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

Credit Based Semester and Grading System

To be implemented from the academic year 2018 – 2019

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	Spectroscopy; Centrifugation		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

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; Concept of pH and Buffers		1
	III	Chromatography		1
	IV	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
		Objectives: 1. To comprehend the concepts in nutrition and the importance of proper nutrition, thus laying a foundation for the field of nutrition and dietetics. 2. To help students understand the physico-chemical properties and biochemical role of carbohydrates, proteins and nucleic acids. 3. To lay a strong foundation of concepts in enzyme and enzyme kinetics. 4. To understand the principle, instrumentation and applications of various biophysical techniques like centrifugation and spectroscopy	
I		**Basic Concepts in nutrition ; Carbohydrates**	15
	1.1	**Basic Concepts in human nutrition**: Proximate principles, energy content of food and calorific value	
	1.1.1	Utilization of energy, Units of energy, BMR, factors affecting BMR and its significance. SDA, SDA for different foods, significance.	
	1.1.2	Physical activity and energy requirements of man.	
	1.2 1.2.1	**Carbohydrates** classification of carbohydrates (mono, oligo & poly) with examples	
	1.2.2	Properties and classification of monosaccharides in terms of – A) functional group and B) Number of carbon atoms	
	1.2.3	Carbohydrate chemistry: Fischers and Haworth formula of glucose Isomers of glucose: D and L, aldose-ketose, optical isomers, epimers and anomers	

	1.2.4	Structure and occurrence of Glucose, Fructose, Galactose, ribose and deoxyribose Disaccharides: maltose, lactose, sucrose	
	1.2.5	Polysaccharides- Classification based on function (storage & structural), composition (homo & hetero) giving examples Storage polysaccharides (Starch and Glycogen), action of amylase on starch. Structural polysaccharides - Cellulose, Chitin	
	1.2.6	Bacterial cell wall polysaccharide: Peptidoglycan framework (With structures of NAG & NAMA)	
	1.2.7	Extracellular matrix proteoglycan - Hyaluronate, Chondroitin sulphate and Heparin (monomers and occurrence/significance	
	1.2.8	Nutritional importance of carbohydrates Functions of carbohydrates, Requirement, Dietary sources, Glycemic index, Significance of fiber	
	1.2.9	Commercial importance of carbohydrates: Starch, Cyclodextrin, chitosan, modified cellulose, pectin	
II		**Amino acids and Proteins**	**15**
	2.0	**Amino acids**	
	2.1.1	Classification of amino acids based on the polarity of R-groups (structure of 20 amino acids with three letter and single letter code words)	
	2.2	**Proteins**	
	2.2.1	Proteins: ASBC-APS classification on the basis of shape and function.	
	2.2.2	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 Tertiary structure - forces stabilizing, example myoglobin Quaternary structure - forces stabilizing, example hemoglobin	
	2.2.3	Primary structure determination 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.	
	2.2.4	Protein denaturation	
	2.2.5	Nutritional significance of proteins Functions of proteins, Requirement, Dietary sources, essential amino acids, Nutritive value of proteins: BV and PER	
III	**3.0**	**Nucleic acid; Enzymes**	**15**
	3.1 **3.1.1**	**Nucleic acids:** Structure of purine and pyrimidine bases, nucleosides and nucleotides, formation of polynucleotide strand with its shorthand representation.	
	3.1.2	RNAs- (various types in pro and eukaryotes), rRNA, t-RNA, m-RNA, their structure and function. Action of alkali on RNA	
	3.1.3	DNA: double helix, Watson –Crick model of DNA and its characteristic features, Forces stabilizing the secondary structure. 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	
	3.1.4	Physical properties of DNA - UV absorption, Hypochromism, Hyperchromism, Denaturation of DNA, Tm.	
	3.2 **3.2.1**	**Enzymes and Enzyme kinetics** 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	
	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.	
	3.2.4	Enzyme inhibition: Competitive and Noncompetitive.	
IV	**4.0**	**Centrifugation; Spectroscopy**	**15**
	4.1	**Centrifugation**	
	4.1.1	General Principle, rpm, RCF, derivation of equation relating RCF and rpm	
	4.1.2	Types of centrifuges and rotors - Clinical, High Speed,	

		Ultra –preparative and Analytical	
	4.1.3	Components and working of - Analytical Ultracentrifuge.	
	4.1.4	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.	
	4.1.5	Use of Analytical Ultracentrifugation in the determination of molecular weights (sedimentation velocity method), conformational studies and purity of a sample.	
	4.1.6	Numerical problems based on above concepts	
	4.2	**Spectroscopy**	
	4.2.1	General Principle, derivation and limitations of Beer-Lambert law, significance of Lambda max, molar extinction coefficient	
	4.2.2	Construction and working of simple colorimeter (Single beam) and a spectrophotometer.	
	4.2.3	Applications of Beer Lambert Law in estimation of Proteins (Biuret method), Sugars (DNSA method).	
	4.2.4	Numerical problems based on above concepts	

Semester V

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

COURSE CODE: **SIUSBCH52**

CREDITS: 2.5

Unit No.	Topic No.	Contents	NOL
		Objectives: 1. To provide an insight about metabolism of carbohydrates and amino acids/proteins 2. To understand the concepts of thermodynamics and its application in living system 3. To study the energy synthesis pathways in plants and animals 4. To study the molecular biology and processes of information transfer 5. To comprehend the role of growth regulators in plants and the chemistry and function of hormones in animals.	
I	**1.0**	**Carbohydrate metabolism**	**15**
	1.1 1.2	Introduction to metabolism: Catabolism, anabolism, role of high energy phosphates viz. ATP and thioesters, role of reduced coenzymes NADH and NADPH. Digestion and absorption of carbohydrates Overview of catabolism, Glycogenolysis (Schematic) Catabolism of glucose: Glycolysis- cellular location, sequence of reactions, products, energetics Fate of pyruvate in aerobic and anaerobic conditions. Kreb's cycle: cellular location, sequence of reactions, products, energetics, amphibolic nature.	
	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, Glyoxylate pathway. Glycogenesis (Schematic)	
	1.4	Anaplerotic reactions – Role of Pyruvate carboxylase, PEP carboxykinase, Malic enzyme.	

II	**2.0**	**Amino acid metabolism; Bioenergetics**	**15**
	2.1	**Amino acids and Protein Metabolism**	
	2.1.1 2.1.2 2.1.3 2.1.4	Digestion and absorption of proteins and amino acids Catabolism - reactions –Transamination (GOT/GPT and mechanism of transamination) Decarboxylation of His,Trp, Glu and physiological significance of the products Deamination: Oxidative (NAD, FAD, FMN-linked oxidases) & Non-oxidative – Asp, Cys, Ser	
	2.1.5	Urea Cycle - Cellular location, sequence of reactions, labeling of N-atom, formation and transport of ammonia.	
	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	
		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,	
		Mechanism of ATP synthesis: Chemiosmotic hypothesis, Proton motive force, Structure of ATPase (F_oF_1 ATPase)	
	2.2.2	**Photosynthesis**	
		Light-dependent and Light-independent reactions. Light dependent reactions, chloroplast, role of reaction center and accessory pigments Photophosphorylation: Linear ETC / Z scheme, two reaction centers, production of oxygen and NADPH, proton gradient and ATP synthesis Cyclic ETC in purple bacteria Light-independent reactions: Calvin cycle (schematic representation only)	

III	**3.0**	**Plant growth regulators; Endocrinology**	**15**
	3.1	**Plant growth regulators:** Role of auxins, cytokinins, abscissic acid, gibberellins and ethylene	
	3.2 3.2.1 3.2.2	**Endocrinology:** Hormones, hormone receptor, classification of hormone on the basis of chemistry, organization of the endocrine system	
	3.2.3 3.2.4 3.2.5 3.2.6 3.2.7	Chemistry, synthesis, secretion and metabolic effects of thyroxine, insulin. Chemistry & physiological role of oxytocin and vasopressin. Physiological role of Glucocorticoids, Epinephrine Endocrine disorders – Diabetes mellitus, Diabetes insipidus, Hypothyroidism (Cretinism & myxedema), Hyperthyroidism (Goitre – Simple & Toxic) Role of second messengers: cAMP, Ca and IP3, Mechanism of action of epinephrine (on glycogenolysis) and steroid hormone (on gene expression).	

IV	**4.0**	**Fundamentals of molecular biology**	**15**
	4.1	**Cell cycle : phases and significance**	
	4.2	**Replication of DNA** - mechanism o f replication, modes of DNA replication, experimental evidence for semi-conservative replication, Mechanism, discontinuous DNA synthesis, termination of replication.	
	4.3	**Transcription of DNA** - in prokaryotes, prokaryotic RNA polymerases, Steps in transcription, processing of RNA species, concept of split genes, reverse transcription	
	4.4	**Translation** (protein biosynthesis) in prokaryotes - activation of amino acids, chain initiation, chain elongation, chain termination, post translational modifications of proteins	
	4.5	**Gene regulation**: Promoters, enhancers, Concept of operon, Lac operon	

PRACTICAL based on SIUSBCH51& SIUSBCH52
US3BCHP5

Sr No.	Experiments
I	**Preparation of solution** Units for expressing concentration Preparation of solution of given concentration and problems based on the above concepts.
II	**Qualitative Analysis: -** 1.Carbohydrates - Glucose, Fructose, Maltose, Lactose, Sucrose, Starch, Dextrin. 2. Proteins - Albumin, Casein, Gelatin, Peptone.
III	**Estimation of biomolecules** **Volumetric analysis:-** 1.Lactose by Cole's method/Glucose by Benedict's method **Colorimetric analysis: -** 1. Verification of Beer-Lambert law and determination of lambda max of colored solution 2. Soluble proteins by Biuret method 3.RNA by Orcinol method 4. Glucose / Maltose by DNSA method
IV	**Isolation** 1. Starch from potato. 2. Casein from milk
V	**Enzymology** 1. Optimum pH of amylase 2. Amylase: Km of amylase
VI	**Biostatistical analysis:** 1.Collection of data, types of data and presentation 2. Frequency distribution 3. Determination of mean, median and mode
VII	**Demonstration Experiments**
	1. Preparation of buffers and use of pH meter 2. Extraction of a phytoconstituent (alkaloid/ flavonoid/pigment) by any one extraction method; distillation, Soxhlet/ solvent 3. Immobilization /entrapment of enzyme (amylase) in alginate 4. Glucose by Folin –Wu method

Semester VI
(SIUSBCH6)

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

COURSE CODE: **SIUSBCH61**
CREDITS: 2.5

Unit No.	Topic No.	Content	NOL
		Objectives: 1. To study the basic concepts in nutrition and understand the importance of vitamins and minerals in nutrition. 2. To familiarize the students to the physic-chemical properties and biochemical role of lipids 3. To emphasize on the structure and function of cell membrane and the role of proteins involved in transport of molecules across membrane. 4. To understand the principle, working and applications of various biophysical techniques like chromatography and electrophoresis	
I	1.0	**Basic Concepts in Nutrition; Lipids**	15
	1.1 1.1.1	**Concepts in nutrition**: Energy balance: Normal weight, underweight and obesity, BMI, Nutritional significance of • vitamins, Deficiency disorders • Minerals: Fe, Ca, P, Mg	
	1.2 1.2.1	**Lipids** 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 Phosphotidyl inositol), Action of Phospholipases Functions of p hosphosphingolipids (ceramide, Sphingomyeline), 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	
II	**2.0**	**Membrane biochemistry ; Concept of acids, bases and buffers**	**15**
	2.1 2.1.1 2.1.2 2.1.3 2.1.4	**Membrane biochemistry** Biological membrane -Membrane constituents and assembly: Fluid-mosaic model, Lipid bilayer, asymmetric distribution of lipids Membrane proteins : integral/transmembrane, Lipid-linked and peripheral Erythrocyte membrane model Membrane transport: Active and Passive, pumps and channels Na^+ – K^+ pump, inhibitors, Secondary transporters-antiporters, symporters.	
	2.2	**Concept of acids, bases and buffers**	
	2.2.1	Water –properties and role, dissociation and ionic Product.	
	2.2.2	Acids and bases, hydrogen ion concentration and pH, dissociation, Hendersen –Hasselbalch equation Titration curve of acetic acid, pKa value.	
	2.2.3	Ionization and titration curve of ala, Gly, Lys and Asp, pI and pKa values of these amino acids.	
	2.2.4	Importance of pH in cells, Buffers, buffer value/capacity, common laboratory buffers, physiological Buffers (Carbonate buffer, phosphate buffer and protein buffer).	
	2.2.5	Numerical problems based on above concepts.	

III	**3.0**	**Chromatography**	**15**
	3.1	**Chromatography :** Principle, requirements, technique and applications of - Partition chromatography (Paper), Adsorption chromatography (TLC and Column), Ion exchange chromatography (Column) and Gel filtration chromatography.	
	3.2	Introduction to GLC, HPLC and Affinity Chromatography -Principles only.	
	3.4	Numerical problems based on above concepts.	

IV	**4.0**	**Electrophoresis**	**15**
	4.1	Principles of electrophoresis, factors affecting the Electrophoretic mobility.	
	4.2	Types of electrophoresis: Moving boundary, Zone electrophoresis (horizontal), set up, Support media (paper, cellulose acetate, agar, agarose and polyacrylamide), technique, detection and recovery.	
	4.3	PAGE: Native and SDS, discontinuous electrophoresis for separation of proteins.	
	4.4	Applications of electrophoresis - Separation of proteins and nucleic acids, Purity determination, Molecular weight determination using PAGE.	
	4.5	Isoelectric focusing	

Semester VI

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

COURSE CODE: **SIUSBCH62**

CREDITS: 2.5

Unit No.	Topic No.	Contents	NOL
		Objectives: 1. To study biochemical oxidation and synthesis of fats 2. To understand the basics of immunology 3. To familiarize the students to bioprocess technology and its applications 4. To study the basic techniques of tissue culture 5. To study recombinant DNA technology and its applications 6. To introduce the field of bioinformatics and make understand the scope, applications and potentials of bioinformatics.	
I	**1.0**	**Lipid metabolism**	**15**
	1.1 1.2	Digestion and absorption of lipids Catabolism - Knoop's experiment, Beta – oxidation of even carbon saturated fatty acids, role of carnitine, energetics from C4 to C20	
	1.3 1.4	Anabolism - Fatty acid biosynthesis (only Palmitic acid), fatty acyl synthetase complex. Ketone bodies formation, utilization. Ketosis, physiological significance in Diabetes mellitus, starvation, alcoholism and pregnancy.	
	1.4	Lipoprotein metabolism.	
II	**2.0**	**Basics of immunology**	**15**
	2.1 2.2	Immunity, antigen, hapten and antibody. Types of immunity: Innate, Acquired, Active and Passive Innate immunity: External barriers, Phagocytosis, Complement, Natural Killer cells Acquired immunity: Humoral and Cell-mediated Specificity, Self-Nonself recognition Humoral immunity: B cells, plasma cells, functions of antibody. Cell-mediated: 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.	
III	**3.0**	**Industrial biochemistry ; Tissue culture techniques**	**15**
	3.1 3.1.1 3.1.2 3.1.3	**Bioprocess technology –** Introduction, Steps in setting up an industrial process, parameters, Selection of organism, screening, types of media, Batch and continuous fermentation, Basic components of a typical fermenter, Downstream processing Applications Fermentation process for production of alcohol/wine/beer	
	3.2 3.2.1 3.2.2 3.2.3	**Tissue Culture: Plant and Animal** Requirements: Physical conditions, Nutritional requirements, General technique, explant, callus, totipotency, dedifferentiation, redifferentiation, role of plant growth regulators. Different types of tissue culture techniques, protoplast fusion Applications of tissue culture	
IV	**4.0**	**Recombinant DNA technology; Introduction to bioinformatics**	**15**
	4.1	**Recombinant DNA technology**	
	4.1.1 4.1.2 4.1.3 4.1.4 4.1.5 4.1.6	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 Transgenic plants – Bt cotton, Cloning in plants using Ti plasmid. Gene libraries, DNA probes DNA amplification by PCR, applications of PCR Applications of recombinant DNA technology.	
	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
US3BCHP6

S.No.	Experiments
I	**Isolation**
	1. Isolation of DNA and detection 2. Separation of DNA by agarose gel electrophoresis
II	**Food analysis**
	Mineral Estimation :- Preparation of food ash 1. Calcium by EDTA method 2. Iron by Wongs method 3. Phosphorus by Fiske-Subbarow method **Vitamin estimation** 1. Estimation of vitamin C / V itamin B1 2. Tests for lipid quality: Acid number
III	**Chromatography** 1. Circular paper chromatography of amino acids 2. Circular paper chromatography of sugars
IV	**Antigen-antibody reactions** Immunodiffusion (Precipitation)
V	**Microbiology** i. Monochrome, Gram and negative staining ii. Isolation of bacteria : streaking and spreading
VI	**Biostatistical analysis (measures of dispersion)** Determination of SD and variance
VII	**Demonstration Experiments:-**
	1.Column chromatography - separation of chlorophylls 2. Agglutination reaction: Blood grouping or Widal qualitative 3. 2D paper/2D TLC chromatography of complex mixture of amino acids/sugars 4. Preparation of media 5. Bioinformatics: Sequence retrieval, Introduction to protein structure database

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**

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 of DNA	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.

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**

Sub Q A: Attempt any three out of four (Objectives/MCQs)------- 03marks each

Sub Q B: Attempt any one out of two ------- 02 marks each

Sub Q C: Attempt any one out of two ------- 04marks each

Sub Q D: Attempt any one out of two ------- 06 marks each

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.

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.