SCHEME OF EXAMINATION

AND

SYLLABUS

(for the Academic Session 2019-2020)

B.Sc. (Part-I) Biochemistry

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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