

**Syllabus and Course Scheme**  
**Academic year 2015-16**



**B.Sc. – Bio-Chemistry**  
**Exam-2016**

**UNIVERSITY OF KOTA**  
**MBS Marg, Swami Vivekanand Nagar,**  
**Kota - 324 005, Rajasthan, India**  
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# UNIVERSITY OF KOTA SYLLABUS

## Examination Scheme & Syllabus

### Bachelor of Sciences in BIOCHEMISTRY (Three year course)

#### **B.Sc. Part-I Examination 2016**

#### **SCHEME OF EXAMINATION**

##### **Proposed scheme for 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 3<sup>rd</sup> year-3 practical. Each practical examinations will carry 100 marks each (25% marks in practical examinations will be reserved for internal assesment 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.

##### **THEORY Examination Duration Hrs Maximum Marks**

1. For Theory papers of 100 marks, 3 hrs./week will be allotted.
2. For a practical paper of 100 marks, 6 periods will be allotted per week .

Theory / Papers	Paper Code	Duration	Theory (Max marks )		Total
			Practical		
<b><u>Ist. Year Theory Papyers</u></b>					
Paper-1 Physical Chemistry Acids & Bases	(BC-101)	3 hours	0	100	100
Paper-2 Organic Chemistry.	(BC-102)				
Paper-3 Physics	(BC-103)	3 hours	0	100	100
Paper-4 Maths & Statistics	(BC-104).	3 hours	0	100	100
Paper-5 Introduction to Biology & Chemistry of Biologically important molecules	(BC-105)	3 hours	0	100	100
<b><u>Ist. Year Practical Papers</u></b>					
Practical-1(BC-106) Physical Chemistry		6 hours	25	75	100
Practical-2 (BC-107) Inorganic & Organic Chemistry.		6 hours	25	75	100
Practical-3 (BC-108) <b>Physics</b>		6 hours	25	75	100
Practical-4 (BC-109) Introductory Biology		6 hours	25	75	100

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.

## **B.Sc Biochemistry - II**

Paper I -Biochemical and Biophysical Techniques

Paper II -Proteins, Enzymes and Coenzymes

Paper III -Human Physiology and Endocrinology

Paper IV-Metabolism of Carbohydrates and Lipids

Paper V-Metabolism of Amino Acids, Nucleotides & Phorphyrins

## **B.Sc. (Biochemistry) III**

### **Paper scheme**

Paper I. Cell biology

Paper II. Physiology

Paper III. Molecular biology

Paper IV. Microbial Biochemistry \$ Immunology

Paper V. Clinical \$ Nutritional Biochemistry

### **Practicals**

Paper I. Clinical \$ Nutritional Biochemistry

Paper II. Physiology \$ Biochemistry

Paper III. Microbial Biochemistry, Immunology \$ Molecular Biology.

## FIRST YEAR

# Paper BC-101 -Physical Chemistry Acids and Bases

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 equilibria in solution up to dibasic/diacid 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 Equilibria, Osmotic pressure, Dialysis Equilibrium, The Donnan 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<sup>nd</sup> 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. Promoters 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 (a) Variation of S, G, and A with P, V, and T.

Gibbs Helmholtz equation criteria of thermodynamic equilibria.

### 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 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, Iodoform reaction, Wurtz reaction, Claisen ester condensation, Hoffmann bromamide reaction (with their mechanism), Markownikoff's rule, Saylzaft rule.

### **Unit-III**

Preparation, typical reactions and uses of the following class of compounds.

Aliphatic and aromatic hydrocarbons (electrophilic substitutions) alkyl and aryl halides (Nucleophilic substitution) alcohols and phenols, aldehydes and ketones, monocarboxylic acids and their derivatives.

### **Inorganic**

### **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, electro negativity, oxidation states.

Concept of coordination in complex and coordination number, Werner's theory, isomerism in coordination compounds, bonding in coordination compounds, Inorganic biomolecules.

## **Paper 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, vlicelson 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. Heat Chemical Equilibria 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 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 parametrically.

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, Curve 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 test 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 algebraic 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.

#### **Unit-IV**

Statistics

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  $X^2$  (Chisquare) tests of goodness of fit and homogeneity, additive property of  $X^2$  and the normal approximation, meaning of very small  $X^2$  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 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, physio-chemical 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 - PA, PG, PE, PS, LPC, PI and plasmalogens, sphingolipids-sphingosine,ceramide, sphingomyelin, glycolipids - cerebroside, 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.

### Syllabus for Practical Courses 1st year

#### 1. Practical course for Physical Chemistry (BC-106) (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 2nd order reactions.

#### 2. Practical course for Inorganic Chemistry (BC-107) (Max Marks 100)

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<sub>4</sub> and K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub>) – using internal indicators.

#### 3. Practical course for Organic Chemistry(BC-108) (Max Marks 100)

1. Preparation of the compounds involving single state reactions:  
nitration, benzylation, 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).

#### 4. Practical Course for Physics BC-109) (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 Poissuelle 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 Jagers method.

**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.

## **B.Sc Biochemistry - II Yr-2016**

### **Paper I -Biochemical and Biophysical Techniques**

#### **1. 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

- (a) Salt and organic solvent fractionation.
- (b) Dialysis, reverse dialysis, ultra filtration
- (c) Electrophoresis – free flow, zone (disc, slab- SDS PAGE) and paper electrophoresis.
- (d) Isoelectric focusing
- (e) Centrifugation – centrifuge of various types, rotors, boundary, differential, density gradient.

### Instrumental methods

## Unit-III

- i. Spectrophotometry - UV, visible
- ii. Fluorometry
- iii. 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 -Proteins, Enzymes and Coenzymes

## 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), immunological and biological characteristics.

## Unit-II

### Purification of Protein,

Criteria for homogeneity 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.

I. 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

II. **Enzyme classification** and nomenclature.

III. **Purification of enzymes**, criteria of purity (affinity and ion exchange chromatography).

#### IV. **Kinetics** of enzyme catalyzed reactions -

Michaelis Menten equation, V<sub>max</sub>, significance of K<sub>m</sub>. applicability of Michaelis Menten equation, Methods of determination of K<sub>m</sub> and V<sub>max</sub> 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**

V. **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).

#### VI. **Chemistry and enzymatic function of water soluble vitamins**

such as riboflavin, pantothenic acid, niacin, pyridoxine, biotin, cobalamine, folic acid, lipoic acid, and ascorbic acid.

#### VII. **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**

VIII. Immobilized enzymes and their applications.

IX. Applications of enzymes for diagnostic purposes.

## **Paper III -Human Physiology and Endocrinology**

### **Unit-I**

#### **Introduction to physiology and hormones**

I. Cell signalling and mechanism of hormone action.

Receptor families

G protein linked receptors

Enzyme linked receptors (self & intracellular)

Intracellular receptors

Steroid receptors & superfamilies

Thyroid hormone receptors

Signal transduction - cAMP, cGMP, Ca<sup>2+</sup>, IPS, DAG

G proteins (RAS) Protein kinase (RAF, MAP Calmodulin,

Prostaglandin.

II. **Ca<sup>2+</sup> homeostasis** - Calcitonin, PTH, Vit D<sub>3</sub>

Bone turnover and related pathophysiology Osteoporosis,

Osteomalacia and Rickets

Pituitary hypophysial axis

### **Unit-II**

III. **Neuro endocrine control of GI** tract, Secretin and Gastrin family.

IV. **Hepatic physiology** Functional anatomy of hepatic lobule,

Detoxification, Bile secretion. Related pathophysiology - Obstructive and hemolytic jaundice.

### **Unit-III**

V. **Glucose homeostasis** • Glucagon, insulin and glucocorticoid Related pathophysiology.

VI. **Thyroid hormone** - T3 & T4 related pathophysiology - Goitre, Cretinism, Myxedema.

#### Unit-IV

VII. Renal physiology, Nephron, Na<sup>+</sup> homeostasis - Aldosterone, Renin, angiotensin system, Kallikrein kinin system, Regulation of water balance, ADH, counter current mechanism, Related pathophysiology - Cushing's, Conn's, Diabetes insipidus

#### VIII. **Physiology of blood and cardiovascular system**

Imposition of blood Plasma, RBC Hemostasis, cardiac muscle and action Potential; Blood pressure regulation, blood flow regulation, blood brain barrier, Related pathophysiology, Anemia, thalassemia, sickle cell anemia, atherosclerosis, hypertension, Myocardial infarction, Stress - hormonal control.

#### Unit-V

IX. **adrenal medullary hormones**, Parkinson's disease

X. **Growth and development** GH, insulin. Growth factors, EGF, NGF, IGF-I & II.

XI. **Reproduction** - male and female sex hormones, Reproductive cycle, Gestation, lactation and contraception.

## Paper IV-Metabolism of Carbohydrates and Lipids

#### 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 Crabtree 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.

(a) Enzymatic hydrolysis in intestine

(b) Enzymatic resynthesis in intestine

(c) Packaging into chylomicrons

Uptake of fatty acids from circulating chylomicrons by tissues, role of lipoprotein lipase.

#### Unit-IV

#### **Mobilization of Triglycerides**

i. Hydrolysis of TG to FFA in adipose tissues by hormone sensitive lipase.

ii. Resynthesis of TG from FFA in adipose tissues and role of

carbohydrate metabolism.

iii. Transport of net free fatty acids from adipose tissues as FFAalbumin complex and uptake of FFA by tissue.

#### Unit-V

##### Oxidation of fatty acids

(a) Activation of Fatty acids

(b) Entry of long chain fatty acyl CoAs into mitochondrial matrix.

(c) Beta-oxidation

(d) Oxidation of unsaturated fatty acids.

(e) 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-Metabolism of Amino Acids, Nucleotides & Phorphyrins

#### 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.

(a) Synthesis of creatine, creatine phosphate and creatinile.

(b) 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, Phenylketonuria,

Alkaptonuria, Mapiesyruap 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 triphosphates, 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.

# Syllabus for Practical Courses

## IIInd year

### I. Practical Course for Bio-Physical Techniques

Measurement - Criteria of reliability, precision, accuracy, sensitivity, specificity

Laboratory rules and safety regulation - First Aid.

Principles of Colorimetry

i. Verification of Beer's law, estimation of protein and phosphate.

ii. Finding out  $X_{max}$ . Relation between O.D. and % transmission. pH, pK, Henderson's equation.

Determination of - pH optimum, Temperature optimum,  $K_m$  value,  $V_{max}$  value, Effect of inhibitor (Inorganic phosphate) and measurement of  $K_i$ .

### II. Practical Course for Bio-Chemical Techniques

Preparation

of buffer. Separation of Amino acids by paper

chromatography. Isolation of phospholipids from liver

and their separation on thin layer chromatography

(TLC). Separation of hemoglobin and potassium

dichromate by gel filtration. Ion exchange chromatography

- CM cellulose, DEAE cellulose. SDS poly acrylamide Gel electrophoresis. (SDS-PAGE)

### III. Practical Course for Enzymological Techniques

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.

## **B.Sc. (Biochemistry) III year**

**Examination – 2016**

### Paper scheme

Paper I.	Cell biology
Paper II.	Physiology
Paper III.	Molecular biology
Paper IV.	Microbial Biochemistry \$ Immunology
Paper V.	Clinical \$ Nutritional Biochemistry

### **Practicals**

Paper I.	Clinical \$ Nutritional Biochemistry
Paper II.	Physiology \$ Biochemistry
Paper III.	Microbial Biochemistry, Immunology \$ Molecular Biology.

## **Paper I- Cell Biology**

### **Unit 1**

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

### **Unit 2**

Structure and Composition of plasma membrane , Varius 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<sup>+</sup> K<sup>+</sup> ATPase

### **Unit -3**

Structure and function of nucleus, mitochondria and chloroplast.

### **Unit 4**

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

### **Unit 5**

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

## **Paper II - Physiology**

### **Unit 1**

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

### **Unit 2**

Components of respiratory system (nasal cavity, trachea, pharynx, larynx, lungs, bronchi, bronchioles and alveoli) and their functions. Diffusion of oxygen and CO<sub>2</sub>, transport of oxygen , role of hemoglobin, dissociation Curve of oxyhemoglobin and its significance, Bohr's effect, transport of CO<sub>2</sub> 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 3**

Kidney: Structure and its organisation . Functions of glomerular membrane echaracteristics of tubules, selective reabsorption and secretion, active and passive transport of various substances (sugars, amino acids, urea and creatinine ), mechanism of urine formation.

### **Unit 4**

Muscles tissue: Structure of myofilaments. Moleculer organization of actin, myosin, troponin and tropomyosin . Biochemistry of muscle contraction.

### **Unit 5**



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- Molecular Biology**

### **Unit 1**

DNA replication in prokaryotes – conservative semiconservative and dispersive types, experimental evidence for semiconservative replication. Mechanism of replication. Inhibitors of replication.

### **Unit 2**

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 -3**

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 and RF2.

Regulation of gene expression in prokaryotes – enzyme induction and repression, Operon concept, Lac operon, Trp operon.

### **Unit -4**

Mutation – Molecular basis of mutation, Types of mutation. Eg. Transition ,transversion, frame shift, insertion, Deletion, Suppressor sensitive, Germinal and somatic. 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 -5**

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

## **Paper IV -Microbial Biochemistry & Immunology.**

### **Unit -1**

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

### **Unit -2**

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

### **Unit -3**

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

#### **Unit -4**

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

#### **Unit -5**

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

### **Paper V- Clinical and nutritional Biochemistry**

#### **Unit -1**

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

#### **Unit -2**

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 3**

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

#### **Unit -4**

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. Basal metabolic rate (BMR) & factor affecting BMR. Specific dynamic action of foods. Energy requirement of various groups.

#### **Unit -5**

Outline of nutritional aspects of some vitamins (A, B1, B2, B12, C, d, E) and minerals (Ca, P, Fe and I2). RDA and composition balanced diet for average Indian adult With different habits