# BHARATHIAR UNIVERSITY: COIMBATORE – 641046

## REGULATIONS FOR B.SC. BIOCHEMISTRY WITH NANOTECHNOLOGY DEGREE COURSE WITH COMPULSORY DIPLOMA IN BIOINFORMATICS SEMESTER SYSTEM

(WITH EFFECT FROM 2009 – 2010)

### SCHEME OF EXAMINATIONS

<table>
<thead>
<tr>
<th>Part</th>
<th>Study Components</th>
<th>Course title</th>
<th>Ins. Hrs/week</th>
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@ No University Examinations. Only Continuous Internal Assessment (CIA)
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<td>Core paper IX – Nanobiotechnology</td>
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| List of Elective papers (Colleges can choose any one of the paper as electives)  |
|-------------------------------|---------------------|
| Elective – I | A Immunology and Immunotechniques |
| B Medicinal Chemistry |
| C Nutritional Biochemistry |
| Elective – II | A Plant and Animal Biotechnology |
| B Genetic engineering and Bioprocess technology |
| C Plant therapeutics |
| Elective - III | A Diagnostic Biochemistry |
| B Sports Biochemistry |
| C Public Health and Hygiene |
SEMESTER I

SUBJECT TITLE: BIO-MOLECULES

SUBJECT DESCRIPTION:

This course emphasizes on various bio-molecules and its significance.

GOALS: To enable the students to learn the basic functions, structures and biological importance of lifeless chemical compounds.

OBJECTIVES: On successful completion of the course the students should have understood the significance of the complex bio-molecules, polysaccharides, lipids, proteins, nucleic acids, vitamins and minerals.

CONTENTS:

UNIT - I
Carbohydrates: Definition, classification, stereochemistry, cyclic structures and anomeric forms, Haworth projections.
Monosaccharides-Reactions-Characteristics of aldehyde and ketone groups. Action of acids and alkalies on sugars. Reactions of sugars due to hydroxyl groups.
Disaccharides- Structure, chemistry and function – Sucrose, Lactose, Maltose and Cellobiose.
    Trisaccharides-Structure of Raffinose.
    Polysaccharides. [Structures not required].
    Homopolysaccharides-starch, glycogen, cellulose, chitin, dextrin and inulin.
    Heteropolysaccharides-hyaluronic acid, chondroitin sulfate and heparin.
Artificial sweeteners – Saccharin Aspartame, Monellin, Neohesperidine dihydrochalcone.

UNIT - II
Lipids; Definition, classification of lipids, simple compound and derived.
Simple lipids-Physical and chemical properties of fats.
Characterisation of fat – Saponification number, acid number, Iodine number and RM number.
Compound lipids-Structure and function of phospholipids, glycolipids and lipoproteins.
    Derived lipids-Fatty acids-saturated and unsaturated. Essential fatty acids.
    Steroids-Structure of cholesterol, ergosterol and stigma sterol.
    Value of lipids in cardiovascular diseases (Atherosclerosis).

UNIT- III
Amino acids and peptides.
Definition, amino acids as ampholytes. Structure and classification of amino acids based on chemical nature, chemical reaction of amino acids due to carbonyl and amino groups.
Essential amino acids
    Peptides; Structure and properties. Identification of N and C terminal residues.
    Determination of primary structure of peptides-Glutathione, Oxytocin and Vasopressin.
UNIT- IV
Nucleic acids; Structure of Purines and Pyramidines; Nucleotides and Nucleosides.
DNA: double helix: A, B and Z forms; DNA denaturation and renaturation.
RNA: types, unusual bases. DNA as genetic material
Structure of chromatids, nucleosome and histones.

UNIT- V
Vitamins and Minerals
Vitamins: Definition, Classification.
Fat soluble vitamins- sources, structure and physiological functions;
Water soluble vitamins-sources, structure and physiological functions.
Minerals: Mineral requirement, essential macro minerals and essential micro minerals,
sources and functions.

REFERENCES

SEMESTER – I

SUBJECT TITLE: CELL BIOLOGY

SUBJECT DESCRIPTION:
This course presents to identify the range of the cellular activities that are very much specific to the multicellular activities and also the basic ways that cells associate to form the tissue.

GOALS:
To enable the students to get themselves aware on how different tissue types are combined to form organs and how the organs function which follows from the structure and function of the constituent tissue.

OBJECTIVES:
On successful completion of the course the students should have:
• Understood the relationship between cellular organization and biological function of normal cell, pro and eukaryotic cells.
• Learnt on the various cell organelles with their functions and actions.
• Learnt the application of cell biology in research.

CONTENTS:

UNIT – I
   Cell Cycle: Phases, Meiotic and Mitotic division.

UNIT – II

UNIT – III

UNIT – IV

UNIT – V
Oncogenesis: Development and causes of cancer, Types of cancer, Properties, early detection, Treatment.
   Oncogenes: Retro viral, proto, tumor suppressor gene.

REFERENCES:
SEMESTER I – ALLIED PAPER I

SUBJECT TITLE: BIO - MEDICAL INSTRUMENTATION

SUBJECT DESCRIPTION:

This course presents the principles, instrumentation, working and application of the instruments commonly used in the laboratories.

GOALS: To enable the students to learn about the functioning components of the various instruments.

OBJECTIVES: On successful completion of the course the students would have learnt the principles and applications of the instruments.

CONTENTS:

UNIT-I
PH meter- pH scale, Henderson- Hassalbath equation, Buffer solutions, Buffer systems of blood-Hb, Protein and Phosphate buffer system. Various ways of expressing and conversion of concentration of solutions-molality, molarity, normality, mole fraction. Simple problems to be worked out.

UNIT-II
Chromatography-principle, materials, methods & applications of paper chromatography, TLC, GLC, Adsorption, Ion-exchange, Affinity chromatography and Molecular sieve. HPLC, FPLC and GC-MS [principles only].

UNIT-III

UNIT-IV
Principle, Instrumentation and application of Colorimetry, Spectrophotometry, Fluorimetry and Flame photometry. ECG, EEG, CT-Scan, Doppler, MRI scan- Principle and application only.

UNIT-V
Tracer and other Techniques-Radioactive decay, units of Radioactivity, detection and measurement of Radioactivity, GM counter, Scintillation counter, Auto radiography. Applications of Radio isotopes in biological and medical sciences.
REFERENCES:


SEMESTER II

SUBJECT TITLE: BASICS OF NANOSCIENCE

SUBJECT DESCRIPTION:
This course emphasizes about material sciences and its significance.

GOALS:
To enable the students to learn various configurations of molecules, bonding pattern and types of organic materials

OBJECTIVES:
Upon successful completion the students should have knowledge about atomic and crystal structures, bonding pattern in solids, various types of organic materials and its significance

UNIT I

UNIT II

UNIT III

UNIT IV

UNIT V
Filaments – Composite Materials – Single Crystals – Accommodated Structures – protective Coatings

REFERENCE:

SEMESTER I & II

SUBJECT TITLE:  CORE - BIOCHEMISTRY PRACTICALS – I

COURSE NUMBER:

QUALITATIVE ANALYSIS

1. ANALYSIS OF SUGARS
   a) Monosaccharides-Glucose, Fructose, Galactose, Mannose, Pentose.
   b) Disaccharides-Sucrose, Maltose and Lactose.
   c) Polysaccharides-Starch and Dextrin.

2. ANALYSIS OF AMINO ACIDS
   a) Histidine  
   b) Tyrosine  
   c) Tryptophan  
   d) Methionine  
   e) Cysteine  
   f) Arginine

3. LIPID ANALYSIS [GROUP EXPERIMENTS]
   a) Determination of Saponification number.
   b) Determination of Acid number.
   c) Determination of Iodine number.
   d) Determination of RM number.

4. DEMONSTRATION EXPERIMENTS
   a) Preparation of buffer and its pH measurements using pH meter.
   b) Separation of amino acids by TLC.
   c) Separation of Carotenoids by Adsorption chromatography.

REFERENCES
2. Pattabiraman, Laboratory manual in bio-chemistry.
3. J.Jayaraman, Practical bio-chemistry.
SEMESTER II – ALLIED A – PAPER II

SUBJECT TITLE : MICROBIOLOGY

SUBJECT DESCRIPTION :
This course presents the Morphological characteristics of Microorganisms, their cultivation methods, identification. Life cycle, economic importance and microbial diseases.

GOALS: To enable the students to learn the basic functions and components of microorganisms and their economic uses.

OBJECTIVES:
On successful completion of the course the student should have:

★ Understood the structure and types of microorganisms
★ Learnt the economical uses of microorganisms
★ Learnt about the pathogenesis of various microbes in the environment

CONTENTS:
UNIT-I
Historical development of microbiology; microscopy; light path, principle and uses of light microscope, phase contrast and electron microscopes, sterilization techniques; culture methods; pure culture: Isolation and maintenance; culture media - selective and enrichment media.
Staining and smearing: Simple staining, Negative staining, and Gram’s staining, Acid-fast staining and spore staining.
Growth curve and generation time. Microbial Nutrition.

UNIT –II
Prokaryotes: - Morphology of bacteria; component parts; cell wall structure. Photosynthetic bacteria; cyanobacteria.
Eukaryotes: - Morphological characteristics and importance of algae; Characteristics, reproductive structures and importance of fungi.

UNIT –III
Morphology of viruses, classification and cultivation of viruses; plaque assay.
Phages: - T4 Phages stages - lifecycle; synthesis and assembly of protein Lambda Phages - Life cycle; switch between lysogeny and lytic cycle.
RNA viruses: - Retroviruses and life cycle- HIV.
DNA viruses: - Oncogenic viruses.
Mechanism of oncogenesis.

UNIT- IV
Microbial diseases: - Normal human micro flora; host - parasitic interaction; epidemics; exo Endotoxins.
Air borne diseases: - Aetiology, symptoms and prevention of Tuberculosis, Diphtheria, Polio - myelitis and Influenza, Food and Waterborne diseases:- Aetiology, symptoms and pathogenesis of Typhoid, Cholera, Bacillary dysentery and Hepatitis.
Direct contact disease: - Aetiology and symptoms of Rabies
UNIT –V
Water microbiology: - Microbes in water, Bacteriological examination of water; sewage and its treatment; purification of drinking water.
Soil microbiology: - Symbiotic and Non-symbiotic Nitrogen fixing organisms: Rhizosphere
Food microbiology ; Microbiology of food borne diseases- Botulism, Salmonellas, Staphylococcal poisoning Perfingeens poisoning and Mycotoxins.

REFERENCES:

SEMESTER II – ALLIED – PRACTICAL

SUBJECT TITLE : MICROBIOLOGY

EXPERIMENTS:

STAINING TECHNIQUES
1. Gram staining
2. Simple staining
3. Negative staining
4. Fungal staining
5. Endospore staining
6. Differential staining

GROUP EXPERIMENTS:
1. Handling of microscopes
2. Growth curve profile of micro-organisms
3. Preparation and maintainence of cultures and sub-cultures.

DEMONSTRATION
1. Sterilization techniques-different types.
2. Preparations of medium and nutrient broths
3. Various streaking techniques
4. Disposition of cultures and broths.
SEMESTER – III

SUBJECT TITLE: ENZYME AND ENZYME TECHNOLOGY

SUBJECT DESCRIPTION:
Enzymes are protein catalyst that regulates the rates at which physiological process takes place. Consequently defects in enzyme function frequently cause diseases. Hence, sound knowledge about enzymes is essential for life science students.

GOALS: To enable the students to learn about the different types of enzymes and its isolation and purification which will pave the ways in which the students can enter in research field.

OBJECTIVES:
On successful completion of the course the students will acquire knowledge about
- Techniques of isolation & purification of the enzymes.
- Kinetics of the enzymes
- Enzymes that are used in medicine and industry

CONTENTS:
UNIT – I
Enzyme as proteins Structure: Primary, Secondary, Tertiary and Quartenary structure with reference to examples.
Extraction, Purification and characterization of enzymes: Source and extraction procedures.
Purification: Dialysis Ultra filtration, density gradient centrifugation, Fractional precipitation by change of pH, Fractional denaturation by heating, Fractional precipitation with organic solvents, Fractional precipitation by salts, Fractional adsorption, column chromatography, Electrophoresis, Crystallization, sequence of fractional methods, Temp, organic solvents, salts, chromatography – adsorption, affinity and ion exchange chromatography, electrophoresis – Starch gel, agarose, Polyacrylamide, SDS PAGE, IEF.
Criteria of Purity of Enzymes.
Characterization: Using ultracentrifugation – Molecular exclusion chromatography. SDS gel electrophoresis, amino acid sequence determination by Sanger’s method.

UNIT – II
Enzyme kinetics and enzyme inhibitors:

UNIT – III

UNIT – IV

UNIT – V

REFERENCES:
2. Enzymes – Dixon and Webb.
3. Enzyme Technology – Chapline & Bucke.

SEMESTER - III
SUBJECT TITLE: CORE PAPER V - INTRODUCTION TO NANOMATERIALS

SUBJECT DESCRIPTION:
This course represents about the nanomaterials and its significance

GOALS:
To enable the students to know about various types of nanomaterials, their synthesis and applications.

OBJECTIVES:
Upon successful completion the students should have knowledge about classification, synthesis, functions and applications of various kinds of nanomaterials.
UNIT I
Introduction and Classification: What is nanotechnology – Classification of Nanostructures - 1D, 2D and 3D nanomaterials – Nanoscale Architecture.

UNIT II

UNIT III

UNIT IV

UNIT V

REFERENCE:

SEMESTER - III
SEMESTER – III (DIPLOMA)
BIOINFORMATICS

UNIT I
BioInformatics:
Introduction, definition, objectives and scope.
BioInformatics and Internet.
Useful BioInformatics sites on www.
Application of BioInformatics.

UNIT II
Biological databases:
Primary protein database – SWISS PROT, TrEMBL, PIR, PDB.
Primary nucleic acid database – EMBL, GEN BANK, DDBJ.
Data mining of biological databases.

UNIT III
Tools for database search:
FASTA- Histogram, Sequence listing, Search and Programs.
BLAST – Algorithm, Services, MEGABLAST, PHI BLAST, PROTEIN BLAST, GRAPPED BLAST, PSI BLAST

UNIT IV
Protein Primary structure analyses and prediction:
Identification and characterization.
Gene Identification and prediction – pattern recognition, prediction method – laboratory based approaches – southern blotting, northern blotting, zoo blot, In situ hybridization.

UNIT V
BioInformatics and drug design:
Introduction, approaches – ligand based, target based.
Methods of drug designing – CAMD, docking program

REFERENCES
4. Mani.K and Vijayraja (2005), BioInformatics – A practical approach

SEMESTER IV
SUBJECT TITLE : INTERMEDIARY METABOLISM

SUBJECT DESCRIPTION :
The nature of the diet sets the basic pattern of metabolism in the tissues. Mammals such as humans need to process the absorbed products of digestion of dietary carbohydrates, lipids and protein. These are mainly glucose, fatty acids, glycerol and amino acids respectively. The fate of dietary components after digestion and absorption constitutes intermediary metabolism. Knowledge of metabolism in the normal human being is a pre requisite to a sound understanding of abnormal metabolism underlying many diseases.

GOALS: To enable the students to learn the basic functions, principles and concepts of metabolism.

OBJECTIVES: Provides much information related to carbohydrate, fat and protein metabolism that takes place in our body.
• Interrelation between carbohydrate, fat and protein metabolism.
• Role of purine and pyrimidines in nucleic acid metabolism.
• Various disorders related to each metabolism.
CONTENTS:

UNIT I:
Approaches to Biochemical investigations: Perfusion of isolated organs, slice techniques, tracer techniques and mutant studies for elucidation of metabolic pathways. Bioenergetics: - Free energy and the laws of thermodynamics; Role of high energy compounds as energy currency of the cell; free energy of hydrolysis of ATP and other organophosphates. The basic metabolic pathways, anabolic, catabolic and amphibolic pathways.

UNIT II:
Fate of absorbed carbohydrates.Glycolysis: - Pathways and energetics; Oxidation of pyruvate to acetyl CoA. TCA Cycle: - Pathway and energetics; anaplerotic reaction.Gluconeogenesis; Pasteureffect .Glycogenesis and glycogenolysis.Pentose Phosphate Pathway (HMP shunt).

UNIT III:

UNIT IV:

UNIT V:

REFERENCE:
SEMESTER – III & IV
SUBJECT TITLE: CORE BIOCHEMISTRY PRACTICAL - II

I. Colorimetry:
1. Estimation of Glucose by O-Toluidine
2. Estimation of phosphorus by Fiske-Subbarow method
3. Estimation of Urea by DAM-TSC method
4. Estimation of Uric acid by Carraway method
5. Estimation of Iron by Wong’s method
6. Estimation of Protein by Lowry’s method
7. Estimation of Creatinine by Picric acid method
8. Estimation of RNA by Orcinol method.

II. Titrimetry:
1. Estimation of Ascorbic acid – Dye method
2. Estimation of Chloride – Vanslyke’s method
3. Estimation of Reducing sugar by Benedict’s method

III. Enzymes: (Group Experiment)
1. Assay of salivary amylase activity.

IV. Separation Techniques: (Demonstration)
1. Separation of serum protein by electrophoresis
2. Column packing.

SEMESTER IV (DIPLOMA)
BASICS OF INFORMATION TECHNOLOGY

UNIT-I
General format of representing a number-Classification of number system: Positional and Non-positional number system. Decimal, Binary, Octal and Hexadecimal. Conversion from one system to another.

UNIT-II

UNIT-III
Internet: Evolution of Internet-Internet terminologies: WWW, FTP, HTML, HTTP, Gopher, E-mail browsers, protocol Archie Telnet, Search engines. Application of Computers in education, business, entertainment, science, engineering and medicine
UNIT IV
Database systems; Definitions: Data abstraction, Instances, Schemes, Entity, Entity set: Strong and weak entity sets, Primary key, Foreign key, Super key. Database models: Basic concepts of E-R model, Hierarchical model.

UNIT-V

REFERENCES
2. Date C.J. Introduction to Database systems.

SEMESTER – V

SUBJECT TITLE : HUMAN PHYSIOLOGY

SUBJECT DESCRIPTION : This course presents an Introduction and provides a comprehensive, balanced introduction to this exciting, evolving and multi-disciplinary field.

GOALS: To enable the students to learn or to know the biological, physiological activities along with the mechanism of action of various organs.

OBJECTIVES:
On successful completion of the course the students should have:
• Understood clearly on various alimentary parts of human body.
• Learnt more specific on the endocrinal activities
• Learnt the mechanisms and actions of vital organs.

CONTENTS:
UNIT – I
Physiology of vision: Structure of eye, image formation and defects of the eye, Receptor mechanism of the eye, photopigments, Visual cycle and colour adaptation
Skeletal Muscle: Structure of skeletal muscle, contraction of muscle fibre, chemical changes during muscle contraction, sources of energy of muscle contraction.

UNIT – II

UNIT – III
Respiratory system: Diffusion of gases in lungs, transport of oxygen from lungs to tissues through blood, factors influencing the transport of oxygen. Transport of CO$_2$ from tissues to lungs through blood, factors influencing the transport of CO$_2$. Excretory System: Mechanism of formation of urine, composition of urine, Micturition. Renal regulation of acid balance, hormone of the kidney.

UNIT – IV

UNIT – V
Male Reproductive system: Structure of testis, Spermatogenesis, functions of testis. Female Reproductive system: Ovarian cycle, Structure and hormones of ovaries, menstrual cycle, menopause, pregnancy and lactation. Steroids as contraceptives

REFERENCES:

SEMESTER V

SUBJECT TITLE: CLINICAL BIOCHEMISTRY

SUBJECT DESCRIPTION
This course emphasizes the students to realize the diagnostic importance of various metabolic disorders.

GOALS : This course enables the students to know the clinical aspects of various metabolic disorders.
OBJECTIVES
This course would have made the students understand the significance of diagnostic biochemistry.

CONTENTS:
UNIT –I
Disorders of Carbohydrate metabolism.
Normal sugar level in blood, renal threshold and regulation of blood glucose concentration.
Hypoglycemia; Definition and causes.
Hyperglycemia; Definition and causes.
Diabetes mellitus; Introduction, aetiology, types of diabetes mellitus, clinical pathology and diagnosis. Urine testing, random blood sugar and GTT
Acute and chronic complications of Diabetes mellitus
Glycosuria- Differential diagnosis of glycosuria, Fructosuria, Pentosouria, Galactosemia and Glycogen storage diseases

UNIT –II
Disorders of Lipid metabolism.
Plasma lipids and lipoproteins. Introduction
Hypolipoproteinemia- A beta lipoproteinemia, Hypo beta lipoproteinemia.

UNIT - III
Disorders of Amino acid metabolism
Plasma protein abnormalities; Total plasma (Serum) protein, Fibrinogen, Albumin, Pre-albumin and Globulins. Abnormal non-protein nitrogen; Urea, Uric acid, Creatinine and Ammonia, Porphyria.
Aminoacid metabolism: Cysteinuria, phenylketonuria, maple syrup disease, alkaptonuria, Albinism and Hartnup disease.
Disorders of Purine and pyrimidine metabolism
Disorders of Purine metabolism: Normal level of uric acid in blood and urine, miscible uric acid pool, hyper uricemia and Gout; Hypouricemia – Xanthinuria and Liathiasis.
Disorders of pyrimidine metabolism: Orotic acid urea.

UNIT – IV
Gastric, pancreatic and intestinal functions.
Gastric function: Introduction, tests of gastric function – The insulin stimulation test, determination of Gastrin in serum and Tubeless gastric analysis.
Pancreatic Function: Introduction, pancreatic function tests, serum amylase and lipase.
Intestinal function: Introduction, test of monosaccharide absorption (xylose excretion test) and determination of total protein (Lowry’s method).
UNIT – V
Liver disease and liver function tests: Introduction, bilirubin metabolism and jaundice, liver function tests. Estimation of conjugated and total bilirubin in serum (Diazo method). Detection of bilirubin and bile salts in urine (Fouchet’s test and Hay’s sulphur test). Thymol turbidity test, prothrombin time, serum enzymes in liver disease – serum transaminases (SGPT & SGOT) and lactate dehydrogenase (LDH).

Kidney function test: Introduction, Physical examination of urine, elimination tests, clearance tests; inulin clearance, Creatinine clearance test and urea clearance test, Renal blood flow and filtration fraction.

REFERENCES:

SEMESTER – V
SUBJECT TITLE: Nanobiotechnology

SUBJECT DESCRIPTION:
This course represents about the basics of nanoscience and its application

GOALS:
This course enable the students to know about basics of nanoelectronics and their processing

OBJECTIVES:
Upon successful completion, the students should have knowledge about the processing and applications of nanobiometrics, nanocomposites, nanoanalytics

UNIT I
Biological Inspired Concepts: Biological Networks – Biological Neurons – The Function of Neuronal Cell – Biological neuronal cells on silicon – Modelling of Neuronal cells by VLSI circuits.

UNIT II
UNIT III
Nanobiometrics: Introduction – lipids as nano-bricks and mortar- Self assembled nanolayers - the bits that do things - proteins – DNA Computer

UNIT IV

UNIT V
Nanoanalytics: Quantum dot Biolabelling – Nanoparticle Molecular labels – Analysis of Biomolecular Structure by AFM.

REFERENCE:

SEMESTER V
PLANT BIOCHEMISTRY

Unit – I
Plant cell – Structure and function of extra cellular organelles. 
Transport mechanisms:- Diffusion, osmosis and imbibition (definition only). Absorption and translocation of water – Mechanism, active absorption and passive absorption.
Factors affecting absorption of water. 
Transpiration – Types, Mechanism of stomatal opening, factors affecting transpiration and guttation.

Unit – II
Photosynthesis – Photosynthetic pigments; chlorophyll pigments, carotenoid pigments and phycobilins. Structure of chloroplast; light absorption.
Light reaction; Two kinds of chemical system – Photosystem I and photosystem II.
Mechanism of photosynthesis – Light reaction or Hill’s reaction and Dark reaction or Blackman’s reaction.

Unit – III
Cycles of elements:- Nitrogen cycle:- Ammonification, nitrification, nitrate reduction and denitrification.
Sulfur cycle:- Release of sulfur from organic compounds; oxidation of sulfur and sulfur compounds. Reduction of sulfate. Phosphorus cycle and carbon cycle.
Plant nutrition:- Specific roles of essential elements and their deficiency symptoms in plants.
Macronutrients:
Carbon, hydrogen, nitrogen, sulfur, phosphorus, calcium, potassium, magnesium and iron.
Micronutrients:- manganese, boron, copper, zinc, molybdenum and chlorine.

Unit – IV

Unit – V

REFERENCES:

SEMESTER V (DIPLOMA)

UNIT – I:

GENOMICS AND PROTEOMICS

Genome maps
Types of Genome maps and their uses: High and low resolution maps – Map elements – polymorphic markers, line sine, RFLP, SNP

Types of Maps:
Cytogenic – Linkage map, Transcript map
Physical map – Comparative map, integrated map
Practical uses of Genome maps:
Locating Genomic regions, target identification, arrangement of genes, SMP diagnosis, Positional specific cloning, Predicting Gene function, identifying regulatory genes.

UNIT –II:
Structural annotations – Locating coding regions and other structural elements of the gene.

Various approaches in gene prediction – ORF prediction, gene prediction in prokaryotes and eukaryotes. Hidden Markov model, Pattern discrimination

UNIT –III:
Human Genome and Genomic analysis: Size, features, composition and characteristics of human genome – Sequence repeats, transposable elements, gene structure and pseudogenes.

Genome analysis – Gene order (Synteny), Chromosome rearrangement, compositional analysis, clustering of genes and composite genes.

UNIT –IV:
Proteomics: - Structural elements and terminology – phi and psi bonds, letter code for amino acids, helix, sheet strand, loop and coil.

Active site, Architecture, blocks, class and domains, fold, motif, PSSM, profile.

Protein structure prediction: Use of sequence pattern – Leucine zipper, coiled coil, transmembrane, signal peptide and cleavage site.
Secondary structure prediction: Chou-Fasman/ GOR method, neural network, nearest neighbour method, tertiary structure prediction, threading, profile, contact potential and modeling.

UNIT –V:
Proteome-analysis:
2D Electrophoresis – Immobilized pH gradient, Sample preparation, first dimension criteria, second dimension criteria, stabilization.
Data analysis – Mass spectrometry based methods for protein identification and analysis. Database for 2D gel.

REFERENCES
1. David W.Mount, (2001), Bio-informatics sequence and genome analysis, Cold Spring Harbor Laboratory press
2. Ed. Andreas D.Baxewanis and Francis quellette, Bio-informatics a practical guide to the analysis of genes and proteins, John willey & sons publications
SEMESTER – VI

SUBJECT TITLE : MOLECULAR BIOLOGY

SUBJECT DESCRIPTION:
This course presents the mechanism of synthesis of DNA, RNA and proteins, gene regulation and gene mutation. Techniques used in molecular biology.

GOALS: To enable the students to learn about the synthesis and functions of molecules that make up living organisms, their mutation and identification of mutants.

OBJECTIVES:
On successful completion of the course the student should have
- Understood the synthesis of genetic material, RNA and proteins.
- Learnt about gene repair mechanism and gene mutation.
- Learnt about the techniques used in identifying gene mutation.

CONTENTS:

UNIT – I
Evidences for DNA as genetic material: - Experimental proof
DNA replication in prokaryotes; Formation of DNA from nucleotides; Semiconservative mechanism and experimental proof; RNA priming; Bidirectional replication; theta mode, rolling circle model.
Enzymology of DNA replication; Initiation, elongation and termination; Fidelity of replication.
Differences in eukaryotic replication; Inhibitors of replication [names only].
DNA repair mechanism: - Excision repair, mismatch repair, photo activation and SOS repair.

UNIT –II
Prokaryotic transcription: - Central dogma; RNA polymerases;
Initiation, elongation and termination of transcription.
Role of eukaryotic RNA polymerases.
RNA splicing and processing of mRNA, tRNA and rRNA.
Reverse transcription.

UNIT - III
Genetic code: - Experimental evidences; Features of genetic code. Composition of prokaryotic and eukaryotic ribosomes.
tRNA - structure; activation of amino acids, coding and non - coding strands of DNA.

UNIT – IV
Recombination in bacteria: - Transformation, Transduction and Conjugation.
Recombination: - Mechanism; forms of recombination, Holliday model for homologous recombination.
Prokaryotic gene regulation: - Operon model; lac operon - positive and negative control; trp operon - repression and attenuation.

UNIT – V
Gene mutations: - Types - Nutritional, Lethal, Conditional mutants. Missense mutation and other point mutations. Spontaneous mutations; chemical and radiation – induced mutations – Ames test; reversion techniques; selection of mutants; Auxotrophs; Replica plating; Penicillin cycling. Bacterial transposons: - Insertion sequences; Mechanism of transposition in bacteria.

REFERENCES:

SEMESTER – VI
SUBJECT TITLE: BIOMEDICAL APPLICATIONS OF NANOMATERIALS

SUBJECT DESCRIPTION:
This course has been designed to provide basic knowledge about the biomedical applications of various nanomaterials.

GOALS:
This enable the students to know various nanomaterials and their application in the field of medicine.

OBJECTIVES:
Upon successful completion the students should have knowledge about the medical applications of nanosensors, nanoparticles, nanocapsules and polymer micelles.

UNIT I

UNIT II

UNIT III
UNIT IV

UNIT V

REFERENCE:

SEMESTER – V & VI

SUBJECT TITLE: BIOCHEMISTRY PRACTICAL – III

CLINICAL PRACTICALS:
I. Urine Analysis:
1. Estimation of creatinine by picric acid method.
2. Estimation of Urea by DAM-TSC method
3. Estimation of Uric acid by Carraway’s method
4. Estimation of Calcium by Permanganate method
5. Estimation of Phosphorus by Fiske-Subbarow method.

II. Blood Analysis:
1. Estimation of Urea in serum by DAM –TSC method
2. Estimation of Uric acid in serum by Carraway method
3. Estimation of Phosphorus in serum by Fiske-Subbarrow method
4. Estimation of Glucose in serum by O- Toluidine method
5. Estimation of Alkaline phosphatase in serum
6. Estimation of Acid phosphatase in serum
7. Estimation of Cholesterol in serum by Zak’s method

III. Kit Method: (Demonstration Experiment)
1. Estimation of SGOT
2. Estimation of SGPT
3. Estimation of Triglycerides
4. Estimation of Hemoglobin
SEMESTER – V & VI

SUBJECT TITLE: BIOCHEMISTRY PRACTICAL – IV

COURSE NUMBER:

Microbiology:
1. Microscopic measurements of micro organisms.
2. Hanging drop techniques.

Microbiology:
3. Simple staining
4. Gram staining
5. Endospore staining
6. Negative staining
7. Fungal staining

Enzymes
8. Preparation of crude enzyme extract.
9. Effect of pH on the activity of acid phosphatase and catalase.
10. Effect of temperature on the activity of acid phosphatase and catalase.
11. Effect of enzyme concentration on the activity of acid phosphatase and catalase.
12. Effect of substrate concentration on the activity of acid phosphatase and catalase.

Immunology:
13. RA factor (Kit method)
14. Pregnancy test – Gravindex test (Kit method)

Plant Biochemistry:
15. Estimation of Chlorophyll
16. Estimation of Starch

Demonstration on plant tissue culture
17. Preparation of media; sterilization
18. Initiation of callus culture

Physiology:
19. Identification blood group
20. Enumeration of RBC
21. Enumeration of WBC
22. Differential staining method
23. Bleeding time and clotting time determination.
SEMESTER VI (DIPLOMA)

PRACTICAL I
Working with MS-Office Packages One exercise each in Word, Excel, Power point and Access.

• Working with HTML Tags and HTML Forms. Creating HTML Pages.
• Basic commands in MS-DOS and command line execution in LINUX.
• Biological Databases Sequence Databases, Structure Databases, Specialised Databases.
• Data retrieval tools and methods.
• Database file formats.
• Molecular visualization.

REFERENCES

PRACTICAL II

• Gene structure and function prediction (using Gen Scan, GeneMark).
• Sequence similarity searching (NCBI BLAST).
• Protein sequence analysis (ExPASy proteomics tools).
• Multiple sequence alignment (Clustal).
• Molecular phylogeny (PHYLIP).
• Analysis of protein and nucleic acids sequences
• Sequence analysis using EMBOSS or GCG Wisconsin Package

REFERENCE:

SEMESTER – V ELECTIVE I - A

SUBJECT TITLE: IMMUNOLOGY AND IMMUNO TECHNIQUES

SUBJECT DESCRIPTION:
This course will provide the basic concepts of immunology which follows the course of immune response. The course will introduce the various mechanisms by which microbial pathogens cause disease and the interaction with the host.
GOALS: To enable the students to acquire a knowledge in the field of infectious diseases and interaction with the host’s immune system.

OBJECTIVES:
On successful completion of the course the students should have:

- Understood the foundation for the future subjects in microbiology and immunology.
- Learnt the basic terminology and techniques in microbiology and immunology.
- Learnt on how much immune system is important to the humans.

CONTENTS:

UNIT – I
Historical development of the science of the immunology. Innate and acquired immunity, Antibody mediated and cell mediated response tolerance. Primary and secondary lymphoid organs. Structure of T, B and NK cells. Receptors on the surface of lymphocytes. Structure and functions of neutrophils, Macrophages – phagocytosis and inflammation, eosinophils and basophils.

UNIT – II

UNIT – III

UNIT – IV
Allergy and Hypersensitivity – Type I, II, III and IV, their clinical manifestations. Immuno Disease: Rheumatoid arthritis, Myasthenia gravis. Immunity to bacteria and viruses. Skin Test: Montex and Penicillin test.

UNIT – V
REFERENCES:
1. Immunology – An introduction, Tizzard R Jan, 1995.

ELECTIVE I - B  
SUBJECT TITLE: MEDICINAL CHEMISTRY

SUBJECT DESCRIPTION:
This course presents to focus on the chemical principles used for drug discovery and it also covers human biology where ever relevant.

GOALS: Course provides for the specific needs and interests of students wishing to obtain experience in a modern research program

OBJECTIVES:
On successful completion of the course the students should have:
• Understood the development of the traditional and modern methods used for drug discovery; of how molecules interact.
• Learnt the fact that the pharmaceutical industry is by far the largest employer of medicine
• Learnt and developed skills in the use of reaction mechanisms and how knowledge of reaction mechanisms can aid in understanding the mode of action of a drug, and the method by which it can be synthesized, and developed.

UNIT –I
Introduction and receptor concept; Introduction to drugs, classification of drugs, passage of drugs across biological membrane; absorption and distribution of drugs; binding of drugs to plasma proteins.

Drug receptor interaction, binding forces in drug receptor interaction, types of receptors. Receptor theories, isolation of receptors, consequences of drug receptor interaction

UNIT –II
Drug metabolism and elimination: Drug metabolism, methods of study of drug metabolism, microsomal drug metabolism, metabolism via hydroxylation, conjugation deamination, N-Oxidation, azo and nitro reduction, non-microsomal oxidation, Oxidative deamination, purine oxidation, dehalogenation, hydrolysis, action of choline esterase. Elimination of drugs from the body with reference to renal system
UNIT - III
   Antiviral, antimalarial and antiTB drugs.

UNIT – IV
   Drugs acting on CNS and cardio-vascular system.
CNS – structure and mode of action of barbiturates, salicylates, MAO inhibitors and drugs for Parkinson’s disease.

Cardio-vascular disease: Structure and mode of action of cardiac glycosides, heparin and coumarin.

UNIT – V
   Cancer chemotherapy- cytotoxic drugs. Immunosuppressive drug therapy.

REFERENCES

ELECTIVE I - C
NUTRITIONAL BIOCHEMISTRY

UNIT I
Introduction to the science of nutrition – function of foods and its relation to nutritional and clinical health, essential nutrients, analysis of food, composition, food habits and food groups.

UNIT II
Carbohydrates- kinds, functions, food sources.
Fats- kinds, functions, food sources, essential fatty acids and cholesterol.
Proteins- kinds, functions, food sources, complete and incomplete proteins.

UNIT-III
Bilogical value, Net protein Utilization
Energy Basal metabolism, measurement of BMR, Factors affecting BMR, regulation of body temperature, energy needs, total energy requirements, estimation of energy requirements and value of foods.

Balanced diet formulation- Assessment of nutritional status.

UNIT IV

Mineral nutrition: Essential – micro and macro mineral nutrients, distribution, sources, functions and abnormalities.

Vitamins – Definition, classification, sources, distribution, functions and abnormalities.

UNIT V

Nutrition at various stages of growth and development; diets for infants, children, adolescents, pregnant women, lactating mothers and older persons.

Nutrition challenges of the future – food production and food storages, future foods, new protein foods, new fat foods and changing food habits.

References:
1. Principles of Nutrition & Dietetics.Dr. M. Swaminathan.The Bangalore printing & publishing Company limited.88, Mysore Road, Bangalore- 560018.

SEMESTER – VI ELECTIVE II - A

SUBJECT TITLE : PLANT & ANIMAL BIOTECHNOLOGY

SUBJECT DESCRIPTION :
This course presents the plant and animal tissue culture methods, explains the mechanism of gene transfer, Methods of selection, Production of novel proteins and their applications.

GOALS:
To enable the students to have a sound knowledge on the methods of tissue culture and large scale production of recombinant proteins.

OBJECTIVES:
On successful completion of the course the students should have:
• Understood the components of culture media and various tissue culture techniques.
• Learnt about the technique of genetic engineering in plants and animals.
• Learnt about the synthesis and applications of recombinant proteins from cell cultures.

CONTENTS:
UNIT – I:
Plant tissue culture: - Media composition, nutrients & growth regulators, MS medium & 
B5 medium. Callus & suspension culture. Initiation & differentiation of PTC.
Micropropagation:- Methods, Production of haploid plants, phytochemicals from plant tissue culture.

UNIT – II:
Protoplast technology:- Isolation, fusion of protoplasts, Electroporation, Biolistics, 
Regeneration of plants from protoplasts.
Gene Transfer in plants: Ti plasmid vectors, mechanism of T- DNA transfer, Vir genes. 
Transgenic plants:- Herbicide, Virus, Pest resistance plants, Male infertility, Genetic engineering of plant oils.

UNIT - III:
Mammalian cell culture: - Establishment of cell in culture: Requirements for invitro growth; importance of serum.
Cell-lines; cell transformation – properties of transformed cells, cell separation, Mass cultivation of cells: suspension culture; immobilized cultivation.

UNIT - IV:
Genetic Engineering of Animal cells: - Mammalian cell culture in protein production.
Gene transfer into mammalian cells, Selectable markers, pSV plasmids; retroviral vectors; 
Expression vectors; reporter genes.

UNIT – V:
Animal Biotechnology:- Artificial insemination and embryo transfer, Invitro fertilization (IVF): embryo cloning. Human embryo research, transgenic mice, Gene therapy; the Human Genome Project.
Recombinant proteins from cell cultures: - Interferons, Viral vaccines, Hybridoma technology- Monoclonal antibodies- production and applications.

REFERENCES:
2. BIOTOL series, Invitro cultivation of animal cells- Butler worth Heineman, 1993
5. Freshney; Animal cell culture; IRL press.
ELECTIVE II - B
GENETIC ENGINEERING AND BIOPROCESS TECHNOLOGY

UNIT I
Basis of gene cloning; Restriction endonucleases – types, features; ligations; linkers and adaptors.
Vectors: Plasmid vectors – basic features – pBR 322; Bacterio phage vectors; cosmids; Artificial chromosomes.
Cloning hosts.
Preparation of plasmid DNA from bacteria.

UNIT II
Genomic library and cDNA library.
Hybridization probes; Southern, Northern and Western blotting techniques.

UNIT III
DNA sequencing:- Outline of Sanger’s method.
Genetic finger printing – applications.
In vitro mutagenesis:- Oligonucleotide directed mutagenesis. Protein Engineering.
PCR – Technique and application; Antisense RNA, RNAi.

UNIT IV
Expression vectors of E. coli:- Constituents; examples of promoters – expression cassettes – problems caused in expression of eukaryotic genes; fusion proteins – Application of gene technology. Recombinant insulin; Recombinant growth hormones. Cloning HBV surface antigen in yeast. Insect cells as host system.
Safety aspects and hazards of genetic engineering.

UNIT V
Gene transfer in plants: Ti plasmid vectors; mechanism of T-DNA transfer, virulence genes.
Electroporation, biolistics and protoplast fusion.
Application : Transgenic plants – herbicide resistance, male infertility, virus resistance, pest resistance.

References:

ELECTIVE II - C
PLANT THERAPEUTICS

UNIT I
Medicinal plants-bioactive principles in medicinal plants: methods of extraction, isolation, separation and screening, pharmacologically active plants – CNS, CVS, Hypoglycemic.

UNIT II
Hepatoprotective, nephroprotective, anti allergic, anticancer, antibacterial, antiviral and antimalarial, anti-inflammatory, immunoactive properties of the medicinal plants, plants protecting against oxidative stress, chemotherapeutic products.

UNIT III
Free radicals – types, sources, importance, production, free radicals induced damages, lipid peroxidation, measurement of free radicals, disease caused by radicals, reactive oxygen species, antioxidant defence system, enzymic and non-enzymic antioxidants, role of antioxidants in prevention of diseases, phytochemicals as antioxidants.

UNIT IV
Primary metabolites, Alkaloids, flavanoids, terpenoids, phenolics, steroids, Vitamins, minerals – Occurrence, distribution & functions.

UNIT V
Production of secondary metabolite in plants, stages of secondary metabolite production, uses of tissue culture techniques, elicitation, biotransformation- production of pharmaceutical compounds

REFERENCES:

SEMESTER VI   ELECTIVE III - A

SUBJECT TITLE:  DIAGNOSTIC BIOCHEMISTRY

SUBJECT DESCRIPTION:
This course presents about the diagnostic values and significance and the interpretation of various enzymes, bio-chemical parameters, hormones and immunoglobulins.

GOALS   The students will have the knowledge about the basic functions in clinical lab test and their interpretations.

OBJECTIVES
After the completion of this course the student would have understood
• The aim and objective of various clinical laboratory test
• The significance of various test and interpretation in diseased conditions.

UNIT I
Clinical chemical test- Blood group, glycosylated haemoglobin, fructosamin, GTT, uric acid, Ca, P, Fe, Cu, CSF analysis.

UNIT II
Enzymes: Acid phosphatases, LDH, CPK, CPK-MB, Alpha amylase,
Hormones – T₃, T₄, TSH, LH
Immunoglobulins – IgA, IgM, IgE.

UNIT III
Serodiagnostic procedures – precipitation tests, VDRL test, Vidal Test, (Slide and Tube method) Brucella agglutination test, ASO test, RA test, CRP test.
Complement fixation test, skin test – Montaux test, Lepramin test.

UNIT IV
Complete haemogram, complete urine analysis, complete motion analysis, semen analysis.

UNIT V
Blood bank – Blood group and Rh factor – Coomb’s test, coagulation studies, prothrombin test (PT), partial PT, Plasma fibrinogen.
Test for aminoacid urias – test for phenyl ketonuria, DNPH test for keto acids, Cyanonitroprusside test for cystinuria and homocysteine.

REFERENCES
4. Joan Zilva and Pannall P.R., Clinical Chemistry and diagnosis and treatment, PG Publishing Pvt Ltd
ELECTIVE III - B
SPORTS BIOCHEMISTRY

UNIT – I
Sports, Exercise and Games:
- Introduction, calisthenics, Gymnastics, combative and swimming;
- Yogasana and its importance – Padmasana, Vajrasana, Dhunurasana, and Suryanamaskar;
- Track and field events – Running and Jumping Team events – Kabaddi.

UNIT – II
Skeletal muscle system and metabolic systems in Exercise:
- Skeletal muscle types; - relation with different types of activities; strength, power and endurance of muscles;
- Muscle metabolic systems in exercise; Recovery of muscle metabolic systems after exercise.

UNIT – III
Cardio respiratory system:
- Muscle blood flow and cardiac output during exercise;
- Oxygen consumption and pulmonary ventilation in exercise; Hypoxia and hypercapnia.

UNIT – IV
Physical fitness assessment:
- Body composition; body fat percentage by skin fold method; BMI; Ideal weight and assessment of muscle mass.

UNIT – V
Nutrition for sports and Exercise:
Nutritional considerations for sports person:- Carbohydrate: Energy source for sports and exercise; carbohydrates composition for pre-exercise, during and recovery period.
Fat: Role as an energy source: effect of fasting and fat ingestion
Protein: Protein requirement during exercise, recovery process and protein supplement.
Vitamins: Role of B-complex vitamins.
Minerals: Role of Potassium and sodium.

References:
3. Essentials of food and Nutrition by M. Swaminathan Vol I – II.
ELECTIVE III – C PUBLIC HEALTH AND HYGIENE

UNIT – I
Concepts of health:- Who definition of health; Positive health; Determinants of health; Responsibility for health.
Health service philosophies:- Health case; Health system; Levels of health case.
Concepts of disease and concept of causation – germ theory of disease; Epidemiological triad; Multifactorial causation; Web of causation.

UNIT – II
Nutrition and Health – Food defined; Nutrition defined; Classification of foods; Nutrients – Sources and functions of Proteins, fats, carbohydrates; sources and functions of vitamins and minerals.
Nutritional Profiles of principle foods; cereals, Millets, Vegetables, Fruits, Milk, and Milk products, Fish and meat, alcoholic beverages, egg, soft drink.
Balanced Diet – PEM Malnutrition and its effects – Kwashiorkor and Marasmus.

UNIT – III
Environment and Health – Basic health requirements in the environment – Water – Sources and uses of water, Water pollution, Water related diseases and purification of water.
Air – Composition and cause of discomfort; Air pollution – Source, Air pollutants, need for proper ventilation.
Housing – Social goals of housing and criteria for healthful housing.

UNIT – IV
Maternal and child Health:- Mother and child – one unit; Intranalatal card; Post natal child care – care of the mother, complications of post portal period, restoration of mother to optimum health, Breast feeding; congenital malformations – Definition, incidence, Risk factors, Prenatal diagnosis and prevention.

UNIT – V
Mental Health – Types and causes of mental illness – Preventive aspects; Alcoholism and drug dependence – Definition, agent factors, Host factors, symptoms, environmental factors, prevention, Treatment and Rehabilitation.
Health care programmes in India – National AIDS control programme and National Immunization programme.

References: