SIES College of Arts, Science & Commerce

RISE WITH EDUCATION

Sion (West), Mumbai – 400022.

(Autonomous)

Faculty: Science

Program: B.Sc. (Double Majors)

Subject: BIOCHEMISTRY (3 Units)

(INTERDISCIPLINARY)

Academic Year: 2022 – 2023

T.Y.B.Sc.

Semester V & VI

Choice Based Credit System as approved by the Board of Studies in Biochemistry

with effect from 2020-2021

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T.Y.B.Sc. Biochemistry (3 units) Syllabus

Credit Based Semester and Grading System

To be implemented from the academic year 2020 – 2021

Summary of Course-wise Units

Semester V

(SIUSBCH5)

Course Code	Unit	Topics	Credits	L/week
SIUSBCH51	NUTRITION, BIOMOLECULES AND BIOPHYSICAL CHEMISTRY-I		2.5	
	I	Basic concepts in nutrition; Carbohydrates		1
	II	Amino acids and Proteins		1
	III	Nucleic acids; Enzymes		1
	IV	Chromatography; Spectroscopy		1
SIUSBCH52	PHYSIOLOGY, METABOLISM, AND APPLIED BIOCHEMISTRY-I		2.5	
	I	Carbohydrate metabolism		1
	II	Amino acid metabolism; Bioenergetics		1
	III	Plant growth regulators; Endocrinology		1
	IV	Fundamentals of Molecular Biology		1
SIUSBCHP5		Practical of course SIUSBCH51 and SIUSBCH52	3	8

T.Y.B.Sc. Biochemistry (3 units) Syllabus

Credit Based Semester and Grading System

To be implemented from the academic year 2020 – 2021

Summary of Course-wise Units

Semester VI

(SIUSBCH6)

Course Code	Unit	Topics	Credits	L/week
SIUSBCH61	NUTRITION, BIOMOLECULES AND BIOPHYSICAL CHEMISTRY-II		2.5	
	I	Basic concepts in nutrition; Lipids		1
	II	Membrane biochemistry		1
	III	Pharmaceutical Biochemistry		1
	IV	Centrifugation; Electrophoresis		1
SIUSBCH62	PHYSIOLOGY, METABOLISM AND APPLIED BIOCHEMISTRY-II		2.5	
	I	Lipid metabolism		1
	II	Basics of Immunology		1
	III	Industrial Biochemistry; Basics of tissue culture		1
	IV	Recombinant DNA technology; Introduction to Bioinformatics		1
SIUSBCHP6		Practical of course SIUSBCH61 and SIUSBCH62	3	8

T.Y.B.Sc.- BIOCHEMISTRY
3 – UNITS INTERDISCIPLINARY SUBJECT
Semester V (SIUSBCH5)

COURSE TITLE: **NUTRITION, BIOMOLECULES AND BIOPHYSICAL CHEMISTRY -I**
COURSE CODE: **SIUSBCH51**
CREDITS: 2.5

Unit No.	Topic No.	Contents	NOL
		Course outcomes: *The learner should be able to* 1. *Discuss concepts in nutrition and express the physiological significance of components of nutrition.* 2. *Compute calorific value, RQ, BMR and deduce their significance.* 3. *Describe the structure and properties of carbohydrates, proteins and nucleic acids and correlate them with their biochemical role.* 4. *Classify enzymes, discuss enzyme kinetics and recognize their importance* 5. *Employ techniques of Chromatography and Spectroscopy in biochemical investigations and solve related analytical problems.*	
I		**Basic Concepts in nutrition ; Carbohydrates**	15
	1.1	**Basic Concepts in human nutrition**: Proximate principles, energy content of food, Units of energy, and calorific value	1L
	1.1.1	Utilization of energy, BMR, factors affecting BMR and its significance. Concept of thermic effect of food (SDA), Physical activity and energy requirements of man	1L
	1.1.2	Nutritional importance of carbohydrates Functions of carbohydrates, Requirement, Dietary sources, Glycemic index, Significance of fiber	2L
	1.2	**Carbohydrates:**	
	1.2.1	Polysaccharides- Starch and Glycogen, Action of amylase on starch, Structural polysaccharides - Cellulose, Chitin	3L
	1.2.2	Bacterial cell wall polysaccharide: Peptidoglycan framework (With structures of NAG & NAMA), beta lactam antibiotics- Penicillin and cephalosporin	2L
		Extracellular matrix proteoglycan - Hyaluronate, Chondroitin sulphate and Heparin (monomers and	3L

		occurrence/Biomedical significance)	
	1.2.3	Commercial importance of carbohydrates: Starch, Dextran, Cyclodextrin, chitosan, modified cellulose, pectin, agar	3L
II		**Amino acids and Proteins**	**15**
	2.1	Nutritional significance of proteins Functions of proteins, Requirement, Dietary sources, Essential and non-essential amino acids, Nutritive value of proteins: BV and PER	2L
	2.2	**Proteins:** Classification on the basis of shape and function. Structural hierarchy of proteins Primary structure: Formation and characteristics of peptide bond, phi and psi angles Secondary structure: alpha helix- characteristics, forces stabilizing, factors influencing helix stability. Example: keratin beta sheet: characteristics, parallel/ antiparallel, forces stabilizing, example: silk fibroin Super secondary structures: Domains and Motifs (DNA binding)	1L 3L
	2.3	Tertiary structure - forces stabilizing, example myoglobin, Function of myoglobin Quaternary structure - forces stabilizing, example hemoglobin, Function of hemoglobin	3L
	2.4	Primary structure/sequence determination of protein: Separation of polypeptide chains, breaking disulphide bonds by mercaptoethanol, End group analysis: Sanger reaction, Edman reaction, Dansyl chloride. Cleavage of polypeptide- Trypsin, Chymotrypsin, Pepsin, Aminopeptidase, Carboxypeptidase.	3L
	2.5	Protein denaturation Diseases resulting from altered protein conformation: Prion and Alzheimer's	1L 2L
III		**Nucleic acid; Enzymes**	**15**
	3.1	**Nucleic acids:**	
	3.1.1	DNA: Structure elucidation: Rosalind Franklin- X-ray diffraction pattern (Physical evidence), Chargaff's rules (Chemical evidence), A, B and Z forms of DNA, Organization of DNA as Chromatin,	2L/3L
	3.1.2	Effect of heat on DNA: Hypochromism, Hyperchromism, Denaturation of DNA, Tm.	1L

	3.1.1	RNA: rRNA, t-RNA, m-RNA, hnRNA, snRNA, miRNA. Catalytic role of RNA	2L
	3.2	**Enzymes and Enzyme kinetics**	1L
	3.2.1	General properties of enzymes, Classification of enzymes- IUB/EC classification (up to I digit)	
	3.2.2	Active site of enzyme, mechanism of action: lock and key, induced fit, transition state theory. Cofactors, Coenzymes (role of vitamins), Prosthetic groups, Apoenzyme and Holoenzyme	2L
	3.2.3	Enzyme kinetics Factors affecting enzyme-catalysed reaction Derivation of Michaelis- Menten equation, Km, Lineweaver Burk plot, Catalytic efficiency- turn over number, Enzyme activity: Katal, IU Specific activity of enzyme.	2L/3L
	3.2.4	Enzyme inhibition: Competitive (allopurinol and Sulphonamides, Methotrexate) and Noncompetitive (Iodoacetate and Diisopropyl fluorophosphate).	2L
	3.2.5	Applications of enzymes in therapy (Streptokinase, Hyaluronidase), diagnosis (Creatine kinase, LDH), industry (Amylase, Protease, lipase)	1L
IV		**Chromatography; Spectroscopy**	**15**
	4.1	**Chromatography**	
	4.1.1	Principle, technique and applications of - Ion exchange chromatography (Column) and Gel filtration chromatography.	5L
	4.1.2	Introduction to GLC, HPLC and Affinity Chromatography -Principles only.	3L
	4.1.3	Numerical problems based on above concepts.	2L
	4.2	**Spectroscopy**	
	4.2.1	General Principle, Beer-Lambert law and its limitations, significance of Lambda max, molar extinction coefficient	3L
	4.2.4	Numerical problems based on above concepts	2L

Semester V

COURSE TITLE: **PHYSIOLOGY, METABOLISM, AND APPLIED BIOCHEMISTRY-I**

COURSE CODE: **SIUSBCH52**

CREDITS: 2.5

Unit No.	Topic No.	Contents	NOL
		Course outcomes: *The learner should be able to* 1. *Explain the biochemical steps of metabolism of carbohydrates and amino acids/proteins* 2. *Analyse the concepts of thermodynamics and deduce their application in living system* 3. *Discuss the energy synthesis pathways in plants and animals* 4. *Explain the processes of information transfer in prokaryotic cell and recognize these as target sites for drugs* 5. *Describe the role of growth regulators/hormones in plants and animals and correlate it to physiological disorders*	
I		**Carbohydrate metabolism**	**15**
	1.1	Digestion and absorption of carbohydrates, Role of GLUT, Lactose intolerance	2L
	1.2	Introduction to metabolism: Catabolism, anabolism, role of high energy phosphates viz. ATP and thioesters, role of reduced coenzymes NADH and NADPH.	1L
	1.3	Overview of catabolism, Glycogenolysis (Schematic) Catabolism of glucose: Glycolysis- cellular location, sequence of reactions, products, energetics Fate of pyruvate in aerobic and anaerobic conditions, Cori cycle Kreb's cycle: cellular location, sequence of reactions,	6L
	1.3	Anabolism - HMP Shunt (Synthesis of pentose phosphates) -Cellular location, sequence of reactions, oxidative and non-oxidative phases of pathway and multifunctional nature. Gluconeogenesis Glycogenesis (Schematic), Anaplerotic reactions – Role of Pyruvate carboxylase, PEP carboxykinase, Malic enzyme.	5L
	1.4	Regulation of blood glucose –role of insulin, glucagon and epinephrine	1L

II		**Amino acid metabolism; Bioenergetics**	**15**
	2.1	**Amino acids and Protein Metabolism**	
	2.1.1	Digestion and absorption of proteins and amino acids	1L
	2.1.2	Catabolism - reactions –Transamination (AST/ALT), Clinical significance	1L
	2.1.3	Decarboxylation of His, Trp, Glu and physiological significance of the products	1L
	2.1.4	Deamination: Oxidative (NAD, FAD, FMN-linked oxidases) & Non-oxidative – Asp, Cys, Ser	1L
	2.1.5	Urea Cycle - Cellular location, sequence of reactions, labeling of N-atom, formation and transport of ammonia.	2L
	2.2	**Bioenergetics**	
	2.2.1	**Mitochondrial ETC** Free energy, free energy change, exergonic and endergonic reactions. High energy compounds, ATP, Synthesis of ATP, Substrate level and oxidative phosphorylation	1L
		Oxidative Phosphorylation: Electron transport chain: electron carriers, redox potentials, basic chemistry, sequence and location of these electron carriers in mitochondrial membrane, Q cycle. Inhibitors of ETC:–Antimycin A, Amytal, Rotenone, CN,	2L
		Mechanism of ATP synthesis: Chemiosmotic hypothesis, Proton motive force, Structure of ATPase (F_oF_1 ATPase)	2L
	2.2.2	**Photosynthesis** Light-dependent and Light-independent reactions. Light dependent reactions, chloroplast, role of reaction center and accessory pigments	1L
		Photophosphorylation: Linear ETC / Z scheme, two reaction centers, production of oxygen and NADPH, proton gradient and ATP synthesis	2L
		Cyclic ETC in purple bacteria Light-independent reactions: Calvin cycle (schematic representation only)	1L

III		**Plant growth regulators; Endocrinology**	**15**
	3.1	**Plant growth regulators:** Role of auxins, cytokinins, abscissic acid, gibberellins and ethylene	2L
	3.2	**Endocrinology:**	
	3.2.1	Hormones, hormone receptor, classification of hormone on the basis of chemistry, organization of the endocrine system	1L
	3.2.3	Chemistry, synthesis, secretion and metabolic effects of thyroxine, insulin.	3L
	3.2.4	Chemistry & physiological role of oxytocin and vasopressin. Physiological role of Glucocorticoids and Epinephrine	4L
	3.2.5	Role of second messengers: cAMP, Ca and IP3, Mechanism of action of epinephrine (on glycogenolysis) and steroid hormone (on gene expression).	3L
		Endocrine disorders – Diabetes mellitus, Diabetes insipidus, Hypothyroidism (Cretinism & myxedema), Hyperthyroidism (Goitre – Simple & Toxic)	2L
IV		**Fundamentals of molecular biology**	**15**
	4.1	**Cell cycle : phases and significance**	1L
	4.2	**Replication of DNA** - modes of DNA replication, experimental evidence for semi- conservative replication, Mechanism, discontinuous DNA synthesis, termination of replication. Antibiotics inhibiting replication of DNA (Quinolones, Methotrexate, 5-fluorouracil)	5L
	4.3	**Transcription of DNA** - in prokaryotes, prokaryotic RNA polymerases, Steps in transcription, processing of RNA species, concept of split genes, reverse transcription Antibiotics inhibiting transcription (Rifamycin, Actinomycin D)	3L
	4.4	**Translation** (protein biosynthesis) in prokaryotes - activation of amino acids, chain initiation, chain elongation, chain termination, post translational modifications of proteins; **A**ntibiotics that inhibit protein synthesis (Streptomycin, tetracyclins, puromycin)	4L
	4.5	**Gene regulation**: Promoters, enhancers, Concept of operon, Lac operon	2L

PRACTICAL based on SIUSBCH51 & SIUSBCH52

Course code: SIUSBCHP5

Course Outcomes: *The learner should be able to*

1. *To develop analytical skills and proficiency in preparation of standard solutions and buffers*
2. *Gain expertise in the isolation of biomolecules from their natural source*
3. *Employ the basic reactions of biomolecules for their identification*
4. *Develop competence in estimation of biomolecules by Spectroscopy*
5. *Acquire training to estimate activity of enzymes and determine the kinetic parameters, Km and Vmax*
6. *To employ basic statistics for analyzing and presenting experimental data.*

Sr No.	Experiments
	Qualitative Analysis: -
I	1.Carbohydrates - Glucose, Fructose, Maltose, Lactose, Sucrose, Starch, Dextrin. 2. Proteins - Albumin, Casein, Gelatin, Peptone.
II	**Estimation of biomolecules** **Volumetric analysis:-** 1.Lactose by Cole's method/Glucose by Benedict's method **Colorimetric analysis: -** 2. Soluble proteins by Biuret method 3. RNA by Orcinol method 4. Glucose by GOD-POD / Maltose by DNSA method
III	**Isolation (Minimum Two)** 1. Starch from potato. 2. Casein from milk 3. Curcumin from turmeric
IV	**Enzymology** 1. Amylase: Km of amylase 2. Estimation of GOT and GPT
V	**Biostatistical analysis:** 1.Collection of data, types of data and presentation 2. Frequency distribution 3. Determination of mean, median and mode
VI	**Demonstration Experiments** 1. Preparation of buffers and use of pH meter 2. Titration curve of amino acid 3. Optimum pH of amylase 4. Immobilization /entrapment of enzyme (amylase) in alginate 5. Glucose by Folin –Wu method

Semester VI
(SIUSBCH6)

COURSE TITLE: **NUTRITION, BIOMOLECULES AND BIOPHYSICAL CHEMISTRY-II**

COURSE CODE: **SIUSBCH61**
CREDITS: 2.5

Unit	Topic	Content	NOL
		Course outcomes: *The learner should be able to* 1. *To express nutritional significance of vitamins and minerals and associated physiological disorders.* 2. *To compute body mass indicators and deduce their significance.* 3. *To describe the structure and properties of lipids and correlate them with their biochemical functions.* 4. *To discuss the composition of biological membranes, their function in transport and recognize the applications of artificial membrane vesicles* 5. *To employ techniques of centrifugation and electrophoresis in biochemical investigations and solve related analytical problems.* 6. *To recognize and express the role of biomolecules as pharmaceuticals* 7. *To explain the steps in discovery and development of a drug/biopharmaceutical*	
I		**Nutrition; Lipids**	15
	1.1	Nutritional significance of	
	1.1.1	Vitamins and Deficiency disorders	
	1.1.2	Minerals: Fe, Ca, P, Mg	
	1.2	**Lipids**	
	1.2.1	Fatty acids & TAG : Saturated fatty acids –classification, C2 to C20 (only even C chain fatty acids) Unsaturated fatty acids – MUFA, PUFA (2,3,4 db), Omega 3, Omega 6 and Omega 9 fatty acids. Triacylglycerols - Simple and mixed.	
	1.2.2	Chemical reactions - Saponification, Iodination, Auto-oxidation, Rancidity of fats. Definition and significance - Acid Number, Saponification Number, Iodine Number and Reichert- Meissel Number.	

1.2.3 Compound lipids –
Structure and function of Glycerophospholipids (Cephalin, Lecithin and Phosphatidyl inositol), Action of Phospholipases Functions of phosphosphingolipids (ceramide, Sphingomyelin), Glycolipids or Cerebrosides (Galacto and Glucocerebrosides)

1.2.4 Steroids and Lipoproteins
Steroids - Cholesterol structure and biochemical significance
Lipoproteins –Types (Chylomicron, VLDL, LDL, HDL) and biochemical significance.

1.2.5 Nutritional significance of lipids, Body fat composition, BMI and Hip: waist ratio

II Membrane biochemistry 15

2.1 Biological membrane -Membrane constituents and assembly: Fluid-mosaic model, asymmetric distribution of lipids;

2.2 Membrane proteins : integral/transmembrane, Lipid-linked and peripheral

2.3 Membrane transport:
Passive Diffusion
Facilitated Diffusion: uniport, antiport, symport, GLUT
Ion channels: Voltage gated and ligand gated; Role in nerve impulse transmission
Active transport : Na^+ –K^+ pump, inhibitors;

2.4 Liposomes and their applications

III Introduction to Pharmaceutical Biochemistry 15

3.1 Biomolecules as pharmaceuticals: Introduction to terms- Drug/Pharmaceutical, Biopharmaceutical, Biologic 1L

3.1.1 Pharmaceuticals of plant origin: Aspirin (salicylate), Alkaloids: Atropine, morphine, cocaine, ephedrine, papaverine, quinine, vinblastine and vincristine. Xanthines: caffeine and theophylline Terpenes: Taxol; Glycosides: Digoxin and Digitoxin 2L

3.1.2 Pharmaceuticals of animal origin: Hormones: Sex hormones- Androgens, Progesterone and oestrogen; Adrenaline, Glucocorticoids and prostaglandins 1L

3.1.3	Pharmaceuticals of microbial origin: Antibiotics: Penicillins, Cephalosporins, Tetracyclines, Aminoglycosides (streptomycin), Ansamycins (Rifamycin) Peptide antibiotics: Bacitracin, Gramicidin and Vancomycin	2L
3.2	**Steps in drug/biopharmaceutical Discovery and Development**: Introduction to Pharmacology, Pharmacognosy,	1L
3.2.1	Drug Discovery: Target identification and validation, lead identification (random screening and rational design approach) and optimization	2L
3.2.2	Pre-clinical trials: Pharmacokinetic profile, Pharmacodynamics profile, Bioavailability, bioequivalence, toxicity study	3L
3.2.3	Clinical trial –phases	2L
3.2.4	Role of regulatory Authority- FDA; IND, NDA	1L

IV Centrifugation; Electrophoresis

4.1 Centrifugation

4.1.1	General Principle, rpm, RCF, derivation of equation relating RCF and rpm, Types of centrifuges - Clinical, High Speed, Ultra –preparative and Analytical, Rotors- Fixed angle and swing out	2L
4.1.2	Applications of centrifugation – Use of preparative centrifuge in the separation of cell organelles by differential centrifugation, proteins by rate zonal centrifugation and nucleic acids by isodensity centrifugation.	3L
4.1.3	Numerical problems based on above concepts	1L

4.2 Electrophoresis

4.2.1	Principles of electrophoresis, factors affecting the Electrophoretic mobility.	2L
4.2.2	Types of electrophoresis: Moving boundary, Zone electrophoresis (horizontal), set up, Support media (paper, cellulose acetate, agar, agarose and polyacrylamide), technique, detection and recovery.	2L
4.2.3	PAGE: Native and SDS, discontinuous electrophoresis for separation of proteins.	3L
4.2.4	Applications of electrophoresis - Separation of proteins and nucleic acids, Purity determination, Molecular weight determination using PAGE, Isoelectric focussing	1L

Semester VI

COURSE TITLE: **PHYSIOLOGY, METABOLISM, AND APPLIED BIOCHEMISTRY-II**

COURSE CODE: **SIUSBCH62**

CREDITS: 2.5

Unit No.	Topic No.	Contents	NOL
		Course Outcomes: *The learner should be able to* 1. *Explain the biochemical steps of metabolism of lipids* 2. *Discuss the basics of immunology and appreciate their application in diagnosis of diseases.* 3. *Articulate steps in bioprocess technology and recognize its applications* 4. *Describe the basic technique of tissue culture and identify its applications* 5. *Explain the steps in recombinant DNA technology and recognize its applications* 6. *Express the scope, applications and potentials of bioinformatics.*	
I		**Lipid metabolism**	15
	1.1	Digestion and absorption of lipids	
	1.2	Catabolism - Knoop's experiment, Beta – oxidation of even carbon saturated fatty acids, role of carnitine, energetics from C4 to C20	
	1.3	Anabolism - Fatty acid biosynthesis (only Palmitic acid), fatty acyl synthetase complex.	
	1.4	Ketone bodies formation, utilization. Ketosis, physiological significance in Diabetes mellitus, starvation, alcoholism and pregnancy.	
	1.4	Lipoprotein metabolism.	
II		**Basics of immunology**	15
	2.1	Immunity, antigen, hapten and antibody. Types of immunity: Innate, Acquired, Active and Passive Innate immunity: External barriers , Phagocytosis , Complement, Natural Killer cells	
	2.2	Acquired immunity: Humoral and Cell - mediated Specificity, Self –Non-self recognition Humoral immunit y: B cells , plasma cells, functions of antibody. Cell-medi ated: T cells , subsets -T helper and cytotoxic T cells , MHC – class I and II.	

2.3 Cells and organs of immune system.

2.4 Immunoglobulins general structure, classes and sub-Classes- their structure and functions.

` 2.5 Antigen– antibody reactions - Precipitation and agglutination, ELISA Principle, Biotin-avidin system

III **Industrial biochemistry ; Tissue culture techniques** **15**

3.1 Bioprocess technology – Introduction, Steps in setting up

3.1.1 an industrial process, parameters, Selection of organism, screening, types of media, Batch and continuous fermentation, Basic components of a typical fermenter, Applications

3.1.2 Fermentation process for production of alcohol/wine/beer

3.2 Plant Tissue Culture

3.2.1 Requirements: Physical conditions, Nutritional requirements, General technique, explant, callus, totipotency, dedifferentiation, redifferentiation, role of plant growth regulators.

3.2.2 Different types of tissue culture techniques, protoplast fusion Applications of tissue culture

IV **Recombinant DNA technology; Introduction to bioinformatics** **15**

4.1 Recombinant DNA technology

4.1.1 Genetic engineering – Steps in DNA cloning, Restriction enzymes, Isolation of gene from cellular chromosomes, Cloning vectors (Plasmid, Phage, Cosmid, Improved vectors, and shuttle vectors), transformation, and selection of recombinant cells. Cloning of insulin gene

4.1.2 Transgenic plants – Bt cotton, Cloning in plants using Ti plasmid.

4.1.3 Gene libraries, DNA probes
DNA amplification by PCR, applications of PCR

4.2 Introduction to Bioinformatics

4.2.1 History of Bioinformatics, Genomics and Proteomics

4.2.2 Databases- types – Public domain database, Sequence database, Structural database, Motif database, Genome database, Proteome database, Annotated sequence database – Gen Bank, EMBL, PIR, SWISS PROT, PDB, GDB.

4.2.3 Sequence analysis Tools - BLAST, FASTA, L-ALIGN, CLUSTAL-X & W, RASMOL, Software for protein sequencing - PROPECT, AMMP, COPIA

4.2.4 Applications of Bioinformatics in – Sequence analysis, Molecular modeling and drug designing, Phylogeny/evolution, Ecology & population studies, Medical informatics and agriculture.

4.2.5 Micro-array analysis-concept

PRACTICALS based on SIUSBCH61 & SIUSBCH62

Course code: US3BCHP6

Course Outcomes: *The learner should be able to*

1. *Gain expertise in the isolation of biomolecules from their natural source*
2. *Recognize plants as models for studying cytotoxicity of drugs*
3. *Employ the chemical properties of biomolecules for their estimation in food sample*
4. *Develop competence in separation and estimation of biomolecules*
5. *Acquire training in basic microbiology techniques*
6. *Employ basic statistics for analyzing experimental data.*
7. *Employ basic bioinformatics tools in the subject of biochemistry*

S.No.	Experiments
I	**Cell Biology** 1. Isolation of DNA and its detection 2. Microscopy of stages of mitosis in actively dividing *Allium cepa* cells 3.Effect of cytotoxic drug (methotrexate)/Colchicine on actively dividing cells of *Allium cepa*
II	**Food analysis** **Mineral Estimation :-** Preparation of food ash 1. Calcium by EDTA method 2. Phosphorus by Fiske-Subbarow method 3. Iron by Wong method **Vitamin estimation** 1. Estimation of vitamin C / Vitamin B1
III	**Chromatography** 1. Circular paper chromatography of amino acids 2. Circular paper chromatography of sugars 3. TLC of pigments
IV	**Pharmaceutical Biochemistry** 1.Extraction of caffeine 2. Preparation of aspirin
V	**Microbiology** Concept of pure culture and Mixed culture; Preparation of media 1. Monochrome, Gram and negative staining 2. Isolation and enumeration of bacteria 3. Antibiotic sensitivity test
VI	**Biostatistical analysis (measures of dispersion)** Determination of SD and variance

VII Demonstration Experiments:-

1. Separation of DNA/proteins by agarose gel electrophoresis
2. Column chromatography - separation of chlorophylls
3. Agglutination reaction: Widal qualitative /Blood grouping
4. Immunodiffusion in gel
5. Bioinformatics: Sequence retrieval, Introduction to protein structure database

OVERALL SCHEME OF EXAMINATION

Biochemistry, as an interdisciplinary subject, consists of 03 (Three) Units of T.Y.B.Sc. carrying 600 marks as follows :

THEORY				
COURSE CODE	**Title of Paper**	**Internal Assessment marks**	**Semester end Examination marks**	**Total Marks**
SIUSBCH51	Nutrition, Biomolecules and Biophysical Chemistry I	40	60	100
SIUSBCH52	Physiology, Metabolism and Applied Biochemistry I	40	60	100
	TOTAL			**200**
SIUSBCH61	Nutrition, Biomolecules and Biophysical Chemistry II	40	60	100
SIUSBCH62	Physiology, Metabolism and Applied Biochemistry II	40	60	100
	TOTAL			**200**

PRACTICAL		
COURSE CODE	**Marks per course**	**Total per semester**
SIUSBCH5	100 for SIUSBCH51 and SIUSBCH52	**100**
SIUSBCH6	100 for SIUSBCH61 and SIUSBCH62	**100**
TOTAL		**200**

I. Scheme of Examination for Third year Science Undergraduate

External Examination : 60%
Internal Examination : 40%

A. Scheme of External Theory examination at TYBsc. (Sem V and Sem VI)

1) Each theory paper shall carry **60 marks**
2) Each theory paper shall be **2 hours** duration
3) Each theory paper shall contain **04 questions of 15 marks each** as follows: -

Q1 Based on Unit I

Q2 Based on Unit II

Q3 Based on Unit III

Q4 Based on Unit IV

4) Marking system for **Questions I to IV**
Each main question of 15 marks be divided into sub questions with internal choice.
Maximum marks for a sub question should be 6 marks.

B. Internal Assessment:

Sr. No.	Particulars	40 Marks
1	ONE class test to be conducted in the given semester (Objectives and /or MCQs/answer in one or two sentences: 20M)	20 Marks
2	One activity/oral presentation/assignment based on curriculum/ report etc.to be assessed by the teacher	20 Marks

C. For Courses with Practical: There will not be any Internal Examination for practicals

D. External Examination for practicals:

Sr. No.	Particulars for External Practical Examination		Marks
	Particulars for External Practical Examination Semester End		100 Marks
1	Laboratory	80 Marks	
2	Journal	10 Marks	
3	Viva	10 Marks	

II. Educational tour /Industrial Visit

It is recommended that the TYBSc students be taken for an Educational tour / Industrial visit in Mumbai /Maharashtra/ other States in India to visit various Universities/ research centers/Industries (Pharma, Food, chemical, Biochemical, Beverages, Oil, etc.) to give first-hand knowledge of current trends in research and the exposure to the working of industry, academia and research centers.

A summary report of this Educational tour / Industrial visit may be evaluated for 10 marks as a part of the 20 marks activity-based internal assessment.

SCHEME OF PRACTICAL EXAMINATION
SEMESTER V

Course SIUSBCHP5	Experiments	Marks
	a. Isolation	20
	b. Estimation of biomolecule: Colorimetry/ Volumetry	15
	c. Enzymology	20
	d. Spots (Statistical analysis -10M; Qualitative and Demonstration experiments-15M)	25
	e. Certified Journal*	10
	f. *Viva voce*	10
	TOTAL	**100**

* Candidate without duly certified Journals **shall not** be allowed to appear for the University Practical Examination.

1. The Sem V practical examination shall be conducted by the college
2. There shall be 02 (Two) examiners to conduct the practical examination, one Internal examiner and other external examiner
3. The external examiner shall be on the panel of examiner
4. The college shall invite one such examiner from approved panel as an external examiner
5. Duration for the Practical examination for Sem V
   a) One day of 02 sessions of 3 ½ hours each
   b) Morning session: 09.00 am to 12.30 pm
      Afternoon session: 01.00 pm to 4.30 pm

SCHEME OF PRACTICAL EXAMINATION

SEMESTER VI

Course SIUSBCHP6	Experiments	Marks
	a. Chromatography	20
	b. Colorimetric Analysis/Isolation	15
	c. Volumetric Analysis	15
	d. Spots (statistical Analysis – 15 M; Microbiology, Immunodiffusion and Demonstration- 15M)	30
	e. Certified Journal*	10
	f. Viva voce	10
	TOTAL	**100**

* Candidate without duly certified Journals **shall not** be allowed to appear for the Sem end Practical Examination.

1. The Sem VI practical examination shall be conducted by the College.
2. There shall be 02 (Two) examiners, one internal and other appointed from the panel of approved examiners.
3. Duration for the Practical examination for Sem VI

a) One day of 02 sessions of 3 ½ hours each
b) Morning session: 09.00 am to 12.30 pm
c) Afternoon session: 01.00 pm to 4.30 pm.

Suggested Reading

1. Nelson, D. L., Lehninger, A. L., & Cox, M. M. (2008). *Lehninger principles of biochemistry*. Macmillan.
2. Voet, D., Voet, J. G., & Pratt, C. W. (2016). Fundamentals of biochemistry: life at the molecular level. John Wiley & sons.
3. Zubay, G. (1993). Biochemistry, Wm. C. *Brown Publishers, Dubuque*, *302312223*, 2.
4. Berg, J. M., Tymoczko, J. L., Stryer, L., & Clarke, N. D. (2002). Biochemistry. 2002. *New York, New York*, *10010*.
5. White, A., Handler, P., & Smith, E. L. (1964). Principles of biochemistry. *Academic Medicine*, *39*(12), 1136. Mc Graw and Hill publishers
6. Murray, R. K., Granner, D. K., Mayes, P. A., & Rodwell, V. W. (2003). Harper's illustrated biochemistry. A Lange medical book. *Section*, *3*, 254.
7. Upadhyay, A. (2009). *Biophysical chemistry*. Himalaya Publishing House.
8. Wilson, K., & Walker, J. (Eds.). (2000). *Principles and techniques of practical biochemistry*. Cambridge University Press.
9. Cooper, T. G. (1977). *The tools of biochemistry* (No. 574.192028 C6).
10. Conn, E., & Stumpf, P. (2009). *Outlines of biochemistry*. John Wiley & Sons.
11. Boyer, R. F., & Boyer, R. (1986). *Modern experimental biochemistry* (pp. 119-144). Reading: Addison-Wesley.
12. Sawhney, S. K., & Singh, R. (Eds.). (2000). *Introductory practical biochemistry*. Alpha Science Int'l Ltd..
13. Segel, I. H., & Segel, A. H. (1976). *Biochemical calculations: how to solve mathematical problems in general biochemistry* (No. 04; QD415. 3, S4 1976.). New York:: Wiley.
14. Hall, J. E. (2015). *Guyton and Hall textbook of medical physiology e-Book*. Elsevier Health Sciences.
15. Hall, J. E. (2015). *Guyton and Hall textbook of medical physiology e-Book*. Elsevier Health Sciences.
16. Orten, J. M., Neuhaus, O. W., & Kleiner, I. S. (1975). *Human biochemistry* (No. 574.192 O7). CV Mosby.

17. Davidson, S., & Passmore, R. (1963). Human nutrition and dietetics. *Human nutrition and dietetics.*, (2nd ed).
18. Joshi, S. A. (1995). *Nutrition and dietetics*. McGraw-Hill Education.
19. Srilakshmi, B. (2006). *Nutrition Science*. New Age International.
20. Lewin, B. (2004). *genes VIII* (No. 04; QH430, L4.
21. Russell, P. J., & Gordey, K. (2002). *IGenetics* (No. QH430 R87). San Francisco: Benjamin Cummings.
22. Owen, J. A., Punt, J., & Stranford, S. A. (2013). *Kuby immunology* (p. 692). New York: WH Freeman.
23. Delves, P. J., Martin, S. J., Burton, D. R., & Roitt, I. M. (2017). *Essential immunology*. John Wiley & Sons.
24. Gajera, H. P., Patel, S. V., & Golakiya, B. A. (2008). *Fundamentals Of Biochemistry Textbook Student Edition*. IBDC Publishers.
25. Casida, L. E. (1968). Industrial microbiology. *Industrial microbiology.*
26. Mahajan, B. K., & Lal, S. (1999). Methods in biostatistics for medical students and research workers. *Indian Journal of Community Medicine*, *24*(03), 140.
27. Rastogi, S. C., Rastogi, S. C., Mendriratta, N., & Rastogi, P. (2006). *Bioinformatics: Concepts, Skills & Applications*. CBS Publishers & Distributors Pvt. Limited.
28. Jogdand, S. N. (2010). *Environmental biotechnolog*. Himalaya Pub. House,
29. Gupta, P. K. (1994). *Elements of biotechnology*. Rastogi publications.
30. Kothari, C. R. (2004). *Research methodology: Methods and techniques*. New Age International.
