CONTENTS

PAPER STRUCTURE

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MSc. BIOCHEMISTRY (CBCS)

The Course of Study And Scheme of Examination for M.Sc Biochemistry

SEMESTER - I

Name of the Course	Title of the Paper& Sub Code	Hrs/ 6-Day order	Exam Hrs.	Marks Distribution			Credits
				Internal	External	Total	
Part - I Core Paper - I	Biomolecules	4	3	25	75	100	4
Part - I Core Paper - II	Intermediary Metabolism	4	3	25	75	100	4
Part - I Core Paper III	Plant Biochemistry	4	3	25	75	100	4
Part - I Core Paper - IV	Enzymes	4	3	25	75	100	4
Part –I Core Practical	**Major Practical –I**	5	-	-	-	-	-
Part –I Core Practical	**Major Practical –II**	5	-	-	-	-	-
Part - II Elective paper I	Membrane Biochemistry	4	3	25	75	100	3
Part - IV	Soft Skill	-	3	-	-	-	2
Total Credits		**30**					**21**

SEMESTER – II

Name of the Course	Title of the Paper	Hrs/ 6-Day order	Exam Hrs.	Marks Distribution			Credits
				Internal	External	Total	
Part – I Core Paper - V	Analytical Biochemistry	4	3	25	75	100	4
Part – I Core Paper - VI	Human Physiology and Nutrition	4	3	25	75	100	4
Part - I Core Paper - VII	Molecular Biology	4	3	25	75	100	4
Part - I Core Practical	**Major Practical –I**	5	6	40	60	100	4
Part - I Core Practical	**Major Practical –II**	5	6	40	60	100	4
Part - I Elective Paper II	Biotechnology	4	3	25	75	100	3
Part – II Elective III Paper	Bioethics, IPR & HR	4	3	25	75	100	3
Part - IV	Soft Skill	-	3	-	-	-	2
	Summer Internship will be carried out during the summer vacation of the first year for 4-6 weeks in any hospital, industry at the end of II semester. Marks will be included in the third Semester Marks Statement.						
Total Credits		**30 hrs**					**28**

SEMESTER - III

Name of the Course	Title of the Paper	Hrs/ 6-Day	Exam Hrs.	Marks Distribution			Credits
				Internal	External	Total	

		order					
Part – I Core Paper VIII	Advanced Clinical biochemistry	5	3	25	75	100	4
Part - I Core Paper – IX	Biostatistics	5	3	25	75	100	4
Part - I Core Paper – X	Microbiology	5	3	25	75	100	4
Part -I Core Practical	Major Practical –III	5	-	-	-	-	-
Part - I Elective Paper -IV	Hormonal biochemistry	5	3	25	75	100	3
Part - III Extra disciplinary Paper-I	Bioinformatics	5	3	25	75	100	3
Part - IV	Soft Skill	-	3				2
	Summer Internship will be carried out during the summer vacation of the first year for 4-6 weeks in any hospital, industry at the end of II semester. Marks will be included in the third Semester Marks Statement.						2
Total Credits		**30 hrs.**					**22**

Semester - IV

Name of the Course	**Title of the Paper**	**Hrs/ 6-Day**	**Exam Hrs.**	**Marks Distribution**			**Credits**
				Internal	**External**	**Total**	

		order					
Part – I Core Paper - XI	Immunology	5	3	25	75	100	4
Part -I Core Practical	Major Practical –III	5	6	40	60	100	4
Part - II Elective Paper -V	Bioremediation	5	3	25	75	100	3
Part - III Extra disciplinary Paper -II	Lifestyle Disease & prevention	5	3	25	75	100	3
Part - I Core Project	Project - Dissertation	15	nil	20	80	100	4
Part - IV	Soft Skill		3				2
Total Credits		**30**					**20**

Practical -I, Practical –II, Practical III Exams will be conducted at the end of the academic year.

Total Number of credits

1. **Semester I - 21**
2. **Semester II - 28**
3. **Semester III - 22**
4. **Semester IV - 20**

Total - 91

Core 11 theory papers x 4 credits = 44
5 Elective theory papers x 3 credits =15
2 Extra disciplinary paper x 3 =6
Core 3 practical x 4 credits = 12
Softskills 4 theory papers x 2 credits =8
Summer Internship =2
Project =4
Total =91

Pattern of Question paper for MSc Biochemistry (Theory)

Time : 3 hours Max Marks :100

Section A (10x2 =20 Marks)

Answer any 10 out of 12 Questions.

(Choose 2 questions from each unit and not more than 3 questions from any unit)

Section B (5 x7 =35 Marks)

Answer any5 out of 7 Questions.

(Choose 1 question from each unit and not more than 2 questions from any unit)

Section C(3 x15 =45 Marks)

Answer any 3 out of 5 Questions

(Choose 1 question from each unit)

SEMESTER – I

CORE PAPER – I BIOMOLECULES

TOTAL NO. OF HRS : 75

Objective: To understand the chemistry, structure, properties and functions of Biomolecules
(Note: Synthesis and degradation of the biomolecules are not a part of this paper)

UNIT I **15 HRS**

Definition, nomenclature, classification, structure, chemistry and function of Carbohydrates:- occurrence, classification and chemical properties of Monosaccharides:- structure and biological importance of sugars, their derivatives , NTPs, lactones, glycosides – Disaccharides, Lactose, Maltose, sucrose – Oligosaccharides – structure and biological importance - Homoglycans ; starch, glycogen, cellulose, dextrin, inulin, Heteroglycans - mucopolysaccharides – cell surface carbohydrates; bacterial cell wall polysaccharides.

UNIT II **15 HRS**

Classification, structure and properties of amino acids - Classification and biological functions of proteins - Primary structure of proteins and sequence determination. Peptide bond and its salient features. Secondary structure – α helix, β-pleated sheet and turns, Ramachandran Plot. Super secondary structures, motifs-helix-loop helix, hair-pin, β-motif, β-α-β motif . Conformational study of collagen .

UNIT III **15 HRS**

Tertiary structure of protein (myoglobin) – quaternary structure of proteins of hemoglobin. Forces that stabilize the protein structure - Chemical synthesis of Peptide, Folding of proteins.

UNIT IV **15 HRS**

Structure of Purine, Pyrimidine, nucleosides and nucleotides - Major classes of RNA, their structure and biological function. Watson and Crick Model, A,B, and Z forms of DNA. DNA super coiling - Properties of DNA – hypochromicity, hyperchromicity denaturation and renaturation, Cot curve, C value paradox. Maxam gilbert method, Sangers dideoxy method and enzymatic methods of sequence analysis. Chemical synthesis of oligonucleotides.

UNIT V **15 HRS**

Definitions, general structure of fatty acids, biological functions of lipids. Properties of lipids-classification of lipids-simple-fats, oil, waxes, compound lipids, phospholipids, sulpholipids , glycolipids. Derived lipids-structure and function of important steroids-cholesterol, progesterone, bile acids. Terpenes - mono,di,poly and sesqueterpenes. Carotene and xanthophylls.

Recommended Books:

1. Principles of Biochemistry - A.L. Lehninger, 4th edition, 2005, W.H. Freeman.
2. Biochemistry – Voet.D & Voet. J.G, 3rd edition, 2004, John Wiley & Sons, Inc.
3. The chemical reactions of living cells – Metzler D.E. 2nd edition, 2001, Academic Press.
4. Biochemistry – Zubay G.L, 4th edition, 1998, Mc Graw-Hill.
5. Harper's Biochemistry-Murray et al., 2000, 25th edition Appleton and lange Publishers`

SEMESTER – I

CORE PAPER II - INTERMEDIARY METABOLISM.

TOTAL NO. OF HRS:75

Objective: - To enable the students to comprehend, the anabolic and catabolic pathways and their regulation.

UNIT I **15 HRS**

CARBOHYDRATES; Definition of Metabolism, Anabolism and Catabolism. Carbohydrate metabolism: Aerobic and anerobic glycolysis and energetics of glycolyis. Pyruvate Dehydrogenase Complex.TCA cycle and energetics. Gluconeogenesis, Metabolism of glycogen, Pentose Phosphate Pathway

UNIT II **15 HRS**

LIPID METABOLISM- Biosynthesis of FA, sphingolipids, phosphoglycerides - Beta oxidation, Alpha oxidation, Omega oxidation. Biosynthesis and degradation of cholesterol, Role of HMG CoA Reductase - Arachidonic acid pathway – Eicosanoids.

UNIT III **15 HRS**

BIOLOGICAL OXIDATION: ETC – Redox potential – redox couple – action potential – free energy - Role of High energy phosphates, Components, sequence and Inhibitors of electron transport chain. Oxidative phosphorylation- the chemiosmotic hypothesis. F_0 F_1 ATP synthase. ATP biosynthesis. Uncouplers, ATP/ADP exchange, malate aspartate/glycerol phosphate shuttle.

UNIT IV **15 HRS**

AMINO ACID METABOLISM:Transamination and its mechanism, oxidative and non-oxidative deamination, decarboxylation-urea cycle and its regulation. Conversion of aminoacids to specialized products. Serotonin, gamma aminobutyric acid, dopamine, epinephrine, nor-epinephrine, creatinine, creatine.

UNIT V **15 HRS**

Nucleic Acid metabolism – Synthesis of Purine and pyrimidine – Denovo and Salvage pathway. Regulation - Degradation of purines and pyrimidines .

Recommended Books

1. Biochemistry - Geoffrey L, Zubay, 1998, 4th edition.
2. Fundamentals of Biochemistry - Donald Voet, Judith Voet and Pratt, 1995, 2nd edition.
3. Harper's Biochemistry - Murray et al, 2000, 25th edition, Appleton and Lange Publishers.
4. Principles of Biochemistry with human focus - Garrett and Grisham, 2002, Harcourt College Publishers, Orlando, Florida, USA.
5. Principles of Biochemistry - Lehninger, Nelson and Cox, 2005, 4th edition, WH Freeman and Company, New York, USA.

SEMESTER – I

CORE PAPER III - PLANT BIOCHEMISTRY

TOTAL NO. OF HRS:75

Objective: - To enable the students to understand the metabolism in plants

UNIT I **15 HRS**

Photosynthesis – Pigments in photosynthesis, Light and Dark reactions, Proton gradient and ATP synthesis in CHLOROPLAST. DCMU, regulation of photosynthesis, CAM metabolism, RUBISCO, photorespiration.

UNIT II **15 HRS**

Plant hormones - types and functions. Structure, mode of action, transport, distribution and physiological effect of Auxin, Gibberillin, Cytokinins, ABA and Ethylene.

UNIT III **15 HRS**

Secondary metabolites:- Special features and uses of terpenoids, flavanoids, lignin, tannins, pigments, phytosterol, alkaloids. Biofertilizers, Nitrate assimilation, structural features of nitrate reductase and nitrite reductase, incorporation of ammonia into organic compounds, regulation of nitrate assimilation. Nitrogen fixation – nodule formation – regulatory factors involved in modulation – nif genes.

UNIT IV **15 HRS**

Toxins of plant origin – Mycotoxins, Phytohemagglutinins, Lathyrogens, Nitriles, protease inhibitors, protein toxins. Stress metabolism in plants – Environmental stresses - salinity, water stress, heat, chilling, Stress due to heavy metals, radiations and their impact on plant growth and metabolism, criteria of stress tolerance.

UNIT V **15 HRS**

Antioxidative defense system in plants – reactive oxygen species and their generation, enzymic and non-enzymic components of antioxidative defense mechanism – peroxidase, glutathione, chlorophyll, pigments, carotenoids, oxidative stress.

Recommended Books

1) Introduction to Plant physiology- T.W.Goodwin,pergamon press,1986.
2) Principles OF Biochemistry by Albert Lehninger.
3) Modern Plant Physiology – R.K.Sinha,Narosa Publishing House
4) Microbiology – L.M.Prescottt 6th Edition,2004
5) Biotechnology-Dubey

SEMESTER I

CORE PAPER – IV ENZYMES

TOTAL NO. OF HRS: 75

Objective:- To understand the structure, function and the kinetics of enzyme catalyzed reactions.

Unit I **15 HRS**

Introduction - chemical nature and general characterization - nomenclature, IUB system of enzyme classification - Definitions with examples. Holoenzyme, apoenzyme, isoenzymes, monomeric enzymes, oligomeric enzymes, multi-enzymic complexes, coenzymes, cofactors , metalloenzymes, activators, inhibitors, active site, allosteric site, catalytic site, regulatory site on the enzyme molecule.Enzyme specificity, Enzyme units – IU, Katal, enzyme turnover number and specific activity.

Unit II **15 HRS**

Enzyme Kinetics - Introduction to chemical kinetics, rate and order of reactions, derivation of Michaelis - Menton Equation. Line - Weaver and Burk plot, Eadie- Hofstee plot, Hanes plot - Bi-substrate reactions - Brief introduction to sequential and ping-pong mechanisms with examples. Factors affecting enzyme activity - enzyme concentration, substrate concentration, pH and temperature. Enzyme Catalysis – Acid-Base catalysis, covalent, metal ion and proximity orientation effects.

Unit III **15 HRS**

Mode of action of enzyme Definition and significance of energy of activation - Lock and key theory and induced fit theory - Regulation of enzyme activity - definition types and examples. Mechanism of action of chymotrypsin, carboxypeptidase, ribonuclease and lysoenzyme.

Unit IV **15 HRS**

Enzyme inhibition – Definition, examples, determination of K_m and V_{max} in presence and absence of Competitive, non- competitive and uncompetitive inhibitiors (with kinetic derivations)

Coenzymes in enzyme catalysis : Reactions involving NAD/NADP, FMN/FAD, Coenzyme A, biotin, lipoamide, TPP, pyridoxal phosphate, Tetra hydro folate and cobamide

Unit V **15 HRS**

Immobilization of enzymes and their industrial application - abzymes - ribozymes - Medical application of enzymes - use of glucose oxidase in enzyme electrodes. Application of enzymes in food industry.

Recommended Books

1. Enzymes – Trevor palmer
2. Enzymes – Dixon and web
3. Biochemistry - Geoffrey L, Zubay, 1998, 4th edition.
4. Fundamentals of Biochemistry - Donald Voet, Judith Voet and Pratt, 1995, 2nd edition.
5. Principles of Biochemistry - Lehninger, Nelson and Cox, 2005, 4th edition, WH Freeman and Company, New York, USA.

SEMESTER I

ELECTIVE PAPER-I MEMBRANE BIOCHEMISTRY

TOTAL NO. OF HRS: 75

Objective:- To study the structure, composition and function of Membranes.

Unit I **15 HRS**

Biological Membranes – Structure and functions of plasma membrane Chemical composition and properties of biomembranes – Models of lipid membranes - preparation and properties. Detergents, micelles, Liposomes. Cytological, chemical and physical methods to study membrane structure, Lipid raft and calveolae - Different models of cell membrane a historical - perspective.

Cell-Cell communication-Gap junctions, desmosomes and tight junctions.

Unit II **15 HRS**

Red cell membrane- Isolation, Major Proteins in RBC membrane (Spectrin, Ankyrin, Band 4.1, Anion exchange proteins. Glycophorin) - Diseases caused due to mutations affect membrane proteins - Hereditary spherocytosis, Paroxysmal nocturnal hemoglobinuria. Plant cell Walls Structure, composition and biosynthesis.

Unit III **15 HRS**

Membranes surrounding mitochondria, Endoplasmic reticulum. Membrane surrounding nucleus and lysosomes. Bacterial cell wall- Structure Composition and biosynthesis. Inhibitors of cell wall synthesis.

Unit IV

Transport across biomembranes - Simple diffusion and Fick's law, facilitated diffusion - Kinetics of facilitated transport - Symport, antiport and Uniport. Active transport - protein Pumps - Na^+ - K^+ ATPase and its metabolic significance, Gastric HCl secretion .

Unit V **15 HRS**

Receptors-Definition and Types - Neurotransmitter and its types - Structure and functions of adrenergic and cholinergic, glucose receptors, Action potential generation, - Photoreceptors and vision - Receptor desensitization, Receptor mediated endocytosis, LDL receptors - biological and clinical significance - Familial hypercholesterolemia . Hormonal receptors -G-proteins and adenylate cyclase . Cystic fibrosis, Wilson disease

Recommended Books

1. Biochemistry – Stryer L, 4th editon, 1999, W.H. Freeman & Company, New York.
2. Biochemistry – Voet.D & Voet. J.G, 1st edition, 1990, John Wiley & Sons, Inc.
3. Principles of Biochemistry – Nelson D.L, Cox M.M, 2nd edition, 1993, CBS publishers & Distributors, Delhi.

SEMESTER II

CORE PAPER – V ANALYTICAL BIOCHEMISTRY

TOTAL NO OF HRS: 75

Objective:- To understand the principles and techniques used in biochemical studies

Unit I **15 hrs**

General approaches to biochemical investigation. Organ and tissue slice technique, and homogenization techniques, cell sorting and cell counting. Electrochemical techniques – principles of redox reactions, pH electrode. Clark's oxygen electrode and their applications. Method of investigating metabolism-principle- isotopic tracers.

Unit II **15 hrs**

Principle of Spectroscopy: spectra - definition, types-absorption & emission-wavelength, wave number, frequency. Principle, procedure and application of NMR and mass spectroscopy. Principle, procedure and application of UV-VIS and ESR spectrophotometry, spectrofluorimetry and X ray diffraction.

Unit III **15 hrs**

Chromatography: definitions, types-adsorption & partition. Principles, procedure and application - Paper chromatography – TLC. Column chromatography - Ion– exchange chromatography, gel filtration and affinity chromatography. Hydroxy apatite chromatography and hydrophobic interaction chromatography (HIC) - GLC and HPLC.

Unit IV **15 hrs**

Electrophoresis : General Properties of electrophoresis, support media, factors affecting electrophoresis, high voltage and low voltage electrophoresis, SDS – PAGE, isoelectric focusing, isotachophoresis, 2D PAGE and capillary electrophoresis. Cellulose acetate and continuous flow electrophoresis, pulse field gel electrophoresis, Agarose gel electrophoresis

Unit V **15 hrs**

Centrifugation- basic principles and laws of sedimentation. Preparative and analytical ultracentrifuges. Sedimentation equilibrium methods. Differential and density gradient centrifugation.

Radioisotopes-definition and examples, half life. Detection- GM counter, and scintillation counter, autoradiography. Units of radioactivity - Hazards and safety aspects in handling radioisotopes.

Recommended Books

1. David T. Plummer, 3rd Edition (1998), An Introduction to Practical Biochemistry
2. Keith Wilson, Kenneth H. Goulding, 3rd Edition 1992.A Biologists guide to Principles and Techniques of practical Biochemistry. Cambridge University Press.
3. Practical biochemistry: principles and techniques (5th edition, 2000) Keith Wilson and John Walker, Cambridge University Press.
4. Modern experimental biochemistry-3rd edition 2001 Oxford University–Rodney Boyer
5. Introductory Practical Biochemistry by Randhir singh and S.K. Shawney, third edition, 2005, Narosa Publising House Private Ltd

SEMESTER II

CORE PAPER - VI HUMAN PHYSIOLOGY & NUTRITION

TOTAL NO OF HRS:75

Objective: To study the physiology of human system and the nutritional aspects of micro and macronutrients

UNIT – I **15 HRS**

a) **Blood**: Composition and function, Red blood cells, Hemoglobin, white blood cells and platelets. Haemotopoiesis- Blood coagulation, blood groups and blood transfusion. Formation and functions of lymph.
b) **Circulatory System**- Heart - position, structure, properties of cardiac muscle. Overview of systemic and pulmonary circulation, conducting system of the heart, heart rate, cardiac cycle, cardiac output.

UNIT – II **15 HRS**

a) **Respiratory system**: components of Respiratory system, Mechanism of respiration. Bohr effect – gas exchange and partial oxygen pressure, chloride shift.
b) **Digestive system**: Secretion of digestive juices, digestion and absorption of carbohydrates, proteins and fats.

UNIT – III **15 HRS**

Excretory System: Components of Excretory system, structure of kidney. Mechanism of formation of urine, composition of urine Nervous system: Structure of neuron, resting potential and action potential, neurotransmitters-definitions, types – cholinergic and adrenergic with examples. Role of GABA -Mechanism of nerve impulse transmission.

UNIT IV **15 HRS**

Nutrition; Definition - Basic food groups. Nutritional Aspects of carbohydrates- Dietary sources, RDA, Physiological role; significance of fiber in the diet; Nutritional Aspects of proteins - Dietary sources, RDA, Physiological role; significance of essential aminoacids, Protein energy malnutrition in children; Nutritional Aspects of lipids - Dietary sources, RDA, Physiological role; significance of essential fatty acids, MUFAs, and PUFAs.

UNIT V **15HRS**

Vitamins - major classification, Dietary sources, RDA , deficiency symptoms and physiological functions of Vitamin A, D, Vitamin C, B1, B2 and folic acid - Dietary sources, RDA, deficiency symptoms and physiological functions of Physiological functions of dietary Calcium, phosphorus, magnesium, iron, iodine , zinc fortification – enrichment with examples.

Recommended Books

1. Physiology by Tora and Tora
2. Physiology by White Handler and smith
3. Human nutrition and Dietetics – Davidson and Passmore
4. Food science – M.S. Swaminathan.
5. Nutrition science-B. Srilakshmi (New Age Publishers)

SEMESTER II

CORE PAPER VII MOLECULAR BIOLOGY

TOTAL NO OF HRS: 75

Objective: To study the various mechanism of nucleic acids in prokaryotes and eukaryotes and regulations of gene in prokaryotes.

UNIT I **15 HRS**

REPLICATION – DNA as genetic material (Meselson & Stahl experiments), enzymology of replication in prokaryotes, replication in E.coli, Øx174 model, mitochondrial replication. Replication in eukaryotes. Regulation of replication in prokaryote and eukaryote.

UNIT II **15 HRS**

DNA REPAIR AND MUTATION- Direct repair , Mismatch repair, base excision,, nucleotide excision repair ,recombinant repair -SOS repair, Mutation-mutant, mutagen, Types-Spontaneous, induced, frameshift, site directed mutagenesis.

Unit III **15 HRS**

TRANSCRIPTION- Role of RNA polymerase, promoter site, consensus sequence, transcriptional factors –mechanism of prokaryotic and eukaryotic transcription, post transcriptional modifications and processing of mRNA- 5'capping, 3'polyadenylation, splicing mechanism ,t RNA, r RNA. Inhibitors of transcription.

Unit IV **15 HRS**

TRANSLATION- characteristics of genetic code, wobble hypothesis, monocistronic mRNA and polycistronic mRNA, structure of t RNA, ribosomal composition, mechanism of protein synthesis in prokaryotes and eukaryotes. shinedalgarno sequence,inhibitors of protein synthesis. Post translational modifications, protein folding- chaperons and heat shock proteins

Unit V **15 HRS**

Regulation of gene expression- gene expression regulation in prokaryotes-operon concept-positive and negative regulation of lac operon – role of cAMP and glucose - Trp Operon - attenuation

Recommended Books

1. Biochemistry Jeremy M. Berg, John L. Tymoczko, and Lubert Stryer (Hardcover - May 19, 2006)
2. Lehninger Principles of Biochemistry by David L. Nelson and Michael M. Cox (Hardcover - Feb 1, 2008)
3. The Biochemistry of the Nucleic Acids by R.L. Adams, J.T. Knowler, and D.P. Leader (Paperback - May 31, 1992)
4. Molecular Biology of the Gene (6th Edition) by James D. Watson, Tania A. Baker, Stephen P. Bell, and Alexander Gann (Hardcover - Dec 15, 2007
5. David Freifelder (1983) Jones & Bartlett publishers. 2ed Molecular biology. Reprint (1993) Narosa Publishing House.

SEMESTER II

ELECTIVE PAPER - II BIOTECHNOLOGY

TOTAL NO OF HRS:75

Objective: To understand the principles and applications of biotechnology

UNIT I **15 HRS**

Biotechnology definition -scope -importance. Basic techniques: agarose gel electrophoresis – isolation , purification and sequencing of DNA – hybridization methods – southern , northern and western blotting amplification of DNA – PCR- quantitative and qualitative.

UNIT II **15 HRS**

Medical pharmaceutical biotechnology – gene therapy – sickle cell anemia , cystic fibrosis.DNA in disease– pharmaceutical products of DNA technology . recombinant vaccines – monoclonal antibodies (hybridoma technology)

UNIT III **15 HRS**

Animal biotechnology: animal cell culture , tissue culture – gene transfer methods in animals – transfection microinjection , electroporation , use of polycation transgenic mice – knock out and knock in technology. Embryo transfer and invitro fertilization - applications

UNIT IV **15 HRS**

Plant biotechnology: Plant tissue culture – Role of Auxins, Cytokinins, Giberellic acid. somaclonal variations –microprojectiles , transgenic plant technology – for pest resistance , herbicide tolerance , delay of fruit ripening and use of plants to produce commercially important proteins – growth promoting bacteria in plants – antisense RNA technology.

UNIT V **15 HRS**

Genetic Engineering: Basic principles - mechanism of natural gene transfer by Agrobacterium, integration of foreign DNA molecules, restriction enzymes, their types and target sites, cutting and joining DNA molecules, linkers, adapters, homopolymers, enzymes used in genetic engineering, cloning vehicles and their properties, natural plasmids, invitro vectors, cosmids and T-DNA based hybrid vectors.

Recommended Books

1. Biotechnology – U.Sathyanarayana
2. Brown T.A gene cloning and DNA analysis
3. Tywann and primrose-principles of gene manipulation
4. Concepts and experiment in cell and molecular biology by Karp
5. Biotechnology by Dubey

SEMESTER II

ELECTIVE PAPER –III BIOETHICS, IPR & HR

TOTAL NO OF HRS:75

Objective: To introduce human rights and ethical issues related to human and animals.

UNIT I **15 hrs**

Introduction to HR, definition fundamental rights- International Instruments- UDHR- United Nation commission for HR- ICCPR (International Covenant on civil and political rights)- Historical Development of HR.

UNIT II **15 hrs**

Development of HR in India – Article 21 of Indian Constitution- Protection of Human Rights Act 1993- NHRC- SHRC (functions)-Economics of HR and Human Relations – Theory of moral sentiments by Adam Smith. Economic philosophy of Thiruvalluvar .

UNIT III **15 hrs**

Students activity – Assignment/seminar- case study- definition, women rights, newspaper articles- right to livelihood, right of women, right to food, water, education, medical care and shelter.

UNIT IV **15 hrs**

Bioethics- Definition; Ethical concerns regarding trangenesis. Bioethical issues of reproductive and therapeutic cloning - Applications of cloning- Therapeutic cloning and FDA approved cloned food. Bioethics in animal genetic engineering – IAEC guidelines of animal experiments; bioethics in plant genetic engineering, ethics of using recombinant drug.

UNIT V **15 hrs**

a) Genetically modified foods- contradiction – health hazards. Labeling- Regulations of field experiments and release of GMOs into the field, Biohazards, Biosafety measures.
b) Intellectual Property Rights- Introductions –Patent Procedure in India.

Recommended Books

1. Benjamin Lewin, 2000, Genes VII, First edition, Oxford, New York.
2. Adam Smith, Theory of Moral Sentiments
3. Thiruvalluvar, Thirukural: Arathuppal and Porutpal
4. Concept, theory and practical of human rights. Praveen Vadkar.
5. Contemporary issues in bioethics – Beuchamp.

SEMESTER – III

COREPAPER – VIII ADVANCED CLINICAL BIOCHEMISTRY

TOTAL NO. OF HOURS-75

Objective: To study the metabolic disorders and enzymes used in clinical studies

UNIT I **15hrs**

Disorders of carbohydrate metabolism - Glucose homeostasis, diabetes mellitus and its management, GTT, assay of $HbA_{IC,}$ glycogen storage disease. Inborn errors of metabolism-galactosemia, fructosuria and lactose intolerance.

UNIT II **15hrs**

Clinical enzymology - enzymes in plasma and their origin, Clinical significance of enzymes - isoenzymes (LDH, CK) - phosphatase, 5' nucleotidase, amylase, lipase, transaminase and gamma glutamyl transferase. Measurement of serum enzymes in diagnosis, enzyme pattern in myocardial infarction, liver, muscle and bone diseases.

UNIT III **14hrs**

Diseases related to lipid metabolism –Hyper cholesterolemia, atherosclerosis role of LDL – hyperlipoproteinemias and its types.

Diseases relating to liver - cirrhosis, hepatitis. Jaundice with its types. Inherited diseases of bilirubin metabolism – Criggler-najjar syndrome, Dubin Johnson syndrome Gilbert syndrome - Liver function tests.

UNIT IV **16 hrs**

Acidity, ulcers – gastrointestinal disorders - gastric, duodenal, colon cancer, pancreatitis, gastric and pancreatic function tests.

Diseases related to kidney - nephritis, nephrosis, uremia, renal failure, renal calculi, renal hypertension, renal tubular acidosis, and diabetes insipidus. Kidney function tests.

UNIT V **15 hrs**

Disorders of Blood - Blood dyschrasias, Agranulocytosis, Thrombocytopenia, Aplastic, Hemolytic anemia, Hemoglobinopathies, Thrombosis, leucocytosis, leucopenia

Recommended Books

1. Varley's Practical Clinical Biochemistry - Alan H Gowenlock, published by CBS Publishers and distributors, 1988, 6th edition, India.
2. Textbook of Biochemistry with clinical correlations-T.M.Devlin, 2002, 5th edition.
3. Biochemistry: A case oriented approach- Montgomery, Comway, Spector, Chappell,1996, 6th edition, Mosby Publishers, USA.
4. Medical Biochemistry by Chatterjea and Ranashinde
5. Medical Biochemistry by vasudevan and Srikumari

SEMESTER – III

CORE PAPER – IX BIOSTATISTICS

Objective: To study the scope and application of statistical analysis

TOTAL NO OF HRS:75

UNIT I **15 HRS**

Statistics – Scope –collection, classification, tabulation of Statistical Data – Diagrammatic representation – graphs – graph drawing – graph paper – plotted curve –Sampling method and standard errors – means – confidence limits – variance.

UNIT II **15 HRS**

Measures of central tendency – spearman test with an example (Problems included) measures of dispersion – skewness, kurtosis, moments – Correlation and regression – correlation table – coefficient of correlation – Z transformation – regression – relation between regression and correlation (Only theory).

UNIT III **15 HRS**

Normal distribution – graphic representation – frequency curve and its characteristics –measures of central value, dispersion, coefficient of variation and methods of computation – Basis of Statistical Inference –Sampling Distribution – Testing of hypothesis – Null Hypothesis –Type I and Type II errors (Only theory)..

UNIT IV **15 HRS**

Tests of significance for large and small samples based on Normal, t, z distributions (Problems included) with regard to mean, variance, proportions and correlation coefficient – chi-square test of goodness of fit – contingency tables – Tests of significance –t tests – F tests – Analysis of variance (Problems included) – one way classification – Two way classification.

UNIT V **15 HRS**

Spreadsheets – Data entry –mathematical functions – statistical function – Graphics display – printing spreadsheets – statistical analysis packages

Recommended Books

1. Zar, J.H. (1984) "Bio Statistical Methods", Prentice Hall, International Edition
2. Sundar Rao P. S.S., Jesudian G. & Richard J. (1987), "An Introduction to Biostatistics", 2nd edition,. Prestographik, Vellore, India,.
3. Warren,J; Gregory,E; Grant,R (2004), "Statistical Methods in Bioinformatics",1st edition,Springer
4. Milton,J.S.(1992),. "Statistical methods in the Biological and Health Sciences", 2nd edition ,Mc Graw Hill,
5. Rosner,B (2005), "Fundamentals of Biostatistics", Duxbury Press

SEMESTER III

CORE PAPER X- MICROBIOLOGY

TOTAL NO OF HRS:75

Objective: To study the structure and pathogenicity of microorganisms and microbial applications in certain industries

UNIT I **15 HRS**

General Microbiology

Ultrastructure of bacteria, fungi, algae and protozoa. Structure and functions of the cellular components. Cultivation of bacteria, Nutritional requirements and nutritional types of bacteria, Physical factors affecting growth, Bacterial growth curve –continuous growth , (chemostat and turbidostat) synchronous culture and enumeration of bacteria.

UNIT II **15 HRS**

DNA organization, extra chromosomal genetic elements – transfer of genetic information, transduction, transformation, conjugation, Hfr strains.

UNIT III **15 HRS**

Medical Microbiology: Distribution and occurrence of normal microbial flora on skin, respiratory tract, genitourinary tract, GI tract. Infection – types, methods of transmission, factors affecting infection - epidemiological terminologies - epidemic, pandemic, endemic - infectious disease transmissions. Pathogenic micro organisms - Salmonella, E.coli, Klebsiella, Streptococcus, and Mycobacterium, HIV.

UNIT IV **15 HRS**

Industrial microbiology: Outline of fermentation process, fermentor-Design and types (Continuous stirred tank fermentor, Airlift fermentor) Producer organism-Development of Industrial strains, Fermentation/Production medium, Downstream Processing. Products of industrial microbiology – penicillin, ethanol, vinegar, citric acid, and protease. Fermented foods - cheese, yoghurt, pickles, bread.

UNIT V **15 HRS**

Water Microbiology –microbes in waste water treatment – domestic and industrial. Bacteriological analysis of water.Food microbiology- food spoilage, food preservation – methods with example- Food infections –Clostridium, Staphylococcus and Salmonella and food toxicity.

Recommended Books

1. Microbiology - Michael J.Pelczar I.R., Chan E.C.S and Noel R.Kreieg, 2004, 5th Edition, 27th reprint Tata McGRAW-Hill, New Delhi.
2. Principles of microbiology-Atlas RM,1997, WCB publishers.
3. Microbiology –Prescott,2003, 3rd edition, Mc Graw hill, Boston.
4. Microbiology – Panicker, 2006,6th edition, Sarup & Sons ,New Delhi
5. Industrial Microbiology by Casida Jr

SEMESTER III

ELECTIVE PAPER - IV HORMONAL BIOCHEMISTRY

TOTAL NO OF HRS:75

Objective: To gain knowledge about the endocrine system and the disease conditions associated with its dysfunctioning along with signal transduction.

UNIT I **15 HRS**

Hormones - Definition. Classification – Based on chemical nature and mechanism of action, class I, class IIa, class IIb with examples - Receptors - structure and types. Agonoist and Antagonist –Definition. Secondary messengers-Definition Role of adenylate cyclase, G proteins, protein kinases, tyrosine kinase, Inositol phosphates, Diacyl glycerol, calcium, calmodulin. Steroid hormone receptors – Mechanism of steroid hormone action.

UNIT II **15 HRS**

Hypothalamus and pituitary hormones- hypothalamic hormones, Anterior pituitary hormones – actions and feedback regulation of synthesis. Glycoprotein hormones and POMC family. Natural Analgesics- Endorphins and Enkephalins. MSH. Posterior pituitary hormones- Oxytocin and vasopressin-Structure and biological functions . Disorders due to Hypo and hyperactivity of pituitary hormones-gigantism, acromegaly, dwarfism. Diabetes insipidus

UNIT III **15 HRS**

Pancreatic hormones – cell types of the islets of langerhans. Insulin – Biosynthesis and regulation of secretion, Biological actions, Mechanism of action. Insulin like growth factors - Glucagon –structure and functions. Role of Glucagon in glycogenolysis - Diabetes mellitus and its metabolic complications. Role of Somatostatin and Pancreatic polypeptide.

UNIT IV **15 HRS**

Thyroid hormones – Synthesis and secretion, Transport and biological actions. Antithyroid agents. Thyroid diseases –Grave's disease and Hashimoto's thyroiditis.

Calcium regulating Hormones: Calcitriol and calcitonin. Biosynthesis, functions. Rickets and osteomalacia – Calcium homeostasis – role of PTH. Hyperparathyroidism

UNIT V **15 HRS**

Adrenal hormones – Glucocorticoids, mineralocorticoids synthesis, secretion, transport. Biological effects. Adrenal androgens and estrogen – metabolic effects and functions.
Adrenal medulla – Catecholamines, biosynthesis, storage, regulation of synthesis. Abnormal secretion of Adrenal gland hormones – Addison's disease, Cushing's syndrome, Phaeochromocytoma.

Recommended Books

1. William's textbook of endocrinology – Wilson and Forester 8th edition.
2. Mechanisms of hormone action – Austin and short.
3. Harper's biochemistry – Murray *et al*.25th ed. McGraw hill, 2000.
4. Principles of biochemistry – mammalian biochemistry – smith *et al*. McGraw Hill 7th Ed.
5. Text book of Biochemistry with clinical correlations (eds.) T.M.Devlin (John Wiley).
6. Endocrinology by Mac.E.Hadley (Prentice Hall).
7. Tietz text book of clinical chemistry by Carl. A.Burtis and Edward R.Ashwood.
8. Essential endocrinology J.E.Wise (Oxford Press).

EXTRA DISCIPLINARY PAPER - I BIOINFORMATICS

TOTAL NO OF HRS:75

OBJECTIVE: To Understand the concepts of Biochemistry with the help of computers

UNIT I **15 HRS**

Basics of computers – Input, output, CPU, ALU and Memory units – definitions and examples. Introduction to operating systems (MS Windows, linux) – Features of WINDOWS operating system, use of internet, email, search engines (Google, yahoo)

Unit II **15 HRS**

Bioinformatics: definitions – Genomics, Proteomics, Metabolomics, Transcriptomics, Homologs, Orthologs and Paralogs. Prokaryotic and eukaryotic genome structure, Gene density, SNPs – gene diversity – gene ontology , gene order (synteny), plasticity zone, gene network, tandem repeats.

UNIT III **15 HRS**

Introduction to Biological databases: nucleotide databases (NCBI, GenBank , EMBL, DDBJ) protein databases (Swissprot, EBI, TrEMBL, PIR,) ; derived database (prosite, Pfam, PRINTS); Sequence submission methods and tools (sequin); sequence retrieval systems (Entrez); sequence file formats and conversion tools ; Genome (TIGR, SANGER); metabolic pathway database (KEGG,EcoCyc); specialized database (COG, LIGAND, BRENDA) Structural databases-PDB.

UNIT IV **15 HRS**

Alignments - sequence alignment – global alignment, local alignment; Scoring matrices - definition and method of derivation of the PAM & BLOSUM matrices. Dynamic Programming-Needleman Wunlch Algorithm, Smith Waterman Algorithm.

Phylogenetic trees- concept of dendogram and cladogram ; methods of construction - maximum parsimony method, maximum likelihood method and distance methods. Molecular Visualization tools-Rasmol, Swiss PDB viewer.

Unit V **15 HRS**

Drug Discovery-History, steps in drug discovery, Target identification, Taget validation-QSAR-Lead identification-Computer aided drug designing-Ligand based approach-Target based approach.

Recommended books

1. Lesk, a.m (2002) Introduction to bioinformatics
2. N. Gautham (2006) Bioinformatics
3. Bioinformatics – Kramer, Pearson education.
4. Rastogi.S.C Bioinformatics methods and applications, Prentice-Hall of India Pvt ltd, New Delhi
5. Lohar S. Prakash, 2009. Bioinformatics, MJP Publishers Chennai.

SEMESTER IV

CORE PAPER – XI IMMUNOLOGY

TOTAL NO OF HRS:75

Objective: To understand the immune system and its structure

Unit I **15 HRS**

Immunity : Classification, Innate immunity- Factors governing innate immunity- Mechanical, and cellular factors. Acquired immunity-Types

Cells of immune system. Lymphoid organs, Central and peripheral. Bone marrow, thymus, bursa of fabricius, spleen, lymph node, MALT, cells of lymphoreticular system. Vaccination – types – live, killed, attenuated, toxoids, recombinant vaccines.

Unit II **15 HRS**

Antigens and immunogens, Haptens, and adjuvants - definition. Factors affecting antigenicity. Epitopes and Paratopes.

Antibodies - Structure and function of IgG, IgA, IgM, IgD, and IgE. Isotypes, Allotypes and Idiotypes. Complements – classical and alternate pathways – disorders of complements activation.

Unit III **15 HRS**

B-cell markers. B cell development. Maturation, activation, differentiation of B cells. Theories of antibody formation - clonal selection theory. Molecular basis of antibody diversity

T cell marker, TCR structure and diversity, . Maturation, activation, differentiation of T cells.

Antigen processing & presentation - Cytosolic and endocytic pathway

Complement components and its activation (classical & alternate pathway)

Unit IV **15 HRS**

Hypersensitivity – immediate & delayed, Autoimmunity – Organ and Systemic specific diseases. Myasthenia gravis, Graves disease, Systemic lupus erythromatosis, Glomerulonephritis and Rheumatoid arthritis.

Transplantation immunology – MHC complex, class I and II structures and functions – graft vs. host reactions, HLA typing – lymphocytotoxicity, cross matching, immune suppressive agents.

Unit V **15 HRS**

Antigen – antibody reactions – precipitation & agglutination reactions – applications – WIDAL test and Coombs test – immunodiffusion – SID, DID – immunoelectrophoresis.

ELISA and its types, Immunofluorescence - Direct, indirect and FACS. Monoclonal antibodies production and applications – RIA.

Recommended Books

1. Janes Kuby, 1997. Immunology, Third edition, W.H. Freeman and company, NewYork.
2. Essential immunology – Ivan Roitt 1997, Blackwell science publications, UK.
3. A Hand book of practical immunology – Talwar G.P, 1983, Vikas Publishing House.
4. An introduction to immunology – Rao C.V 2002, 1st edition, Narosa Publishers, India.
5. Roitt. 1996. Immunology. Black well Scientific Publications.

SEMESTER IV

ELECTIVE PAPER - V BIOREMEDIATION

TOTAL NO OF HRS: 75

OBJECTIVE:

This course will introduce students to the variety of ways in which microbes interact with their immediate surroundings, i.e. soil and water, and plant and animal hosts. It will also demonstrate how microbes have adapted to survive in extreme environments, and how the properties of microbes can be exploited for human benefit.

Unit I bioremediation 15 HRS

Introduction to Bioremediation, Types of Bioremediation, Bioremediation of surface soil and sludges, Bioremediation of subsurface material, In situ technologies, Ex-situ technologies, Phytoremediation, Bioaugmentation of naturally occurring microbial activities :- Environmental modification- use of co-substrates, oxygen supplementation (Composting and aerobic bioreactors, in situ aeration).

Unit II biodegradation 15 HRS

General microbial strategies for initiating attack on xenobiotics - Biodegradation strategies for key classes of compounds - Factors affecting biodegradation.

Unit III molecular techniques in bioremediation 15 HRS

Use of genetically altered microorganisms for field biodegradation of hazardous materials. Bio leaching and Bio mining. Bioremediation technologies to remove heavy metals and radionuclides using iron Fe(III) , sulphate and sulphur reducing bacteria.

Unit IV hazardous waste management: 15 HRS

Introduction - Hazardous wastes-biodegradation of Hazardous wastes - biological detoxification of cyanide -market for hazardous wastes management-biotechnology applications to hazardous wastes management- Source and Management Safety.

Unit V special topics in bioremediation technology 15 HRS

Environmental Nanotechnology Research - Nanotechnology for Bioremediation of Heavy metals - Bioremediation of Petroleum Sludge using Bacterial Consortium and Biosurfactant - Biofilms in Porous Media: Mathematical Modeling and Numerical Simulations – Biosensor Technology for monitoring pollutants.

Recommended Books

1. Environmental biotechnology, 1995 S.N.Jogdand. Himalaya Publishing House, Bombay, Delhi, Nagpur.
2. Bioremediation 1994 Baker, K.H.and Herson, D.S. McGraw Hill, Inc.New York.
3. Biotechnology biology 1997 P.K.Gupta, Rastogi Publications, Meerut.
4. Molecular biology of the gene IV edition Watson, J.D.,Hopkins, N.H., Roberts, J.W.,Steitz, J.A.,Weiner, A.M. The Benjamin- Cummings Publications company Inc.
5. Environmental Bioremediation Technologies by Shree N. Singh; Rudra TripathI
6. Crawford R.L. Crawford D.L. Bioremediation: Principles and Applications Cambridge Univ. Press, 1996.

SEMESTER IV

EXTRA DISCIPLINARY PAPER-II LIFE STYLE – DISEASE AND PREVENTION

TOTAL NO OF HRS: 75

Objective- To educate the students on various common lifestyle diseases and its preventive measures.

UNIT-I

Obesity- prevalence –causes, consequences, symptoms- Coronary Heart.
Disease and type 2 diabetes mellitus- lifestyle and dietary management of obesity.

UNIT-II

Hypertension – blood pressure - normal level of blood pressure, dietary management of hypertension, stroke and chronic renal failure due to hypertension.
Kidney stone- causes, types, symptoms and treatment (only Lithotropy), dietary management for prevention of kidney stones.

UNIT-III

Cancer-types of cancer, etiology of breast cancer diagnosis (self examination, Mammography) and treatment (radiation, chemotherapy, surgery).Cervical cancer causes, types, symptoms, diagnosis and treatment (radiation, chemotherapy, surgery). Cigarette smoking and symptoms, diagnosis and treatment (chemotherapy).

UNIT-IV

Aging-Factors influencing aging. Age related diseases- dementia, osteoporosis,
Osteo arthritis - causes sign and symptoms, preventive measures of aging with special reference to antioxidants.

UNIT-V

Gallstones- causes, factors, aetiology of gall stones, types of gall stones, symptoms, preventive aspects of gall stone. Drug therapy – ursodeoxy cholic acid, surgical treatment and dietary management. **–** Ulcer – causes and prevention.

Recommended books

Thomas M.Devlin (2014) Textbook of Biochemistry with Clinical Correlations (7th ed). John Wiley & Sons
2.Montgomery R, Conway TW, Spector AA (1996),Biochemistry: A Case-Oriented Approach (6th ed), Mosby Publishers, USA.
3.Tietz Fundamentals of Clinical Chemistry and Molecular Diagnostics (2014) (7th ed),Saunders
4. Dinesh Puri, (2002), Text book of Biochemistry : A clinically oriented approach - Churchill Livingstone Inc., India.
5. M.N.Chatterjee and Rana Shinde (2007).Textbook of Medical Biochemistry (7th ed)