PERIYAR UNIVERSITY

PERIYAR PALKALAI NAGAR

SALEM – 636011

DEGREE OF MASTER OF SCIENCE

CHOICE BASED CREDIT SYSTEM

SYLLABUS FOR

M.SC. BIOCHEMISTRY

(SEMESTER PATTERN)

(For Candidates admitted in the Colleges affiliated to Periyar University from 2017-2018 onwards)

REGULATIONS

Biochemistry is a fundamental science between the exact sciences like physics, chemistry, computer science, and the biological sciences. It deals with the molecular structures and functions of living organisms. In a wider sense, molecular and cell biology, biotechnology.

The primary objectives of the major are

- To give students a solid foundation in biology and chemistry;
- To develop analytical and critical-thinking skills that allow independent exploration of biological phenomena through the scientific method
- To introduce students to modern methods of biochemical experimentation within the disciplines of biology, chemistry and biotechnology.

The degree program will be offered in collaboration with Biological and Physical Science departments. The students will acquire practical and theoretical understanding of basic metabolism, Molecular Biology and Biotechnology. Other areas included in the programme are cell and Molecular Immunology, Industrial and Nutritional Biochemistry, Biochemical Pharmacology and Medical Biochemistry. These courses are designed to expose students to a wider perspective in Biochemistry course to achieve these goals; the program has crafted a curriculum courses already offered in each participating department that cover the essential material listed in the scheme in each semester. These courses prepare students to participate in independent research. Depending on his/her background, a student required to complete as many as 17 theory papers and 6 practicals to complete the programme. On completing first year students have toparticipate in a capstone laboratory experience, in the second year, students must conduct an independent research projects on which they then base a thesis.

MAJOR OBJECTIVES

- To impart analytical knowledge in Biochemistry and Molecular Biology.
- To provide students with practical skills in the areas of Biochemistry and Molecular Biology.
- To train students on relevant and recent advances in Biochemistry and Molecular Biology. Oncology, Clinical Chemistry and Cancer Research heavily depend on Biochemistry.

- The objective of the course has therefore been to consolidate students training in Biochemistry and other integrated sciences and encourage them to develop intellectual independence, critical thinking skills and versatility for problem solving in Biochemistry and other related courses. This and the core values have been the guiding principle of the research programmes.

- The Biochemistry Programme has pursued its curryculum and research agenda in recognition of the role of Biochemistry in contributing to both basic life sciences and applied research in industries.

1. PREAMBLE AND OBJECTIVES OF THE COURSE:

The syllabus aims to provide the strength to acquire an advanced knowledge and understanding of the core principles of Biochemistry.

The major objectives of B.Sc., Biochemistry course are,

- ❖ To study the structures and functions of biomolecules.
- ❖ Tounderstand the principles, instrumentation and applicationsof analytical techniques.
- ❖ To study the principles of enzyme catalysis, bioenergetics and major metabolic pathways.
- ❖ To study the expression of molecular genes and molecular techniques.
- ❖ To understand human physiology and nutritional requirements.
- ❖ To study molecular concepts of body defenses and its mechanisms.
- ❖ Toimpart knowledge in principles and applicationsof clinical Biochemistry.
- ❖ Toobtain knowledge in Pharmaceutical, Microbial and Industrial Biochemistry.
- ❖ To acquire skills for laboratory experiments.
- ❖ To prepare candidates for a career in Pharmaceutical industries, food industries etc.

2. CONDITION FOR ADMISSION

A candidate who has passed B.Sc degree in Biochemistry or an Equivalent B, Sc. Examination in Bachelor in Medical Laboratory Course or some other B.Sc board equivalence submitted by the respective University may be acceptedby the syndicate as equivalent there to with Biochemistry shall be eligible for admission into M.Sc., course in Biochemistry.

3. DURATION OF THE COURSE:

The course for the degree of Master of Science shall consist of two academic years divided into four semesters.

4. COURSE OF STUDY:

The course of study for the M.Sc. Degree in the Branch Biochemistry shall comprise the following subjects according to the syllabus,

i) Major: Biochemistry

ii) Integrated and Skilled Based Elective Course and Non Major Elective Course subjects

iii)Human Rights (Languages and English)

Non major elective course subjects may be chosen by the respective colleges and the same must be communicated to the University.

SEMESTER I

SEMESTER II

SEMESTER III

SEMESTER IV

5. EXAMINATIONS

There shall be four examinations- two in the first year, two in the second year. Candidates failing in any subject / subjects will be permitted to appear for such failed subject / subjects at subsequent examinations. The Syllabus has been divided into four semesters. Examinations for I and III semesters will be held in November/ December and for II and IV semesters will be held in April / May.

The practical examination I&II will be held in semester-I. Practical III & IV will be held at the semester-II. Practical- V & VI will be held in semester –III and in semester-IV individual Research Project should be performed and dissertation should be submitted and their report shall be evaluated in Viva -Voce examination conducted before the examiners at the end of IV - semester.

6. PASSING MINIMUM

A candidate shall be declared to have passed the examination if he /she secure not less than 40% of the marks in each paper / practical. Candidates who do not secure the required 6 minimum marks for a pass in a paper / practical shall be required to appear for and pass the same at a subsequent appearance. For practical, the minimum for a pass includes the record notebook marks also. There is no passing minimum for the record notebook. However submission of a record notebook is a must.

7. CLASSIFICATION OF SUCCESSFUL CANDIDATES

Candidates who secure not less than 60% of the aggregate marks in the whole examination shall be declared to have passed the examination in First Class. All other successful candidates shall be declared to have passed in the Second Class. Candidates who obtain 75% and above in the aggregate shall be declared to have passed the examination in First Class with Distinction provided they pass all the examinations prescribed for the course at the first appearance.

8. RANKING

Candidates who pass all the examinations prescribed for the course in the first instance and within a period of three academic years from the year of admission to the course only are eligible for University Ranking.

9. MAXIMUM DURATION FOR THE COMPLETION OF THE PG PROGRAMME

The maximum duration for completion of the PG Programme shall not exceed EIGHT semesters.

10. COMMENCEMENT OF THIS REGULATION

These regulations shall take effect from the academic year 2017-2018, i.e. for students who are to be admitted to the first year of the course during the academic year 2017-2018 and thereafter.

11. TRANSITORY PROVISION

Candidates who were admitted to the PG course of study before 2015-2016 shall be permitted to appear for the examinations under those regulations for a period of three years i.e. up to and inclusive of the Examination of April/May 2020. Thereafter, they will be permitted to appear for the examination only under the regulations then in force.

12. PAPERS GIVEN BY THE BOARD AS NON – MAJOR ELECTIVE COURSE

Semester III

Fundamentals of Human physiology (Or) Biochemistry in Nutrition

Semester IV

Biochemistry and Health (Or) Biochemistry in Diagnosis

13. PATTERN OF QUESTION PAPER (FOR MAJOR, ELECTIVE AND EDC)

Maximum – 75 marks Duration – 3 hours

Section –A (1 x10 = 10 marks)

Answer all the questions

(Multiple Choice Questions- Two questions from each unit)

Section –B (5x5 = 25 marks)

Answer all the questions

(Either or Choice-Two questions from each unit)

Section –C (3x9 = 45 marks)

Answer any three questions (One question from each unit)

COURSE OF STUDY AND SCHEME OF EXAMINATION

S.No.	Subject	Subject Title	Instruction Hrs / Week	Exam Hours	University Examination			Credits
					Internal (25%)	External (75%)	Total	
		I SEMESTER						
1.	Core I	BIOMOLECULES	5	3	25	75	100	4
2.	Core II	ADVANCED ENZYMOLOGY	4	3	25	75	100	4
3.	Core III	CELL AND CANCER BIOLOGY	4	3	25	75	100	4
4.	Elective I	BIOCHEMICAL TECHNIQUES	5	3	25	75	100	4
5.	Core Practical I	LAB - I	6	6	40	60	100	4
6.	Core Practical II	LAB - II	6	6	40	60	100	4
		II SEMESTER						
1.	Core IV	INTERMEDIARY METABOLISM	5	3	25	75	100	4
2.	Core V	MOLECULAR BIOLOGY AND GENETIC ENGINEERING	5	3	25	75	100	4
3.	Elective II	PLANT BIOCHEMISTRY AND BIOTECHNOLOGY	4	3	25	75	100	4
4.	EDC	* Paper Supportive - III	4	3	25	75	100	4
5.	Common Paper	Human Rights	2	6	40	60	100	2
6.	Core Practical III	LAB - III	5	6	40	60	100	4
7.	Core Practical IV	LAB - IV	5	6	40	60	100	4

S.No.	Subject	Subject Title	Instruction Hrs / Week	Exam Hours	University Examination			Credits
					Internal (25%)	External (75%)	Total	
		III SEMESTER						
1.	Core VI	ADVANCED CLINICAL BIOCHEMISTRY	4	3	25	75	100	4
2.	Core VII	CONCEPTS OF IMMUNOLOGY	4	3	25	75	100	4
3.	Core VIII	PHARMACEUTICAL BIOCHEMISTRY	4	3	25	75	100	4
4.	Core IX	BIOSTATISTICS AND RESEARCH METHODOLOGY	4	3	25	75	100	4
5.	Elective III	MICROBIAL BIOCHEMISTRY	4	3	25	75	100	2
6.	Core Practical V	LAB COURSE - V	6	6	40	60	100	4
7.	Core Practical VI	LAB COURSE - VI	6	6	40	60	100	4
		IV SEMESTER						
1.	Core X	HUMAN PHYSIOLOGY AND ENDOCRINOLOGY	4	3	25	75	100	4
2	Elective IV	BIOINFORMATICS AND NANOTECHNOLOGY	5	3	25	75	100	4
3.	Project						200	5
4.	**TOTAL**		**99**				**2300**	**90**

***(Choose from other departments EDC papers)**

No. Of Core papers/practical/project : 17

Elective - Major : 04

Non Major Supportive course -[EDC] : 02

M.Sc. BIOCHEMISTRY

SEMESTER I

CORE I - BIOMOLECULES

UNIT I- CARBOHYDRATES

Classification, Structure, functions, physical and chemical properties of Mosaccharides, Disaccharides; N-linked, O-linked and GPI linked Oligosaccharides, glycoproteins structure, function and recognition, Polysaccharides; Homo & hetero polysaccharides, Bacterial Cell wall Polysaccharides. Structure, location and biological role of Proteoglycans (Glycosaminoglycans) and peptidoglycans.

UNIT II - LIPIDS

Classification, structure, function, physical and chemical properties of lipids. Fatty acids- saturated, unsaturated and hydroxy fatty acids. Amphipathic lipids- micelles, emulsion & liposomes. Lipids in cell membrane, Diversity of biological membranes. Sterols – Structure, Properties and functions of cholesterol. Eicosanoids - Structure and biological role of Prostaglandins, Leukotrienes, Prostacyclins, Thrombaxanes and lipoxins. Lipoproteins classification and functions.

UNIT III - AMINOACIDS AND PROTEINS AMINOACIDS

Classification, structure, properties (physical and chemical) of amino acids and proteins.

Amino acid sequencing, Ramachandran plot, Peptide bond link. Polypeptide synthesis.

PROTEINS

Protein sequencing (Sanger's method & Edmand reaction), Dansyl chloride protein degradation and evolution. Proteins: Primary structure, secondary structure: α-helix, β-sheets & turns, Keratin: Coil, Collagen-Triple helix, fibrous protein secondary structure, Tertiary structure: Super secondary structures; β α β motifs, - heparin, αα motif, Greek Key motif. Quaternary Structure: Structure and functions of Hb, actin, myosin, elastin.

UNIT IV - NUCLEIC ACIDS

DNA: Physical (Buoyant density, viscosity) and chemical properties (renaturation and denaturation). Structure of nitrogenous bases, nucleosides, nucleotides, DNA Double

helix -Watson & Crick model of DNA, Other forms; A, B and Z DNA, Triple helix, Palindromes, Inverse repeats, cruciform and hairpins & quadruple structures, C_0t value. Histone proteins, chromatin and non-histone proteins. Miscellaneous alternative confirmation of DNA - slipped mispaired DNA, parallel stranded DNA and anisomorphic DNA. RNA Classes; mRNA, tRNA and rRNA, hnRNA, SnRNA, miRNA structure and functions.

UNIT V – VITAMINS AND MINERALS

Classification, structure and function of fat soluble and water soluble vitamins (including antioxidant properties). Minerals of biological significance: Na, K, Ca, Mg, Mn, P, Fe, Cu, I, Zn, Se, Co.

REFERENCE BOOKS

1. Lehninger Principles of Biochemistry, Nelson, David L. and Cox, 2008.5th edition. W.H.Freeman and Co., NY
2. Fundamentals of Biochemistry,Donald Voet, Judith G.Voet and Charlotte W 2008, 3rd edition Pratt, John Wiley &Sons,
3. Outlines of Biochemistry Eric E.Conn, P.K. Stumpf, G.Brueins and Ray H.Doi, John 2005. 5th edition. Wiley and sons, Singapore.
4. Biochemistry, Lubert Stryer , 1995.4th edition. WH freeman and Co, Sanfrancisco.
5. Text book of Biochemistry Thomas M Devlin, 1997.4th edition. A John Wiley, Inc publication, New York.
6. Biochemistry Zubay G L, 1988. 4th edition W M C Brown publishers.
7. Principles of Biochemistry, Garrette & Grisham, 1994. Saunders College publishing.
8. Biochemistry U. Sathayanarayana, 2006 3rd edition. Books and allied (P) ltd., India

M.Sc. BIOCHEMISTRY

SEMESTER I

CORE II - ADVANCED ENZYMOLOGY

UNIT I

Factors affecting rate of reactions - activation energy & transition state theory and catalysis. IUB Classification and Nomenclature, Intracellular Location of Enzymes, Enzyme Units, Active site - Determination of 3D structure of active site, Enzyme Turn over, Significance of Enzyme Turn over. Extraction, Purification and characterization of enzymes: Source and extraction procedures. Iso Enzymes, Antioxidant Enzymes.

UNIT-II

Enzyme Kinetics - Steady state theory, MM Equation, LB Plot, Eadie Hofstee Plot, Briggs -Hanes Plot, Effect of pH, Temperature and Substrate Concentration on Enzyme activity. Enzyme catalysis and Mechanism of Enzyme catalysis - Serine proteases (Chymotrypsin) and Lysozyme. Mechanism of Bi Substrate reaction. Metalloenzymes and Metal - activated Enzymes. Coenzymes – Structure and functions of TPP, NAD, NADP, FAD, FMN, Coenzyme A.

UNIT-III

Enzyme Regulation: Mechanism, forward stimulation, Feedback inhibition- Allosteric Enzymes, Sigmoidal Kinetics and their Significance, Hill's Equation, Scatchard Plot and their application. Reversible and irreversible inhibition- types, Kinetics, Determination of Inhibitor constant and LB Plot.

UNIT-IV

Multi Enzyme complex-Structure and Mechanism of action and Regulation of Pyruvate Dehydrogenase complex. Enzyme Immobilisation- Source and techniques of immobilization. Effect of immobilization on enzyme activity. Application of immobilized enzymes. Enzymes as Biosensors - Calorimetric, Amperometric , Optical and Immuno biosensors.

UNIT-V

Application of Enzymes - Enzymes as analytical reagents, Enzymes in Textile, Food and Detergent Industry. Enzymes used in diagnosis and various diseases. Therapeutic application of enzymes. Biotechnological applications of Enzymes. Enzyme Engineering: Artificial enzymes. Future prospects of Enzyme engineering.

REFERENCE BOOKS

1. Enzymes. Dixon , E.C Webb, CJR Thorne and K.F. Tipton, Longmans , London
2. Fundamentals of Enzymology, Nicholas C.Price, Lewis Stevans. 2 ed., (1998), Oxford University Press,
3. Understanding Enzymes, Trevor Palmer, 1991. Third Edition Ellis Horwood Limited.
4. Protein Biotechnology. Gary Walsh and Denis Headon, 1994.John Wiley and Sons,
5. Protein Biochemistry and Biotechnology, Gary Walsh ,2002. John Wiley and Sons Ltd. .

M.Sc. BIOCHEMISTRY

SEMESTER I

CORE III - CELL AND CANCER BIOLOGY

UNIT I

Cell and Sub cellular organelles

Molecular organization of prokaryotic and eukaryotic cells. Structure and function of sub cellular organelles. Cytoskeleton - Microtubule and Microfilaments. Types of tissues. Cell - Cell adhesion molecules - Cadherins, Integrins, Selectins, Collagen, Laminin and Fibronectins and Lignins. Classes of Cell Junctions; Gap, anchoring and tight junctions, desmosomes, Plant cell wall - Architecture and composition.

UNIT II

Cell Membrane architecture and Functions

Membrane structure; Lipid bilayer and membrane proteins [Types], Endocytosis and Exocytosis. Principle of Membrane transporters; Active transport - Na^+ - K^+ - ATPases like P- Type ATPase, F-Type ATPase [ATP synthases], Passive transport and Facilitated transport with relevant illustrations. Co – transporters - Symporters and antiporters. Electrical properties of membrane; Ion channels, Ion pores and Voltage – gated channels. Epithelial transporters. Compartmentalization of cells. Peroxisomes in transport and communication

UNIT III

Cell Signaling

Cell Signaling; Extracellular signal molecules - Receptors, Types of cells - Types of signaling. Three largest classes of cell surface receptor proteins - Ion-channel linked, G-Protein coupled, Enzyme-linked receptors. Signal transduction; Receptor Tyrosine Kinases and Ras, MAP Kinase pathways. Second messengers. Interaction and regulation of signaling pathways. UNIT IV

Cancer Biology

Overview of cell cycle, check - points in cell cycle regulation. S-phase, mitotic phase and cytokinesis, control of cell division and cell growth. Programmed cell death or Apoptosis; mechanism, regulation, pro-apoptotic factors, Pro-apoptotic regulators. Benign and malignant tumors. Cancer transformation, Metastatic tumor cells -

Alteration in cell - cell interaction - blood vessel formation - Tumor micro environment influence cancer development - Isolation ofDNA from tumor cells - Transformation of normal cultured cells. Types of cancer cells and their morphological architecture

UNIT V

Carcinogenesis

Aberrant metabolism in cancer, paraneoplastic syndrome. Tumor markers, stages in chemical carcinogenesis; Initiation, promotion and progression. Oncogenes, proto - oncogenes and viral oncogenes - mechanism of oncogene activation. Growth factors – EGF, TNFα and TNFβ and growth factor receptors. Tumor suppressor genes: Loss of heterozygosity, Over expression of glycoproteins, P53 & Bcl2 role in carcinogenesis, Retinoblastoma.

REFERENCE BOOKS

1. Molecular cell Biology of the cell , 2008. B.Alberts, Alxendar Johnson,Julian Lewis, Martin Raff, Keith Roberts, Peter Walter 5th Edition, G S Garland Sceinces, Taylor & Francis Group, New York.
2. Molecular Cell Biology, Harvey Lodish, Arnold Berk, S. Lawrence Zipursky, Paul Matsudaira, David Baltimore, James Darnell 2000. 4th Edition. W.H.Freeman and Company.
3. Cell Biology- Organelle structure and Function- David E Sadava 2004, Panima publishing Corporation, New Delhi

M.Sc. BIOCHEMISTRY
SEMESTER I
ELECTIVE I - BIOCHEMICAL TECHNIQUES

UNIT I

Buffers – Definition and determination of pH, Henderson Hasselbalch Equation. Dialysis, Surface tension and Viscosity.

Microscope - Principle, Instrumentation, Light and bright field, Phase contrast and Fluorescence microscope. Electron microscopy – TEM, SEM, AFM: principle, preparation of specimens. Organ and Tissue slice technique, Microtomy: Staining and fixation.

UNIT-II

Chromatography - Fundamental concepts, Types, Principle, Instrumentation and application of Chromatography – Paper, TLC, Ion- Exchange, Molecular sieving, Affinity, Adsorption, GLC, HPLC and FPLC.

Electrophoresis - Separation methods and fundamental concepts. Types, Principle, Instrumentation, Applications of Paper, Gel (Starch, Agarose, Polyacrylamide) SDS, Native Gel, Isoelectric Focusing, Pulse Field Electrophoresis, Capillary Electrophoresis.

UNIT-III

Spectroscopy - Flame and flameless spectrophotometry & Flourimetry - Basic Principle, Instrumentation and Applications. UV, Visible & FT - I R Spectrophotometers - Basic Principle, Instrumentation and Applications. Basic principles of NMR [types included], Mass Spectrophotometry and ESR. Types and applications. Instrumentation and applications of Atomic absorption spectroscopy and Luminometry.

UNIT IV

Centrifugation - Sedimentation - Principle, Instrumentation: Low speed and high speed centrifuges. Types of Rotors. Types of Centrifugation; Ultracentrifuge, Analytical and Preparative centrifuges and applications, Ultracentrifuge; Instrumentation, applications - molecular weight and density determination. Density – gradient centrifugation - Rate zonal and Isopycnic types - Sub-cellular fractionation, Cellular disruption, homogenization and extraction - Membrane bound proteins.

UNIT V

Radioisotopes - stable and radioactive isotopes, units of radioactivity, Detection, Quantification and Measurement; GM Counter, Liquid and Solid Scintillation Counter & Autoradiography. Radiation Hazards & Safety measures. Diagnostic & therapeutic uses of radioactive isotopes. Applications in DNA, RNA and protein isolation. Applications in biological research. Circular dichroism: Principle, theory of operation and application. X-ray diffraction - Principle, theory of operation and application.

REFERENCE BOOKS

1. Principles and techniques of practical biochemistry , Keith Wilson and John Walker 2010, 7th edition. Cambridge University Press.
2. An introduction to Spectroscopy for Biochemist,. Brown , SB Academic Press.
3. Molecular Spectroscopy John.M .,2005. oxford university press.
4. Introduction to Centrifugation Ford T.C and Graham J.N., Bioscientific Publishers Ltd, Oxford.
5. Biophysical chemistry - Principles and Techniques Avinash Upadhyay and Nirmalendhe Nath ,2002-2010, 3rd edition. Himalaya Publishers.
6. Modern Experimental Biochemistry, Addison 2000 3rd Edition. Wesley Longman
7. A Biologist Guide to Principles and Techniques of Biochemistry. Keith Wilson and Kenneth Goulding ,1994. EdWard Arnold Publishers.

M.Sc. BIOCHEMISTRY

SEMESTER I

PRACTICAL I -LAB COURSE I - BIOCHEMICAL TECHNIQUES

1. Isolation and Estimation of Glycogen by Colorimetric method.
2. Estimation of Calcium from Milk by Titrimetry.
3. Estimation of Magnesium from leaves/fruit
4. Estimation of Vitamin C from fruit juice
5. Estimation of Thiamine and Riboflavin by Flourimetry method
6. Estimation of Sodium and Potassium by Flame Photometry.
7. Separation of Lecithin from Egg yolk by TLC.
8. Differential centrifugation of cell organelles and identification of Marker Enzymes.
9. Mitotic Preparation –Onion Root tip.
10. Separation of Amino acids, Sugars and Lipids by Paper Chromatography (Ascending, Descending and Circular).
11. Separation of plant pigments by column chromatography
12. Separation of Serum LDH by SDS PAGE.

M.Sc. BIOCHEMISTRY

SEMESTER I

PRACTICAL II -LAB COURSE II - BIOCHEMICAL TECHNIQUES

I. Enzyme Isolation and Assay of Enzyme/Specific Activity.

a. Extraction and Purification of Enzyme and Specific Activity - Peroxidase/Urease

b. Molecular Weight Determination of Enzymes –Peroxidase/Urease by Molecular Sieve

c. Determination of Aspartate transaminase activity

d. Determination of Alanine transaminase activity

e. Determination of activity of Amylase

f. Determination of specific activity of Lipase

g. Determination of specific activity of ACP

h. Determination of specific activity of ALP

II. Immobilisation Enzyme

a. Immobilisation of peroxidase/Acid phosphatase by matrix entrapment, ionic and cross linking

III. Enzyme Kinetics

a. Effect of pH, Temperature, Substrate and enzyme concentration of Lipase/Cellulase [determine Km value]

b. Effect of pH, Temperature, Substrate and enzyme concentration of Peroxidase

c. Effect of pH, temperature, Substrate and enzyme concentration of Urease.

REFERENCE BOOKS (LAB COURSE –I & LAB COURSE – II)

1. Practical clinical biochemistry, volume I and II- Harold Varley, et al., 1980. Fifth Edition. CBS publishers,

2. Biochemical Methods. II Edition. Sadasivam.S and Manickam, A New Age International private Ltd Publishers.

3. Laboratory techniques in Biochemistry and Molecular biology, Copyrright 2017. Ed. T.S. Work and E.Work., 1969. Vol I & II, Elsevier.

4. A Biologist's guide to principles and Techniques of Practical Biochemistry, Modern Experimental Biochemistry Boyer, R III Edition, Benjamin Cummings Publishers.

5. A Text book of practical biochemistry. David Plummer

6. Enzymes Structure and Mechanism, Aln Fessht 1997.

M.Sc. BIOCHEMISTRY

SEMESTER II

CORE IV -INTERMEDIARY METABOLISM

UNIT I

Carbohydrate metabolism and regulation

Introduction to metabolism of cells, Aerobic glycolysis & Fermentation - Energetics of glycolysis. Gluconeogenesis, substrate cycle & reciprocal regulation of glycolysis & gluconeogenesis. Metabolism of glycogen & regulation. Maintenance of blood sugar by liver. Citric acid cycle and energetics. The amphibolic nature of the Citric acid cycle - Anaplerotic mechanism, HMP shunt, Uronic acid pathway, Cori's cycle, Glyoxalate pathway. Metabolism of fructose, Galactose & Mannose.

UNIT II

Fatty acid metabolism and regulation

Oxidation of saturated & unsaturated fatty acids. Oxidation of fatty acids with even & odd numbered carbon atoms. Alpha, Beta & Omega oxidation. Ketogenesis, Biosynthesis of saturated & unsaturated fatty acids. Regulation of fatty acid metabolism. Mitochondrial and microsomal chain elongation. Metabolism of triacyl glycerol, phospholipids & sphingolipids. Cholesterol biosynthesis & regulation. Degradation of cholesterol, lipoprotein metabolism. Cyclic & linear pathways of Arachidonic acid metabolism – Prostaglandins, Prostacyclins and thrombaxenes metabolism.

UNIT III

Amino acid metabolism and regulation

Degradation of amino acids – transamination, oxidative and non - oxidative deamination, decarboxylation - Urea cycle and regulation. Catabolism of amino acids - carbon skeleton of amino acids to amphibolic intermediates, key role of glutamate dehydrogenase in nitrogen metabolism. Conversion of amino acids to specialized products: Serotonin, Gamma amino butyric acid, Dopamine, Epinephrine, Nor - Epinephrine, Melanin, Creatinine, Creatine. Integration of Metabolism - Interrelationship of Carbohydrates, Protein and Fat metabolism. Metabolism of individual amino acids; few important amino acids.

UNIT IV

Bioenergies in metabolism

High energy phosphates. Components of Electron Transport chain and the sequence of electron transport. Mechanism of ATP synthesis; Oxidative phosphorylation – the chemiosmotic theory. Uncoupling of oxidative phosphorylation. Inhibitors of respiratory chain and oxidative phosphorylation. Mitochondrial transport systems, ATP/ADP exchange, malate/glycerol phosphate shuttle.

UNIT V

Metabolism of Porphyrin - Biosynthesis and degradation of Porphyrin, Heme formation, Biosynthesis of Bilirubin, transport and excretion of bile pigment.

Metabolism of Nucleotides, De novo synthesis and Salvage pathway of Purine nucleotides, degradation of Purine nucleotides, De novo synthesis and Salvage pathway of Pyrimidine nucleotides. Degradation of Pyrimidine nucleotides, Inhibitors of Nucleotide metabolism.

REFERENCE BOOKS

1. Lehninger's Principles of Biochemistry. Nelson, David and Cox, 2000. M.M. Macmillan/ worth,.NY
2. Fundamentals of Biochemistry,1999. Donald Voet, Judith G.Voet and Charlotte W Pratt, John Wiley& Sons, NY.
3. Outlines of Biochemistry, Eric E.Conn, P.K. Stumpf, G.Brueins and Ray H.Doi, 1987. Wiley & Sons, NY .
4. Biochemistry Stryer, 1994.3rd edition. Ubert W H freeman and co, Sanfrancisco
5. Text book of biochemistry,. Thomas M Devlin, 1997.4th edition A John Wiley, In.
6. Biochemistry Zubay G L , 1988. 4th edition. W M C Brown Publishers.
7. Principles of Biochemistry, Garrette & Grisham, 1994.Saunders College Publishing

M.Sc. BIOCHEMISTRY

SEMESTER II

CORE V -MOLECULAR BIOLOGY AND GENETIC ENGINEERING

UNIT I

DNA is the genetic material – experimental evidence. DNA replication – Messelson and Stahl's semi conservative replication model, enzymes of replication (Polymerases, Topoisomerases, Ligases, Helicases, Primases and SSB proteins). DNA replication in Prokaryotes and eukaryotes. Rolling circle model of replication. Transcription in Prokaryotes and eukaryotes – Initiation, elongation and termination of transcription. Post transcriptional modifications; hnRNA, hsRNA, mRNA and tRNA

UNIT II

Genetic code – features of genetic code, exceptions to the nearly universal genetic code, One DNA sequence can determine more than one protein. Translation in prokaryotes and eukaryotes, translation of mRNAs and the role of ribosomes and tRNAs in protein synthesis. Regulation of gene expression – Basic elements in control of gene expression, structural and regulatory genes. Mechanism of activation of gene expression; Lac operon, Trp operon, Arab operon, catabolic repression, attenuation, anti- termination and methylation.

UNIT III

Recombination - Holliday model. Mutations – Occurrence, kinds of mutation, Spontaneous mutations, natural mode DNA replication errors, spontaneous chemical changes. Induced mutations – environmental mutagenesis, radiation and chemical induced mutations. Mutagens - types, Detection of mutation, Lethal mutations. DNA repair – Excision repair, SOS repair and photo repair.

Restriction Modification enzymes in recombinant DNA technology and cloning, enzymes in gene cloning, ligations, linkers and adaptors. Cloning vectors – Plasmid vector - pBR322, pUC18. Bacteriophage vectors, cosmids, phagemids, YAC and BAC vectors, Viral vectors - SV 40 and Retrovirus as vectors. Marker genes selectable and screenable markers and aptamers

UNIT IV

Gene expression in prokaryotes - Tissue specific promoter, wound inducible promoters, strong and regulatable promoters, Fusion proteins. Mammalian cell

expression; Two – vector expression, two – gene expression vectors. Host cell types. Transformation, selection of transformed cells and identification of recombinants.Therapeutic applications - Insulin, Growth hormones, Hepatitis B vaccines. Gene therapy: Stem cell gene therapy, Somatic cell gene therapy, gene therapy for inherited diseases; familial hypercholesterolemia, ADA and Cystic fibrosis.

UNIT V

Isolation and purification of nucleic acids. Hybridization: RAPD, RFLP, types of probes and application, Southern, Northern and Western blotting techniques. FISH, DNA Finger printing and Foot printing. DNA sequencing – Sanger's method. PCR - principle, types and applications. Applications of rDNA technology,. DNA Transfer techniques; Chemical induction and electroporation, Gene targeting and gene tagging. Construction of genomic and cDNA libraries.

REFERENCE BOOKS

1. Molecular Biology David Friefeld, 1987.2nd edition. Friefeldernarosa Publishing house, New Delhi.
2. Molecular Biology Weaver R.F. Tata, 2005,3rd edition, Mc graw-hill companies, inc. India
3. Essential Molecular Biology A Practical approach Brown T.A 2007, 2nd edition. IRL Press, Oxford.
4. Alberts, Johnson, Lewis, Raff, Roberts and Walter, 2002.. Molecular Biology of the cell 4th edition., Garland Publication, NY.
5. Molecular Biology of the gene Watson, Baker, Bell, 2004.5th edition. Dorling Kinderly (P) Ltd.
6. Molecular Biotechnology Glick B.R. and Pasternak J.J 2010. 4th edition. ASM Press, USA.
7. Cloning 1 and 2, Glover D.M. and Hames B.D. 1995. IRL Press.
8. Recombinant DNA 2nd edition. Watson 1992,W.H, Freeman and Co., NY Metabolism of individual amino acids; few important amino acids.

M.Sc. BIOCHEMISTRY

SEMESTER II

ELECTIVE II - PLANT BIOCHEMISTRY AND BIOTECHNOLOGY

UNIT I

Photosynthesis – apparatus, role of photosynthetic pigments, Biochemistry of Dark and light reaction, photo systems I and II, factors affecting photosynthesis, cyclic and non-cyclic photophosphorylation. Carbon reactions in C3, C4 and CAM plants – Calvin cycle, Hatch – Slack pathway. Water absorption – Mechanism of water absorption, symplast and apoplast concept. Transpiration – types, mechanism and factors affecting transpiration.

UNIT II

Nutrients – Role of macro and micronutrients in plants and hydroponics, Nitrogen fixation and its types. Biochemistry of symbiotic and asymbiotic nitrogen fixation. Physiology of nodule formation, genetics and genetic manipulation for nitrogen fixation genes. Nitrogen assimilation, interrelationship between photosynthesis and nitrogen metabolism.

UNIT III

Biosynthesis, transport, distribution, mechanism of action and physiological effects of Phytohormones - auxin, gibberellins, cytokines, abscisic acid and ethylene. Phytochrome, biological clock, physiology and biochemistry of seed germination. Dormancy – types and methods to overcome dormancy. Senescence.

UNIT IV

Secondary metabolites – Basic biosynthetic pathways. Functions of secondary metabolites – Flavonoids, alkaloids, terpenoids, anthocyanins, Tannins, steroids and lignin. Applications of secondary metabolites - Drug development, Biopesticides and Biofertilizers.

Plant tissue culture – Micropropagation, Callus induction, cell and protoplast culture, organogenesis and somatic embryogenesis. Applications of tissue culture for crop improvement in agriculture, horticulture and forestry. Haploid production – Anther, pollen, embryo and ovule culture and their applications. Soma clonal variation.

UNIT V

Agrobacterium and crown gall tumors – Ti plasmid and Ri plasmid vectors. Mechanism of T-DNA transfer to plants. Plant viral vectors, Direct transformation of plants by physical methods. Selectable markers and reporter genes used in plant vectors. Transgenic plants – plant resistance to bacteria, fungi, virus, pest and herbicides. Transgenic plants for improved nutrition, crop yield and as bioreactors. GM foods.

REFERENCE BOOKS

1. Plant Biochemistry, Dey J.B. Harborne, 2000. Academic Press.
2. Plant Biochemistry and Molecular Biology Peter J. Lea Richard. C. Lee good,1999 2nd edition. John Wiley & Sons, NY.
3. Introduction to Plant Biochemistry Goodwin T.W. and Mercer E.I 1998. 2nd edition. CBS publication.
4. Plant pathology by Pandey B.P, S. 2009 Chand & Co.
5. An introduction to Plant Tissue culture. Razdan M.K. 2003. Oxford & IBH Publishing Co, New Delhi.
6. Plant Tissue culture, A Practical approach Dixon R.A and Gonzales R.A., 2nd edition.
7. Natural Products: A Laboratory Guide. Raphael Ikan. 1991. Academic Press

M.Sc. BIOCHEMISTRY

SEMESTER II

PRACTICAL III - LAB COURSES III

I. PLANT TISSUE CULTURE

1. Streilization and media preparation
2. Callus Induction and micro propagation
3. Isolation of protoplasts
4. Protoplast Culture
5. Anther culture
6. Somatic Embryogenesis

II. PHYTOCHEMICAL ANALYSIS

1. Qualitative analysis of secondary phytochemicals in medicinal plants
2. Estimation of chlorophyll in leaves
3. Determination of aldehydes in lemon oil
4. Extraction and confirmation
   a. Pectin from orange peel
   b. Caffeine from tea
   c. Solanine from potato

III QUANTITATIVE ANALYSIS

1. Estimation of total alkaloids
2. Estimation of total phenols
3. Estimation of total flavonoids
4. Estimation of Phytosterols

M.Sc. BIOCHEMISTRY

SEMESTER II

PRACTICAL IV - LAB COURSES IV

1. Estimation of DNA
   a) Diphenylamine method
   b) UV method
2. Estimation of RNA
   a) Orcinol method
   b) UV method
3. Comet Assay
4. Agarose Gel Electrophoresis
5. Isolation of plasmid DNA
6. Isolation of Genomic DNA
7. Isolation of RNA
8. Restriction digestion of DNA
9. Preparation of competent cell and Transformation
10. PCR – Demonstration
11. Southern Blotting –Demonstration

REFERENCE (LAB COURSE –III & LAB COURSE –IV)

1. Plant biochemistry – Practical. C.C. Giri & Archana Giri.
2. Introductory practical Biochemistry. S.K. Sawhney, Randhir Singh.
3. Biochemical methods, S.Sadasivam and A.Manickam 1992. Willey Eastern Limited, New Delhi.
4. J. Sambroke, E.F. Fritsch & T.Maniatis. Molecular cloning – A laboratory manual.
5. James .J. Greene, Veningalla.B.Rao. Recombinant DNA principles and methodologies
6. D.M. Glover and B.D.Hames. DNA cloning – a practical approach,

M.Sc. BIOCHEMISTRY

SEMESTER III

CORE VI - ADVANCED CLINICAL BIOCHEMISTRY

UNIT I

Approaches to clinical biochemistry: Concepts of accuracy, precision, sensitivity and reproducibility. Automation in clinical biochemistry laboratory and factors in quality control. Specimen collection and processing: Blood collection methods, anticoagulants. Collection of urine - urine preservatives, Timed urine specimens. Tests and Clinical significance of urinary compounds with reference to sugars, proteins, ketone bodies, bilirubin and porphyrins. Stool – chemical examination and clinical significance. CSF – collection and composition, chemical examination and clinical significance. Amniotic fluid: Origin, collection, composition and analysis of amniotic fluid.

UNIT - II

Disorders of carbohydrate metabolism – Diabetes mellitus - type I, II and gestational DM. metabolic abnormalities, diagnosis and management, acute and long term complications. glycogen storage diseases and Mucopolysaccharidoses.

Disorders of lipid metabolism, Lipid storage diseases - Taysach's and Niemann picks diseases, fatty liver and lipoproteinemias. Atherosclerosis – risk factors, biochemical findings and management. Obesity - types, metabolic changes.

UNIT -III

Disorders of amino acid metabolism: Inborn errors of Branched chain amino acids, aromatic amino acids, aliphatic amino acids.

Disorders of Nucleic acid metabolism: Purine and Pyrimidine metabolism – Hyper uricemia, Hyper uricemia, Gout, Lesch Nyhan syndrome and hereditary Ortotic aciduria.

UNIT – IV

Liver function test: clinical significance of AST, ALT, ALP and GGT. Jaundice – types and differential diagnosis.

Renal function test: clearance tests, tests for renal blood flow, concentration and dilution tests. Acute and chronic renal failure, glomerulonephrities, nephrotic syndrome, urinary calculi and dialysis.

Pancreatic function test. Gastro intestinal function test: fractional gastric analysis, stimulation tests. Detection of inborn errors in fetus and heterozygous carriers by enzyme assay in amniotic fluid.

UNIT – V

Disorders of mineral metabolism: Porphyrins, Hemoglobin - Disorders of erythrocyte metabolism, hemoglobinopathies, thalassemia and anemia, Classification of anemia, blood clotting disorders.

REFERENCE BOOKS

1. Teitz Fundamentals of Clinical Chemistry, Burtis,C. and Bruns,D.20073rd Edition, W.B. Saunders Company.
2. Practical Clinical Biochemistry, Volume I and II, Harold Varley, 19885th Edition, CBS Publishers.
3. Clinical Biochemistry in diagnosis and treatment, Philip. D. Mayne, 1994, 6th edition, ELBS publication.
4. Text Book of Biochemistry for Medical Students. Vasudevan D.M and Sreekumari S. 20075th Edition. Jaypee Publishers.
5. Textbook of Biochemistry. Thomas M. Devlin. 1997. 4th Edition. John Wiley, Inc Publication, New York.
6. Clinical Biochemistry – Metabolic and clinical aspects, William J.Marashall and Stephen K Bangert 1995.Pearson professional Ltd.
7. Biochemistry Jeremy M .Berg, John L Tymoczko and Lubert Stryer. 2007. 6th Edition. W H Freeman and Co, New York.

M.Sc. BIOCHEMISTRY

SEMESTER III

CORE VII - CONCEPTS OF IMMUNOLOGY

UNIT I

Overview of the immune system: Non – specific and specific components of immunity. Cells, primary and secondary organs of immune system. Hematopoiesis. Antigens – Immunogenicity, haptens, adjuvants, epitopes - T cell and B cell epitopes. Immunoglobulins- Structure, classes, biological activities, antigenic determinants, Ig superfamily, organization and expression of Ig genes, abzymes.

UNIT II

T cell and B cell receptors, Interaction of T cells and B cells. T cell and B cell maturation, activation and differentiation. Effector mechanism- Macrophage activation, cytokine mediated immunity. Clonal selection theory, Immunoglobulin rearrangements, Class switching. Complement system and regulation. Cytokines and Cell – mediated effector responses.

UNIT III

Organization and functions of MHC, structure of MHC molecules, Antigen processing and presentation. Classes of MHC molecules. Hypersensitive reactions [all types]. Immune response to infectious diseases. Transplantation types, MHC antigens in transplantation, Mechanism of graft rejection and Immunosuppressive therapy. Autoimmunity and Immunodeficiency diseases ; types, mechanism of HIV organization and pathogenesis

UNIT IV

Oncogenes, tumor antigens and cancer induction, metastasis, immune response to tumors, cancer immunotherapy. Immunization – Active and passive Immunization, types of vaccine and vaccine technology; Peptide vaccine, toxoids, Recombinant vector vaccine, DNA vaccine, Synthetic peptide vaccine. Hybridoma techniques- HAT media, Production of monoclonal and polyclonal antibodies. Gene transfer into mammalian cells – cultured cells and mouse embryosUNIT V

Experimental animal models – Inbred strains, Adaptive - transfer systems, Hemolytic plaque assay, SCID mice. Cell – culture systems - primary, cloned and hybrid lymphoid cell lines. Protein labeling techniques. Antigen - Antibody reactions –

Agglutination and precipitation, Immuno-electrophoresis, Immuno - blotting technique, RIA, ELISA - principle, types and applications. Immuno-fluorescence, Avidin-biotin mediated assay, Flow cytometry.

REFERENCE BOOKS

1. Kuby Immunology – Thomas J. Kindt, Richard A Golds 2013, 7th Edn., Publisher W H Freeman & Co.
2. Roitt's Essential Immunology Ivan Roitt, Peter Delves, et al., 2011, 12th Edition, Wiley –Blackwell Science.
3. Immunology, An Introduction. Ian R. Tizard, I.R Thomson press
4. The Immune System. Peter Parham Publisher Garland publishing
5. Cellular and Molecular Immunology. Abbas et al., 2011. Elsevier

M.Sc. BIOCHEMISTRY
SEMESTER III
CORE VIII - PHARMACEUTICAL BIOCHEMISTRY

UNIT I

Biopharmaceutical properties of drugs: Mechanism of drug absorption – physiochemical factors versus drug absorption. Drug dissociation versus drug absorption. Isomerism and pharmacological activity. Structural features and pharmacological activity; geometric isomerism, configuration influence on pharmacologic activity. Effect of conformational isomerism on biological activity of drugs.

UNIT II

Theoretical aspects of drug designing. Molecular modeling: Principles of computational chemistry, molecular mechanics, chemical methods. Hardware considerations, Software considerations. Receptors and drug action, Affinity – Role of chemical bonding. Dose – Response relationships, Receptor location, Receptor and the biological response. Receptor subtypes. Dynamic nature of receptors. Nonsteroidal anti – inflammatory drugs. Drugs affecting sugar metabolism. Drugs of clinical significance.

UNIT III

Drug metabolism: First pass metabolism – Elimination pathway – Entero - hepatic cycling of drugs. Drug biotransformation pathway – phase I – Hepatic cytochrome P_{450} enzyme system; Cytochrome P_{450} cycle – induction and inhibition. – Oxidation catalyzed by cytochrome P_{450} isoforms – All types of hydroxylation, Deamination – Dealkylation – Dehalogenation. Oxidations: Microsomal & Non – microsomal oxidations. Miscellaneous reductions.

UNIT-IV

Drug conjugation pathways (Phase – II): Hyaluronic acid conjugation – sulfate conjugation – conjugation with amino acids; Acetylation, Glutathione conjugation, cyanide conjugation. Extra hepatic metabolism – Toxicity from oxidative metabolism. Drug interactions – Ames test. Metabolic pathways of common drugs. Lovastatin, Acetaminophen, Ciprofloxacin, Caffeine, Theophylline, Nicotine, Ibuprofen, Tamoxifen. General toxicology: Basic principles of diagnosis. Mechanism of toxic effect, toxicokinetics. Response of respiratory system, reproductive system, liver, kidney to toxic agents. Toxic effects of metals, solvents and environmental pollutants.

UNIT-V

Toxicology: Principles of toxicology and treatment of poisoning. Heavy metals and antagonists. Non-metallic environmental toxicants. Methods involved in the development of new drugs. Preclinical toxicological studies. Determination of LD_{50} and ED_{50}. Acute, sub acute and chronic toxicity studies. Antidotes in the management of poisoning. Applied analytical toxicology and toxicovigilance.

REFERENCE BOOKS

1. Text Book of Biochemistry, B.Harrow and A.Mazur, 1966. 9th Edition, W.B.Saunders Co., Philadelphia.
2. An Introduction to Practical Biochemistry, D.T.Plumer, 19883rd Edition, Tata McGraw Hill, New Delhi.
3. Pharmacology and Pharmacotherapeutics, Satoskar,R.S et al., 2015 24th Edition, Popular Prakasham, Bombay.
4. Applied Biopharmaceutics and Pharmacokinetics, Shargel,L. et al., 2015. 7th Edition, McGraw-Hill Medical.

M.Sc. BIOCHEMISTRY

SEMESTER III

CORE IX - BIOSTATISTICS AND RESEARCH METHODOLOGY

UNIT I

Organizing a statistical survey, Planning and executing the survey. Source of data - Primary and secondary data collection. Classification and tabulation of data. Diagrammatic and graphic presentation of data.

UNIT II

Measure of central tendency - arithmetic mean, median, mode, quartiles, d eciles and percentiles. Measure of variation - range, quartile deviation, mean deviation, standard deviation, Coefficient of variation. Correlation analysis - Scatter diagram, Karl's Pearson's coefficient of correlation and Spearman's rank method. Regression analysis.

UNIT III

Sampling distribution and test of significance – Concepts of sampling, Testing of hypothesis, errors in hypothesis testing, standard error and sampling distribution, sampling of variables (large samples and small samples.). Student's " t" distribution and its applications. Chi-square test and goodness of fit. Analysis of variance - one way and two way classification. Duncan's Multiple Range test.

UNIT IV

Meaning and significance of research, characteristics and types of research, the research process, features of good research study. Research applications. Research report - Structure and components of scientific reports, types of report, writing and documentation of research report, developing successful research proposals,

UNIT V

Research problem - components of research problem, formulation of research problem, Research Design - Classification of research designs, need for research design, features of good research design, experimental research design

REFERENCE BOOK

1. Biostatistics analysis 1984, ZAR, J.H, Prentice Hall, New jerse
2. Statistical methods for biologists. Palanichamy. S and Manoharan. M 1990.
3. Statistical methods S.P Gupta, 2011. 4^{1st}edition. . S. Chand & Co.,
4. Biostatistics – A foundation for analysis in health science. Daniel 2006.
5. Research methodology- methods and techniques. Daniel 2006.
6. Research methods for biological science. Gurumani.N, 2007.MJP pub.
7. Research methods in biological science. Dr.S.Palanichamy, & M. Shanmugavelu,
8. Biochemical calculation and biostatistics. Dr. E.Padmini

M.Sc. BIOCHEMISTRY

SEMESTER III

ELECTIVE III - MICROBIAL BIOCHEMISTRY

UNIT I

Microbes; Bacteria, fungi, algae and protozoa. Viruses: Classification, characteristics. Ultra structure of bacteria - cell wall, cell membrane, cytoplasmic structures and cell inclusions. Cyanobacteria, Archeabacteria; Occurrence and classification. Classification and structure of bacterial, plant, animal and tumor viruses. Microbial growth – growth curve, measurement of growth, synchronuous growth, continuous culture, factors affecting growth. Microbial culture

- sterilization, preparation of culture media, enrichment culture techniques for isolation of autotrophs and heterotrophs.

UNIT II

Microbial metabolism – overview. Photosynthesis in microbes. Role of chlorophylls, carotenoids and phycobilins, Calvin cycle. Chemolithotrophy; Hydrogen – iron – nitrite oxidising bacteria; nitrate and sulfate reduction; methanogenesis and acetogenesis, fermentations – diversity, syntrophy - role of anoxic decomposition. Entner Doudoroff pathway, stickland reaction, Bacterial photosynthesis, pectin and aldo-hexuronate pathway. Nitrogen metabolism, nitrogen fixation, hydrocarbon transformation. Anaphlerotic reactions. Autotrophic metabolism. Amino acid synthesis in microbes.

UNIT III

Introduction to fermentation technology: Isolation and screening of industrially important microbes, Inoculum preparation - primary and secondary strain improvement. Detection and assay of fermentation products. Fermentation – Submerged and solid state fermentation. Fermenter - Types, Downstream processing. Microbes in mineral recovery and petroleum recovery - Bioleaching and Biosorption, Production of Biomass, Production of Single cell protein and Mushrooms.. Organic acids – Acetic acid, lactic acid, citric acid and gluconic acid. Solvent production - Ethanol and Butanol.

UNIT IV

Industrial Production: Antibiotics - Penicillin and streptomycin. Vitamins - B12 and riboflavin. Amino acid – Glutamic acid , Lssine , Threonine and Phenylalanine and Enzymes production; commercialpurposes and industrial production - Amylases, Lipases, Proteases,

Cellulases and Pectinases. Whole cell immobilization and industrial applications, nutritional values and safety evaluation, advantages.Types and sources of microorganisms in food. Factors influencing microbial growth in food. Fermented foods- Yoghurt, cheese. Production of beer, wine and vinegar.

UNIT V

Wastewater treatment- physical, chemical and biological treatment processes. Effluent treatment. Bioremediation, oil spill clean-up. Microbial mining. Bio fertilizers - bacteria and blue-green algae. Biopesticides in integrated pest management – Bascillus and Pseudomonas as biocontrol agents. Soil microbiota. Biogeochemical role of soil microorganisms. Microbial degradation of xenobiotics in the environment.

REFERNCE BOOKS

1. Basic Biotechnology Ratledge and Kristiansen 3rd edn., 2006. Cambridge Univ. Press.
2. Understanding Biotechnology, Borem, Santos, Bowen. 2003. Prentice Hall.
3. Industrial Microbiology, Casida L.E. JR 1987, 3rd Wiley Eastern reprint. John Wiley and Sons Inc.
4. Biotechnology. Smith JE. 4th edn Cambridge University Press.
5. Elements of Biotechnology, Gupta PK. 1998. Rastogi Publication.
6. Environmental Microbiology, Scragg A. 2005.1st ed. Amer Society for Microbiology.
7. Industrial and Environmental Biotechnology, 2001 Ahmed N.. Horizon Scientific Press.
8. Principles of gene manipulation, Primrose Twyman and Old.2001. 6th ed. Blackwell Science.
9. Encyclopedia of Bioprocess Technology. 5 vol. set. Flickinger and Drew (eds). 1999, John Wiley & Sons,

M.Sc. BIOCHEMISTRY

SEMESTER III

PRACTICAL V - LAB COURSE V

I Haematology

1. Enumeration of RBC and WBC
2. Differential count
3. Estimation of Haemoglobin
   a) Colorimetric method
   b) Sahli's method
4. Bleeding Time and Clotting time
5. ESR and PSV

II Blood/ Serum Analysis

1. Estimation of total blood sugar
2. Estimation of Total protein by Lowry's method
3. Determination of A:G ratio by Biuret method
4. Estimation of Urea DAM method
5. Estimation of Creatine and Creatinine- Alkaline picrate method
6. Estimation of Cholesterol- Zak's method
7. Estimation of Bilirubin [TB, DB & IB]
8. Estimation of Triglycerides
9. Estimation of Free Fatty Acids
10. Estimation of Vitamin C
11. Determination of LDH activity
12. Determination of AST & ALT activity
13. Determination of tissue antioxidant enzyme activity – SOD/CAT

III Urine Analysis

1. Estimation of Urea, Uric acid, Creatine and Creatinine
2. Estimation of Titrable acidity
3. Estimation of Phosphate
4. Estimation of Na & Ka
5. Estimation of Chloride- Vanslyke's method

1. IVUrinary Calculi analysis

V Internship- 30 days training in fully automated Diagnostic laboratory Score; 20 out of 40 marks in practical Internals

*Note: Practical + Internship combined for 3+1 credits

M.Sc. BIOCHEMISTRY
SEMESTER III
PRACTICAL VI - LAB COURSE VI

I IMMUNOLOGY

1. Blood grouping and Rh typing.
2. Cross matching.
3. VDRL Test
4. Pregnancy / Slide test
5. Immunodiffusion- Ag & Ab estimation
   a. Single/ Radial Immuno diffusion
   b. Double diffusion- Ouchterlony Method
   c. Counter Current Immunoelectrophoresis
   d. Immunoprecipitation
   e. Rocket Immunoelectrophoresis

II MICROBIOLOGY

1. Microscopic examination of bacteria, fungi, yeast morphology
2. Staining & Identification of microorganisms
   a. Simple staining
   b. Differential staining
   c. Acid fast staining
   d. Capsule staining
   e. Endospore staining
3. Culture of micro organisms
   a. Sterilization of glass wares
   b. Preparation of basal and selective media
   c. Pure culture tech – Streak plate (Different types), Pour plate, Screw plate
   d. Enumeration of microbes in soil and water (Serial dilution)
4. Biochemical characterization of organisms [Fermentation, Citrate utilization, VP-Test, Methyl Red test]
5. Determination of growth curve [Log phase – death phase]
6. Antibiotic sensitivity pattern comparison with natural phyto specimens

REFERENCE BOOKS

1. Principles and techniques of Biochemistry and Molecular Biology., J.Wilson and W.Walker, 2012. 7th Edn Cambridge University Press
2. Basic and Practical Microbiology ,Ronald M.Atlas , 1986, McMillian Publishers
3. Practical Clinical Biochemistry, volume I and II 1988. Harold Varley et al. 4th Edn CBS publishers.
4. Medical Laboratory Technology (Volume III): Procedure Manual for Routine Diagnostic Tests Kanai L.Mukerjee 2nd Edition, NewDelhi

PRACTICAL QUESTION PAPER PATTERN

LAB COURSE V [60 marks]

Experiment- I [25 marks]

Estimation in Serum/Blood sample

Experiment –II [20 marks]

Estimation of metabolites in urine sample

Viva [5 marks]

Record [10 marks]

LAB COURSE VI [60 marks]

Experiment- I [20 marks]

Staining and Identification of organism

Experiment –II [20 marks]

Enumeration of colonies [Serial dilution] in the given sample

Spotters [5marks]

Viva [5 marks]

Record [10 marks]

M.Sc. BIOCHEMISTRY

SEMESTER IV

CORE X - HUMAN PHYSIOLOGY AND ENDOCRINOLOGY

UNIT I

Digestive system – Structure, Digestive juices; composition and functions; digestion and absorption of carbohydrates, lipids, proteins. Intestinal and bile secretion and functions

Respiratory system - components and functions – transport and exchange of respiratory gases.

Circulatory system – structure and functions of heart, functions of blood, blood coagulation mechanism.

UNIT II

Excretory system – structure of nephron, formation of urine, tubular reabsorption; glucose, water, electrolytes and tubular secretion. Normal and abnormal constituents of urine.

Reproductive system - structure and functions of male and female reproductive system. Physiology of pregnancy and lactation. Spermatogenesis and Oogenesis. Brief account on the biological actions of testosterone and estrogen.

UNIT III

Nervous system – organization, conduction of nerve impulse and neuro transmission, action potential. Anatomical structure and function of nervous system, Gross anatomical structure of brain; CNS - Cerebral hemisphere, Diencephalon, brain stem, the spinal cord.

Muscle; Types of muscle. Structure of skeletal muscle. proteins - myosin, actin, troponin, tropomyosin and other proteins. Action potential, Reflex action, Mechanism and regulation of contraction and relaxation of skeletal muscle. The neuromuscular junction, Role of acetylcholine and Ach Receptor.

UNIT IV

Hormones; classification and mechanism of action of peptide hormones. Concepts of receptors – G protein coupled receptors – adenylate cyclase. Second messengers;

types and mechanism of action and Neurohormones. Mechanism of action of steroid hormones, structure of steroid receptors – functional domain – DNA binding sites. Nuclear transport mechanism, transcriptional and post transcriptional mechanism.

The hypothalamus-pituitary axis. Hypothalamic hormones, Anterior and posterior pituitary hormones: Biological functions and regulation.

UNIT V

Thyroid hormones: synthesis (no structures), secretion, regulation and biological actions. Hyperthyroidism and Hypothyroidism. Structures, synthesis, secretion, mechanism of action and Pathophysiology of hormones parathyroid.

Adrenal cortical hormones: synthesis (no structure), secretion, regulation and biological actions. Cushing's syndromes and Addison's disease. Adrenal medullary hormones: synthesis (no structures), secretion, regulation and biological actions of catecholamines. Pancreatic hormones: synthesis (no structures), regulation and biological actions of insulin and glucagon.

REFERENCE BOOKS

1. Endocrinology, Mac E. Hadley Publishers – prentice hall international Inc, 4th edition.
2. Text book of medical physiology Guyton, (2001. 10th edition.W.B.Saunders publishers
3. Principles of biochemistry. Emil I. Smith,
4. William's Endocrinology, Shlomo Melmed Kenneth Polonsky P. Reed Larsen Henry Kronenberg ,2015. 13th Edn. Elsevier publishers
5. Thompson. Molecular medical biochemistry., J.P. Luzio, R.J. Thompson, 1999. Cambridge University
6. Cell signaling , John T.Hanuck (2006). 2nd edition. Oxford University.

M.Sc. BIOCHEMISTRY

SEMESTER IV

ELECTIVE IV - BIOINFORMATICS AND NANOTECHNOLOGY

UNIT I

History, Scope and Importance

Important contributions - Aims and tasks of Bioinformatics - applications of Bioinformatics - challenges and opportunities - internet basics – HTML - introduction to NCBI data model - Various file formats for biological sequences.

Databases -Tools and their uses

Primary sequence databases - Composite sequence databases - Secondary databases - Nucleic acid sequence databases - Protein sequence data bases - Structural databases –- Protein structure visualization tools (RasMol, Swiss PDB Viewer)

UNIT II

Sequence Alignment Methods

Sequence analysis of Biological data - Significance of Sequence alignment - Pairwise sequence alignment methods - Use of Scoring matrices and Gap penalties in sequence alignments - Multiple sequence alignment methods – Tools and application of multiple sequence alignment. Definition of genome and genomics. Types of gene map-genetic, cytogenetic and physical. Molecular markers for mapping - RFLPs, microsatellites and SNPs. Assembling a physical map of the genome - chromosome walking and jumping.

UNIT III

Proteomics and Genomics

Genome projects: E.coli, D.melanogaster, A. thaliana and mouse. The human genome project: goals, mapping strategies, markers, sequencing technologies, results of final sequence, potential benefits and risks, ethical, legal and social issues (ELSI).UNIT IV

Introduction to Nanotechnology

Introduction, Definition, and Nanoscale, Classification of Nanomaterials: Quantum Dots, Wells and Wires. Carbon-based Nanomaterials - Nanotubes, Metal based Nanomaterials (Nanogold, Nanosilver and metal oxides). Properties of nano-structured materials

UNIT V

Synthesis and applications of Nanomaterials

Top-down (Nanolithography, CVD), Bottom-up (Sol-get processing, chemical synthesis). Biological methods of Synthesis: Use of Plant extracts, bacteria, fungi, yeast and other biological particles. Applications of Nanotechnology in Biomedical and Pharmaceutical Industries.

REFERENCE BOOKS

1. Bioinformatics - Concepts, Skills, and Applications " S.C. Rastogi & others 2003, "CBS Publishing.
2. "Bioinformatics - A practical guide to analysis of Genes & Proteins ", Andreas D Baxevanis & B F Francis, 2000. John Wiley.
3. "Introduction to Bioinformatics", Pearson Education, T K Attwood, D J parry – Smith, 2005. 1st Edition, 11th Reprint.
4. Nano: The Essentials Understanding Nanoscience and Nanotechnology, Pradeep.T (2007).I Edition, Tata McGraw – Hill Publishing Company Limited, New Delhi.
5. Nanotechnology Lakshman Desai ,2007. 1st Edition, Paragon International Publishers.
6. "Bioinformatics", C S V Murthy 2003, Himalaya Publishing House, 1st t Edition.
7. "Basic Bioinformatics', S. Ignacimuthu, S.J., 1995. Narosa Publishing House,
8. An Introduction to Computational Biochemistry, C.S. Tsai, 2002. Wiley Liss, New York.

M.Sc. BIOCHEMISTRY

EDC - PAPER II - HUMAN PHYSIOLOGY AND NUTIRITION

UNIT I

Digestive system: outline of digestive system. Buccal, gastric and Intestinal digestion. Role of liver in digestion. Intestinal- Absorption and assimilation- hormonal influence in digestion.

Excretory system ; Structure of kidney and ultra-structure of nephron. Formation and composition of urine. Outline of excretory system - ' Micturition'.

UNIT - II

Respiratory and Circulatory system: Types of respiration. - Outline of respiratory system' respiratory pigments, Transport of 0_2 and CO_2. Factors affecting oxygen dissociation curve and carbon dioxide dissociation curve. Chloride shift.

Circulatory organs, composition of blood, systemic, pulmonary circulation, Heartbeat, cardiac cycle, origin and conduction of heart beat, Regulation of heart beat, human heart' coronary circulation, ischemic heart disease, ECG, Blood pressure and cardiac output.

UNIT - III

Nervous and Muscular system: outline of nervous system, structure of neuron, types of neuron, neurotransmitters. Condition of nerve impulse transmission, synaptic transmission. Muscle –Types of muscle- Role of Actin and Myosin.-Action Potential. Neuro muscular junction. Reflex action.

UNIT - IV

Introduction on Nutrition: Food factors for human being. Nutritional classification, foods, Energy – Energy value of food and its determination, energy expenditure – components – basal metabolism, physical activity and thermogenesis- foods' Basal metabolism: Definition, determination of basal metabolic rate (BMR). Standards of BMR factors affecting BMR, energy utilization in cells and energy balance. Dietary fiber- Definition, types of fiber in plant foods, sources, composition, role of dietary fiber and resistant starch in nutrition, effect of over consumption of fiber.

UNIT - V

Nutritional consequences and Dietary Allowances Nutritive value of protein' Protein calorie malnutrition in children. protein and energy/ requirements Nitrogen balance

and imbalance.Deficiency Disease of Vitamins and Minerals (Iron, sodium, potassium, fluoride, magnesium and calcium.) Infant nutrition, nutrition for preschool children, school children, adolescents, pregnant and lactating mothers. Industrial workers. Geriatric nutrition and Lathyrism. Obesity: Aetiology and occurrence, physiological regulation of foods intake assessment, complication, treatment and prevention of obesity. Therapeutic diets.

REFERENCE BOOKS

1. Food Science ,Potter .
2. Text book of Medical Physiology -Guyton.A.C , W. B. Saunders publications
3. Text Book of Medical Biochemistry ,M.N, Chatterjea and Rana Shindhe 2002. 5th Edition Chatterjee . JayPee publications, NewDelhi.
4. Food facts and principles, 1987. Shakuntala Manay , John Wley and Sons
5. Modern nutrition in Health and disease , Robert S. Goodhart,Maurice,E. Shils.1980. Michael G. Wohl, Robert S. Goodhart and Maurice E. Shils (Editor)
6. Review of Medical Physiology by Ganong .W.F .2016, 25th Edition, A& L Lange series
7. Concise Human Physiology ,Sukkar.M.Y,EI-Munshid.H.Aand Ardawi.M.S.M.2000, John Wiley and Sons. .
8. Human nutrition and dietetics,s.Davidson and J.R.Passmore . ELBS, Zurich.
9. Nutrition in health and disease ,Whol& Gccd har-t .
10. Human nutrition and dietetics I.S. Garral ,W.P.T.James lLPs co3

M.Sc. BIOCHEMISTRY

EDC - PAPER III - HOSPITAL MANAGEMENT AND MEDICAL CODING

UNIT I

Introduction on Hospital management: Eligibility and personal skills required for Hospital management .Job opportunities in Hospital management. Important hospital management Institutes in India and World Hospital management. Concept of Modern Hospital & privatization in Health Sector, Public Sector Hospitals and Level of care f offered, facilities, Effects of Globalization in Health care, Concept of Corporate Hospital in developing countries,.

UNIT - II

Infrastructure and lay out of an ideal corporate hospital, -l Functioning of modern hospitals & changing need of patients Hospitality in Hospital Care, - Invasive and non-invasive diagnostic facilities in modern hospital Care offered in Specialty and Super specialty Hospitals. Hospital management system: Benefits of Hospital management systems, Modules of Hospital management system .Interfacing of analyzer Pathology lab management. Radiology, Blood Bank, Pharmacology management softwares.

UNIT - III

History of Medical Transcription: Drawbacks of MRP system, Advent of Medical Transcription .Web friendly operating system. Market information on companies. What Medical Transcription does? Benefits in a nut shell. Planning on Medical Transcription set up Induction and orientation.

UNIT - IV

Impact of Medical Transcription: Medical Transcription impact on its stock holders

Impact during the implementation process. Impact on Departments, Organization as whole, Employment, Nature of job, Information access and Individual employees. Advantages in corporate entity, Disadvantages.

.UNIT - V

Medical Transcription implementation: Medical Re engineering, Choosing appropriate transcription, Customise to suit the changes Medical Transcription: Best practices Costs, Failure, Gap analysis. Implementation, Life cycle Medical Transcription- Trouble and their solutions.

REFERENCE BOOKS

1. Hospital Management module II- NIHFW, New Delhi
2. G. D. Kunders. Hospital Administration.
3. Tabish. Hospital Administration. calorie malnutrition in children. protein and energy/ requirements Nitrogen balance