

# UNIVERSITY OF MUMBAI



**Syllabus for sem V & VI**  
**Program: B.Sc.**  
**Course: Biochemistry (3 Units)**  
**(Inter-disciplinary subject)**

(Credit Based Semester and Grading System with  
effect from the academic year 2013–2014)

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

**Credit Based Semester and Grading System**

**To be implemented from the academic year 2013-2014**

**Semester V**

<b>Course Code</b>	<b>Unit</b>	<b>Topics</b>	<b>Credits</b>	<b>L/week</b>
<b>US3BCH501</b>	<b>Bio-organic and biophysical chemistry I</b>		<b>2.5</b>	
	<b>I</b>	Proteins and amino acids		1
	<b>II</b>	Enzymes and Nucleic acids		1
	<b>III</b>	Carbohydrates		1
	<b>IV</b>	pH and Radioactivity		1
<b>US3BCH502</b>	<b>Metabolism, nutrition and advanced biochemical concepts-I</b>		<b>2.5</b>	
	<b>I</b>	Nutrition and Biostatistics		1
	<b>II</b>	Carbohydrate metabolism		1
	<b>III</b>	Amino acid and protein metabolism and Immunology		1
	<b>IV</b>	Genetics and Industrial Biotechnology		1
<b>US3BCHP05</b>		Practicals of course USBCH 501 & course USBCH 502	<b>3</b>	8

## Semester VI

Course Code	Unit	Topics	Credits	L/week
<b>US3BCH601</b>	<b>Bio-organic and biophysical chemistry II</b>		<b>2.5</b>	
	<b>I</b>	Lipids		1
	<b>II</b>	Chromatography		1
	<b>III</b>	Electrophoresis		1
	<b>IV</b>	Centrifugation and Spectroscopy		1
<b>US3BCH602</b>	<b>Metabolism, nutrition and advanced biochemical concepts-II</b>		<b>2.5</b>	
	<b>I</b>	Lipid Metabolism		1
	<b>II</b>	Bioenergetics and photosynthesis		1
	<b>III</b>	Endocrinology		1
	<b>IV</b>	Recombinant DNA technology and Bioinformatics		1
<b>US3BCHP06</b>		Practicals of course USBCH 601 & course USBCH602	<b>3</b>	<b>8</b>

**T.Y.B.Sc. - BIOCHEMISTRY**  
**3 – UNITS INTERDISCIPLINARY SUBJECT**  
**Semester V**

COURSE TITLE : **BIO-ORGANIC AND BIOPHYSICAL CHEMISTRY**

COURSE CODE : **US3BCH501**

**CREDITS : 2.5**

Unit No.	Topic No.	Contents	NOL
<b>I</b>	<b>1.0</b>	<b>Amino acids and Proteins</b>	<b>15</b>
	<b>1.1</b>	<b>Amino acids</b>	
	1.1.1	Classification of amino acids based on the polarity of R-groups(structure of 20 amino acids)	
	1.1.2	Chemical reactions of amino acids with following reagents –Ninhydrin, Sanger’s, Edman’s, Dansyl chloride. Cleavage of polypeptide- Trypsin, Chymotrypsin, Pepsin, Aminopeptidase, Carboxypeptidase, (S-S bond- Mercaptoethanol).	
	<b>1.2</b>	<b>Proteins</b>	
	1.2.1	Proteins: ASBC-APS classification on the basis of shape and function. Formation and characteristic of peptide bond.	
	1.2.2	Primary structure, Secondary structure-alpha helix and beta sheet. Tertiary structure - myoglobin, Quaternary structure - hemoglobin.	
	1.2.3	Forces stabilizing protein structure	
	1.2.4	Protein denaturation	
<b>II</b>	<b>2.0</b>	<b>Enzymes and Nucleic acids</b>	<b>15</b>
	<b>2.1</b>	<b>Enzymes</b>	
	2.1.1	Definition - enzyme, apoenzyme, holoenzyme, prosthetic group, active site, enzyme specificity, turnover number, specific activity, Katal, IU, coenzyme,	

		cofactor, allosteric enzymes. ( Only definition )	
	2.1.2	IUB/EC Classification (up to one digit)	
	2.1.3	Factors affecting enzyme reaction - substrate, pH and temperature.	
	2.1.4	Enzyme kinetics-Derivation of Michaelis-Menten equation and Lineweaver-Burk plot for mono-substrate reaction and numerical problems based on them.	
	2.1.5	Enzyme inhibition - Competitive and Non-competitive	
	<b>2.2</b>	<b>Nucleic acids</b>	
	2.2.1	Structure of purine and pyrimidine bases, ribose, deoxyribose, nucleosides and nucleotides. c AMP and formation of polynucleotide strand with its shorthand representation.	
	2.2.2	RNAs- (various type in pro and eukaryotes) rRNA, t-RNA(Clover –leaf model), m-RNA (general account) and action of alkali on RNA	
	2.2.3	DNA-X-ray diffraction pattern (Physical evidence), Chargaff's rules (Chemical evidence), Watson –Crick model of DNA and its characteristic features.	
	2.2.4	Physical properties of DNA - Ionisation, Viscosity, Buoyant density, UV absorption and Hypochromism, Hyperchromism, Denaturation of DNA, Tm.	
<b>III</b>	<b>3.0</b>	<b>Carbohydrates</b>	<b>15</b>
	3.1	Monosaccharides –Definition and classification of carbohydrates (mono, oligo & poly), classification of monosaccharides in terms of – A) aldoses and ketoses. B) Number of carbon atoms. Reactions of monosaccharides – 1) Oxidation to produce aldonic, aldaric and Uronic acid (only w.r.t glucose), 2) Osazone (only w.r.t glucose and fructose), 3) Reducing action of sugar in boiling alkaline medium (enediol formation) - only w.r.t glucose and fructose, 4) Orcinol (for ribose)	
	3.2	Disaccharides - Occurrence and structure of maltose, lactose, sucrose	
	3.3	Polysaccharides- Classification based on function (storage & structural), composition (homo & hetero) giving examples. Storage polysaccharrides (Starch and	

		Glycogen), action of amylase on starch.	
	3.4	Structural polysaccharides - Cellulose, Chitin and Peptidoglycan frame work. (With structures of NAG & NAMA)	
	3.5	Extracellular matrix proteoglycan - Hyaluronate, Chondroitin sulphate and Heparin (function and structure).	
<b>IV</b>	<b>4.0</b>	<b>Acids, Bases, Buffers and Ionic Equilibria, Radioactivity</b>	<b>15</b>
	<b>4.1</b>	<b>Acids, Bases, Buffers and Ionic Equilibria :</b>	
	4.1.1	Definition - pH, pK, Kw, Isoelectric pH, buffer, buffering capacity	
	4.1.2	Derivation of Hendersen –Hasselbalch equation, ionic product of water and relation between Isoelectric pH, pKa <sub>1</sub> and pKa <sub>2</sub> (for neutral amino acid).	
	4.1.3	Titration and ionization of Gly, Lys and Asp and relation between IEPH, pI and pKa values of these amino acids, Sorensen's reaction and formol titration of amino acids (Ala).	
	4.1.4	Physiological Buffers ( Hb – Carbonate buffer, phosphate buffer and protein buffer).	
	4.1.5	Numerical problems based on above concepts.	
	4.1.6	pH meter, glass electrode.	
	<b>4.2</b>	<b>Radioactivity</b>	
	4.2.1	Definition – Radioactivity, radioisotope with 2 examples ( <sup>14</sup> C, <sup>15</sup> N) , decay constant, Half-life period, Applications of radioisotopes in biological studies ( w.r.t <sup>14</sup> C, <sup>15</sup> N ) – Metabolic pathway ( glycolysis, TCA, Urea), Molecular biology studies (w.r.t <sup>32</sup> P, Clinical studies ( <sup>131</sup> I in hypo/hyperthyroidism detection)	

## Semester V

**COURSE TITLE: METABOLISM, NUTRITION AND ADVANCED BIOCHEMICAL CONCEPTS-I**

**COURSE CODE : US3BCH502**

**CREDITS : 2.5**

Unit No.	Topic No.	Contents	NOL
<b>I</b>	<b>1.0</b>	<b>Nutrition and Biostatistics</b>	<b>15</b>
	<b>1.1</b>	<b>Nutrition</b>	
	1.1.1	Definition-Calorie and Joule	
	1.1.2	Food calorimetry-calorific value by Bomb calorimeter, calorific values of proximate principles, concept of BMI, BV and PER.	
	1.1.3	BMR- definition, factors affecting BMR, significance of BMR in clinical diagnosis.	
	1.1.4	SDA - General concept and significance, energy requirement of individuals for various activities- sedentary, moderate and heavy.	
	1.1.5	Nutritional significance of carbohydrates, protein, lipids, vitamins, minerals and water.	
	1.1.6	Numerical problems based on above concepts	
	<b>1.2</b>	<b>Biostatistics</b>	
	1.2.1	Data-collection and presentation.	
	1.2.2	Frequency distribution, normal distribution	
	1.2.3	Measures of central tendency – Mean (Arithmetic), Median and Mode.	
	1.2.4	Measures of variation - Range, Variance and Standard deviation.	
	1.2.5	Numerical problems based on above concepts to the biological data.	
<b>II</b>	<b>2.0</b>	<b>Carbohydrate metabolism</b>	<b>15</b>
	2.1	Definition of Glycolysis, glycogenesis, glycogenolysis. Catabolism - Cellular location, sequence of reactions, labeling of C-atoms and energetics of glycolysis (aerobic and anaerobic) and Krebs cycle.	

	2.2	Anabolism - HMP Shunt (Synthesis of pentose phosphates)-Cellular location, sequence of reactions, oxidative and non-oxidative phases of pathway and multifunctional nature. Schematic account of gluconeogenesis, Glyoxylate pathway.	
	2.3	Anaplerotic reactions – Definition, Role of Pyruvate carboxylase, PEP carboxykinase, Malic enzyme.	
<b>III</b>	<b>3.0</b>	<b>Amino acids and Protein Metabolism and Immunology</b>	<b>15</b>
	<b>3.1</b>	<b>Amino acids and Protein Metabolism</b>	
	3.1.1	Catabolism - reactions of amino acids –Transamination (GOT/GPT and mechanism of transamination), Decarboxylation (His,Trp, Glu and mechanism of decarboxylation ). Deamination (Oxidative – Glu, Tyr & Nonoxidative – Asp, Cys, Ser).	
	3.1.2	Urea Cycle - Cellular location, sequence of reactions, labeling of N-atom, formation and transport of ammonia.	
	<b>3.2</b>	<b>Immunology</b>	
	3.2.1	Definition of immunity, types of immunity, definition of antigen, hapten and antibody.	
	3.2.2	Cells and organs of immune system.	
	3.2.3	Immunoglobulins basic structure, classes and sub-classes-their structure and functions..	
	3.2.4	Antigen– antibody reactions - Precipitation, agglutination.	
<b>IV</b>	<b>4.0</b>	<b>Genetics and Industrial Biotechnology</b>	<b>15</b>
	<b>4.1</b>	<b>Genetics</b>	
	4.1.1	Replication of DNA - mechanism of replication, modes of DNA replication, semi-conservative replication, discontinuous DNA synthesis, termination of replication.	
	4.1.2	Transcription of DNA - in prokaryotes, prokaryotic RNA polymerases, synthesis of RNA species and their processing, concept of split genes, reverse transcription.	
	4.1.3	Translation (protein biosynthesis) in prokaryotes - activation of amino acids, chain initiation, chain	



		elongation, chain termination, post translational modifications of proteins.	
	<b>4.2</b>	<b>Industrial Biotechnology</b>	
	4.2.1	Fermentation processes – Basic components of a typical fermenter, fermentation process for alcohol production.	
	4.2.2	Plant tissue culture - definition of totipotency, callus regeneration, protoplast fusion and application of plant tissue culture in brief.	

**PRACTICALS based on US3BCH501 & US3BCH502  
US3BCHP05**

Sr No.	Experiments
<b>I</b>	<b>Chromatography techniques:-</b>
	Separation by Circular Paper Chromatography of: 1. Amino acids 2. Sugars
<b>II</b>	<b>Colorimetry:-</b>
	1. Proteins by Biuret method 2. RNA by Orcinol method 3. Glucose by Folin –Wu method
<b>III</b>	<b>Volumetry:-</b>
	1. Lactose by Cole’s method 2. Vitamin C by Iodo /iodimetric method 3. Glucose by Benedict’s method
<b>IV</b>	<b>Qualitative Analysis:-</b>
	1. Carbohydrates - Glucose, Fructose, Maltose, Lactose, Sucrose, Starch, Dextrin. 2. Proteins - Albumin, Casein, Gelatin, Peptone.
<b>V</b>	<b>Viva- Voce :-</b>
	Based on fundamental concepts covered in practicals.
<b>VI</b>	<b>Journal:-</b>
	Duly signed by the Teacher –in –charge and certified by the - Head of the department.
<b>VII</b>	<b>Demonstration Experiment</b>
	(To be entered in the Journal but not to be asked in the university Practical Examination) 1. TLC of oils and plant pigments 2..Preparation of buffers and use of pH meter

## Semester VI

COURSE TITLE : **BIO-ORGANIC AND BIOPHYSICAL CHEMISTRY**

COURSE CODE : **US3BCH601**

**CREDITS : 2.5**

Unit No.	Topic No.	Contents	NOL
<b>I</b>	<b>1.0</b>	<b>Lipids</b>	<b>15</b>
	1.1	Definition and Bloor's Classification of lipids.	
	1.2	Fatty acids & TAG : Saturated fatty acids – definition, classification of C2 and 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. Triacylglycerol - Simple and mixed	
	1.3	Chemical reactions - Saponification, Iodination, Ozonolysis, Auto-oxidation, Phospholipases, action of heat on glycerol and choline, Rancidity of fats. Definition and significance - Acid Number, Saponification Number, Iodine Number and Reichert-Meissel Number.	
	1.4	Compound lipids – Structure and function of Glycerophospholipids (Cephalin, Lecithin and Phosphotidyl inositol), Phosphosphingolipids (ceramide, Sphingomyeline), Glycolipids or Cerebrocides (Galacto and Glucocerebrocides).	
	1.5	Steroids and Lipoproteins Steroids - Cholesterol structure and biochemical significance Lipoproteins –Types (Chylomicron, VLDL, LDL, HDL) and biochemical significance - Schematic depiction of interrelationship.	
<b>II</b>	<b>2.0</b>	<b>Chromatography</b>	
	2.1	<b>Chromatography</b> : Principle, requirements and working of-Partition chromatography (Paper), Adsorption chromatography (TLC and Column), Ion exchange chromatography (Column) and Gel filtration.	

	2.2	Introduction to GLC, HPLC and Affinity chromatography -Principles only	
	2.3	Applications of partition, adsorption, ion exchange and gel filtration chromatography techniques	
	2.4	Numerical problems based on above concepts	
<b>III</b>	<b>3.0</b>	<b>Electrophoresis</b>	<b>15</b>
	3.1	Principles of electrophoresis, Factors affecting the rate of migration of sample in electric field	
	3.2	Supporting media - paper, cellulose acetate, agar, agarose and polyacrylamide.	
	3.3	Discontinuous electrophoresis – Native, PAGE.	
	3.4	Application of electrophoresis - Separation of proteins and nucleic acids. (one staining method each). Molecular weight determination using PAGE.	
	3.5	Isoelectric focusing	
<b>IV</b>	<b>4.0</b>	<b>Centrifugation and Spectroscopy</b>	<b>15</b>
	<b>4.1</b>	<b>Centrifugation</b>	
	4.1.1	Definition of RCF and RPM, derivation of equation relating RCF and RPM, Nomogram	
	4.1.2	Types of centrifuges - Clinical, High Speed, Ultra – preparative and Analytical	
	4.1.3	Components and working of - Analytical Ultracentrifuge – ( with diagram).	
	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	
	<b>4.2</b>	<b>Spectroscopy</b>	
	4.2.1	Definition, derivation and limitations of Beer-Lambert Law. Concepts of Lambda max, Definition and	

		determination of molar extinction coefficient.	
	4.2.2	Construction and working of simple colorimeter (single beam) and a spectrophotometer.	
	4.2.3	Application of Beer Lambert Law in estimation Of proteins (Biuret method), Sugars (DNSA method).	
	4.2.4	Numerical problems based on above concepts	

## Semester VI

**COURSE TITLE : METABOLISM, NUTRITION AND ADVANCED BIOCHEMICAL CONCEPTS-II**

**COURSE CODE :US3BCH602**

**CREDITS : 2.5**

<b>Unit No.</b>	<b>Topic No.</b>	<b>Contents</b>	<b>NOL</b>
<b>I</b>	<b>1.0</b>	<b>Lipid Metabolism</b>	<b>15</b>
	1.1	<b>Lipid Metabolism</b> : Catabolism - Knoop's experiment, Beta – Oxidation of even –Carbon saturated fatty acids and its energetics from C4 to C20	
	1.2	Anabolism - Fatty acid biosynthesis ( only Palmitic acid ) and role of fatty acyl synthetase complex. Ketone bodies formation, utilization, and physiological significance in Diabetes mellitus, starvation, alcoholism and pregnancy.	
<b>II</b>	<b>2.0</b>	<b>Bioenergetics and Photosynthesis</b>	<b>15</b>
	<b>2.1</b>	<b>Bioenergetics</b>	
	2.1.1	Definition of Free energy, respiratory electron transport chain, - basic chemistry, electron carriers, sequence - redox potentials, location of these electron carriers on mitochondrial membrane, Inhibitors of ETC –Antimycin A, Amytal, Rotenone, CN, Azide, CO.	
	2.1.2	Definition of Oxidative Phosphorylation, Structure of ATPase (F <sub>0</sub> F <sub>1</sub> ATPase), Chemiosmotic hypothesis, Proton motive force.	
	<b>2.2</b>	<b>Photosynthesis</b>	
	2.2.1	<b>Photosynthesis:</b> Light and Dark reactions, Z-scheme and electron carriers, photophosphorylation (linear and cyclic), Calvin cycle (schematic representation only)	
<b>III</b>	<b>3.0</b>	<b>Endocrinology</b>	<b>15</b>
	3.1	Definition of Hormone, hormone receptor, classification of hormone on the basis of chemistry, Hierarchical organisation. Chemistry, synthesis,	

		secretion and metabolic effects of thyroxine, insulin. Chemistry & physiological role of oxytocin and vasopressin. Physiological role of Glucocorticoids. Mechanism of action of epinephrine on glycogenolysis and steroid hormone. Endocrine disorders – Diabetes mellitus, Diabetes insipidus, Hypothyroidism ( Cretinism & myxedema ), Hyperthyroidism ( Goitre – Simple & Toxic ).	
<b>IV</b>	<b>4.0</b>	<b>Recombinant DNA technology and Bioinformatics</b>	<b>15</b>
	<b>4.1</b>	<b>Recombinant DNA technology</b>	
	4.1.1	Genetic engineering – Basis of DNA cloning, cloning vectors, isolation of gene from cellular chromosomes, gene library, DNA probes, DNA amplification by PCR ( Cycle - with diagram , role of TAQ polymerase), applications of recombinant DNA technology in medicine ( Insulin ) and agriculture ( Bt cotton ).	
	<b>4.2</b>	<b>Bioinformatics</b>	
	4.2.1	Definition, Aims and History of Bioinformatics	
	4.2.2	Applications of Bioinformatics in – Sequence analysis, Molecular modeling and drug designing, Phylogeny/evolution, Ecology & population studies, Medical informatics and agriculture.	
	4.2.3	Genomics and Proteomics – Explanation in brief.	
	4.2.4	Databases- Definition & types – Public domain database, Sequence database, Structural database, Motif database, Genome database, Proteome database, Annotated sequence database. Full form & function in brief of – Gen Bank, EMBL, PIR, SWISS PROT, PDB, GDB.	
	4.2.5	Sequence analysis Tools - Explain the following terms in brief - BLAST, FASTA, L-ALIGN, CLUSTAL- X & W, RASMOL, Software for protein sequencing - PROPECT , AMMP, COPIA (Explanation of the terms in brief ).	
	4.2.6	Micro-array analysis-concept and applications.	

**PRACTICALS based on US3BCHP601 & US3BCHP602  
US3BCHP06**

<b>I</b>	<b>Preparation:-</b>
	1. Casein from milk 2. Starch from potato.
<b>II</b>	<b>Enzymes:-</b>
	A) AMYLASE : Km of amylase B) UREASE : Km of Urease
<b>III</b>	<b>Minerals Estimation :-</b>
	1. Calcium by EDTA method 2. Magnesium by Titan Yellow method 3. Iron by Wongs method 4. Phosphorus by Fiske-Subbarow method
<b>IV</b>	<b>Viva- Voce :-</b>
	Based on fundamental concepts covered in practicals.
<b>V</b>	<b>Journal:-</b>
	Duly signed by the Teacher –in –charge and certified by the Head of the department.
<b>VI</b>	<b>Demonstration Experiments:-</b>
	(To be entered in the Journal but not to be asked in the university Practical Examination) 1. Column chromatography - separation of chlorophylls 2. Agar/Agarose/PAGE gel electrophoresis of serum proteins



## SCHEME OF EXAMINATION

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

<b>THEORY :</b>				
<b>COURSE CODE</b>	<b>Title of Paper</b>	<b>Internal Assessment marks</b>	<b>Semester end Examination marks</b>	<b>Total Marks</b>
<b>US3BCH501</b>	Bio-organic and Biophysical Chemistry I	40	60	100
<b>US3BCH502</b>	Metabolism, Nutrition and Advance Biochemical concepts I	40	60	100
	<b>TOTAL</b>			<b>200</b>
<b>US3BCH601</b>	Bio-organic and Biophysical Chemistry II	40	60	100
<b>US3BCH602</b>	Metabolism, Nutrition and Advance Biochemical concepts II	40	60	100
	<b>TOTAL</b>			<b>200</b>

<b>PRACTICALS :</b>		
<b>COURSE CODE</b>	<b>Marks per course</b>	<b>Total per semester</b>
<b>US3BCHP05</b>	100 for USBCH501& USBCH502	<b>100</b>
<b>US3BCHP06</b>	100 for USBCH601 & USBCH602	<b>100</b>
<b>TOTAL</b>		<b>200</b>

**SCHEME OF PRACTICAL EXAMINATION  
SEMESTER V**

<b>Course</b>	<b>Experiments</b>	<b>Marks</b>
<b>US3BCHP05</b>	a. Chromatography Technique	20
	b. Colorimetry	20
	c. Volumetry	20
	d. Qualitative Analysis	20
	e. Certified Journal*	10
	f. <i>Viva voce</i>	10
	<b>TOTAL</b>	<b>100</b>

\* 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 respective colleges on behalf of the University
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 approved by the University of Mumbai.
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 days of 02 sessions of 3 ½ hours each
  - b) Morning session : 09.00 am to 12.30 pm  
Afternoon session : 01.00 pm to 04.30 pm.

## SCHEME OF PRACTICAL EXAMINATION

### SEMESTER VI

Course	Experiments	Marks
US3BCHP06	a. Preparation	20
	b. Mineral Estimation	20
	c. .Enzymology	20
	d. Interpretation and analysis of data provided	10
	e. Summary report of educational tour/Industrial visit/Assignments	05
	f. Certified Journal*	10
	g. <i>Viva voce</i>	10
	<b>TOTAL</b>	<b>100</b>

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

1. The Sem VI practical examination shall be conducted by the University of Mumbai
2. There shall be 02 (Two) external examiners appointed by the University from the panel of approved examiners
3. Duration for the Practical examination for Sem VI
  - c) One days of 02 sessions of 3 ½ hours each
  - d) Morning session : 09.00 am to 12.30 pm  
Afternoon session : 01.00 pm to 04.30 pm.

### **Scheme of Theory examination at TYBsc. (Sem V and Sem VI)**

- 1) Each theory paper shall carry 60 marks
- 2) Each theory paper shall be 2 1/2 hours duration

3) Each theory paper shall contain 05 questions of 12 marks each as follows:-

Q I : Based on Unit I

Q II : Based on Unit II

Q III : Based on Unit III

Q IV : Based on Unit IV

Q V : Based on Unit I to Unit IV

4) Marking system for **Questions I to IV**

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

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

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

Sub Qs B & C may be further sub-divided into 2 marks x 2 and 3 marks x 2 if necessary.

5) Marking system for **Questions V**

Q no V shall contain 08 sub-questions i.e

Two sub questions based on each of the units I to IV.

Each sub question shall carry 03 marks.

Sub Q (a) and Sub Q (b) : Based on Unit I

Sub Q (c) and Sub Q (d) : Based on Unit II

Sub Q (e) and Sub Q (f) : Based on Unit III

Sub Q (g) and Sub Q (h) : Based on Unit IV

Student shall attempt one sub question (a) **OR** (b) and(c) **OR** (d)and (e) **OR** (f)and (g) **OR** (h). Thus a student shall attempt a total of 04 sub questions carrying 03 marks each from Q No V.

## **Scheme of Examination for Third year Science Undergraduate**

External Examination 60% Internal

Examination 40%

### 1. Internal Examination for Theory:

Sr. No.	Particulars	Marks
1	ONE class test/ case study / online examination to be conducted in the given semester	20 Marks
2	One assignment based on curriculum to be assessed by the teacher concerned	10 Marks
3	Active participation in routine class instructional deliveries	05 Marks
4	Overall conduct as a responsible learner, communication and leadership qualities in organizing related academic activities	05 Marks

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

### 3. External Examination for practicals:

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

## **Educational Tour / Industrial Visit**

It is COMPULSORY that TYBSc students of Biochemistry MUST go for Educational Tour / Industrial Visit in Mumbai / Maharashtra / other States in India to visit various Universities / Research Centres / Industries (pharma, food, chemicals, biochemicals, beverages, oils etc) to give the first hand knowledge of current trends in research and the exposure to the working of industry, academia and research centres.

A 2-5 pages Summary Report of Educational Tour / Industrial Visit must be entered in the Journal as a part of Practical USBCHP602 for evaluation and such report shall carry 10 (TEN) marks separately at the University Practical Exam of P 602.

**OR**

## **ASSIGNMENT**

Students of TYBSc Biochemistry are required to complete an Assignment (10- 15 pages, handwritten or typed on A – 4 Size Paper and spiral- bound) on any of the Topics within the prescribed syllabus or related to the syllabus.

Such topics for the assignment may be selected by the students or assigned by the respective teachers to the students.

The Certified Assignment will have to be submitted for evaluation at the time of University Practical Exam of Sem VI as a part of USBCHP602 and shall carry 10 (TEN) marks separately in P 602.

## **PRINTED JOURNALS**

Use of Printed Journals for Sem V and Sem VI at TYBSc Biochemistry is permitted.

## Suggested Reading

1. Biochemistry by Lehninger, Albert L.; Kalyani publishers.
2. Principles of Biochemistry by Lehninger, Albert L., Nelson David and Cox, Michael M.; CBS publishers.
3. Principles of Biochemistry by Lehninger, Albert L., Nelson David and Cox, Michael M.; CBS publishers.
4. Biochemistry by Voet, Donald and Voet, Judith G.; John Wiley & sons publishers.
5. Biochemistry by Zubay, Geoffrey L.; Wm.C.Brown publishers
6. Biochemistry by Stryer, Lubert; W.H. Freeman publishers.
7. Principles of biochemistry by White, Abraham; Handler, Philip and Smith, Emil L.; Mc Graw and Hill publishers.
8. Harpers illustrated biochemistry by Murray, Robert K. *etal.*; Mc Graw Hill.
9. Harpers illustrated biochemistry by Murray, Robert K. *etal.*; Mc Graw Hill.
10. A biologists guide to principles and techniques in practical biochemistry by William, B.L. and Wilson, K; Universities press publishers.
11. Principles and techniques of practical biochemistry by Wilson, Keith and Walker, John ; Cambridge University Press publishers
12. Tools of biochemistry by Cooper, Terence G.; Wiley & Sons publishers.
13. Outlines of Biochemistry by Conn, E.E. and Stumpf, P.K.; Wiley

publications.

14. Introduction to practical biochemistry by Plummer, David T.; Tata Mc. Graw and Hill publishers.
15. Modern experimental biochemistry by Boyer, Rodney F.
16. Introductory practical biochemistry by Sawhney, S.K. and Singh, Randhir; Narosa Publishing House.
17. Biochemical calculation by Segel, Irwin H.; John Wiley & Sons publishers.
18. Text book of Medical physiology by Guyton, Arthur C. and Hall, John E.; Harcourt Brace & Company Asia Pvt Ltd.
19. Human biochemistry by Orten, J.M. and Neuhaus, O.W.; Mosby publishers.
20. Human nutrition and dietetics by Davidson, S. *etal.*; Churchill Livingstone Publishers.
21. Nutrition and dietetics by Joshi, Shubhangini A.; Tata Mc Graw and Hill publishers.
22. Nutrition Science by Srilakshmi, B.; New Age International publishers.
23. Genes VIII by Lewin, Benjamin; Pearson Prentice and Hall publishers.
24. Genetics by Russell, Peter J.; Benjamin Cummings publishers.
25. Immunology by Kubly, Janis; W.H. Freeman publishers.
26. Immunology by Roitt, Ivan M. *etal.*; Mosby publishers.
27. Fundamentals of biotechnology by Patel, A. H.
28. Industrial microbiology by Casida, L.E.; New Age International



publishers.

29. Methods of biostatistics for medical students and research workers by Mahajan, B.K.; Jaypee brothers publishers.
30. Bioinformatics- Concepts, Skill and applications by Rastogi, S.C.; Mendiratta, Namita and Rastogi, Parag; C.B.S. Publishers & Distributors
31. Gene biotechnology by Jogland.
32. Essentials of biotechnology by Gupta