SCHEME OF EXAMINATIONS

AND

SYLLABUS

B.Sc. (Part-I, II & III) Biochemistry

(Effective from the Academic Session 2016-2017)

Bachelor of Science (B.Sc.)
Biochemistry

Faculty of Science

UNIVERSITY OF KOTA

MBS Marg, KOTA (Rajasthan)-324 005

INDIA

Bachelor of Science

BIOCHEMISTRY
(Three Year Course)

B.Sc. BIOCHEMISTRY

1. The duration of the course will be three years.
2. There will be five theory papers in each year and each theory paper will carry 100 marks..
3. There will be practical examinations in each year & in first-four practical, 2nd year and 3rd year-3 practical. Each practical examinations will carry 100 marks each (25% marks in practical examinations will be reserved for internal assessment and viva-voce, respectively). Thus, total marks during the 3 years duration will be 1500 for theory examinations and 1000 for practical examinations.
4. The minimum pass marks for theory and practical examinations will be 45% AGGREGATE & individual 40%.
5. Practical exam duration will be 6 hrs. And Theory exams duration will be 3hrs.
6. For Theory papers of 100 marks, 3 hrs./week will be allotted.
7. For a practical paper of 100 marks, 6 periods will be allotted per week .

Note: The paper is divided into 5 independent units. The questions will be set from each unit. The candidates are required to attempt one question from each unit.

SCHEME OF EXAMINATION
B.Sc. (Part-I) Biochemistry Examination

Number of Paper	Code of Paper	Nomenclature of Paper	Duration of Examination	Max. Marks		
				Int.	Ext.	Total
Theory Papers						
Paper-I	BC-101	Physical Chemistry	3 Hours	--	100	100
Paper-II	BC-102	Organic & Inorganic Chemistry	3 Hours	--	100	100
Paper-III	BC-103	Physics	3 Hours	--	100	100
Paper-IV	BC-104	Mathematics & Statistics	3 Hours	--	100	100
Paper-V	BC-105	Introduction to Biology & Chemistry of Biologically Important Molecules	3 Hours	--	100	100
Practical Papers						
Paper-I	BC-106	Physical Chemistry	6 Hours	25	75	100
Paper-II	BC-107	Organic & Inorganic Chemistry	6 Hours	25	75	100
Paper-III	BC-108	Physics	6 Hours	25	75	100
Paper-IV	BC-109	Introduction to Biology & Chemistry	6 Hours	25	75	100

SCHEME OF EXAMINATION
B.Sc. (Part-II) Biochemistry Examination

Number of Paper	Code of Paper	Nomenclature of Paper	Duration of Examination	Max. Marks		
				Int.	Ext.	Total
Theory Papers						
Paper-I	BC-201	Biochemical and Biophysical Techniques	3 Hours	--	100	100
Paper-II	BC-202	Proteins, Enzymes and Coenzymes	3 Hours	--	100	100
Paper-III	BC-203	Human Physiology and Endocrinology	3 Hours	--	100	100
Paper-IV	BC-204	Metabolism of Carbohydrates and Lipids	3 Hours	--	100	100
Paper-V	BC-205	Metabolism of Amino Acids, Nucleotides & Phorphyrins	3 Hours	--	100	100
Practical Papers						
Paper-I	BC-206	Bio-Physical Techniques	6 Hours	25	75	100
Paper-II	BC-207	Bio-chemical Techniques	6 Hours	25	75	100
Paper-III	BC-208	Enzymological Techniques	6 Hours	25	75	100

SCHEME OF EXAMINATION
B.Sc. (Part-III) Biochemistry Examination

Number of Paper	Code of Paper	Nomenclature of Paper	Duration of Examination	Max. Marks		
				Int.	Ext.	Total
Theory Papers						
Paper-I	BC-301	Cell Biology	3 Hours	--	100	100
Paper-II	BC-302	Physiology	3 Hours	--	100	100
Paper-III	BC-303	Molecular Biology	3 Hours	--	100	100
Paper-IV	BC-304	Microbial Biochemistry & Immunology	3 Hours	--	100	100
Paper-V	BC-305	Clinical & Nutritional Biochemistry	3 Hours	--	100	100
Practical Papers						
Paper-I	BC-306	Clinical & Nutritional Biochemistry	6 Hours	25	75	100
Paper-II	BC-307	Physiology & Biochemistry	6 Hours	25	75	100
Paper-III	BC-308	Microbial Biochemistry, Immunology & Molecular Biology	6 Hours	25	75	100

Bachelor of Science

BIOCHEMISTRY
(Three Year Course)

Syllabus

B.Sc. (Part-I) Biochemistry

Paper-I (BC-101): Physical Chemistry

Duration : 3 Hrs. **Max. Marks :100** **Min. Marks : 36**

Note: This paper is divided into five units. Two questions will be set from each unit. The candidates are required to attempt one question from each unit.

Unit-I

Dissociation of water and pH scale, ionic equilibrium in solution up to dibasic/diacidic bases, pH changes during acid base titration (weak and strong), acid bases indicator common ion effect. Hasselbach-Henderson equation, buffer solution, buffer index and buffer capacity.

Unit-II

Conductance:

Elementary idea of conductance, Kohlrauch law and its application.

Fundamentals of Solution Thermodynamics:

Globular Macromolecules, Membrane Equilibrium, Osmotic pressure, Dialysis Equilibrium, The Domnan Equilibrium, and Active transport.

Unit-III

Chemical Kinetics:

Basics of orders and molecularity, Experimental methods for the determination of order of a reaction up to 2^{nd} order. Steady state approximation and reaction mechanism. Complex reactions, opposite, parallel consecutive and chain reactions (qualitative idea). Effect of temperature on reaction rate, collision theory and absolute reaction rate theory.

Adsorption and catalysis:

Homogenous and heterogenous catalysis, adsorption, physical adsorption and chemisorption, various types of adsorption, isotherms, nature of adsorbed state, heterogeneous catalysis, kinetics of catalytic decomposition. Promotors and inhibitors.

Unit-IV

Chemical Thermodynamics:

Enthalpies of ionization and enthalpy of formation of ions, use of Born-Haber cycle for calculation of lattice energy, Kirehoff's Equation, maximum flame temperature and its calculations. Second law, Basic idea of entropy and its variation with temperature and pressure. Third Law, Statement of third law, Gibb's free energy and Helmholtz free energy. Variation of S, G, and A with P, V, and T. Gibbs Helmholtz equation criteria of thermodynamic equilibrium.

Unit-V Concept of Chemical Potential:
Electrochemical cell, Electrolytic cell and Galvanic cell. Reversible and Irreversible cells. Electromotive force of a cell and its measurement. Free energy, entropy, and enthalpy changes of cell reactions. Nernst equation, standard electrode (reduced) potential, types of electrode (including reference electrode). Determination of equilibrium constant, liquid junction potential, pH determination using hydrogen electrode, glass electrode and quinone, isoquinone electrode, potentiometric (acid and bases, redox and precipitation) titrations. The molecular spectroscopy consisting of generation of different spectra viz. X-rays, UV, IR, NMR, ESR and microwave.

Paper-II (BC-102): Organic & Inorganic Chemistry

Duration : 3 Hrs. **Max. Marks :100** **Min. Marks : 36**
Note: This paper is divided into five units. Two questions will be set from each unit. The candidates are required to attempt one question from each unit.

Unit-I
Organic chemistry in everyday life. Tetrahedral concept in carbon compounds, nomenclature. Hybridization and types of bonds, atomic and molecular orbitals. Electronic displacements inductive, electromeric, hyper conjugative and resonance effects. Nucleophiles and electrophiles and their importance in biological Systems. Characteristics and types of organic reactions. Additions, eliminations, substitutions and rearrangements.

Unit-II
Tautomerism, metamerism stereoisomerism, geometrical isomerism, E&Z designations of geometrical isomers, optical isomerism, Specify and molar notations, D&L designations, absolute configurations in terms of R&S notations. Aldol Condensations, Cannizzaro's reaction, lodoform reaction, Wurtz reaction, Claisen ester condensation, Hoffmann bromamide reaction (with their mechanism), Markownikoff's rule, Saylzaff rule.

Unit-III
Preparation, typical reactions and uses of the following class of compounds.
Aliphatic end aromatic hydrocarbons (electrophillic substitutions) alkyl and aryl halides (Nucleophillic substitution) alcohols and phenols, aldehydes and ketones, monocarboxylic acids and their derivatives.

Unit-IV
Chemical bonding
Ionic: General characteristics, types of ions, size effects, radius ratio, packing of ions in crystals, lattice energy. Covalent: General characteristics, coordinate covalent bonds, valence bond approach, directional characteristics of covalent Bond, multiple bonding, sigma and pi bonding, bond lengths, bond order, formal charge, valence shell, electron pair repulsion (VSEPR) theory. Hydrogen bond (theories of hydrogen bonding), Metallic bond.

Unit-V
Chemistry of s- & p-block elements (excluding metallurgy and compounds), general trends in groups, electronic configuration, atomic radii, ionic radii, ionization potential, electron affinity, electronegativity, oxidation states. Concept of coordination in complex and

coordination number, Werner's theory, isomerism in coordination compounds, bonding in coordination compounds, Inorganic biomolecules.

Paper-III (BC-103): Physics

Duration : 3 Hrs. **Max. Marks :100** **Min. Marks : 36**

Note: This paper is divided into five units. Two questions will be set from each unit. The candidates are required to attempt one question from each unit.

Unit-I

Centrifugal centripetal forces, sedimentation, Moments of inertia, Radius of gyration, Theorem of parallel and perpendicular axis, Expression for M.I. of regular shaped bodies (no derivation). Acceleration due to gravity and its variation with depth, altitude and latitude, determination of 'g' by compound pendulums. Surface tension and vapour pressure over flat and curved liquid surface and effects on evaporation and condensation, determination of surface tension by Jaegers method. Viscosity-Poiseuille's formula and method of determination of coefficient of viscosity. Colloids, colligative properties. Coulombs law, Gauss theorem and its application, force on surface of a charged conductor, Energy per unit volume of the medium.

Unit-II

Magnetic field due to a current, Ampere's law, field due to current in a straight and circular wire and solenoid. Kirchoff's laws and their application, wheat stone bridge, Carey foster's bridge, Crompton potentiometer. Semiconductors, p n junctions Transistors, rectifier, use of filters, Oscillators, Bark hausen criteria of oscillation with one example, Amplifier transistor as an amplifier ex; CE amplifier.

Unit-III

Free damped and forced vibration, resonance, nature and equation of wave motion. Superposition of waves, standing waves, Doppler Effect. Coaxial system of two thin lenses separated by distance, cardinal points, Defects of images chromatic and spherical aberrations. Achromatic combination of lenses and prism, Direct vision spectroscope. Eye piece (Ramsden and Huygens)

Unit-IV

Electron microscope. Interference of two beams, Division of amplitude and division Of wave front, double slit, biprism, colour of thin films, Newton's ring, Michelson interferometer. Rectilinear propagation of light, diffraction-Diffraction of straight edge, slit and wire, Fraunhofer class of diffraction, Expression for intensity due to a single slit (no derivation), Rayleigh criterion for resolving power, resolving power of telescope and eye double refraction, Polarization of light and polarimetry. Measurement of charge of "e" by Millikan expt., e/m of electron by Thompson's Method, Rutherford model of atom, Bohr's model of hydrogen atom, Atomic spectra, De broglie waves, Heisenberg uncertainty relation, Schrodinger wave equation and its solution for square well potential.

Unit-V

Vibrational, electronic and nuclear magnetic spectroscopy. Chemical Equilibrium and thermodynamics Mosley's expt. on X-rays, Diffraction of X-rays, Bragg's law. Liquid drop model of nucleus, Nuclear fission and fusion. Radioactivity, alfa, beta and gamma rays,

radioactive decay, consequences of decay and unit of radioactivity, production of radioisotopes, Interaction of radiation with matter and effect of ionizing radiation on biomolecules, detection of radiation GM and scintillation counters.

Paper-IV (BC-104): Mathematics and Statistics

Duration : 3 Hrs. **Max. Marks :100** **Min. Marks : 36**

Note: This paper is divided into five units. Two questions will be set from each unit. The candidates are required to attempt one question from each unit.

Mathematics

Unit-I

Differential calculus:

Derivatives of inverse functions, inverse trigonometric functions, logarithmic functions and exponential functions, Derivatives of implicit functions and derivatives of functions defined pararnetrically. Successive differentiation, Leibnitz's theorem, Rolle's theorem, Mean value theorems, Taylor's theorem, Maclaurin's theorem (without proofs), Maclaurin's expansions, Indeterminate forms, Maxima and minima, Partial differentiation, Euler's theorem, Tangents and Normals, Curvature (Cartesian and polar coordinates), Asymptotes, Singular points of curves, Cure tracing.

Unit-II

Integral Calculus :

Integration by partial fractions, Integration of rational and irrational functions, Properties of definite integrals, Reduction formulae for integrals of trigonometric functions. Infinite series: Ratio test and root rest for positive term series, Leibnitz's test for alternating series.

Unit-III

Trigonometry and Algebra :

Trigonometry: De Moivre's theorem and its simple application. Algebra: Relations between roots and coefficients of algebric equations, Solution of cubic equations, Algebra of matrices. Determinants and their simple properties, Rank of a matrix and its invariance under elementary row and column transformations, System of linear equations. Differential Equations: Separable variable, homogenous, exact and linear equations of second order.

Statistics

Unit-IV

Concepts in statistics, probability significance level, Degree of freedom, relative frequency presentation of data, types of graphics, Normal distribution, Measurement of central tendency, Arithmetic mean, median and mode, measure of variation, Range, standard deviation, standard error, coefficient of variation, Exponential and Logarithmic functions, Binomial, Poisson and normal distribution. Tests of significance, test for proportion, to and t tests, contingency tables of χ^2 (Chi square) tests of goodness of fit and homogenety, additive property of χ^2 and the normal approximation, meaning of very small χ^2 values.

Unit-V

Theory of errors, errors and residual precision, probable error of a function, rejection of observations, averages, least squares and linear regression, associated test of significance, Analysis of variance for one and two way classification and design of experiments,

randomization, replication local control, completely randomized and randomized block design.

Paper-V (BC-105): Introduction to Biology and Chemistry of Biologically Important Molecules

Duration : 3 Hrs. Max. Marks :100 Min. Marks : 36

Note: This paper is divided into five units. Two questions will be set from each unit. The candidates are required to attempt one question from each unit.

Unit-I

Definition and characteristics of life, General account of various classes of living organisms such as viruses, bacteria, algae, fungi higher eukaryotes and plants, Cell theory, cell cycle, mitosis, meiosis and their significance. Structure and function of cellular constituents: Cell wall, plasma membrane, protoplast and its colloidal nature, chloroplast, mitochondria, endoplasmic reticulum, ribosome, lysosomes, golgi apparatus, centrioles, basic granules, cells, flagellum and itochondria. Biomolecules-Structure, function, diversity and distribution. General composition of Living matter - A brief introduction.

Unit-II:

Carbohydrates

Monosaccharides and their inter relationship, structure of sugars, Stereoisomerism and optical isomerism of sugars, Reactions of aldehyde and ketone groups, Ring structure and tautomeric forms, mutarotation, Reaction of sugars due to OH groups, Important derivatives of Monosaccharides, Disaccharides and Trisaccharides (glucose, fructose, maltose, lactose, cellobiose, gentiobiose, melibiose, turanose, sucrose, trehalose, mannotriose, rabinose, rhamnose, raffinose, gentionose, melizitose.) Identification and analysis of mono and oligosaccharides, structure and importance. Structure, occurrence and biological importance of structural polysaccharides e.g. Cellulose, chitin, agar, algenic acids, pectins, proteoglycans, sialic acids, blood group polysaccharides, bacterial cell wall polysaccharides etc.

Unit-III: Lipids

Building block of lipids - fatty acids, glycerol, sphingosine Definition and classification of lipids. Classification of fatty acids, physiochemical properties of fatty acids, separation of fatty acids, distribution of fatty acids in nature and characterization of fatty acids, saponification and iodine number, properties of glycerol, fats and oils. Systematic nomenclature and classes of glycerides-MAG, DAG, TG, phospholipids- A, PG, PE, PS, LPC, PI and plasmalogens, sphingolipids-sphingosine, ceramide, sphingomyelin, glycolipids-cerebrosides, gangliosides and sialic acids. Properties and function of phospholipids, Prostaglandins. Classes, structure and synthesis. Isoprenoids-types and structures, Chemistry of sterols, Bile acids, steroid hormones, plant sterol, ergosterol, stigma sterol, cholesterol, glucocorticoid, mineralocorticoids. Lipoproteins-classification, composition and their importance, Role of Lipids in cellular architecture and functions.

Unit-IV:

Amino acids

Classification and formulae, Proteinaceous and nonproteinaceous, essential and non-essential amino acids. Physical, chemical and optical properties of amino acids. Introduction to biologically active peptide e.g. Insulin, Functional diversity of proteins with examples.

Unit-V: Nucleic acids

Importance of nucleic acids in living system, general composition of nucleic acids, the purine and pyrimidine bases, Tautomeric forms of bases. Reactions of purines and pyrimidines, structure of nucleosides and nucleotide, deoxynucleotides, cyclic nucleotides and polynucleotides. Watson and crick model for DNA. Different types of DNA and RNA.

Vitamins

Discovery and role in body functions. Chemistry of fat soluble vitamins A, D, E & K. Water soluble vitamins such riboflavin, pantothenic acid, niacin, pyridoxine, biotin, cobalamine, folic acid and ascorbic acid.

Biochemistry Practical Courses

Paper-I (BC-106) : Physical Chemistry (Max Marks 100)

1. Determination of viscosity of liquids.
2. Adsorption (acetic acid on charcoal)
3. Enthalpy of Neutralization.
4. Determination of enthalpy of solution dilution.
5. Preparation of buffer solutions and measurement of their pH values using indicators and pH meters. Knowledge of ionization constant of weak acids and bases involved.
6. Conductometric titration of acids and bases.
7. Determination of order of reactions for first and second order reactions.

Paper-II (BC-107) : Organic & Inorganic Chemistry (Max Marks 100)

Organic Chemistry

1. Preparation of the compounds involving single state reactions: nitration, benzoylation, and brominations, suggested examples are : m-dinitrobenzene, benzanilide and tribromoaniline.
2. Purification of organic compounds by crystallization.
3. Systematic identification of functional group of organic compounds (Monofunctional only).

Inorganic Chemistry

1. Preparation of complex salts (two preparations)
2. Qualitative Analysis : Mixture containing not more than 4 ions including interfering radicals.
3. Oxidation reduction titration ($KMnO_4$ and $K_2Cr_2O_7$) – using internal indicators.

Paper-III (BC-108) : Physics (Max Marks 100)

1. 'g' by bar pendulum.
2. 'g' by Kater's pendulum.
3. Focal length of combination of lens by magnification method.
4. Refractive index of liquid using Travelling Microscope.,
5. Low resistance by Carey Foster Bridge.
6. Reduction factor of a Tangent galvanometer.
7. Resistance of a galvanometer by Kelvin's method.
8. Determination of Viscosity of water using Poisuelle method.
9. Refractive index of the material of a prism using spectrometer.
10. Wave length of sodium light by Newton's ring.
11. Wave length of sodium light by Diffraction grating.
12. Specific rotation of sugar using Polarimeter.

13. Transistor Characteristics.
14. Surface tension by Jaggers method.

Paper-I (BC-107) : Organic & Inorganic Chemistry (Max Marks 100)

5. Practical Course for Introductory Biology BC-110) (Max Marks 100)

1. Identification tests for Carbohydrates, proteins and lipids.
   - Carbohydrates : 1. Molisch test
     2. Benedicts
     3. Barfoed's
     4. Fehling's test
     5. Iodine test
   - Proteins : 1. Biuret
     2. Xantho protein
     3. Ninhydrin
     4. Hopkin cole
   - Lipids : 1. Salkowski
     2. LieBermann Burchard
2. Preparation of solutions of different molarities and normalities.
3. Adjusting the pH of solution and preparation of buffer
4. Isoelectric point of casein.

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Bachelor of Science

BIOCHEMISTRY
(Three Year Course)

Syllabus

B.Sc. (Part-II) Biochemistry

Paper-I (BC-201): Biochemical and Biophysical Techniques

Duration : 3 Hrs. **Max. Marks :100** **Min. Marks : 36**

Note: This paper is divided into five units. Two questions will be set from each unit. The candidates are required to attempt one question from each unit.

Separation techniques:

Unit-I

Chromatography

1. Partition chromatography
2. Adsorption chromatography
3. Ion exchange chromatography
4. Thin layer chromatography
5. Molecular sieve (Gel chromatography)
6. Hydrophobic chromatography
7. Gas liquid chromatography
8. Affinity chromatography
9. High pressure liquid chromatography

Unit-II

1. Salt and organic solvent fractionation.
2. Dialysis, reverse dialysis, ultra filtration
3. Electrophoresis – free flow, zone (disc, slab-SDS PAGE) and paper electrophoresis.
4. Isoelectric focusing
5. Centrifugation–centrifuge of various types, rotors, boundary, differential, density gradient.

Instrumental methods:

Unit-III

1. Spectrophotometry - UV, visible
2. Fluorometry
3. Radioactive counters, GM, liquid scintillation

Unit-IV

Radioisotopes in Biology, applications and precautions.

Unit-V

Microbiology: Types of media, selective and enrichment media, sterilization, cell counting, cell number, viable & non-viable, Growth, maintenance of cultures, staining procedures, plating, microtomy.

Microscopy: Compound, electron, phase contrast, confocal and Preparation of samples.

Paper-II (BC-202): Proteins, Enzymes and Coenzymes

Duration : 3 Hrs. **Max. Marks :100** **Min. Marks : 36**

Note: This paper is divided into five units. Two questions will be set from each unit. The candidates are required to attempt one question from each unit.

Unit-I

Peptide Bond: Nature, identification and conformation. Primary, Secondary, tertiary and quaternary structure of proteins. N and C terminal determination, Ramachandran plot, peptide mapping with respect to myoglobin and hemoglobin.

Characterization of Proteins: Physicochemical (molecular weight, molecular size, isoelectric point, viscosity, Svedberg's coefficient), immunologic al and biological characteristics.

Unit-II

Purification of Protein: Criteria for homogenity for peptides and proteins, techniques for sequencing of proteins, Isoelectric point. Solid phase synthesis of proteins :

Protein folding: Role of molecular chaperone

Enzymes: Historical background and importance of enzymes. chemical nature of enzymes, enzymes as catalysts, Units of enzyme action, Turnover number, Assay of enzymes, Enzyme specificity, Concept of active centres, concept of holoenzyme, co-enzyme, apoenzyme and prosthetic groups.

Unit-III

Enzyme classification and nomenclature.

Purification of Enzymes: Criteria of purity (affinity and ion exchange chromatography).

Kinetics of enzyme catalyzed reactions: Michaelis-Menten equation, Vmax, significance of Km, applicability of Michaelis-Menten equation, Methods of determination of Km and Vmax and their limitations, various factors influencing the rate of enzyme catalyzed reactions.

Enzyme inhibitions: Competitive, non -competitive, uncompetitive and mixed inhibitors, reversible and non-reversible inhibitions, suicide in activators.

Unit-IV

Mechanism of enzyme catalysis (acid base and covalent catalysis, proximity effect, induced fit theory, catalysis, due to strain and distortion e.g. lysozyme, chymotrypsin and hexokinase two substrate reactions, general mechanisms (ordered and ping pong).

Chemistry and enzymatic function of water soluble vitamins such as riboflavin, pantothenic acid, niacin, pyridoxine, biotin, cobalamine, folic acid, lipoic acid, and ascorbic acid.

Regulation of enzyme activity: (a) Allosteric enzymes, feedback inhibitions, concerted and sequential model, homotropic effect, negative and positive cooperativity e.g. Atcase. (b) Zymogens, isoenzymes, multienzyme complexes. (c) Isoenzymes and their role in metabolism.

Unit-V

Immobilized enzymes and their applications. Applications of enzymes for diagnostic purposes.

Paper-III (BC-203): Human Physiology and Endocrinology

Duration : 3 Hrs. **Max. Marks :100** **Min. Marks : 36**
Note: This paper is divided into five units. Two questions will be set from each unit. The candidates are required to attempt one question from each unit.

Unit-I
Introduction to Physiology and Hormones: Cell signaling and mechanism of hormone action. Receptor families G protein linked receptors. Enzyme linked receptors (self & intracellular). Intracellular receptors. Steroid receptors & super-families. Thyroid hormone receptors. Signal transduction-cAMP, cGMP, Ca^{2+}, IPS, DAG G proteins (RAS) Protein kinase (RAF, MAP Calmodulin, Prostaglandin.
Ca^{2+} Homeostasis: Calcitonin, PTH, Vit. D_3. Bone turnover and related pathophysiology Osteoporosis, Osteomalacia and Rickets. Pitutary hypophysial axis.

Unit-II
Neuroendocrine Control of Gl tract, Secretin and Gastrin family.
Hepatic Physiology: Functional anatomy of hepatic lobule, Detoxification, Bile secretion. Related pathophysiology-Obstructive and hemolytic jaundice.

Unit-III
Glucose Homeostasis- Glucagon, insulin and glucocorticoid Related pathophysiology.
Thyroid Hormones - T3 & T4 related pathophysilogy - Goitre, Cretinism, Myxedema.

Unit-IV
Renal physiology, Nephron, Nau homeostasis - Aldosterone, Renin, angiotensin system, Kallikrein kinin system, Regulation of water balance, ADH, counter current mechanism, Related pathophysiology - Cushing's, Conn's, Diabetis insipidis
Physiology of Blood and Cardiovascular System: Imposition of blood Plasma, RBC Homeostasis, cardiac muscle and action Potential; Blood p assure regulation, blood -H gulation, blood brain barrier, Related patho-physiology, Anemia, thallesemia, sickle cell anemia, atherosclerosis, hypertensions, Myocardial inferno, Stress - hormonal control.

Unit-V
Adrenal medullary hormores, Parkinson's disease
Growth and development GH, insulin. Growth factors, EGF, NGF, IGF-l & II.
Reproduction-male and female sex hormones, Reproductive cycle, Gestation, lactation and contraception.

Paper-IV (BC-204): Metabolism of Carbohydrates and Lipids

Duration : 3 Hrs. **Max. Marks :100** **Min. Marks : 36**
Note: This paper is divided into five units. Two questions will be set from each unit. The candidates are required to attempt one question from each unit.

Unit-I
Dynamic state of body constituents, General features of regulation of metabolism. Sources of carbohydrates, Glycolysis, Gluconeogenesis, Enzymatic and hormonal control of glycolysis,

and gluconeogenesis. Alcoholic fermentation, Pasteur and crab free effect. Futile cycles Metabolism of 2,3 diphosphoglyceric acids.

Unit-II
Tricarboxylic acid cycle, regulation of TCA cycle, Design of TCA cycle and nutritional consequences. Hexose monophosphate shunt and its regulation. Metabolism of glycogen, glycogenolysis and glycogenesis and regulation of glycogen metabolism. Synthesis of sugars in plants, Calvin cycle, Hatchin Slack Cycle

Unit-III
General outlines of lipid metabolism, Digestion and absorption. Enzymatic hydrolysis in intestine**.** Enzymatic resynthesis in intestine**.** Packaging into chylomicrons**.** Uptake of fatty acids from circulating chylomicrons by tissues, role of lipoprotein lipase.

Unit-IV
Mobilization of Triglycerides: Hydrolysis of TG to FFA in adipose tissues by hormone sensitive lipase. Resynthesis of TG from FFA in adipose tissues and role of carbohydrate metabolism. Transport of net free fatty acids from adipose tissues as FFA albumin complex and uptake of FFA by tissue.

Unit-V
Oxidation of Fatty Acids: Activation of Fatty acids, Entry of long chain fatty acyl CoAs into mitochondrial matrix. Beta-oxidation, Oxidation of unsaturated fatty acids. Beta-oxidation of fatty acids in mitochondria and in peroxisomes. Formation of ketone bodies, Oxidation of ketone bodies, Ketosis, Propionic acid metabolism. Biosynthesis of fatty acids, Biosynthesis of phosphoglyceride, Sphingolipids. Diseases of lipid metabolism, Refsum disease, Respiratory distress syndrome, ganglioside breakdown, fatty livers, Synthesis of cholesterol, bile acids and bile salts, biosynthesis of eicosanoids.

Paper-V (BC-205): Metabolism of Amino Acids, Nucleotides & Phorphyrins

Duration : 3 Hrs. **Max. Marks :100** **Min. Marks : 36**
Note: This paper is divided into five units. Two questions will be set from each unit. The candidates are required to attempt one question from each unit.

Unit-I
Amino Acids: Nitrogen cycle - Protein calorie malnutrition. Outlines of amino acids metabolism. Fixation of nitrogen, mechanisms of reduction of elemental nitrogen, incorporation of ammonia into amino acids, uptake of amino acids by cell. Urea synthesis. Catabolic pathways of individual amino acids. Glucogenic and ketogenic amino acids.

Unit-II
Metabolism of one-carbon atom groups. Role of pyridoxal phosphate. Precursor functions of amino acids. Synthesis of creatine, creatine phosphate and creatinile. Synthesis of amines - Spermine, spermidine, epinephrine, nor-epinephrine, Serotonin, GABA, Glutathione. Synthesis of non-essential amino acids, Nitrogen balance.

Unit-III

Disorders of amino acids metabolism, Phenylketoneuria, Alkaptonuria, Mapiesyrup disease, Parkinson's diseases. Metabolism of purine and pyrimidine nucleotides. Biosynthesis of purine nucieotides, Biosynthesis of IMP, pathway from IMP to AMP and GMP, conversion to trjphosphates, regulation of purine, nucleotide biosynthesis, salvage pathways.

Unit-IV

Biosynthesis of pyrimidine nucleotides. Biosynthesis of UMP, conversion of triphosphate, Regulation of pyrimidine nucleotide synthesis, Biosynthesis of deoxyribon-ucleitdes, biosynthesis and formation of coenzyme nucleotides. Anticancer drugs.

Unit-V

Degradation of purine and pyrimidine nucleotides. Digestion of nucleic acids, degradation of mononucleotides catabolism of purines, catabolism of pyrimidines. Disorders of purine and pyrimidine biosynthesis - Lesh Nyhan syndrome, Gout, SCID, Adenosine deaminase deficiency. Classification, structure and biological function of porphyrins.

Chemistry Practical Courses

Paper-I (BC-206): Bio-physical Techniques (Max Marks 100)

1. Measurement - Criteria of reliability, precision, accuracy, sensitivity, specificity
2. Laboratory rules and safety regulation - First Aid.
3. Principles of Colorimetry
   i. Verification of Beer's law, estimation of protein and phosphate.
   ii. Finding out Xmax. Relation between O.D. and % transmission. pH, pK, Henderson's equation.
4. Determination of - pH optimum, Temperature optimum, Km value, Vmax value, Effect of inhibitor (Inorganic phosphate) and measurement of K..

Paper-II (BC-207): Bio-chemical Techniques (Max Marks 100)

1. Preparation of buffer.
2. Separation of Amino acids by paper chromatography.
3. Isolation of phospholipids from liver and their separation on thin layer chromatography (TLC).
4. Separation of hemoglobin and potassium dichromate by gel filtration.
5. Ion exchange chromatography- CM cellulose, DEAE cellulose.
6. SDS poly acrycamide Gel electrophoresis. (SDS-PAGE)

Paper-III (BC-208): Enzymological Techniques (Max Marks 100)

Isolation of enzyme Acid Phosphatase from germinating lentils (moong) using $(NH_4)_2SO_4$ precipitation and its assay using p-nitrophenyl phosphate and calculation of specific activity.

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Bachelor of Science

BIOCHEMISTRY
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Syllabus

B.Sc. (Part-III) Biochemistry

Paper-I (BC-301): Cell Biology

Duration : 3 Hrs. **Max. Marks :100** **Min. Marks : 36**
Note: This paper is divided into five units. Two questions will be set from each unit. The candidates are required to attempt one question from each unit.

Unit-I
Morphology of Cell, Prokaryotic and eukaryotic Cell structure, Differences in plant and animal cell, Ultra structure and Composition of plant and bacterial Cell.

Unit-II
Structure and Composition of plasma membrane, Various models of plasma membrane. Transport of metabolites across plasma membrane.
Membrane Transport–Laws of diffusion across membranes, Simple diffusion, facilitated diffusion and active transport –glucose transporter Na+ K+ ATPase

Unit-III
Structure and function of nucleus, mitochondria and chloroplast.

Unit-IV
Structure and functions of ribosomes, endoplasmic reticulum, golgi apparatus , peroxisomes and lysosomes.

Unit -V
Cell Cycle – Phases of the cycle, regulation by cyclins and CDKs $ Meiosis.

Paper-II (BC-302): Physiology

Duration : 3 Hrs. **Max. Marks :100** **Min. Marks : 36**
Note: This paper is divided into five units. Two questions will be set from each unit. The candidates are required to attempt one question from each unit.

Unit-I
Blood components and their functions, Blood groups: the ABO system, the rhesus system, Blood clotting factors, intrinsic and extrinsic pathways for blood clotting.

Unit-II
Components of respiratory system (nasal cavity, trachea, pharynx, larynx, lungs, bronchi, bronchioles and alveoli) and their functions. Diffusion of oxygen and CO_2, transport of

oxygen, role of hemoglobin, dissociation curve of oxyhaemoglobin and its significance, Bohr's effect, transport of CO_2 and chloride shift. Various buffer system of the blood: Acid – base balance , factors affecting acid – base balance, acidosis and alkalosis, role of lung and kidney in regulation of acid – base balance.

Unit-III
Kidney: Structure and its organization. Functions of globular membrane, characteristics of tubules, selective re-absorption and secretion, active and passive transport of various substances (sugars, amino acids, urea and creatinine), mechanism of urine formation.

Unit -IV
Muscles tissue: Structure of myofilaments. Molecular organization of actin, myosin, troponin and tropomyosin . Biochemistry of muscle contraction.

Unit-V
Nerve cells , nerve fibers, and nerve impulses and neurotransmission, synapses: chemical and electrical synapses, functional properties of nerve fiber, action potential, the reflex action and reflex arc.

Paper-III (BC-303): Molecular Biology

Duration : 3 Hrs. **Max. Marks :100** **Min. Marks : 36**
Note: This paper is divided into five units. Two questions will be set from each unit. The candidates are required to attempt one question from each unit.

Unit-I
DNA replication in prokaryotes–conservative semi-conservative and dispersive types, experimental evidence for semi-conservative replication. Mechanism of replication. Inhibitors of replication.

Unit-II
Transcription in prokaryotes, RNA polymerase, promoters, initiation, elongation and termination of RNA synthesis, inhibitors of transcription, Reverse transcriptase, post transcriptional processing of RNA in eukaryotes.
Genetic code–Basic features, biological significance of degeneracy, Wobble hypothesis, gene with genes and overlapping genes.

Unit-III
Mechanism of translation–Ribosome structure, A and P sites, charged RNA, f-met-tRNA, initiator codon, Shine–Dalgarno consensus sequence, formation of 70s initiation complex, role of EF-Tu, EF-Ts, EF-G and GTP, nonsense codons and release factors, RF1 andRF2. Regulation of gene expression in prokaryotes–enzyme induction and repression, Operon concept, Lac operon, Trp operon.

Unit-IV
Mutation–Molecular basis of mutation, Types of mutation. Eg. Transition, transversion, frame shift, insertion, Deletion, Supressor sensitive, Germinal and sometic. backward and forward, true reversion and suppression, dominant and recessive mutation, spontaneous and induced mutations. DNA repair- UV repair system in *E.coli*, significance of thymine in DNA.

Unit-V
Recombinant DNA technology–Restriction endonucleases, brief description of steps in DNA cloning, Applications of recombinant DNA technology.

Paper-IV (BC-304): Microbial Biochemistry & Immunology

Duration : 3 Hrs. **Max. Marks :100** **Min. Marks : 36**

Note: This paper is divided into five units. Two questions will be set from each unit. The candidates are required to attempt one question from each unit.

Unit-I

Isolation of bacteria and pure culture techniques, culture media, Types of bacteria, Bacterial growth curve. Aerobic and Anaerobic respiration, Bacterial photosynthesis.

Unit-II

Bacterial fermentation & types, Food spoilage and preservation, Food borne infections, Production of citric acid, Ethanol, Wine and vinegar.

Unit-III

Structures and classification of viruses, Replication of RNA and DNA viruses, Virus host interaction, Types and life cycle of Bacteriophages.

Unit-IV

Types of immunity, Innate, Acquired, Passive and Active immunity, Humeral and cellular immunity, Antigens, Haptens, Adjuvents, Structures and functions immunoglobulins.

Unit-V

Antigen–antibody reaction, Agglutination and precipitation, Immuno-diffusion, Immuno-fluorescence, RIA and ELISA, Monoclonal antibodies.

Paper-V (BC-305): Clinical & Nutritional Biochemistry

Duration : 3 Hrs. **Max. Marks :100** **Min. Marks : 36**

Note: This paper is divided into five units. Two questions will be set from each unit. The candidates are required to attempt one question from each unit.

Unit-I

Collection and preservation of biological fluids, blood serum, Plasma urine and CSF, Normal values of important constituents in blood, CSF and Urine. Hypo- and Hyper-glyceamia, Hyperlipideamia, lipid malabsorption, Steatorrhoea, sphingolipidosis, role of lipoproteins in health and diseases. Gout and hyperuricemia

Unit-II

Definition of functional and non functional plasma enzymes, Isozymes, enzyme pattern in health and diseases for the enzymes alkaline and acid phosphatase, SGOT and SGPT, LDH and CPK.

Unit-III

Liver function test &kidney function test, Function test of pancreas and stomach.

Unit-IV

Nutritional aspects of carbohydrates, fats and proteins, Essential fatty acids and amino acids Protein calorie malnutrition (kwashiorkor and marasmus). Body water and its importance. Respiratory quotient. Basel metabolic rate (BMR) & factor affecting BMR. Specific dynamic action of foods. Energy requirement of various groups.

Unit-V

Outline of nutritional aspects of some vitamins (A,B1,B2,B12,C,d,E) and minerals (Ca, P, Fe and I_2). RDA and composition balanced diet for average Indian adult With different habits.

Chemistry Practical Courses

Paper-I (BC-306): Clinical & Nutritional Biochemistry (Max Marks 100)

Paper-II (BC-307): Physiology & Biochemistry (Max Marks 100)

Paper-III (BC-308): Microbial Biochemistry, Immunology & Molecular Biology (Max Marks 100)

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