SOPHIA COLLEGE FOR WOMEN (AUTONOMOUS)

Affiliated to

UNIVERSITY OF MUMBAI

Programme: **Biochemistry** (3 Units)

Programme Code: SBSBCH

T. Y. B.Sc. Biochemistry

2019-20

(Choice Based Credit System with effect from the year 2018 - 2019)

Course overview

Programme Objectives (PO):

The subject of Biochemistry is offered at third year level as a double major.
Two papers are offered spread over two semesters V and VI.

PO1	Bioorganic and Biophysical Chemistry introduces the students to all the biomolecules which constitute life.
PO2	The biophysical parameters involved, and the various techniques and instrumentation utilized to study these molecules are also included.
PO3	Metabolism, Nutrition and Advanced Biochemical Concepts gives the students an overview of all that encompasses Biochemistry: o nutrition the feeder branch, metabolism of various biomolecules for maintenance of life, o genetics for perpetuation of life, o immunology dealing with defense mechanisms, o endocrinology the regulatory process branch, o biotechnology the industrial application branch and o biostatistics, bioinformatics the data analysis branch.

Programme Specific Outcomes (PSO):

At the end of the course the Biochemistry double majors will be able to:

PSO Number	Statement of PSO
PSO1	Demonstrate an understanding of fundamental biochemical principles, such as the structure/function of biomolecules, metabolic pathways, and the regulation of biological/biochemical processes.
PSO2	The course will enable them to learn and integrate fundamentals in Chemistry, Biology and Biochemistry and will prepare them for careers and postgraduate education

Programme Outline: T.Y.B.Sc. Biochemistry (SEMESTER V)

Course Code	Unit	Topics	Credits	L/week
SBSBCH501	**Bio-organic and biophysical chemistry - I**		**2.5**	4
	1	Proteins and amino acids		
	2	Enzymes and Nucleic acids		
	3	Carbohydrates		
	4	pH and Radioactivity		
SBSBCH502	**Metabolism, nutrition and advanced biochemical concepts - I**		**2.5**	4
	1	Nutrition and Biostatistics		
	2	Carbohydrate metabolism		
	3	Amino acid and protein metabolism and Immunology		
	4	Genetics and Industrial Biotechnology		
SBSBCHP5		Practical based on courses SBSBCH 501 & US3BCH 502	**3**	8

Programme Outline: T.Y.B.Sc. Biochemistry (SEMESTER VI)

Course Code	Unit	Topics	Credits	L/week
SBSBCH601	**Bio-organic and biophysical chemistry - II**		**2.5**	4
	1	Lipids		
	2	Chromatography		
	3	Electrophoresis		
	4	Centrifugation and Spectrophotometry		
SBSBCH602	**Metabolism, nutrition and advanced biochemical concepts - II**		**2.5**	4
	1	Lipid Metabolism		
	2	Bioenergetics and photosynthesis		
	3	Endocrinology		
	4	Recombinant DNA Technology and Bioinformatics		
SBSBCHP06		Practical based on courses SBSBCH 601 & SBSBCH602	**3**	8

T.Y.B. Sc. - BIOCHEMISTRY
3 - UNITS INTERDISCIPLINARY SUBJECT
SEMESTER V

NAME OF THE COURSE	BIO-ORGANIC AND BIOPHYSICAL CHEMISTRY - I	
CLASS	T.Y.B. Sc.	
COURSE CODE	SBSBCH501	
NUMBER OF CREDITS	2.5	
NUMBER OF LECTURES PER WEEK	4	
TOTAL NUMBER OF LECTURES PER SEMESTER	60	
EVALUATION METHOD	INTERNAL ASSESSMENT	SEMESTER END EXAMINATION
TOTAL MARKS	25	75
PASSING MARKS	10	30

Course Objectives (CO):

CO1	This paper is focused to acquaint the learner with the chemistry and reactions of important biomolecules which constitute life i.e. carbohydrates, amino acids, proteins, nucleic acid and enzymes.
CO2	The learner should also comprehend the principle, working and applications of analytical techniques that serve as important tools in separation and in deciphering the structure and function of biomolecules.
CO3	This paper will acquaint the student to concepts of pH, acids- bases and the important phenomenon of radioactivity and its significance in biochemistry.

Course Learning Outcomes (CLO):

At the end of the course the learner should

CLO1	Be familiar with the chemistry of biomolecules and should be able to appreciate and correlate how structure determines the function of these biomolecules.
CLO2	Be well versed with properties of acids, bases and buffers and should be able to solve numerical problems based on the concept of pH and buffers.
CLO3	Have learnt the applications of radioactivity and radioisotopes in biology.

Unit No.	Topic
1	**Amino acids and Proteins (15 lectures)**
1.1	**Amino acids**
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.
1.2	**Proteins**
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
2	**Enzymes and Nucleic acids (15 lectures)**
2.1	**Enzymes**
2.1.1	Basic concepts- enzyme, apoenzyme, holoenzyme, prosthetic group, active site, enzyme specificity, turnover number, specific activity, Katal, IU, coenzyme, cofactor, allosteric enzymes. Isozymes
2.1.2	IUB/EC Classification (up to one digit)
2.1.3	Factors affecting enzyme reaction – pH, temperature, substrate concentration, enzyme concentration, product concentration, inhibitors, activators
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
2.1.6	Enzymes of clinical significance – ALT, AST, ALP, LDH, amylase, lipase
2.2	**Nucleic acids**
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 types in pro and eukaryotes) rRNA, t-RNA (Clover – leaf model), m-RNA 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, A, B, Z forms of DNA

2.2.4	Physical properties of DNA - Ionization, Viscosity, Buoyant density, UV absorption and Hypochromism, Hyperchromism, Denaturation of DNA, Tm.
3	**Carbohydrates (15 lectures)**
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 framework. (With structures of NAG & NAMA)
3.5	Extracellular matrix proteoglycan - Hyaluronate, Chondroitin sulphate and Heparin (function and structure).
4	**Ionic Equilibria and Acids, Bases, Buffers & Radioactivity (15 lectures)**
4.1	**Ionic Equilibria and Acids, Bases, Buffers:**
4.1.1	Importance of water as solvent: Kw Concept of acids, bases: pH, pK
4.1.2	Concept of buffer and buffering capacity, Derivation of Hendersen – Hasselbalch equation
4.1.3	Amino acids as buffers: Titration and ionization of Gly, Lys and Asp and relation between IEpH, pHm 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	pH meter, glass electrode.
4.1.6	Numerical problems based on above concepts.
4.2	**Radioactivity**
4.2.1	Definition – Radioactivity, types of emissions, decay constant, half-life period, applications of radioisotopes in biological studies: – Metabolic pathway (glycolysis, TCA, Urea) w.r.t ^{14}C,^{15}N, Molecular biology studies w.r.t ^{32}P, Clinical studies (w.r.t.^{131}I in hypo/hyperthyroidism detection)
4.2.2	Radioisotopes in distribution studies and therapeutics

References

- Biochemistry by Lehninger, Albert L.; Kalyani Publishers.
- Principles of Biochemistry by Lehninger, Albert L., Nelson David and Cox, Michael M.; CBS Publishers.
- Biochemistry by Voet, Donald and Voet, Judith G.; John Wiley & Sons.
- Biochemistry by Zubay, Geoffrey L.; Wm. C. Brown Publishers
- Biochemistry by Stryer, Lubert; W.H. Freeman Publishers.
- Principles of Biochemistry by White, Abraham; Handler, Philip and Smith, Emil L.; Mc Graw and Hill Publishers.
- Harpers illustrated biochemistry by Murray, Robert K. *et al*.; Mc Graw Hill.
- A Biologists Guide to Principles And Techniques In Practical Biochemistry by William, B.L. and Wilson, K; Universities press Publishers.
- Principles And Techniques Of Practical Biochemistry by Wilson, Keith and Walker, John ; Cambridge University Press Publishers
- Tools of Biochemistry by Cooper, Terence G.; Wiley & Sons Publishers.
- Outlines of Biochemistry by Conn, E.E. and Stumpf, P.K.; Wiley publications.
- Introduction To Practical Biochemistry by Plummer, David T.; Tata Mc. Graw and Hill Publishers.
- Modern Experimental Biochemistry by Boyer, Rodney F.
- Introductory Practical Biochemistry by Sawhney, S.K. and Singh, Randhir; Narosa Publishing House.
- Biochemical Calculation by Segel, Irwin H.; John Wiley & Sons Publishers.

SEMESTER V

NAME OF THE COURSE	METABOLISM, NUTRITION AND ADVANCED BIOCHEMICAL CONCEPTS - I	
CLASS	T.Y.B. Sc.	
COURSE CODE	SBSBCH502	
NUMBER OF CREDITS	2.5	
NUMBER OF LECTURES PER WEEK	4	
TOTAL NUMBER OF LECTURES PER SEMESTER	60	
EVALUATION METHOD	INTERNAL ASSESSMENT	SEMESTER END EXAMINATION
TOTAL MARKS	25	75
PASSING MARKS	10	30

Course Objectives (CO):

CO1	The objective of this paper is to familiarize the learner with the concepts of nutrition.
CO2	This paper also aims to acquaint the learner with the life processes like digestion and absorption of biomolecules like carbohydrates and proteins and the reactions/pathways involved in their oxidation and biosynthesis.
CO3	The learners will also be exposed to an introduction to the branch dealing with the protective mechanisms/defense processes, immunology; branch dealing with the blue print of our cells and perpetuation of life, genetics; and application based industrial biotechnology.
CO4	As statistics is an indispensable tool for a biochemist, the paper aims to lay a foundation for learning statistics during higher studies.

Course Learning Outcomes (CLO):

At the end of the course the learner should be able to:

CLO1	Familiarize with the important components of food and learn the techniques and tools employed for nutritional assessment.
CLO2	Understand basic concepts related to metabolism, be familiar with the various metabolic pathways and should be able to appreciate the importance of enzymes and coenzymes in pathophysiology of diseases.
CLO3	Be acquainted with basics of immunology and application based industrial Biochemistry
CLO4	Appreciate the experiments carried out by various scientists to prove DNA as the genetic material and understand the mechanisms of DNA

	replication, transcription and translation in prokaryotes.
CLO5	Perform statistical analysis of experimental results.

Syllabus

Topic No.	**Topic**
1	**Nutrition and Biostatistics (15 Lectures)**
1.1	Nutrition
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
1.2	Biostatistics
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.
2	**Carbohydrate metabolism (15 Lectures)**
2.1	Digestion and absorption of carbohydrates
2.2	An introduction to carbohydrate metabolism: Glycolysis - Cellular location, sequence of reactions, labeling of C-atoms and energetics of glycolysis (aerobic and anaerobic) Krebs cycle: Cellular location, sequence of reactions, and energetics
2.3	Other pathways of glucose metabolism
2.3.1	HMP Shunt (Synthesis of pentose phosphates)-Cellular location, sequence of reactions, oxidative and non-oxidative phases of pathway and multifunctional nature.
2.3.2	Glycogenesis and glycogenolysis
2.3.3	Gluconeogenesis
2.3.4	Glyoxylate pathway.
2.4	Anaplerotic reactions –Pyruvate carboxylase, PEP carboxykinase, Malic enzyme, role of Kreb's cycle in anabolism
3	**Amino acids and Protein Metabolism and Immunology (15 Lectures)**
3.1	Amino acids and Protein Metabolism

3.1.1	Digestion and absorption of proteins
3.1.2	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.
3.1.3	Formation and transport of ammonia and ammonia toxicity Urea Cycle - Cellular location, sequence of reactions, labeling of N-atom
3.2	Immunology
3.2.1	Immunity, types of immunity, An introduction to antigen, hapten and antibody.
3.2.2	Cells and organs of immune system.
3.2.3	Immunoglobulin's basic structure, classes and sub-classes-their structure and functions.
3.2.4	Antigen– antibody reactions - Precipitation, agglutination.
4	**Genetics and Industrial Biotechnology (15 Lectures)**
4.1	Genetics
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.
4.2	Industrial Biotechnology
4.2.1	Concept of fermentation, general process overview, steps involved in setting up an industrial fermentation process basic component of a typical fermenter, fermentation process for alcohol / wine/beer production.
4.2.2	An introduction to Plant tissue culture - definition of totipotency, callus regeneration, protoplast fusion and techniques and application of plant tissue culture in brief.

References

- Biochemistry by Lehninger, Albert L.; Kalyani Publishers.
- Principles of Biochemistry by Lehninger, Albert L., Nelson David and Cox, Michael M.; CBS Publishers.
- Biochemistry by Voet, Donald and Voet, Judith G.; John Wiley & sons Publishers.
- Introduction to practical biochemistry by Plummer, David T.; Tata Mc. Graw and Hill Publishers.
- Introductory practical biochemistry by Sawhney, S.K. and Singh,

Randhir; Narosa Publishing House.
- Biochemical calculation by Segel, Irwin H.; John Wiley & Sons Publishers.
- Text book of Medical physiology by Guyton, Arthur C. and Hall, John E.; Harcourt Brace & Company Asia Pvt Ltd.
- Human Biochemistry by Orten, J.M. and Neuhaus, O.W.; Mosby Publishers.
- Human nutrition and dietetics by Davidson, S. *et al.*; Churchill Livingstone Publishers.
- Nutrition and dietetics by Joshi, Shubhangini A.; Tata Mc Graw and Hill Publishers.
- Nutrition Science by Srilakshmi, B.; New Age International Publishers.
- Genes VIII by Lewin, Benjamin; Pearson Prentice and Hall Publishers.
- Genetics by Russell, Peter J.; Benjamin Cummings Publishers.
- Immunology by Kuby, Janis; W.H. Freeman Publishers.
- Immunology by Kuby, Janis; W.H. Freeman Publishers.
- Immunology by Roitt, Ivan M. *et al*.; Mosby Publishers.
- Fundamentals of biotechnology by Patel, A. H.
- Industrial microbiology by Casida, L.E.; New Age International Publishers.
- Methods of biostatistics for medical students and research workers by Mahajan, B.K.; Jaypee brothers Publishers.

PRACTICAL based on SBSBCH501 & SBSBCH502
SBSBCHP05

SEMESTER V

NAME OF THE COURSE	BIOCHEMISTRY PRACTICAL - I	
CLASS	T.Y.B. Sc.	
COURSE CODE	SBSBCHP5	
NUMBER OF CREDITS	3	
NUMBER OF HOURS PER WEEK	8	
TOTAL NUMBER OF HOURS PER SEMESTER	120	
EVALUATION METHOD	JOURNAL & VIVA	SEMESTER END EXAMINATION
TOTAL MARKS	20	80
PASSING MARKS	-	40

Sr No.	Experiments
I	**Isolation:**
	1. Casein from milk 2. Starch from potato.
	Colorimetric estimations:
	1. Proteins by Biuret method 2. RNA by Orcinol method 3. Glucose by Folin –Wu method/ by GOD- POD method
III	**Volumetric estimations:**
	1. Lactose by Cole's method 2. Vitamin C by iodimetric method 3. Glucose by Benedict's method
IV	**Qualitative Analysis:**
	1. Carbohydrates - Glucose, Fructose, Maltose, Lactose, Sucrose, Starch, Dextrin. 2. Proteins - Albumin, Casein, Gelatin, Peptone.
V	**Demonstration Experiment**
	(To be entered in the Journal but not to be asked in the Semester end Practical Examination) 1. TLC of oils and plant pigments 2. Preparation of buffers and use of pH meter

ASSESSMENT DETAILS:

Internal Assessment (25 marks)

Part 1: There shall be 3 questions.

2. All questions shall be compulsory with internal choice within the questions

Questions	Sub-questions	Maximum marks
Q1	Objective type questions	5/10
Q2	Answer in one/two sentences	5
Q3	Derivation/Problem solving	5/10
Total marks		25

Part 2: Attendance **–05 marks**

Semester End Examination –External Assessment (75 marks)

- The duration of the paper will be 2.5 hours.
- There shall be four compulsory questions
- Q1-Q3 questions shall be of 20 marks on each unit and fourth question will be of 15 marks based on Unit I, II and Unit III.
- Q-4 : There shall be 6 sub-questions each one is of 5 marks and attempt any 3.

Practical Assessment (for papers with practicals)

- The duration of the practical exam will be:
  One day of 2 sessions of 3½ hours each.
  Morning session: 09.00 am to 12.30 pm. Afternoon session: 01.00 pm to 04.30 pm.
- The students are allowed to write the paper if the attendance for practicals is more than 75%
- To appear in the practical exam, students must bring a properly certified journal.

Semester VI

NAME OF THE COURSE	BIO-ORGANIC AND BIOPHYSICAL CHEMISTRY - II	
CLASS	T.Y.B. Sc.	
COURSE CODE	SBSBCH601	
NUMBER OF CREDITS	2.5	
NUMBER OF LECTURES PER WEEK	4	
TOTAL NUMBER OF LECTURES PER SEMESTER	60	
EVALUATION METHOD	INTERNAL ASSESSMENT	SEMESTER END EXAMINATION
TOTAL MARKS	25	75
PASSING MARKS	10	30

Course Objectives (CO):

CO1	This paper aims that the learner learns the types, chemistry and reactions of lipids.
CO2	• The learner should be familiarized with various separation and analytical techniques used to study the biomolecules i.e. the principle and biochemical applications of i.e. Chromatography, Spectrophotometry, Centrifugation and Electrophoresis.

Course Learning Outcomes (CLO):

At the end of the course the learner should

CLO1	Be well versed with the classes of lipids, their structure and biochemical functions.
CLO2	Have learnt the principle, working and applications of various analytical techniques.
CLO3	Be able to appreciate the contribution of these techniques (chromatography, colorimeter/spectrophotometer, centrifuges and electrophoresis) as tools in understanding the structure and function of biomolecules.

Syllabus

Unit No.	**Topic**
1	**Lipids (15 Lectures)**
1.1	Definition and Bloor's Classification of lipids.
1.2	Fatty acids & Tri acyl glycerols: 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.
2	**Chromatography (15 Lectures)**
2.1	**Chromatography:** Principle, instrumentation 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
3	**Electrophoresis(15 Lectures)**
3.1	Principles of electrophoresis, Factors affecting the rate of migration of sample in electric field
3.2	Moving boundary and Zone electrophoresis; Components of electrophoresis unit/apparatus
3.3	Support media - paper, cellulose acetate, agar, agarose and polyacrylamide
3.4	Technique of electrophoresis with staining/visualization method • agarose electrophoresis for separation of DNA • Native PAGE for separation of proteins • SDS PAGE for molecular weight determination; • Discontinuous electrophoresis Other applications of electrophoresis: blotting techniques- Southern, Northern, and Western.
3.5	Isoelectric focusing of proteins
4	**Centrifugation and Spectrophotometry (15 Lectures)**
4.1	Centrifugation
4.1.1	Basic concept and principle 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
4.2	Spectrophotometry
4.2.1	Principle and concept of lambda max, derivation and limitations of Beer-Lambert Law, molar extinction coefficient and its significance
4.2.2	Construction and working of simple colorimeter (single beam) and a UV/Vis spectrophotometer (double beam)
4.2.3	Application of Beer Lambert Law & Numerical problems based on above concepts.

References

- Biochemistry by Lehninger, Albert L.; Kalyani Publishers.
- Principles of Biochemistry by Lehninger, Albert L., Nelson David and Cox, Michael M.; CBS Publishers.
- Biochemistry by Voet, Donald and Voet, Judith G.; John Wiley & sons Publishers.
- Biochemistry by Zubay, Geoffrey L.; Wm. C. Brown Publishers
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- Outlines of Biochemistry by Conn, E.E. and Stumpf, P.K.; Wiley publications.
- Introduction to practical biochemistry by Plummer, David T.; Tata Mc. Graw and Hill Publishers.
- Modern experimental biochemistry by Boyer, Rodney F.
- Introductory practical biochemistry by Sawhney, S.K. and Singh, Randhir; Narosa Publishing House.
- Biochemical calculation by Segel, Irwin H.; John Wiley & Sons Publishers.

Semester VI

NAME OF THE COURSE	METABOLISM, NUTRITION AND ADVANCED BIOCHEMICAL CONCEPTS - II	
CLASS	T.Y.B. Sc.	
COURSE CODE	SBSBCH602	
NUMBER OF CREDITS	2.5	
NUMBER OF LECTURES PER WEEK	4	
TOTAL NUMBER OF LECTURES PER SEMESTER	60	
EVALUATION METHOD	INTERNAL ASSESSMENT	SEMESTER END EXAMINATION
TOTAL MARKS	25	75
PASSING MARKS	10	30

Course Objectives (CO):

CO1	This paper aims to acquaint the learner with the life processes like digestion and absorption of lipids and the reactions/pathways involved in their oxidation and biosynthesis.
CO2	This paper also aims to acquaint the learner with oxidative phosphorylation, photophosphorylation and fixation of carbon dioxide.
CO3	The learner will also be introduced to application based Recombinant DNA Technology.
CO4	The last unit of this paper introduces "Bioinformatics" and lays the foundation to comprehend Bioinformatics during higher studies.

Course Learning Outcomes (CLO):

At the end of the course the learner should

CLO1	Be familiar with the metabolic pathways of lipids and should be able to appreciate the importance of enzymes and coenzymes in pathophysiology of diseases.
CLO2	Be able to appreciate conversion of food energy and light energy to chemical energy though electron carriers and appreciate the correlation between energy molecules, reducing equivalents and pathways.
CLO3	Be acquainted with the various hormones and their clinical significance.
CLO4	Be familiar with the molecular biology of gene cloning, understand the basic tools & techniques and its applications for benefit of the society.
CLO5	Be able to understand basics of bioinformatics.

Unit No.	Topic
1	**Lipid Metabolism**
1.1	Digestion and absorption of lipids
1.2	Lipid Metabolism: Catabolism - Knoop's experiment, Beta – Oxidation of even –Carbon saturated fatty acids and its energetics from C4 to C20
1.3	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.
2	**Bioenergetics and Photosynthesis**
2.1	Bioenergetics
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_oF_1 ATPase), Chemiosmotic hypothesis, Proton motive force.
2.2	Photosynthesis
2.2.1	**Photosynthesis:** Light and Dark reactions, Z-scheme and electron carriers, photophosphorylation (linear and cyclic), Calvin cycle (schematic representation only)
3	**Endocrinology**
3.1	Hormone, hormone receptor, Classification of hormones on the basis of chemistry; Hierarchical organization ; 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 and other related disorders – Diabetes mellitus, Diabetes insipidus, Hypothyroidism (Cretinism & myxedema), Hyperthyroidism (Goiter – Simple & Toxic).
4	**Recombinant DNA technology and Bioinformatics**
4.1	Recombinant DNA technology
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), techniques used (colony hybridization, blotting techniques) and applications of recombinant DNA technology in medicine (Insulin) and agriculture (Bt cotton).
4.2	An introduction to Bioinformatics
4.2.1	History of Bioinformatics and concept of genomics and proteomics
4.2.2	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.
4.2.4	Micro-array analysis-concept and applications.
4.2.5	Applications of Bioinformatics in – Sequence analysis, Molecular modeling and drug designing, Phylogeny/evolution, Ecology & population studies, Medical informatics and agriculture.

References

- Outlines of Biochemistry by Conn, E.E. and Stumpf, P.K.; Wiley publications.
- Introduction to practical biochemistry by Plummer, David T.; Tata Mc. Graw and Hill Publishers.
- Modern experimental biochemistry by Boyer, Rodney F.
- Introductory practical biochemistry by Sawhney, S.K. and Singh, Randhir; Narosa Publishing House.
- Biochemical calculation by Segel, Irwin H.; John Wiley & Sons Publishers.
- Text book of Medical physiology by Guyton, Arthur C. and Hall, John E.; Harcourt Brace & Company Asia Pvt Ltd.
- Human biochemistry by Orten, J.M. and Neuhaus, O.W.; Mosby Publishers.
- Genes VIII by Lewin, Benjamin; Pearson Prentice and Hall Publishers.
- Genetics by Russell, Peter J.; Benjamin Cummings Publishers.
- Fundamentals of biotechnology by Patel, A. H.
- Industrial microbiology by Casida, L.E.; New Age International Publishers.
- Methods of biostatistics for medical students and research workers by Mahajan, B.K.; Jaypee brothers Publishers.
- Bioinformatics- Concepts, Skill and applications by Rastogi, S.C.; Mendiratta, Namita and Rastogi, Parag; C.B.S. Publishers & Distributors

PRACTICALS based on SBSBCHP601 & SBSBCHP602
SBSBCHP06

NAME OF THE COURSE	BIOCHEMISTRY PRACTICAL - II	
CLASS	T.Y.B. Sc.	
COURSE CODE	SBSBCHP6	
NUMBER OF CREDITS	3	
NUMBER OF HOURS PER WEEK	8	
TOTAL NUMBER OF HOURS PER SEMESTER	120	
EVALUATION METHOD	JOURNAL & VIVA	SEMESTER END EXAMINATION
TOTAL MARKS	20	80
PASSING MARKS	-	40

1	**Chromatographic techniques:**
	Separation by Circular Paper Chromatography of: 1. Amino acids 2. Sugars
2	**Enzymes:**
	1. AMYLASE: • Activity of beta amylase • Km of amylase 2. UREASE: • Activity of urease • Km of urease
3	**Minerals Estimation:**
	1. Calcium by EDTA method 2. Magnesium by Titan Yellow method 3. Iron by Wong's method 4. Phosphorus by Fiske-Subbarow method
4	**Viva- Voce:**
	Based on fundamental concepts covered in practical.
5	**Journal:**
	Duly signed by the Teacher in charge and certified by the Head of the department.
6	**Demonstration Experiments:**

	(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

Educational Tour/Industrial Visit

It is COMPULSORY that TYBSc students of Biochemistry MUST go for an 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 firsthand knowledge of current trends in research and the exposure to the working of industry, academia and research centres.

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

Student 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 Semester VI as a part of USBCHP602 and shall carry 10 (TEN) marks separately in P 602.

Note: The syllabus has been adopted from the Mumbai University syllabus

ASSESSMENT DETAILS:

Internal Assessment (25 marks)

Part 1: There shall be 3 questions.

2. All questions shall be compulsory with internal choice within the questions

Questions	Sub-questions	Maximum marks
Q1	Objective type questions	5/10
Q2	Answer in one/two sentences	5
Q3	Derivation/Problem solving	5/10
Total marks		25

Part 2: Attendance **–05 marks**

Semester End Examination –External Assessment (75 marks)

- The duration of the paper will be 2.5 hours.
- There shall be four compulsory questions
- Q1-Q3 questions shall be of 20 marks on each unit and fourth question will be of 15 marks based on Unit I, II and Unit III.
- Q-4 : There shall be 6 sub-questions each one is of 5 marks and attempt any 3.

Practical Assessment (for papers with practicals)

- The duration of the practical exam will be:
  One day of 2 sessions of 3½ hours each.
  Morning session: 09.00 am to 12.30 pm. Afternoon session: 01.00 pm to 04.30 pm.
- The students are allowed to write the paper if the attendance for practicals is more than 75%
- To appear in the practical exam, students must bring a properly certified journal.