

Tumkur University
B. Sc., BIOCHEMISTRY SYLLABUS (CBCS)

The Tumkur University proposed to introduce credit based B. Sc. Programme from the academic year 2016-17. The enclosed syllabus has been prepared based on these guidelines provided by task force committee. Board of Studies was formed to accomplish this task, which included the senior teachers from affiliated colleges which are offering Biochemistry as cognate subject and also the teachers from the University department. The teachers of the core committee played a pivotal role in preparing the syllabi. The final draft syllabus was circulated among the members for approval. The approved syllabus is enclosed herewith. The Chairman records his thanks to the teachers involved in the preparation of this syllabus.

B.Sc. Programme: Course Matrix for semester I-IV

Sl #	Course Number in Sem	Title of the paper	Type of instruction & hrs per week/ Course	Credits	Hrs of Exam (SEE) per course/ Sem	Max. Marks for IA/ Course/ Sem	Max. Marks for SEE per Course/ Sem	Max. Marks per Course/ Sem
1	1.3	Atoms and Colligative Properties of Solutions	T 4	4	3	10	90	100
2	1.4	Biochemistry Practical-I	P 4	2	3	-	50	50
3	2.3	Bioorganic and Bioinorganic Chemistry	T 4	4	3	10	90	100
4	2.4	Biochemistry Practical-II	P 4	2	3	-	50	50
5	3.3	Biological Macromolecules	T 4	4	3	10	90	100
6	3.4	Biochemistry Practical-III	P 4	2	3	-	50	50
7	4.3	Physiology and Nutrition	T 4	4	3	10	90	100
8	4.4	Biochemistry Practical-IV	P 4	2	3	-	50	50
Open Elective								
9	4.9	Basics of Clinical Biochemistry	T-2/P-4	2	3	-	50	50

B.Sc. Programme: Course Matrix for semester V -VI

Sl #	Course Number in Sem	Title of the paper	Type of instruction & hours per week/ course	Credits	Hours of Exam(SEE) per course/sem	Max. Marks for IA/ Course/ Sem	Max. Marks for SEE per course/ Sem	Max. Marks per course/ Sem
1	5.1	Metabolism and Bioenergetics	T 3	3	3	10	90	100
2	5.2	Cell Biology and Endocrinology	T 3	3	3	10	90	100
3	5.3	Biochemistry Practical-V/VI	P 6	3	3	-	100	100
4	6.1	Molecular Biology	T 3	3	3	10	90	100
5	6.2	Immunology and Microbiology	T 3	3	3	10	90	100
6	6.3	Biochemistry Practical-VII/VIII	P 6	3	3	-	100	100

I semester

1.3 Atoms and Colligative Properties of Solutions 60 Hrs

Unit-I 15 Hrs

Periodic Classification: Trends in the periodic table atomic and ionic radii, ionization energy, electro negativity and electron affinity. Concept of oxidation number and its computation.

Atomic structure: Electromagnetic radiation, Wave particle duality- Louis de Broglie equation. The Heisenberg uncertainty principle. The Schrödinger wave equation, Quantum numbers. Atomic orbital and their shapes. The Pauli Exclusion Principle. Hund's rule. The Aufbau process. Electronic Configuration of the elements.

Chemical Bonding: Types of bonds-Ionic bond. Covalent bond-Valence bond theory. Hybridization-examples: ammonia, water and ethane. Sigma and pi bonds. Concept of resonance. Molecular Orbital theory. Properties of covalent bond, bond length, bond energy and bond angle, Polarity of Molecules. Coordinate bond, Vander Wal's Forces. Hydrogen Bonds; inter and intra molecular types. Hydrophobic forces.

Unit-II 15 Hrs

Radioactivity: Natural & artificial radioactivity. Detection of radioactivity, Characteristics of radio elements, Disintegration constant. Half-life. Applications of radioactive isotopes in Biological studies. Biological effect of radiations and their safety measures.

Solutions and Colligative properties: Concentration units-molarity, molality, normality and mole fraction. Types of Solutions- homogenous and heterogeneous. Hypo, hyper and isotonic solutions. Osmotic pressure and its measurement by the Berkley-Hartley method. Laws of osmotic pressure. Effect of osmotic pressure on living cells. Donnan membrane equilibrium. Colloidal solution, distinction between lyophilic and lyophobic solutions. Methods of preparation of colloidal solution, Tyndall effect, application of colloidal chemistry, emulsion and emulsifying agents.

Unit-III 15 Hrs

Electrolytic Dissociation and Mass Law: Strong and weak electrolytes. Activity and activity coefficient. Relationship between activity coefficient and ionic strength. Common ion effect, solubility product and their applications. Conductance and its measurement. Electrochemical cells: Oxidation-reduction reactions, Reversible electrodes and cells. Single electrode potential. Nerst's equation. Standard electrode potentials. Reference electrodes. Ion selective electrodes and their applications.

Water, Acids and Bases: Dissociation of water, ionic product of water, concepts of pH, pOH, simple numerical problems of pH, determination of pH using indicators, pH meter and theoretical calculations. Dissociation of weak acids and electrolytes, Bronsted theory of acids and bases, shapes of titration curve of strong and weak acids and bases.

Buffers: Meaning of K_a and pK_a values, buffers and buffer action. Buffers in biological system, Henderson -Hasselbalch equation with derivation, simple numerical problems involving application of this equation, simple numerical problems on buffer composition.

Adsorption, Viscosity and Surface tension: Adsorption of gases by solids. Heat of adsorption Freundlich and Langmuir adsorption isotherms with derivations. Applications of adsorption. Determination of viscosity of liquids using Ostwald's viscometer. Relation of viscosity and shape of molecules with examples. Surface tension: Definition, determination of surface tension of liquids using Stalagmometer. Effect of surfactants.

References:

- 1) Physical Chemistry-N.B. Singh- Newagepublishers, 2nd Ed, 2007.
- 2) Textbook of Physical Chemistry- Dr M V Sangaranarayanan and Dr V Mahadevan- Universities Press; 1st Ed, 2011
- 3) General Chemistry-S. Ekambaram, 1st Ed, Pearson Education, 2012
- 4) Chemistry-The Molecular Science-Olmsted and Williams, 2nd Ed, WCB Publishers, 1997
- 5) Principles of General Chemistry-Bruce A. Averill and Patricia Eldredge, Ingram, 2011

1.4: Biochemistry Practical-I

1. Calibration of glassware.
2. Determination of Density and Viscosity of the given organic liquid.
3. Determination of Density and Surface tension of the given liquid.
4. Determination of percentage composition of binary liquid (water/acetic acid) by viscosity method.
5. Partition coefficient of benzoic acid iodine between benzene and water.
6. Decomposition of hydrogen peroxide in presence and absence of a catalyst.
7. Determination of the equivalent conductivity of an electrolyte.
8. Determination of Heat of neutralization strong acid v/s strong base.
9. Conductometric titration of strong acid v/s strong base.
10. Preparation of buffer and determination of pH (Acetate-pH 5.0; phosphate pH 8.0).

Semester-II

2.3:	<u>Bioorganic and Bioinorganic Chemistry</u>	60 Hrs
Unit I		15 Hrs
Introduction to Bio-organic chemistry: IUPAC nomenclature of organic compounds including bifunctional groups. Inductive effect, resonance and hyper conjugation concepts. Reactive intermediates- carbocations, carbonians, carbenes and free radicals. Conjugate dienes. 1,3-Butadiene stability, mechanism of addition of HBr (Markonic rule). Conformation analysis of ethane and n-butane.		
Alkyl halides: SN1 and SN2 mechanisms taking primary, secondary and tertiary alkyl halides as examples. Mechanistic concepts of elimination reactions-t-butyl chloride.		
Natural products: Biologically important heterocyclic compounds, antioxidants, flavonoids, terpenoids, alkaloids, and carotenoids.		
Drugs: Antibiotics- Classification and applications, anticancer drugs-classification based on their action and applications.		
Unit II		15 Hrs
Chemical equilibrium: Reversible reactions – characteristics of chemical equilibrium Homogeneous and heterogeneous equilibrium. Redox equilibria.		
Reaction Kinetics: Rate equation and order of a reaction, Velocity constant. Molecularity and order of a reaction. Factors influencing the rate of reaction. Kinetic equations of zero, first and second order reactions. Arrhenius hypothesis for Activated complex. Energy of activation. Elementary treatment of Transition state theory.		
Catalysis: General characteristics of catalytic reactions. Types of catalysis-homogeneous and heterogeneous. Theories of homogeneous catalysis. pH dependence of catalyzed reactions. Enzymes as catalysts.		
Thermodynamics Introduction and terminology: Elementary concepts of First & Second law of Thermodynamics. Free energy change and entropy. Chemical potential. Standard free energy change of chemical reactions. Exergonic and endergonic reactions. Relationship between free energy change and equilibrium constant.		
Unit III		15 Hrs
Environmental Chemistry: Air pollution, Pollutants and their control- carbon dioxide, oxides of nitrogen and hydrocarbons. Carbon dioxide and the green house effect, Chlorofluorocarbons and the ozone layer, Biochemical toxicology-Toxicity and detoxification of fluoride, lead, mercury, cadmium, arsenic and melamine. Water pollution- BOD and COD. Pesticides, insecticides (DDT, allethrin and malathion) and Herbicides (2, 4-D and 2, 4, 5-T) hazards.		
Coordination Chemistry: Transition metal ions and oxidation states, Double and complex salts, Werner's and valence bond theories. Types of ligands, Crystal and ligand field theories, Geometric and optical isomerism.		
Bio-inorganic Chemistry: Metal ions in biological systems, Roles of iron in myoglobin, hemoglobin and cytochrome, copper in haemocyanin, Magnesium in chlorophyll, Cobalt in vitamin B12 and Molybdenum in nitrogenase.		
Photochemistry: Laws of photochemistry, chemiluminescence, bioluminescence, photocatalysis and photochemical reactions.		

Unit IV

15 Hrs

Separation and detection techniques: Chromatography: General principle, Adsorption-TLC. Partition-Paper, GLC, Electrophoresis (gel and paper): Principle and applications. Ultra centrifugation- Principle and applications. Spectroscopy: Principle and applications of UV- Visible, IR spectroscopy and NMR.

Stereochemistry: Stereoisomerism; Types, Stereochemical terminology, Optical isomerism; Molecular di-symetry, Chirality: examples-glyceraldehydes, lactic acid and tartaric acid, Nomenclature of enantiomers-The RS system and DL Rotation, racemization, Fischer projection formulae, Geometrical isomerism; Cis trans isomerism in alkenes and ring compounds, Structure and properties of maleic and fumaric acids (E)-(Z) system of specifying geometrical isomers, Significance of chirality in the biological world.

References:

- 1) Introduction to Bioorganic chemistry and chemical biology- Van Vranken DL and Weiss GA, Garland Science, 2013
- 2) Chemistry of Plant Natural Products: Stereochemistry, Conformation, Synthesis, Biology, and Medicine- Talapatra SK and Talapatra B, Springer Berlin Heidelberg, 2015
- 3) Bioinorganic chemistry-Rehder D, OUP Oxford, 2014
- 4) Stereochemistry- Sharma RK, Discovery Publishing House, 2008
- 5) Basic Separation Techniques in Biochemistry- Okotore RO, New Age International, 1998
- 6) Fundamentals of Photochemistry- Rohatgi KK-Mukherjee, New Age International, 1978
- 7) Text Book of Coordination Chemistry- Sharma RK, Discovery Publishing House, 2007
- 8) Textbook of Environmental Chemistry-Balram Pani, I. K. International Pvt Ltd, 2007
- 9) Thermodynamics: Concepts and Applications (Vol 1)-Stephen R. Turns, Cambridge University Press, 2006
- 10) Photochemistry and Reaction Kinetics-Ashmore PG, Sugden TM, Dainton FS, Cambridge University Press, 2010

2.4:

Biochemistry Practical-II

1. Preparation of standard sodium oxalate and estimation of potassium permanganate.
2. Preparation of standard potassium dichromate solution and estimation of sodium thiosulphate.
3. Estimation of hardness of water using EDTA.
4. Determination of activation energy of ethyl acetate hydrolysis.
5. Determination of COD.
6. Determination of BOD.
7. Separation of amino acids by circular\descending\ascending paper chromatography.
8. Separation of amino acids and lipids by TLC.
9. Separation of plant pigments by column chromatography.
10. Detection of adulterants in food stuff.

III Semester

3.3:	<u>Biological Macromolecules</u>	60 Hrs
Unit I		15 Hrs
Carbohydrates:	Biological importance and classification. Monosaccharides; D and L designation. Glucose-structural elucidation and conformation. Ring structure of fructose, galactose, mannose and ribose. Straight chain structure of sedoheptulose. Epimers and anomers; ascending and descending of monosaccharide series. Derived monosaccharides; structure and biological importance of amino sugars, sugar phosphates, sugar-acids and deoxy sugars. Disaccharides, glycosidic linkage, cellobiose and trehalose. Polysaccharides; Storage-starch, and glycogen, Structural-cellulose and chitin, pectins, glycosaminoglycans, cell wall components-peptidoglycan, teichoic acid and LPS.	
Amino acids:	Amino acids- structure and classification. Acid-base, chemical and optical properties. Essential aminoacids, Peptides, the peptide bond, biologically important peptides-Glutathione and endorphins.	
Unit II		15 Hrs
Proteins	Proteins-Classification based on composition, shape, function and structure. Structural organization of Proteins-Primary, secondary, tertiary and quaternary. Primary structure of insulin. Denaturation and renaturation of proteins (Anfinsen experiment).	
Enzymes:	Characteristic features, classification and specificity. Enzyme assays and International Units. Energy of activation, cofactor, coenzyme roles of B-complex vitamins. Active site and theories of interaction between active site and substrate.	
	Enzyme kinetics-Factors affecting the rate of enzyme catalyzed reactions- enzyme concentration, substrate concentration, Michaelis-Menten equation, pH, and temperature. Significance of Km and Vmax and their determination using Line-Weaver-Burk plots.	
	Enzyme inhibition- reversible and irreversible, Reversible-competitive, non-competitive, un-competitive inhibition with graphical representations using L-B plots. Brief mention of allosteric enzymes and isoenzymes. Biotechnological and clinical applications of enzymes.	
Unit III		15 Hrs
Lipids:	Classification and biological functions of Fatty acids; classification based on structure, properties of fatty acids. Acyl glycerols; Hydrolysis and Rancidity. Acid, saponification and iodine values. Phosphoglycerides; structures and biological roles, sphingolipids; phosphosphingolipids- sphingomyelins; Glycosphingolipids-gangliosides and cerebrosides. Prostaglandins; An overview of biological roles, structure of PGE2. Waxes-biological importance. Lipoproteins- types and functions.	
Unit IV		15 Hrs
Nucleic acids:	Components of nucleic acids, nucleosides, nucleotides and poly nucleotides. Occurrence and isolation of nucleic acids. Physico-chemical properties of nucleic acids. DNA; Biological role, structure, polymorphism, denaturation and Renaturation. Structural organization of prokaryotic and eukaryotic DNA. Nucleoproteins. RNA; Types and biological roles, structure of t-RNA.	

References:

- 1) Lehninger Principles of Biochemistry- Nelson DL and Cox MM, WH Freeman Pub, 5th Ed, 2008
- 2) Biochemistry- Berg JM and Stryer L, WH Freeman Pub, 5th Ed, 2002
- 3) Enzyme Kinetics and Mechanism-Cook PF and Cleland WW, Garland Science Pub, 1st Ed, 2007
- 4) Biochemistry-U. Sathyanarayana, Books & Allied (P) Ltd. (2008)
- 5) Essentials of Biochemistry-Fromm HJ and Hargrove M- Springer, 2012
- 6) Fundamentals of Biochemistry- J.L. Jain, Sujay Jain and Nitin Jain, S Chand Publishers, 2007
- 7) Harper's illustrated Biochemistry, 26th Ed, McGraw-Hill companies, 2003
- 8) Text book of Biochemistry- S.P. Singh, CBS Publishers, 5th Ed, 2012

3.4:**Biochemistry Practical-III**

1. Determination of the amylase activity in saliva.
2. Determination of specific activity of salivary amylase.
3. Effect of time on amylase activity.
4. Effect of temperature and pH on the activity of the salivary amylase.
5. Determination of the activity urease.
6. Assay of phosphatase from potato/green gram.
7. Assay of phosphatase from green gram.
8. Determination of activity of urease.
9. Estimation of glucose by Folin -Wu method.

IV Semester

4.3: Physiology and Nutrition 60 Hrs

Unit I 15 Hrs

Nutrition: Basic Principles of a balanced diet to provide energy and nutrients. Proximate analysis of foods. Calorific value of foods-bomb calorimeter, Respiration quotient, Basal metabolism-Direct and indirect calorimetry, Basal Metabolic Rate (BMR) and factors affecting BMR. Specific dynamic action of food. Energy requirements and recommended dietary allowance (RDA) for infants, children and pregnant women. Protein calorie malnutrition.

Unit II 15 Hrs

Fuel molecules: The role of carbohydrates, fats and proteins as fuel molecules: Sources, Requirements and storage forms. The role of fuel molecules in the diet. Essential fatty acids and their biological importance. Nitrogen balance, essential aminoacids, Complete and incomplete proteins, Mutual supplementation of proteins. Fortification of foods, Protein requirement for different categories, dietary fibers.

Micronutrients: Vitamins: Structure, sources, daily requirements, functions and deficiency symptoms/syndromes of water-soluble and fat-soluble vitamins, Hypervitaminosis, Absorption and transport of fat soluble vitamins.

Unit III 15 Hrs

Minerals: Macro minerals (Ca, P, Mg, Na, K and Cl) and micro minerals/trace elements (Co, I, Fe, Mn, Zn and Se)- source, daily requirement, functions and deficiency disease symptoms.

Cells and Tissues: Ultra structure of cell: prokaryotic and eukaryotic cell. Sub-cellular organelles and marker enzymes-Nucleus, mitochondria, chloroplast, ribosomes, endoplasmic reticulum, golgi complex, lysosomes, glyoxysomes and peroxysomes. Microfilaments, microtubules and intermediate filaments.

Tissues-epithelial and connective. Collagen and elastin, Bone-composition, growth and remodeling; factors affecting growth.

Unit IV 15 Hrs

The Body Fluids: The intra and extra cellular fluid compartments, distribution of water between the two components. The composition of blood, lymph and CSF. Blood coagulation. Transport of oxygen and carbon dioxide in blood.

Digestion and absorption of fuel molecules: Anatomy of GIT and accessory organs, Digestion, absorption and transport of carbohydrates, lipid and proteins.

The Liver: The structure of lobule. Functions of the liver, Liver function tests.

The Kidneys: The Nephron. Formation of urine- glomerular filtration, tubular reabsorption and secretion. Kidney function tests, Renal failure and dialysis.

References:

- 1) Essentials of Biochemistry-Fromm HJ and Hargrove M- Springer, 2012
- 2) Fundamentals of Biochemistry- J.L. Jain, Sujay Jain and Nitin Jain, S Chand Publishers, 2007

- 3) Harper's illustrated Biochemistry, 26th Ed, McGraw-Hill companies, 2003
- 4) Text book of Biochemistry- S.P. Singh, CBS Publishers, 5th Ed, 2012
- 5) Biochemistry-U. Sathyanarayana, Books & Allied (P) Ltd. (2008)
- 6) Essentials of Biochemistry-Fromm HJ and Hargrove M- Springer, 2012
- 7) Guyton and Hall Text Book of Medical Physiology, Saunders Pub, 12th Ed, 2010

BSBC 4.4:

Biochemistry Practical-IV

1. Qualitative analysis of carbohydrates
2. Qualitative analysis of amino acids, proteins.
3. Qualitative analysis of lipids.
4. Estimation of amino acids by formal titration.
5. Determination of iodine value of a lipid.
6. Determination of saponification value of oil/fat.
7. Estimation of Calcium from milk.
8. Preparation of starch from potato, casein from milk
9. Extraction of oil from seeds.
10. Determination of albumin and A / G ratio in serum.
11. Estimation of ascorbic acid from biological samples by titrimetric method.
12. Qualitative analysis of body fluids such as blood (total count, plasma volume) and Urine (pH, odor, colour, sp. Gravity, proteins, blood, sugar).

V Semester

5.1:

Metabolism and Bioenergetics

45 Hrs

Unit I

15 Hrs

Introduction to metabolism: Metabolism- anabolism and catabolism. Stages in catabolism, compartmentalization of metabolic pathways in cells and energy conservation.

Carbohydrates metabolism: Glycolysis-entry of fructose and galactose into glycolysis, the fate of pyruvate, the citric acid cycle, the energetic of glucose metabolism. Enzymatic control of glycolysis and TCA cycle. Outline of pentose phosphate pathway and its significance. The Cori cycle, outline of gluconeogenesis and glycogen metabolism. Substrate level phosphorylation. Regulation of blood sugar level, Diabetes mellitus. Glycogen storage disorders.

Unit II

15 Hrs

Lipid metabolism: The α , β -oxidation pathway- even and odd numbered saturated and unsaturated fatty acids. Structure and function of ACP and outline of fatty acid biosynthesis. Outline of cholesterol biosynthesis, ketone bodies and atherosclerosis.

Unit III

15 Hrs

Amino acid metabolism: General reactions of amino acid metabolism- transamination, deamination and decarboxylation. The Urea cycle and its regulation. Biosynthesis of glycine, alanine, cysteine and aspartic acid. Biosynthesis of biologically active amines-epinephrine, nor-epinephrine and polyamines. Inborn errors of amino acid metabolism (PKU and AKU).

Unit IV

15 Hrs

Nucleic acid metabolism: Biosynthesis and degradation of purine and pyrimidine nucleotides. Regulation of nucleic acid metabolism. Disorder of Nucleic acid metabolism-Gout.

Bioenergetics and biological oxidation: Bioenergetics- energy transformations in living systems, free energy concept. Exergonic and endergonic reactions, ATP and other high energy compounds, energy coupling.

Mitochondrial electron transport chain –components, schematic representation indicating sites of ATP synthesis. Oxidative phosphorylation – Chemi-osmotic theory (an outline)

References:

- 1) Text book of Biochemistry- S.P. Singh, CBS Publishers, 5th Ed, 2012
- 2) Biochemistry-U. Sathyanarayana, Books & Allied (P) Ltd. (2008)
- 3) Essentials of Biochemistry-Fromm HJ and Hargrove M- Springer, 2012
- 4) Harper's illustrated Biochemistry, 26th Ed, McGraw-Hill companies, 2003
- 5) Essentials of Biochemistry-Fromm HJ and Hargrove M- Springer, 2012
- 6) Lehninger Principles of Biochemistry- Nelson DL and Cox MM, WH Freeman Pub, 5th Ed, 2008
- 7) Biochemistry- Berg JM and Stryer L, WH Freeman Pub, 5th Ed, 2002

V Semester

5.2:	<u>Cell Biology and Endocrinology</u>	45 Hrs
Unit I		15 Hrs

Biomembranes: Plasma membrane- Fluid mosaic model, structure and composition. Transport across the plasma membrane- simple diffusion- definition with example. Facilitated diffusion- definition, types with examples. Symport, uniport and antiport. Active and passive transport. Ion channels, sodium potassium ATPase.

Behaviour of amphipatic lipids in water, formation of micelles, bilayers and liposomes.

Steroids- Function of cholesterol in membrane organization.

Biochemistry of Specialized tissues: Muscle- types of muscles, muscle proteins, organization of contractile protein and mechanism of muscle contraction (Sliding filament theory) Sources of energy for muscle contraction.

Unit II	15 Hrs
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Biochemistry of Nervous system- Generalized structure of neuron, mechanism of nerve impulse transmission (action/membrane/resting potentials). Neurotransmitters- acetyl choline, GABA, serotonin, dopamine.

Bone- Role of calcium, phosphorus, vitamin D and hormones in bone metabolism. Collagen in bone formation.

Cell cycle: Cell cycle- different phases including cell division - Mitosis and meiosis. Apoptosis- definition, difference between apoptosis and necrosis. Outline of apoptotic pathway and role of caspases. Tumors- benign and malignant. Properties of malignant cells.

Unit III	15 Hrs
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The Endocrine system: Classification of hormones on the basis of structure and site of production. General mechanism of hormone action- Peptide and steroid hormones. Membrane receptors for hormones and second messengers. Intracellular receptor and the regulation of gene expression. Functions of the hormones of the hypothalamus (ACTH), the pituitary, the adrenal cortex and the medulla, the parathyroid, the pancreas, the gonads, the placenta, thyroids and kidney.

References:

- 1) Text book of Biochemistry- S.P. Singh, CBS Publishers, 5th Ed, 2012
- 2) Lehninger Principles of Biochemistry- Nelson DL and Cox MM, WH Freeman Pub, 5th Ed, 2008
- 3) Biochemistry- Berg JM and Stryer L, WH Freeman Pub, 5th Ed, 2002
- 4) Biochemistry-U. Sathyanarayana, Books & Allied (P) Ltd. (2008)
- 5) Essentials of Biochemistry-Fromm HJ and Hargrove M- Springer, 2012
- 6) Biomembranes: Molecular Structure and Function-Robert B. Gennis, Springer, 1st Ed, 1988
- 7) Textbook of Medical Biochemistry- MN Chatterje and Rana Shindhe, JP Brothers Pub, 7th Ed, 2007

5.3:

Biochemistry Practical-V/VI

Colorimetric estimation

1. Estimation of protein by F-C method.
2. Estimation of inorganic phosphate by fiske and Subbarow method.
3. Estimation of glucose by Nelson-Somogyi method.
4. Estimation of reducing sugar by DNS method.
5. Estimation of Creatinine by Jaffe's method.
6. Estimation of iron by ammonium thiocyanate method.
7. Estimation of urea by DAMO method.
8. Estimation of cholesterol by Zak method.
9. Titration curve of an amino acid using pH meter.
10. Determination of pKa of weak acid by pH meter.
11. Titration curves of amino acid/weak acids and determination of pK value.
12. Estimation of calcium in ragi/serum.
13. Separation of serum and plasma from blood
14. Determination of pro/anti-coagulant properties of plant products
15. Direct and indirect hemolysis by drugs and detergents.
16. Demonstration of gel electrophoresis.

VI Semester

6.1: Molecular Biology 45 Hrs

Unit I 15 Hrs

Genetics: Mendel's laws of inheritance, gene interaction, Dominance and co-dominance relationship, multiple alleles and linkage. Chromosomal aberrations: Monosomy, trisomy. Mutagens and mutagenesis.

Introduction to Molecular Biology: Central dogma of molecular biology, experiments related to DNA as a genetic material.

Unit II 15 Hrs

DNA replication: Semi-conservative mode of replication, and experimental verification. Steps involved in DNA replication. Enzymes involved in DNA replication. An outline of the mechanism of action of prokaryotic DNA polymerases.

Transcription: initiation, elongation, and termination. RNA polymerase, comparison of RNA polymerases with DNA polymerases. An outline on post-transcriptional modifications. Reverse transcription- HIV replication.

Genetic code and Translation: The Genetic code- general features. Ribosomes-structure and function. Protein synthesis (prokaryotic): Activation of amino acids, initiation, elongation, and termination. Factors involved in the protein synthesis. Properties of amino acyl t-RNA synthases. Post translational modifications.

Regulation of gene expression in prokaryotes. Operon concept, Lac operon, tryptophan operon.

Replication, transcription and translations as targets for antibiotic action.

Unit III 15 Hrs

Introduction to Recombinant DNA Technology: Enzymes used in recombinant DNA technology, Vectors, chimeric DNA molecules, introduction of recombination DNA molecules into host cells. Selection of transformed cells, Libraries and library construction probes, blotting and hybridization techniques. Application of recombinant DNA technology- insulin production. Polymerase chain reaction, DNA finger-printing, blotting techniques, Application of genetic engineering.

References:

- 1) Molecular Biology and Biotechnology- Walker JM and Rapley R, 5th Ed, Royal Society of Chemistry, 2009
- 2) Molecular Biology: Genes to proteins- Tropp BE, 4th Ed, Jones & Bartlett Publishers, 2012
- 3) Essential of Molecular Biology- Malacinski GM, Jones & Bartlett Learning, 2005
- 4) Cell and Molecular Biology- Rathogi SC, 2nd Ed, New Age International, 01-Jan-2006
- 5) Molecular Cell Biology-Lodish H, Berk A, Kaiser CA, Krieger M, Bretscher A, Ploegh H, Amon A, Scott MP, WH Freeman Publishers, 2012
- 6) The world of the Cell-Becker, Pearson Education India, 2007
- 7) Human Genetics-Lewis R, Garland Science, 2010

VI Semester

6.2:

Immunology and Microbiology

45 Hrs

Unit I

15 Hrs

Immunology: Organs of Immune system: Primary and secondary lymphoid organs, Cells of Immune system- lymphoid cells, B and T lymphocytes, Mononuclear cells, granulocytic cells

Immunity: Innate immunity (Non specific)- Anatomic barriers, Physical barrier, Phagocytic, Inflammatory.

Adaptive (Specific Immunity)-Humoral and cell mediated immune responses. Recognition of antigens by B and T lymphocytes. Cellular interaction for generation of humoral and cell mediated response. Role of cytokines and interferons.

Antigens: Factors that influence immunogenicity, epitopes, haptens. Immunoglobulins- Structure of immunoglobulins, Classes of immunoglobulins and their functions. Antigenic determinants of immunoglobulins. Monoclonal antibody and polyclonal antibodies.

Unit II

15 Hrs

Antigen-antibody interactions: Precipitation reaction, agglutination, ELISA and Immunoprecipitation, Blood typing. Hypersensitivity reactions-Types with examples.

Vaccines: Active and passive immunization, types of vaccines. Autoimmune diseases- Definition. Types of immune diseases like Multiple sclerosis, Rheumatoid arthritis, and Insulin depended diabetic mellitus.

Microbiology: Microscopy-The compound microscope and its uses, brief mention of electron microscope and its applications. Classification of Microorganisms- Eubacteria, archaeobacteria, fungi, protozoa, and viruses.

Bacterial cell and Virus structure: Ultra Structure and composition of bacterial cell wall and cell membrane, flagella (Motility) capsule and spore. Gram-staining-classification of bacteria based on Gram's staining and spore stains.

Unit III

15 Hrs

Animal viruses: Brief account of animal viruses- polio, influenza, HIV; plant virus – TMV and bacteriophage.

Cultivation of microorganisms: Nutritional requirements, temperature, pH, and oxygen levels for optimal growth. Bacterial growth curve, control of microorganisms by chemical and physical methods.

Tissue Engineering and Regenerative Medicine: Introduction to biomaterials and tissue engineering. Biopolymers and bioscaffolds. Control release of drugs using biomaterials. Applications of biomaterials in the field of tissue Engineering and Regenerative Medicine. Nanomaterials- Graphene and silver oxide-Applications.

References:

- 1) General Microbiology, Vol. I & II – Powar, Daginawala – Oscar Publications
- 2) Textbook of Microbiology- CKJ Panikar, Orient Blackswan, 2005
- 3) Medical Microbiology-Kayser FH, Bienz KA and Eckert J, Thieme Publishers, 2011
- 4) Microbiology- Pelczar, Tata McGraw-Hill Education, 1998
- 5) Fundamental Immunology- Paul WE, Lippincott Williams & Wilkins Publishers, 2012
- 6) Immunology, Introductory textbook-Nandini Shetty, New Age International, 2005

- 7) Textbook of Microbiology and Immunology-Parija SC, Elsevier India, 2009
- 8) Immunology: An illustrated outline-Male DK, Elsevier Health Sciences, 2004

6.3: Biochemistry Practical-VII/VIII

1. Extraction of genomic DNA of plant source.
2. Extraction of genomic DNA of animal source.
3. Estimation of DNA by diphenylamine reaction.
4. Determination of contamination of carbohydrate in isolated DNA.
5. Determination of contamination of protein in isolated DNA.
6. Estimation of RNA by orcinol reaction.
7. Preparation of bacteria and fungi media
8. Isolation of microorganism by serial dilution technique.
9. Pure culture technique: spread plate method, pour plate method, streak plate method
10. Simple staining of Bacterial pure culture
11. Gram staining of bacterial pure culture.
12. Ouchterlony immunodiffusion.
13. Determination of blood groups (ABO & Rh system).

References for Practical papers

- 1) Introduction to Practical Biochemistry-Plummer Mu, David T. Plummer, Tata McGraw-Hill Education, 1988
- 2) A Textbook of Practical Biochemistry-Rashmi JA and Saraswat M, B. Jain Publishers, 2002
- 3) Practical Clinical Biochemistry: Methods and Interpretations-Ranjna Chawla, JP Medical Ltd, 2014
- 4) Practical Biochemistry for Students- Malhotra VK, Jaypee Brothers Publishers, 2003
- 5) Principles and Techniques of Practical Biochemistry-Keith Wilson, John M. Walker, 5th Ed, Cambridge University Press, 2000
- 6) Clinical Biochemistry: Techniques and Instrumentation : a Practical Course-John S. Varcoe, World Scientific, 2001
- 7) Practical Handbook of Biochemistry and Molecular Biology-Gerald D. Fasman, CRC Press, 1989
- 8) Analytical Techniques in Biochemistry and Molecular Biology-Rajan Katoch, Springer Science & Business Media, 2011
- 9) Physical Biochemistry: Principles and Applications-David Sheehan, John Wiley & Sons, 2013
- 10) Practical Biotechnology- Gaud RS, Gupta GD, Gokhale SB, Nirali Prakashan, 2008
- 11) Chemical Calculations: Mathematics for Chemistry-Paul Yates, 2nd Ed, CRC Press, 2007
- 12) Laboratory Techniques in Organic Chemistry- Ahluwalia VK, I. K. International Pvt Ltd, 2005
- 13) Experimental Inorganic/Physical Chemistry: An Investigative, Integrated Approach to Project work- Malati MA, Elsevier, 1999
- 14) College Practical Chemistry-Ahluwalia VK, Dhingra S, Universities Press, 2005

OPEN ELECTIVE: 4.9 Basics of Clinical Biochemistry

UNIT-I	9 Hrs
Brief introduction to Units of measurements of solutes in solution, e.g. Normality, Molality, Molarity, Osmolarity, Ionic strength. Use of units and abbreviations in expressing the concentration and standard solutions.	
Introduction to macromolecules: Brief introduction to carbohydrates, proteins, lipids and nucleic acids. Classification and biological functions of macromolecules.	
UNIT-II	9 Hrs
Specimen collection and processing (Blood, urine, feaces), anti-coagulants and preservatives for blood and urine. Transport of specimens. Osmosis and its application. Isotonic solution, hyper, hypo and isotonic solutions. Blood sugar level- factors controlling blood sugar level. Hypo and hyper glycemia, Introduction to Diabetes mellitus and its types.	
UNIT-III	6 Hrs
Introduction of Liver function tests.. Hemolysis and Bilirubin, Jaundice-types and diagnosis	
Renal functional tests -clearance test –Urea and Creatinine.	
UNIT-IV	6 Hrs
Functional and non-functional plasma enzymes. Isoenzymes with examples. Clinically important enzymes and their patterns in liver damage, bone disorder and myocardial infarction.	

B.Sc Biochemistry Theory Question Paper Pattern
Tumkur University B.Sc Degree Examinations (CBCS)
Biochemistry

Time: 3 Hrs

Max. Marks: 90

Note to candidates: Answer Part A, any SIX questions from Part B and any FOUR questions from Part C

PART-A

Answer any **TEN** of the following

2X10= 20

- 1)
- 2)
- 3)
- 4)
- 5)
- 6)
- 7)
- 8)
- 9)
- 10)
- 11)
- 12)

PART-B

Answer any **SIX** of the following

6X5= 30

- 13)
- 14)
- 15)
- 16)
- 17)
- 18)
- 19)
- 20)

PART-C

Answer any **FOUR** of the following

4X10= 40

- 21)
- 22)
- 23)
- 24)
- 25)
- 26)

B.Sc Biochemistry (CBCS) Practical Question Paper Pattern

For Semester I-IV

The distribution of marks in practical shall be as follows.

- | | |
|------------------------|----------|
| 1) Procedure writing | 05 marks |
| 2) Experiment(s) | 25 marks |
| 3) Spotters (2 number) | 10 marks |
| 4) Practical record | 05 marks |
| 5) Viva | 05 marks |

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Total - 50 marks
.....

For Semester V-VI

The distribution of marks in practical shall be as follows.

- | | |
|------------------------|----------|
| 1) Procedure writing | 10 marks |
| 2) Experiment- Major | 35 marks |
| 3) Experiment-Minor | 20 marks |
| 4) Spotters (3 number) | 15 marks |
| 5) Practical record | 10 marks |
| 6) Viva | 10 marks |

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Total - 100 marks
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