Mangalore University
Choice Based Credit System
Course pattern & scheme of Examination
Core Subject: **Biochemistry**

Core/Elective	Course Code	Title of the Course	Instruction hours/ week	Duration of the examination (hours)	Max. marks			Credits
					Exam	IA	Total	
I Semester BSc								
Group I Core subjects	Theory BSCBCC 131	Bioinorganic & Biophysical Chemistry	4	3	80	20	100	2
	Practical BSCBCP 132	Biochemistry Practical-I	3	3	40	10	50	1
Group II Elective	Core Elective BSCBCCE 133	Cell Biology	2	2	40	10	50	1*
Total number of credits for core subjects in I Semester=03								

Core/Elective	Course code	Title of the Course	Instruction hours/week	Duration of the examination (hours)	Max. marks			Credits
					Exam	IA	Total	
II Semester BSc								
Group I Core subjects	Theory BSCBCC 181	Bioorganic Chemistry-I	4	3	80	20	100	2
	Practical BSCBCP 182	Biochemistry Practical-II	3	3	40	10	50	1
Group II Elective	Core Elective BSCBCCE 183	Cell Cycle & Genetics	2	2	40	10	50	1*
Total number of credits for core subjects in II Semester=03								

Core/Elective	Course code	Title of the Course	Instruction hours/ week	Duration of the examination (hours)	Max. marks			Credits
					Exam	IA	Total	
III Semester BSc								
Group I Core subjects	Theory BSCBCC 231	Bio-organic Chemistry II	4	3	80	20	100	2
	Practical BSCBCP 232	Biochemistry Practical-III	3	3	40	10	50	1
Group II Elective	Core Elective BSCBCOE 233	Food-Environmental Chemistry & Hematology	2	2	40	10	50	1*
Total number of credits for core subjects in III Semester=03								

Core/Elective	Course code	Title of the Course	Instruction hours/week	Duration of the examination (hours)	Max. marks			Credits
					Exam	IA	Total	
IV Semester BSc								
Group I Core subjects	Theory BSCBCC 281	Biomolecules & Biochemical Techniques	4	3	80	20	100	2
	Practical BSCBCP 282	Biochemistry Practical-IV	3	3	40	10	50	1
Group II Elective	Core Elective BSCBCCE 283	Analytical Techniques	2	2	40	10	50	1*
Total number of credits for core subjects in IV Semester=03								

Core/Elective	Course code	Title of the Course	Instruction hours/week	Duration of the examination (hours)	Max. marks			Credits
					Exam	IA	Total	
V Semester BSc								
Group I Core subjects	Theory BSCBCC 331	Enzymology & Metabolism	4	3	80	20	100	2
	Theory BSCBCC 332	Molecular Biology & Genetic Engineering	4	3	80	20	100	2
	Practical BSCBCP 333	Biochemistry Practical -V	4	3	80	20	100	2
Total number of credits for core subjects in V Semester=06								

Core/Elective	Course code	Title of the Course	Instruction hours/week	Duration of the examination (hours)	Max. marks			Credits
					Exam	IA	Total	
VI Semester BSc								
Group I Core subjects	Theory BSCBCC 381	Human Physiology & Clinical Biochemistry	4	3	80	20	100	2
	Theory BSCBCC 382	Nutrition, Microbiology & Immunology	4	3	80	20	100	2
	Practical BSCBCP 383	Biochemistry Practical -VI	4	3	80	20	100	2
Total number of credits for core subjects in VI Semester=06								

*Credits for elective papers will be considered for the entire BSc program.

BASIS FOR INTERNAL ASSESSMENT, PATTERN OF THEORY QUESTION PAPERS AND PRACTICAL EXAMINATION IN SCIENCE SUBJECTS

1. Basis of internal Assessment in Theory and Practical

The internal assessment marks in theory papers shall be based on two tests. The tests shall be of at least 1 hour duration each and to be conducted after 6 and 12 weeks after the start of a semester. The average of the two tests shall be taken as the internal assessment marks in theory papers.

The practical internal assessment marks shall be based on one test and continuous evaluation during the practical. The practical test shall be conducted after 10 weeks after the start of a semester. The average of the tests and continuous evaluation shall be taken as the internal assessment marks in practical.

2. Theory Question Papers Pattern:

Theory Question Papers in Biochemistry shall carry 80 marks. The syllabus of each paper is grouped into four (4) units of 12 teaching hours. The Question Paper shall consist of Parts A and B, as detailed below:

Part A: Part A shall contain 12 objective type questions/divisions (Q. No. 1) drawn from all the 4 units of the syllabus (3 divisions per unit) carrying 2 marks each (a, b, c, d, e, f, g, h, i, j, k& l.). 10 divisions are to be answered. 10x2=20 marks

Part B: Part B shall contain eight (8) brief and long answer questions (Q. Nos. 2 to 9) carrying 15 marks each drawn from all the four units of the syllabus (2 questions per units). There shall be three divisions per question. The students are required to answer 4 full questions, choosing one full question from each unit. **4x15=60 marks**

	Unit I		**Unit II**		**Unit III**		**Unit IV**	
Q. Nos. (Max. Marks 15)	2	3	4	5	6	7	8	9
Marks Splitting	4+4+7 (4+3)	3+5+7 (3+4)	4+4+7 (4+3)	3+5+7 (3+4)	4+4+7 (4+3)	3+5+7 (3+4)	4+4+7 (4+3)	3+5+7 (3+4)

BIOCHEMISTRY- SEMESTER SYLLABUS

I SEMESTER

BSCBCC 131: BIO-INORGANIC AND BIO-PHYSICAL CHEMISTRY

Unit-I

1. Acids, bases and buffers: 5 Hrs.

Lewis concept of acids and bases. Ionic product of water. pH scale, buffers. Derivation of Henderson-Hesselbach equation, buffer capacity. Preparation of acidic and basic buffer solutions. Buffer of blood plasma, RBC, and tissue fluids. Theory of acid-base indicators. pH titration curve and isoelectric pH of amino acids.

2. Electrochemistry: 6 Hrs.

Specific, equivalent and molar conductance. Reference Electrodes- Hydrogen electrode, Calomel electrode, Quinhydrone electrode, Glass Electrode. Determination of Equivalent conductance of a strong electrolyte. Conductance titration (strong acid against strong base, weak acid against NaOH, Determination of pKa values of weak acid by potentiometric titration. Determination of pH of a buffer by potentiometric method using quinhydrone electrode.

3. Viscosity: 1 Hr.

Definition, Determination of viscosity of liquids and solutions by Ostwald's viscometer.

Unit-II

1. Photochemistry: 5 Hrs.

Laws of photochemistry, quantum efficiency, Light absorption, Luminescence- Fluorescence, Phosphorescence, Bioluminescence, Chemiluminescence. Beer-Lambert's law, Spectrophotometer, Colorimeter.

2. Metal ions in Biological System: 5 Hrs.

Examples of some naturally occurring complex compounds in living systems. Role of iron in Haemoglobin, myoglobin and cytochromes. Copper in Haemocyanin, magnesium in Chlorophyll, cobalt in Vitamin $B_{12,}$ and molybdenum in Nitrogenase. Metalloenzymes.

3. Stoichiometry: 2 Hrs.

Mole concept, equivalent weights of elements, acids, bases, oxidizing agents, reducing agents. Volumetric Analysis- Normality, Molarity, Molality.

Unit-III

1. Air Pollution: 5 Hrs.

Air pollution types and sources of air pollutants- (inorganic gases, oxides of carbon, nitrogen and sulphur, organic gases and particulate matter- lead fibrous silicate), their sources, effects and control. Determination of carbon monoxide and sulphur dioxide in air. Bhopal Gas Tragedy.

2. Water Pollution: 5 Hrs.

Types of water pollutants, sources of water pollution, domestic, industrial and agricultural soil. Biodegradation dissolved oxygen level of water, biochemical oxygen demand of water, chemical oxygen demand, industrial effluents and their effects. Treatment of polluted water and sewage treatment. Purification of water for drinking purpose. Acid rain. Taj Mahal incidence.

3. Biochemical Toxicology: 2 Hrs.

Toxicity of Lead, Mercury, Cadmium and Arsenic

Unit-IV

1. Radioactivity: 6 Hrs.

Natural and artificial radioactivity. Characteristics of radioactive elements, units of radioactivity, disintegration constant, Half-life period, α- and β- radiation. Detection of radioactivity by GM counter. Application of radioisotopes- ^{3}H,^{14}C,^{131}I, ^{60}Co and ^{32}P. Biological effects of radiations. Free radicals: generation, detection, scavenging and affects. Radioactive decay- uranium to lead.

2. Radiation safety aspects: 6 Hrs.

Sources of pollutants, effects on vegetation and health. Detection and monitoring of radioactive pollutants. Methods of safe disposal of radioactive wastes. Nuclear disaster. Safety measurements in handling radioisotopes. Dosimetry. Units- Rad, ram, film badge. Safety limits of exposure to radiation. Detection of radiation. Scintillation-solid and liquid.

I SEMESTER

BSCBCP 132: BIOCHEMISTRY PRACTICAL - I

1. Use of analytical balance and calibration of pipette.
2. Preparation of standard sodium carbonate solution, standardization of HCl and estimation of NaOH in the given solution.
3. Preparation of standard oxalic acid solution, standardization of NaOH and estimation of $H_2 SO_4$ in the given solution.

4. Preparation of standard potassium bipthalate solution, standardization of NaOH and estimation of HCl in the given solution.
5. Titration curve for amino acids and determination of p^{Ka} value using p^{H} meter.
6. Verification of Beer-Lambert's law for copper-ammonia complex.
7. BOD
8. COD
9. Conductometric titration of strong acids against strong base.
10. Preparation of acidic and basic buffers and determination of p^{H} using p^{H} meter.

References:

1. Principles of physical chemistry- Puri and Sharma
2. Text book of inorganic chemistry- P.L Sony (2000) Sulthan Chand & Sons
3. Biophysical chemistry, principles and techniques- Upadhyaya, Upadhyaya and Nath (2005) Himalaya publishing house.
4. Biophysics- G.R.Chatwal (2003) Himalaya publishing house

II SEMESTER

BSCBCC 181: BIO-ORGANIC CHEMISTRY-1

Unit-I

1. **Introduction to Organic Chemistry:** **2 Hrs.**

Classification of organic compounds, unique characteristics. IUPAC nomenclature of organic compounds

2. Bonding: **2 Hrs.**

Covalent bond, non-covalent bonds, ester bond, phosphodiester bond, N-C bond. Bonding in water. Significance of water in biological system.

3. Stereochemistry of organic compounds: **8 Hrs.**

Optical isomerism, elements of symmetry, molecular chirality, enantiomers stereogenic center, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogenic center- example-lactic acid and tartaric acid, diastereomers, threo and erythro diastereomers, meso compounds, resolution of enantiomers. Inversion and racemization, relative and absolute configuration sequences. D an L, R and S systems of nomenclature.

Geometrical isomerism, determination of configuration of geometric isomers, E and Z system of nomenclature, geometric isomerism in oximes and alicyclic compounds.

Unit-II

1. Aliphatic Hydrocarbons: 6 Hrs.

Dienes: Types with examples. 1,3-butadiene- preparation from n-butane and 1,4-dihaloalkanes. Mechanism of addition of HBr. Diels-Alder reaction. Mechanism of Markownikoff's rule-addition of HBr to propene. Mechanism of Antimarkownikoff's addition of HBr to propene. Conformational analysis of ethane and butane.

2. Arenes: 6 Hrs.

Structure of benzene- Resonance and molecular orbital theories. Aromaticity. Electronic interpretation of the orienting influence of substituents in the electrophilic substitution of toluene, chlorobenzene, nitrobenzene and phenol.

Polynuclear hydrocarbons: Naphthalene and Anthracene, Reactions- oxidation, nitration, sulphonation of naphthalene and oxidation of Anthracene.

Unit-III

1. Reaction Mechanisms: 8 Hrs.

Concept of inductive effect, hyper conjugation and resonance. Classification of organic reactions with one example each. Concepts of the following- carbanions, carbocations, free radicals and nitrenesñtheir formation and stability. Nucleophiles and electophiles. Mechanism of substitution reaction- S_N1 and S_N2 reactions. Mechanism of elimination reactions -E1 and E2

2. Polymers: 4 Hrs.

Classification, polymerization process, number average and weight average molecular weights. Manufacture and applications of polythene, PVC, Nylon and terylene. Biomedical polymers and polymer drugs

Unit-IV

1. Hydroxy acids: 3 Hrs.

Structure, preparation and properties of lactic, tartaric and citric acids. Biological importance of hydroxyl acids.

2. Dicarboxylic acids: 4 Hrs.

Structure preparation and properties of Succinic, maleic and fumaric acids. Ketoacids- preparation and properties of pyruvic acid.

3. Pharmaceutical chemistry: 5 Hrs.

Analgesic, antipyretic, antibiotics, antiseptics, disinfectants, antivirals, antifungals, tranquilizers, antimalerials with example. Preparation of aspirin, paracetamol, chloroxyleneol chloremphenicol, sulphanilide and barbituric acid. Structure, chemistry and uses of aspirin, paracetamol, penicillin, chloroxylenol, barbituric acid and chloroquin.

II SEMESTER

BSCBCP 182: BIOCHEMISTRY PRACTICAL - II

Qualitative analysis of following organic compounds:

Urea, Benzamide, Benzaldehyde, Aniline, Acetophenone, O-Cresol, Nitrobenzene, Chlorobenzene, Bromobenzene, Toluidine, Benzoic acid, Resorcinol, Oxalic acid

References:

1. Advances in organic chemistry- Arun Bhal and B.SBhal.(2000), Sulthan Chand & Sons.
2. Organic chemistry- P.Y.Bruice(2002) Pearson Publishers.
3. Text book of organic chemistry- P.L Sony (2000) Sulthan Chand & Sons.
4. Chemistry of Natural products- O.P.Agarwal(1998) Goel Publishing House

SEMESTER-III

BSCBCC 231: BIO-ORGANIC CHEMISTRY-2

Unit-I

1. Amines: 4 Hrs.

Classification, Basicity of amines. Effect of substituents on basicity of amines, Reaction of amines- Alkylation, Acylation, reaction with HNO_2 and Schiff base formation. Diazotization and aromatic substitution, Separation of primary, secondary and tertiary amines from a mixture, Distinguishing reactions of primary, secondary and tertiary amines.

2. Water soluble vitamins: 8 Hrs.

Structural formula, co-enzyme forms, dietary sources, deficiency symptoms and biological role of B1, B2, B6, Niacin, Folic acid, biotin, pantothenic acid and vitaminB_{12}. Synthesis sources, deficiency symptoms and biological role of Vitamin C. Vitamin C as redox reagent.

Unit-II

1. Heterocyclic compounds: 6 Hrs.

Biological occurrence, structural formula and importance of Furan, Pyrrole, Thiopene, Pyridine, Pyran, Thiazole, Pyrimidine, Purine, Indole, Imidazole, Quinoline and Isoquinoline.

2. Fat soluble vitamins: 6 Hrs.

A, D, E and K- structural formula, dietary sources, requirements, deficiency symptoms and biological role. Synthesis of vitamin-A

Unit-III

1. Steroids: 4 Hrs.

Basic ring system in steroids, structure, occurrence, properties and physiological activity of Cholesterol, structure and biological importance of Ergosterol, Bile acids and Ecdysone.

2. Terpenoids: 4 Hrs.

Isoprene rule, Classification, structure, occurrence and importance of Monoterpene- limonene, menthol and camphor and α-pinene. Sesquiterpenes- Santonin, Juvenile hormone-I and Abscisin-II. Diterpenes- Phytol. Triterpenes- Lanosterol. Tetraterpenes- Lycopene, β-carotene. Polyprenols-Dolichols.

3. Natural Pigments: 4 Hrs.

Structure, occurrence, functions and applications of Heme, Chlorophyll, flavones and anthocyanin.

Unit-IV

4. Alkaloids: 6 Hrs.

Definition, occurrence, general properties, Classification with examples, structure and physiological action of LSD, Morphine, Aristolochic acid, Nicotine Atropine, cocaine and quinine.

5. Spectroscopy: 6 Hrs.

Electromagnetic radiation, Principle of spectroscopy, IR spectroscopy, UV spectroscopy, NMR spectroscopy, Mass Spectroscopy-Principle, instrumentation and applications in the elucidation of structure of organic molecules.

III SEMESTER PRACTICAL

BSCBCP 232: BIOCHEMISTRY PRACTICAL- III

1. Organic Preparations:

Preparation of a) Benzoic acid from Benzaldehyde or Toluene

b) Acetanilide from aniline

c) Aspirin from salicylic acid

d) p-bromo acetanilide from acetanilide.

2. Quantitative analysis of Biomolecules:

i) Estimation of Vitamin C from lemon and gooseberries.

ii) Estimation of keto acid by DNPH method.

3. Extraction of Biomolecules:

a) Caffeine from tea leaves.

b) Starch from potato.

c) Casein from milk.

d) Oil from oil seeds.

References:

1. Advances in organic chemistry- Arun Bhal and B.SBhal.(2000), Sulthan Chand & Sons.
2. Organic chemistry- P.Y.Bruice(2002) Pearson Publishers.
3. Text book of organic chemistry- P.L Sony (2000) Sulthan Chand & Sons.
4. Chemistry of Natural products- O.P.Agarwal(1998) Goel Publishing House

SEMESTER-IV

BSCBCC 281: BIOMOLECULES AND BIOCHEMICAL TECHNIQUES

Unit-I

6. Carbohydrates: **12 Hrs.**

Classification, Biological importance. Monosaccharides: Configuration relationship of D- aldoses, D-ketoses. General properties of aldoses and ketoses- oxidation, reduction, reducing property, formation of glycosides, acylation, methylation, condensation-phenyl hydrazine, addition- HCN. Interconversion of aldoses and ketoses by chemical method. Ascending and descending series by chemical methods. Stereochemistry of monosaccharides (+) and (-), D and L, Epimers, anomers and diastereomers.

Glucose: Elucidation of open chain structure and ring structure of glucose. Conformation of glucose (only structures), mutarotation. Structure of galactose, mannose, ribose and fructose. Structure and biological importance of amino sugars, deoxy sugars, sugar acids, neuraminic and muramic acids.

Disaccharides: sucrose, maltose and lactose.,

Polysaccharides: Partial structure, occurrence and importance of starch, Seliwanoff's and osazone test.

Unit-II

Lipids and Bio-membranes: **12 Hrs.**

Classification and biological role. Fatty acids: Nomenclature of saturated and unsaturated fatty acids. Physical properties and chemical reactions- esterification, rancidity. Essential fatty acids.

Acylglycerols: Saponification, Saponification value, Iodine value, Acid value and significance.

Phoshoglycerides: Structure of Lecithin, Cephalins, Phosphotidyl inositol, Plasmalogens and Cardiolipin. Biological role of phosphoglycerides. Sphingolipids: Structure and importance of Sphingomyelin. Glycerosphingolipids: Structure and importance of Gangliosides an Cerebrosides.

Prostaglandins: Structure of PGE2 and PGF2. Biological role of Thromboxane, leukotrienes and Prostaglandins.

Plasma lipoproteins: Types and functions.

Biological Membrane: Composition of membrane. Fluid Mosaic Model, functions of plasma membrane- endocytosis, phagocytosis. Membrane receptors and their functions.

Unit-III

7. Amino acids and peptides: 5 Hrs.

Structure and classification of amino acids based on polarity, structure. Reactions of the amino group with HNO_2 , Ninhydrin, phenyl isothiocyanate , dansyl chloride, Fluoro dinitrobenzene. Zwitter ionic properties, pKa value. Reaction of carboxyl group- hydrazine. Any method for chemical synthesis of amino acids- Gabriel synthesis and Strecker synthesis. D and L notations. R and S notations.

Peptide bond, structure and biological importance of Glutathione, Valinomycin, Leu-enkaphalin. Synthetic peptides- polyglutamate, polylysine. Chemical synthesis of dipeptides.

8. Proteins: 7 Hrs.

Isolation, methods of purification- dialysis, salting out, pH precipitation and solvent precipitation. Classification of proteins based on solubility, structure and functions with examples. Primary structure of proteins, methods of determining N- and C- terminal amino acids, amino acid composition, sequencing by Edman's method. Colour reactions of proteins- Biuret, Millon's, Xanthoproteic tests. Secondary structure- α-helix, β-pleated sheet, β-bend. Tertiary and quaternary structure. 3D structure of haemoglobin. Denaturation and renaturation of proteins. Anfinsen's experiment.

Unit-IV

9. Nucleic Acids: 5 Hrs.

Isolation and purification of DNA and RNA. Composition of DNA. Nucleotides and Nucleosides. Chargoff's rule. Watson and Crick model of DNA. Melting of DNA.RNA- Composition, types (mRNA, tRNA and rRNA), Secondary structures of tRNA- Clover-leaf model. Chemical reactions of RNA and DNA with acid and alkali. Colour reactions of DNA and RNA. Circular and linear chromosomes. Structure of eukaryotic chromosome and nucleosome.

10. Chromatographic Techniques: 4 Hrs.

General principles of chromatography- Adsorption and Partition techniques, Paper chromatography- ascending, descending and circular, 1D, 2D-chromatography. Rf values. TLC, GC, IEC, Affinity chromatography and their applications.

11. Electrophoresis: 1 Hr.

Principle of electrophoresis, paper and gel electrophoresis.

12. Centrifugation: 2 Hrs.

Types of centrifuges, Principal of differential centrifugation. Ultracentrifugation-construction and application

IV SEMESTER PRACTICAL

BSCBCP- 282: BIOCHEMISTRY PRACTICAL- IV

1. Qualitative analysis of Biomolecules

   i) Carbohydrates: Glucose, Fructose, Lactose, Maltose and sucrose.

   ii) Proteins- Albumin, Casein.

2. Biochemical Techniques:

   a) Identification of amino acids and carbohydrates by

   i) Circular paper chromatography

   ii) Ascending paper chromatography

   iii) Descending paper chromatography

   b) Separation of amino acids by TLC

   c) Separation of plant pigments by column chromatography using silica gel G.

References:

1. Fundamentals of Biochemistry-JL Jain, S. Jain and N. Jain (2000), S. Chand.
2. Lenhinger's Biochemistry- Nelson and Cox (2005) CBS Publishers.
3. Biochemistry- U. Sathyanrayana and U.Chakrapani (2006) .
4. Biophysical chemistry, principles and techniques- Upadhyaya, Upadhyaya and Nath (2005) Himalaya publishing house.

Open elective papers

I SEMESTER: BSCBCCE 133 - Cell Biology

UNIT –I

1. **Cell & Organelles-** Cell structure, Cell wall, Cell membrane-structure and functions, Nucleus, Cytoplasm and its organelles- Endoplasmic reticulum, Golgi complex, Mitochondria, Lysosome, Ribosomes, Peroxisomes.

12 hrs.

UNIT –II

2. **Cytoskeleton-** Microtubules, Microfilaments, Cell junctions. Cell Transport mechanism- Passive transport – types, Glucose transport mechanism. Active transport- types, Na+-K+ transporting ATPase system.

12 hrs.

II SEMESTER: BSCBCCE 183 - Cell Cycle & Genetics

UNIT –I

1. **Cell division and Cell cycle** - Overview of cell cycle, events of mitotic phases, cytokinesis, events of Meiosis, regulation of cell division and cell growth. definition and differences between apoptosis and necrosis. Biochemistry of cancer cells and carcinogenesis-Properties of cancer cells, causes of carcinogenesis, Types, Tumor markers.

12 hrs.

UNIT –II

2. **Genetics:** Introduction, DNA, Genes, Chromosomes, chromatin structure- Euchromatin and heterochromatin, structure and nucleosome assembly. Mendel's selection of experimental plant, Phenomenon of Dominance, variations on dominance (complete, incomplete and co-dominance), Law of segregation, law of independent assortment, Interaction of gene- supplementary gene, complementary genes, multiple factors, epistasis, multiple allelism. 12 hrs.

III SEMESTER: BSCBCOE 233- Food- Environmental Biochemistry & Hematology

UNIT –I

1. **Biochemistry of food-** Biomolecules- carbohydrates, proteins, lipids, Vitamins. Digestion of carbohydrates, proteins and lipids. ATP. Obesity, Atherosclerosis, Diabetes Mellitus.
2. **Blood-** Composition, RBC, WBC, Platelets-Functions, hemoglobin- functions. Blood clotting, Anemia, sickle cell anemia, Jaundice.

12hrs.

UNIT –II

1. **Environmental Biochemistry**- Definition, -Alteration in atmospheric temperature- Causes and consequences of alteration in atmospheric temperature – Chemical stress and pollution: air pollution- Definition, sources, indicators, Health effects. Water pollution: Definition, sources, Health effects and Importance of pure water. Food contamination, Processing of food, natural toxins, Food adulteration.

12 hrs.

IV SEMESTER: BSCBCEE 283 - Analytical Techniques

UNIT –I

1. **Techniques in Biochemistry-** Autoradiography, Flame photometry, X-ray crystallography, HPLC. Hybridization and gene probes, Making antibodies- polyclonal and monoclonal antibody production

12 hrs.

UNIT –II

2. **Protein -ligand interactions:** Ligands, Receptor ligand binding affinity, Methods used to study binding. 12 hrs.

References

1. Text book of Medical Biochemistry- MN Chatterjee and Rana Shinde
2. Text book of cell and molecular biology – Ajoy Paul
3. Biochemistry – U. Sathyanarayana and U. Chakrapani
4. Cell Biology- C.B. Power
5. Text book of Biochemistry- D.B. Vasudevan and Sreekumari S.
6. Principles and Techniques of Biochemistry and Molecular Biology- Keith Wilson and John Walker
7. Fundamentals of Biochemistry – JL Jain.

V Semester

BSCBCC 331: ENZYMOLOGY AND METABOLISM

Unit-I

13. Enzymes: **4 Hrs.**

Introductory aspects, General characteristics, co-factors, coenzyme and metal ions. Classification of enzymes based on IUB with examples. Unit of enzymes, activity- specific activity. Enzyme specificity. Concept of active site. Theories of enzyme catalysis- Lock and key model, Koshland's induced fit theory. Regulation of enzymes.

14. Enzyme Kinetics: **4 Hrs.**

Factors affecting rate of enzyme catalyzed reaction. Effect of substrate, enzyme, product concentration, pH, temperature. Michali's-Menton equation (Derivation not required). Lineweaver-Burk plot. Determination of Vmax and Km from L-B plot and its significance.

3. Enzyme Inhibition: **2 Hrs.**

Competitive, noncompetitive and uncompetitive inhibition. Graphical representation by L-B plot. Application of competitive inhibition in chemotherapy.

4.Allosteric enzymes: **2 Hrs.**

Definition, ATCase as an allosteric enzyme. Isoenzymes- LDH, Multienzyme -complex- pyruvate dehydrogenase complex. Ribozyme. Clinical and Biotechnological application of enzymes.

Unit-II

15. Metabolism: **1 Hr.**

Anabolism and catabolism- stages involved in it. Compartmentalization of metabolic pathway.

16. Metabolism of Carbohydrates: **7 Hrs.**

Glycolysis- aerobic and anaerobic and energetics of Glycolysis, regulation of glycolysis. Entry of other carbohydrates into glycolytic pathway. Fate of pyruvate. Amphibolic integrating roles of TCA cycle. Anapluerosis. Gluconeogenesis and its importance. Outlines of HMP shunt pathway and its significance. Importance of Cori's cycle and 2,3- BPG. Glycogen metabolism, glycogenolysis and glycogen synthesis.

17. Metabolism of Lipids: 4 Hrs.

Oxidation of fatty acids- alpha, beta and omega types. Beta- oxidation of even number saturated fatty acids. Energetics of beta oxidation. Biosynthesis of even number saturated fatty acids. Ketone bodies formation and ketosis. Outline of Cholesterol synthesis.

Unit-III

18. Metabolism of Amino acids: 5 Hrs.

General reaction of amino acid degradation- transamination and its mechanism of action. Deamination and decarboxylation. Ketogenic and Glucogenic amino acids. Urea cycle and its significance. Biosynthesis of biologically important amines epinephrine, nor epinephrine, Histamine and polyamines. Disorders of amino acid metabolism PKU and AKU.

2. Metabolism of Nucleic acids: 3 Hrs.

Schematic pathway of synthesis and degradation of purines and pyrimidines.

3. Photosynthesis: 4 Hrs.

The photosynthesis apparatus and pigments. light harvesting antennae complex, Chemistry and structural components of photo systems I and II. Outlines of light dependent reactions. outlines of C_3 (Calvin cycle) and C_4 cycle in plants.

Unit-IV

19. Biological oxidation: 6 Hrs.

Ultrastructure of mitochondria, ETC and its complexes-I, II, III, IV. Uncouplers and inhibitors of respiration (Rotenone, Actinomycin D, Cyanide and 2,4-DNP). Oxidative phosphorylation, P/O ratio. Formation of ATP-Outline of Mitchell's hypothesis. Substrate level phosphorylation with examples. Biological importance of ETC.

20. Bioenergetics: 6 Hrs.

Laws of thermodynamics- First and second law. Concept of enthalpy, entropy, free energy. Endergonic and exergonic reactions. Coupled reactions. High energy compounds- structure of ATP and its free energy change during hydrolysis, other high energy compounds.

References:

1. Fundamentals of Biochemistry-JL Jain, S. Jain and N. Jain (2000), S. Chand.
2. Lenhinger's Biochemistry- Nelson and Cox (2005) CBS Publishers.

3. Biochemistry- U. Sathyanrayana and U. Chakrapani (2006).

4. Enzymes: Biotechnology, Biochemistry and Clinical Chemistry- Trevor Palmer (2006).

V SEMESTER

BSCBCC 332: Molecular Biology and Genetic Engineering

Unit-I

1. Central dogma of molecular biology:
2Hrs

Historical perspective. Central dogma of molecular biology and its modification. DNA as genetic material- Griffith and Hershey Chase experiment.

2. Replication of DNA: 5 Hrs.

Semiconservative mechanism, Messelson and Stahl experiment. Enzymes and regulatory proteins involved in replication, Mechanism of replication in prokaryotes. Fidelity of replication.

3.Transcription: 5 Hrs.

Prokaryotic RNA synthesis, Role of RNA polymerase. Initiation, elongation and termination. Reverse transcription. Outlines of eukaryotic transcription, Post-transcriptional process- mRNA splicing, cap addition and poly A tail addition. RNA dependent RNA synthesis.

Unit-II

1.Genetic Code: 4 Hrs.

Triplet codon, universal features of genetic code, Wobble hypothesis. Variation in the codon usage

2.Protein biosynthesis: 8 Hrs.

Activation of amino acids, aminoacyl tRNA synthesis, Initiation, elongation and termination of protein synthesis in prokaryotes and Eukaryotes. Protein translation inhibitors (any three examples) Post translational modifications, Protein sorting and targeting.

Unit-III

21. Concept of gene: 6 Hrs.

Functional units in prokaryotic and eukaryotic gene- promoter, introns and exons. Gene expression in prokaryotes, concept of operon, Lac-Operon, Tryptophan Operon, Galactose operon.

22. Mutation and DNA repair: 6 Hrs.

Concept of mutation and mutagens- effect of HNO_2, Alkylating agents, Inter-chelating agents and UV- radiation. Concept of Point mutation and frameshift mutation. DNA repair.

Unit IV

23. Genetic Engineering: 12 Hrs.

Basic principles of recombinant DNA technology. Isolation of DNA, Cutting of DNA by restriction endonucleases- staggered cut and blunt cut. Separation of DNA fragments by agarose gel electrophoresis. Vectors, Plasmids- PBR322. Insertion of foreign DNA into vectors. Transfection of vectors into host cell. cDNA, cDNA library. Principle of polymerase chain reaction and its application. Blotting techniques- Principle of Southern, Western and Northern blotting. DNA fingerprinting. RFLPs. Transgenic plants, Transgenic animals. Gene Therapy, Human genome project. Application of Genetic Engineering.

BSCBCP 333: BIOCHEMISTRY PRACTICAL -V

Enzyme Assays (3 Hrs. per week)

1. Salivary Amylase
   a) Determination of activity of salivary amylase by DNS.
   b) Determination of specific activity of salivary amylase by DNS method.
   c) Determination of optimum pH for salivary amylase.
   d) Determination of Km and Vmax of salivary amylase
2. Acid Phosphatase
   a) Determination of specific activity of aid phosphatase by PNPP.
   b) Determination of optimum pH of acid phosphatase.
   c) Determination of Km and Vmax of acid phosphatase.
3. **Colorimetric estimation**
   a) Glucose by DNS method.
   b) Protein by Biuret method
   c) Protein by Lowry's method
   d) Extraction and estimation of DNA from coconut endosperm
   e) Extraction and estimation of RNA from spinach leaves.
   f) Agarose gel electrophoresis.

g) Demonstration of PAGE of protein.

References:

1. Fundamentals of Biochemistry-JL Jain, S. Jain and N. Jain (2000), S. Chand.
2. Lenhinger's Biochemistry- Nelson and Cox (2005) CBS Publishers.
3. Biochemistry- U. Sathyanarayana and U. Chakrapani (2006).
4. Molecular Biology- David Freifilder (2000) ACS Publications

VI SEMESTER

BSCBCC 381: HUMAN PHYSIOLOGY AND CLINICAL BIOCHEMISTRY

24. Nervous System: **4 Hrs.**

Types of neurons, Generalized structure of multipolar neuron. Resting membrane potential, Action potential. Transmission of nerve impulse along an axon and across synapse. Neurotransmitters.

25. Muscle: **4 Hrs.**

Types of muscles and their structure. Ultrastructure of skeletal muscle. Contractile and regulatory proteins of skeletal muscle. Sliding filament model of skeletal muscle contraction.

26. Bone: **2 Hrs.**

Composition and structure of long bone. Growth and remodeling of long bone. Factors affecting its growth.

27. Excretory System: **2 Hrs.**

Structure of nephron. Formation of urine- Glomerular filtration, tubular reabsorption and tubular secretions.

Unit-II

28. Body Fluids: **6 Hrs.**

Blood- Blood volume, composition and functions. RBC, WBC and platelets- structure and functions. Mechanism of blood coagulation. Biochemical events in transport of CO_2 and O_2 in blood. Blood brain barrier. Cerebrospinal fluid- composition and functions Lymph- composition and functions.

29. Acid-Base balance: **3 Hrs.**

Blood buffers- Bicarbonate, phosphate and protein buffer system. Role of lungs and kidney in acid-base balance.

30. Liver: **3 Hrs.**

Structure of lobule. Functions- metabolic, storage and detoxification.

Unit-III

31. Endocrine System: **12 Hrs.**

Endocrine organs. Classification of hormones. Functions of the hormones of Hypothalamus, Pituitary, Adrenal, Thyroid, Pancreas and Gonads. General mechanism of hormone action. Mechanism of action of steroid hormones. Concept of second messengers- cAMP, DAG, IP3, G-protein.

Unit-IV

32. Urine: **3 Hrs.**

Normal composition of urine- volume, specific gravity. Constituents- urea, uric acid, creatinine, pigments and their clinical significance in brief. Kidney disorder.

33. Blood: **4 Hrs.**

Normal constituents of blood. Urea, Uric acid, Creatinine, Glucose, Bilirubin, Total protein, Albumin/ globulin ratio- Variation in pathological conditions. Lipid Profile- Cholesterol, Triglycerides, lipoproteins, HDL and LDL.

34. Diagnostic enzymes: **3 Hrs.**

SGOT, SGPT, Alkaline Phosphatase. Cardiac injury profile- CPK and LDH.

35. Inborn errors of metabolism: **2 Hrs.**

Sickle cell anemia, Glycogen storage disease, Neimann-Pick disease, Lesch -Nyhan syndrome

References:

1. Fundamentals of Biochemistry-JL Jain, S. Jain and N.Jain (2000), S. Chand.
2. Lenhinger's biochemistry- Nelson and Cox (2005) CBS Publishers.
3. Biochemistry- U. Sathyanrayana and U.Chakrapani (2006).

4. Textbook of Physiology- A.K. Jain (2005). APC.

VI SEMESTER

BSCBCC 382: NUTRITION, MICROBIOLOGY AND IMMUNOLOGY

Unit-I

36. Introduction: 4 Hrs.

Concept of nutrition. Calorific value of foods and its determination (bomb calorimeter). Different components of energy expenditure, respiratory quotient, basal metabolic rate, determination of BMR, factors affecting BMR, specific dynamic action of foods. Energy expenditure at rest and work.

37. Carbohydrates: 1 Hr.

Dietary sources, dietary fibres and protein sparing action.

38. Proteins: 3 Hrs.

Dietary sources, nutritional classification, nutritional value of protein- PER, NPU and biological value of proteins. Essential amino acids. Nitrogen balance. Mutual supplementation of proteins.

39. Fat: 1 Hr.

Dietary sources of fats, invisible fats, essential fatty acids and their biological importance.

40. Minerals: 3 Hrs.

Macronutrients- Ca, P, Na, K, Cl and Mg. Micronutrients- Fe, Zn, Cu, I_2. Dietary sources, physiological functions, deficiency disorders, absorption and excretion.

Unit-II

41. Water metabolism: 2 Hrs.

Distribution of water in body fluids. Factors influencing water metabolism.

42. Antinutritional factors: 2 Hrs.

Sources and harmful effects of anti-vitamins (eg: Avidin and dicoumarol), Natural toxicants (*Lathyrus sativa*), and adulterants (eg: Butter yellow, Lead chromate, Malachite green).

43. Abnormal nutritional States: 2 Hrs.

Malnutrition- Kwashiorkar and Marasmas. Obesity. Prescription of diet, Glycemic index of common food items.

44. Digestion: **4 Hrs.**

Absorption and transport of carbohydrates, proteins and fats. GI tract, secretion, composition, and function of saliva, gastric juice, bile, pancreatic and intestinal juices. Appetite, Gastrointestinal hormones.

Unit-III

45. Study of microorganisms: **1 Hr.**

Staining microorganism- principle and procedure of gram stain and acid-fast stain

46. Microbial nutrition: **3 Hrs.**

Growth of microorganisms, measurement of growth. Factors influencing growth- nutrition, carbon source, nitrogen source, temperature, pH, oxygen. Growth curve.

47. Industrial microbiology: **2 Hrs.**

Production and importance of alcoholic beverages- beer and wine. Fermented products of milk- cheese, Antibiotic production- penicillin. Single cell protein- spirulina.

48. Antibiotics: **2 Hrs.**

Definition, mechanism of action of penicillin, streptomycin and chloramphenicol.

49. Viruses: **2 Hrs.**

Classification. Plant viruses- TMV- morphology, general characteristics and its replication.

50. Bacteriophages: **2 Hrs.**

Morphology, general characteristics, life cycle (lytic and lysogeny cycle) of T-even bacteriophage

Unit-IV

Immunology

51. Introduction: **2 Hrs.**

Definition, Haptenes, Epitopes, General features. Antigenicity, primary lymphoid organs.

1.Antibodies:

2 Hrs.

Definition, types and structure of a typical immunoglobulin (IgG)

52. Antigen-antibody reaction *in vitro*:

3 Hrs.

Formation of antigen-antibody complex. Precipitation reactions- Immunodiffusion- single, double diffusion, immune-electrophoresis. ELISA, RIA.

53. Immunity: **5 Hrs.**

Cellular and humoral immunity. Role of immunologically important organs and cells- bone marrow, thymus, spleen and lymphocytes. Formation and functions of T and B lymphocytes and macrophages. Helper T-cells and Killer T-cells. Allergy- definition, types AIDS.

BSCBCP 383: Biochemistry Practical-VII

Physiology and Clinical Biochemistry Experiments
(3 Hrs. per week)

1. Qualitative analysis of organic and inorganic constituents of urine.
2. Qualitative analysis of abnormal constituents of urine.
3. Determination of titrable acidity of urine.
4. Estimation of reducing sugar by Nelson-Somogy's method.
5. Estimation of creatinine.
6. Urea by DAM method
7. Uric acid
8. Cholesterol by Zak's method
9. Determination of calcium in *ragi*.
10. Determination of iron in drumstick.
11. Gram Staining.
12. Growing microbes from soil and sewage water.
13. Estimation of inorganic phosphate by Fiske-Subba Rao method.
14. Estimation of amino acids by formal titration
15. Determination of saponification value of an oil or fat.

16. Determination of Iodine value of an oil or fat

17. Determination of acid value of an oil or fat.

Project report-10 Marks

Viva- 5Marks

References:

1. Fundamentals of Biochemistry-JL Jain, S. Jain and N. Jain (2000), S. Chand.
2. Text Book of Microbiology - R. Ananthanarayan and CKJ Pannikar (2005) CBS Publishers.
3. Immunology: Introductory text book- Nandini Shetty (2008). New Age Publications
4. Textbook of Physiology- A.K. Jain (2005) APC.

****