglandins.

CO 8. Describe nucleotides chemistry and properties. Explain Nucleic acids: DNA and RNA forms and functions.

CO 9. Describe the principles and applications of centrifugation, chromatography (gel, ion exchange and affinity), electrophoresis (PAGE & SDS-PAGE), UV/visible spectrophotometry, X-ray crystallography, spectroflourimetry, microscopy (light & electron) and NMR.

CO 10. Explain isotopes, radioactive decay, α, β and γ radiation.

CO 11. Describe the methods for detection of radioactivity (scintillation counting, labeling, quenching and autoradiography).

Course: Paper I P – Biochemistry Practical – I

The students will learn how to:

CO 1. Prepare buffer solution using Henderson-Hasselbalch equation and describe the verification of Beer-Lambert's Law.

CO 2. Estimate protein by Lowry's method and Bradford's method.

CO 3. Estimate DNA using diphenylamine.

CO 4. Estimate RNA using orcinol.

SEMESTER II

Course: Paper II T – Thermodynamics, Membrane Biophysics and Biostatistics (Theory)

After successful completion of the course, students will be able to:

CO 1. Describe thermodynamics, membrane biophysics, law of thermodynamics and its application to biological systems, first law of thermodynamics, heat of formation and heat of reaction, second law of thermodynamics, molecular basis of entropy, Helmholtz and Gibbs free energy.

CO 2. Analyse the types of cells, electrodes, oxidation-reduction reaction, standard electrode potential and its determination, measurement of ΔG.

CO 3. Understand electron transfer measures and phosphate group transfer potentials, coupled reactions and simultaneous equilibria.

CO 4. Determine membrane and membrane transport like Fluid Mosaic model, uniport, symport, antiport, active and passive transport.

CO 5. Understand biostatistics, collection of data, primary and secondary data, classification and tabulation of data.

CO 6. Determine measures of central tendency, measures of dispersion, methods of sampling-sampling theory and test of significance (definition of random sampling, simple random sampling, systematic and stratified sampling and confidence level for those sample statistics), correlation coefficient and regression analysis.

CO 7. Describe probability (theorem on total probability of two events, definition of conditional probability with some elementary problems).

CO 8. Understand distribution - definition properties and uses of Bernoulli trials, Binomial, Poisson and Normal distribution.

CO 9. Describe the definition and applications of x2, t, F & Z statistic: definition of confidence level and limits.

CO 10. Estimate amino acids by Ninhydrin method and estimate carbohydrates by Anthrone method.

CO 11. Analyse separation of carbohydrates by paper chromatography, amino acids by paper chromatography and Separation of lipids/pigments using thin layer chromatography (TLC).

Course: Paper II P – Biochemistry Practical – II

The students will learn how to:

CO 1. Estimate amino acids by Ninhydrin method

CO 2. Estimate carbohydrates by Anthrone method.

CO 3. Analyze separation of carbohydrates by paper chromatography

CO 4. Analyze separation of amino acids by paper chromatography

CO 5. Analyze separation of lipids/pigments using thin layer chromatography (TLC).

SEMESTER III

Course: Paper III T – Proteins and Enzymes (Theory)

After successful completion of the course, students will be able to:

CO 1. Describe proteins, protein isolation and purification techniques like salt precipitation, dialysis and chromatography.

CO 2. Analyse criteria for homogeneity and protein sequencing.

CO 3. Describe enzymes, enzyme activity and specific enzyme activity with its classification.

CO 4. Understand enzyme-substrate (ES) complex: concept of substrate binding sites and active sites, significance of activation energy and free energy.

CO 5. Determine the Factors affecting enzyme activity

CO 6. Understand coenzymes (Pyridoxal phosphate, NAD+ & FAD+) and cofactors.

CO 7. Analyse the mechanism of enzyme catalysis (chymotrypsin & lysozyme).

CO 8. Determine the Michaelis-Menten equation: derivation, significance of Vmax, kcat, Km and Lineweaver-Burk Plot.

CO 9. Undestand enzyme inhibition: competitive, non-competitive and uncompetitive.

CO 10. Determine the regulation of enzyme activity, allosteric regulation, covalent modification, zymogenicity and protein turnover.

CO 11. Analyse the separation of proteins by SDS-PAGE, Gel filtration chromatography using protein mixture or dye and assay of urease/amylase activity

CO 12. Determine Km and Vmax of urease/amylase and effect of temperature and substrate concentration on enzyme activity.

Course: Paper III P – Biochemistry Practical – III

The students will learn how to:

CO 1. Analyze the separation of proteins by SDS-PAGE.

CO 2. Perform gel filtration chromatography of protein mixture or dye.

CO 3. Assay urease/amylase activity.

CO 4. Determine Km and Vmax of urease/amylase.

CO 5. Analyze the effect of temperature and substrate concentration on enzyme activity.

SEMESTER IV

Course: Paper IV T – Cell Biology and Physiology (Theory)

After successful completion of the course, students will be able to:

CO 1. Understand cell structure and components like structure of viruses (bacteriophages and TMV).

CO 2. Describe eukaryotic cell structure and sub cellular organelles, differentiate between plants and animal cells in structure and functions.

CO 3. Determine the methods for studying cells and organelles.

CO 4. Understand phase contrast, staining and freeze fracture technique.

CO 5. Analyze sub-cellular fractionation using centrifugation, differential and density gradient centrifugation.

CO 6. Describe cytoskeleton: microtubules and microfilaments; cell motility - ciliary and flagellar movement, bacterial taxis.

CO 7. Understand the concept of cell division (mitosis & meiosis), cell cycle and its regulation.

CO 8. Understand the importance of apoptosis and stem cells.

CO 9. Determine the physiology of homeostasis.

CO 10. Understand the physiology of digestion, absorption and transport of carbohydrates, lipid, proteins and nucleic acids.

CO 11. Understand absorption and transport of minerals (Fe++ and Ca++) and vitamins (C and D).

CO 12. Describe blood cells, importance of hemoglobin, oxygen and carbon dioxide transport; regulation of respiration and blood clotting.

CO 13. Describe formation of urine, regulation of water, electrolyte balance and role of hormones in its maintenance.

CO 14. Analyze action potential, impulse transmission, synaptic transmission, muscle protein, mechanism of muscle contraction (skeletal and smooth) and the biochemistry of vision.

CO 15. Describe and classify hormones.

CO 16. Understand receptors, intracellular cell surface and second messengers.

CO 17. Analyze hormones of the pituitary, thyroid and pancreas.

CO 18. Evaluate the basic mode of steroid and protein/peptide hormone action mechanisms.

CO 19. Identify the RBC and WBC count.

CO 20. Understand mitosis and meiotic cell division.

CO 21. Understand sub-cellular fractionation of organelles.

Course: Paper IV P – Biochemistry Practical – IV

The students will learn how to:

CO 1. Identify RBC and WBC count.

CO 2. Study mitosis and meiotic cell division.

CO 3. Perform sub-cellular fractionation of organelles.

SEMESTER V

Course: Paper V T – Intermediary Metabolism (Theory)

After successful completion of the course, students will be able to:

CO 1. Understand the basic concepts of metabolism.

CO 2. Describe carbohydrate metabolism, importance of glycolysis, Warburg effect and alcoholic fermentations, TCA cycle, regulation of glycolysis of TCA cycle, gluconeogenesis, glycogenesis, glycogenolysis and pentose phosphate pathway.

CO 3. Describe lipid metabolism: hydrolysis of triacylglycerols, transport of fatty acids into mitochondria, β-oxidation of saturated fatty acids, oxidation of unsaturated and odd chain fatty acids, ATP yield from fatty acid oxidation.

CO 4. Describe biosynthesis of saturated fatty acids, unsaturated fatty acids, triglycerides and cholesterol.

CO 5. Analyze the amino acid metabolism, transamination, oxidative deamination and decarboxylation.

CO 6. Explain urea cycle, biosynthesis of amino acids such as glutamine, tryptophan and histidine.

CO 7. Understand degradation of amino acids.

CO 8. Describe nucleotide metabolism: sources of atoms in purine and pyrimidine molecules, biosynthesis, degradation and regulation.

CO 9. Understand importance of bioenergetics: photosynthetic and respiratory electron transfer chain, photophosphorylation, mechanism of ATP production, inhibitors of electron transport chain and uncouplers of oxidative phosphorylation.

CO 10. Determine the isolation of casein from milk, isolation and estimation of starch from potato, isolation and estimation of glycogen from animal tissues and isolation and estimation of photosynthetic pigments.

Course: Paper V P – Biochemistry Practical – V

The students will learn how to:

CO 1. Isolate casein from milk.

CO 2. Isolate and estimate starch from potato.

CO 3. Isolate and estimate glycogen from animal tissues.

CO 4. Isolate and estimate photosynthetic pigments.

SEMESTER V

Course: Paper VI T – Nutritional and Clinical Biochemistry (Theory)

After successful completion of the course, students will be able to:

CO 1. Understand the concepts of nutritional biochemistry

CO 2. Understand dietary habits: nutritive values of carbohydrates, fats, protein, vitamins (A, D, E, K, vit B complex and vit C) and minerals (Ca, Fe and iodine).

CO 3. Describe basal metabolic rate (BMR).

CO 4. Analyse calorimetry: specificdynamic action (SDA) and recommended daily allowance (RDA) of foods; protein-calorie malnutrition (Kwashiokor and Marasmus).

CO 5. Identify overnutrition and obesity.

CO 6. Describe clinical biochemistry: basic concepts and scope in health and diseases.

CO 7. Analyse the collection and preservation of biological fluids [blood, plasma, serum, urine, cerebral spinal fluid (CSF) and amniotic fluid], blood and urine.

CO 8. Understand the normal values of important constituents in blood (Plasma/serum), CSF and urine, clearance test for urea.

CO 9. Explain enzyme pattern in health and diseases such as lipases, amylases, cholinesterases, alakaline and acid phosphatases, SGOT, SGPT, LDH and CPK.

CO 10. Describe isoenzymes and diagnostic tests such as functional tests of liver and kidney.

CO 11. Understand the inborn errors of metabolism such as alkaptonuria, phenylketonuria and albinism.

CO 12. Discuss the metabolic disorders such as Hypo- and Hyper-glycemia, gout and porphyrias.

CO 13. Determine the estimation of blood haemoglobin, serum GOT, serum GPT, blood urea, serum alkaline phosphatase, bilirubin, blood glucose, and creatinine.

Course: Paper VI P – Biochemistry Practical – VI

The students will learn how to:

CO 1. Estimate blood haemoglobin.

CO 2. Estimate serum GOT and serum GPT.

CO 3. Estimate urea in blood.

CO 4. Estimate serum alkaline phosphatase.

CO 5. Estimate bilirubin.

CO 6. Estimate blood glucose.

CO 7. Estimate creatinine.

SEMESTER VI

Course: Paper VII T – Microbiology and Immunology (Theory)

After successful completion of the course, students will be able to:

CO 1: Describe types and characteristics of microorganisms.

CO 2. Understand growth curve and use of selection media in bacterial cultivation.

CO 3. Describe the role of microorganisms in food spoilage and food-borne infections.

CO 4. Understand microbial genetics: transformation, conjugation, transduction and transfection and plasmids.

CO 5. Understand basic concepts in immunology: immunity, innate and adaptive immunity.

CO 6. Describe cells and organs of the immune system.

CO 7. Determine immunoglobulins: structure, functions and classes of antibodies

CO 8. Explain antigens, mechanism of antigen-antibody interactions, immunogens, haptens, adjuvants and haemotopoietic stem cells.

CO 9. Describe clonal selection theory.

CO 10. Discuss the structure and functions of MHC molecules.

CO 11. Understand the genetic basis of antibody diversity, complement fixation, hypersensitivity and allergy.

CO 12. Describe autoimmune diseases, monoclonal antibody and its application in biology and vaccines.

CO 13. Describe the isolation of microbes from water and soil using selective media, bacterial growth kinetics and the effect of antibiotic on bacterial growth.

CO 14. Determine ABO blood groups and Rh factor and antigen-antibody specificity by immunodiffusion (ODD).

Course: Paper VII P – Biochemistry Practical – VII

The students will learn how to:

CO 1. Isolate microbes from water and soil using selective media.

CO 2. Analyze bacterial growth kinetics.

CO 3. Analyze effect of antibiotic on bacterial growth.

CO 4. Determine ABO blood groups and Rh factor.

CO 5. Determine antigen-antibody specificity by immunodiffusion (ODD).

Course: Paper VIII T – Molecular Biology (Theory)

After successful completion of the course, students will be able to:

CO 1. Understand the concept of nucleic acids as genetic material, its experimental evidence like bacterial genetic transformations and Hershey-Chase experiment.

CO 2. Describe the salient features of viral, prokaryotic and eukaryotic genomes; repetitive DNA sequences.

CO 3. Understand basic concepts of DNA replication in prokaryotes (semi-conservative, semi-discontinuous and mechanism), inhibitors of DNA replication and compare with eukaryotic replication.

CO 4. Describe transcription mechanism in prokaryote and inhibitors of transcription.

CO 5. Identify regulatory RNA (miRNA and snRNA), catalytic RNA and salient differences in eukaryotes.

CO 6. Understand the basic features of the genetic code, wobble hypothesis, mechanism of prokaryotic translation, salient differences in eukaryotes and signal sequences.

CO 7. Describe the regulation of gene expression in prokaryotes: lac operon and trp operon.

CO 8. Describe molecular cloning, general approach and application of recombinant DNA technology such as PCR, RT-PCR and qPCR.

CO 9. Understand the basic concepts in bioinformatics: gene and protein databases.

CO 10. Analyse the isolation of DNA from animal/plant systems, agarose gel electrophoresis of DNA, measurement of melting temperature (Tm) of DNA sample and the amplification of DNA using PCR technique.

Course: Paper VIII P – Biochemistry Practical – VIII

The students will learn how to:

CO 1. Isolate DNA from animal/plant systems.

CO 2. Perform agarose gel electrophoresis of DNA.

CO 3. Measure the melting temperature (Tm) of DNA sample.

CO 4. Perform amplification of DNA using PCR technique.