

CIRCULAR :-

A reference is invited to the Ordinances, Regulations and syllabi relating to the Bachelor of Science (B.Sc.) degree course vide this office Circular No. UG/266 of 2007 dated 11th June, 2007 and the Principals of the affiliated colleges in Science are hereby informed that the recommendation made by the Board of Studies in Biochemistry at its meeting held on 14th February, 2008 has been accepted by the Academic Council at its meeting held on 15th April, 2008 vide item No.4.3 and that, in accordance therewith, the syllabus in the subject of Biochemistry at the T.Y.B.Sc. (3 Units Interdisciplinary subject) (Theory and Practicals) is modified as per Appendix and that the same has been brought into force with effect from the academic year 2008-2009.

MUMBAI-400 032
16th June, 2008


for REGISTRAR

To,

The Principals of the affiliated colleges in Science.

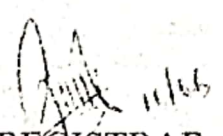
AC/4.3/15.04.2008

No.UG/ 249-A of 2008,

16th June, 2008.

Copy forwarded with compliments for information to :-

- 1) The Dean, Faculty of Science.
- 2) The Chairperson, Board of Studies in Biochemistry
- 3) The Controller of Examinations
- 4) The Co-Ordinator, University Computerization Center.


for REGISTRAR

Copy to :-

The Director, Board of College and University Development, , the Deputy Registrar (Eligibility and Migration Section), the Director of Students Welfare, the Executive Secretary to the Vice-Chancellor, the Personal Assistant to the Pro-Vice-Chancellor, the Registrar and the Assistant Registrar, Administrative sub-center, Ratnagiri for information .

The Controller of Examinations (10 copies), the Finance and Accounts officer (2 copies), Record Section (5 copies), Publications Section (5 copies), the Deputy Registrar, Enrollment, Eligibility and Migration Section (3 copies), the Deputy Registrar, Statistical, Affiliation Section (2 copies), the Director, Institute of Distance Education, (10 copies) the Director University Computer Center (IDE Building), Vidyanagari, (2 copies) the Deputy Registrar (Special Cell), the Deputy Registrar, (PRO). The Assistant Registrar, Academic Authorities Unit (2 copies) and the Assistant Registrar, Executive Authorities Unit (2 copies). They are requested to treat this as

350 copies

418
15/4/08

Enclosure to Item No.
Appendix

UNIVERSITY OF MUMBAI



Modified Syllabus in the Subject
of Biochemistry
(3 Units-Interdisciplinary Subject)
at the
T.Y.B.Sc. Examination

(With effect from the academic year 2008-2009)

T.Y.B.Sc. – BIOCHEMISTRY
3 – UNITS INTERDISCIPLINARY SUBJECT

PAPER - 1 : BIO-ORGANIC AND BIOPHYSICAL CHEMISTRY
(MARKS 100)

Unit No.	Topic No.	Contents	NOL
I	1.0	Amino acids, Proteins, Enzymes and Nucleic acids :-	25
	1.11	Classification of amino acids based on the polarity of R-groups(structure of 20 amino acids)	
	1.12	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).	
	1.13	Proteins.: ASBC-APS Classification on the basis of shape and function. Formation and characteristic of peptide bond.	
	1.14	Primary structure, Secondary structure-alpha helix and beta sheet. Tertiary structure - myoglobin, Quaternary structure - hemoglobin.	
	1.15	Forces stabilizing protein structure	
	1.16	Protein denaturation	
	1.21	Enzymes : Definition - Enzyme, Apoenzyme, Holoenzyme, Prosthetic group, active site, enzyme specificity, Turnover number, Specific activity, Katal, IU, Coenzyme, Cofactor, Allosteric enzymes. (Only definition)	
	1.22	IUB/EC Classification (up to one digit)	
	1.23	Factors affecting enzyme reaction - substrate, pH and temperature.	
	1.24	Enzyme kinetics-Derivation of Michaelis-Menten	

		equation and Lineweaver-Burk plot for monosubstrate reaction and numerical problems based on them.	
	1.25	Enzyme inhibition - Reversible and Irreversible - Competitive and Non-competitive	
	1.31	Nucleic acids: Structure of purine and pyrimidine bases, ribose, deoxyribose, nucleosides and nucleotides. cAMP and formation of polynucleotide strand with its shorthand representation.	
	1.32	RNAs- (various type in pro and eu-karyotes) rRNA, t-RNA (Clover -leaf model), m-RNA (general account) and action of alkali on RNA	
	1.33	DNA-X-ray diffraction pattern (Physical evidence), Chargaff's rules (Chemical evidence), Watson -Crick model of DNA and its characteristic features.	
	1.34	Physical properties of DNA - Ionisation, Viscosity, Buoyant density, UV absorption and Hypochromism, Hyperchromism, Denaturation of DNA, T_m .	
II	2.0	Carbohydrates and Lipids :-	25
	2.11	Carbohydrates : 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)	
	2.12	Dissaccharides - Occurrence and structure of maltose, lactose, sucrose	
	2.13	Polysaccharides- Classification based on function (storage & structural) , composition (homo & hetero) giving examples. Storage polysaccharides (Starch and Glycogen), action	

		of amylase on starch.	
	2.14	Structural polysaccharides - Cellulose, Chitin and Peptidoglycan frame work. (With structures of NAG & NAMA)	
	2.15	Extracellular matrix proteoglycan - Hyaluronic acid, Chondroitin sulphate and Heparin (function and structure).	
	2.21	Lipids : Definition and Bloor's Classification of lipids.	
	2.22	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), Omega3, Omega6 and Omega9 fatty acids. Triacylglycerol - Simple and mixed	
	2.23	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.	
	2.24	Compound lipids – Structure and function of Glycerophospholipids (Cephalin, Lecithin and Phosphatidyl inositol), Phosphosphingolipids (ceramide, Sphingomyelin), Glycolipids or Cerebroside (Galactose and Glucocerebroside).	
	2.25	Steroids and Lipoproteins Steroids - Cholesterol structure and biochemical significance Lipoproteins –Types (Chylomicron, VLDL, LDL, HDL) and biochemical significance - Schematic depiction of interrelationship.	
III	3.0	Acids, Bases, Buffers and Ionic Equilibria, Radioactivity, Chromatography :-	25
	3.11	Acids, Bases, Buffers and Ionic Equilibria : Definition - pH, pK, K_w , Isoelectric pH, buffer, buffering capacity	

	3.12	Derivation of Hendersen –Hasselbalch equation, ionic product of water and relation between Isoelectric pH, pK_{a1} and pK_{a2} (for neutral amino acid).	
	3.13	Titration and ionization of Gly, Lys and Asp and relation between IEpH, pHm and pK_a values of these amino acids, Sorensen's reaction and formal titration of amino acids (Ala).	
	3.14	Physiological Buffers (Hb – Carbonate buffer, phosphate buffer and protein buffer).	
	3.15	Numerical problems based on above concepts.	
	3.16	pHmeter, glass electrode.	
	3.21	Radioactivity	
		Definition – Radioactivity, radioisotope with 2 examples ($^{14}C, ^{15}N$) , decay constant, Half-life period, Applications of radioisotopes in biological studies (w.r.t $^{14}C, ^{15}N$) – Metabolic pathway (glycolysis, TCA, Urea), Molecular biology studies (w.r.t ^{32}P , Clinical studies (^{131}I in hypo/hyperthyroidism detection)	
	3.31	Chromatography : Principle, requirements and working of-Partition chromatography (Paper), Adsorption chromatography (TLC and Column), Ion exchange chromatography (Column) and Gel filtration.	
	3.32	Introduction to GLC, HPLC and Affinity chromatography -Principles only	
	3.33	Applications of partition, adsorption, ion exchange and gel filtration chromatography techniques	
	3.34	Numerical problems based on above concepts	
IV	4.0	Electrophoresis, Centrifugation, Spectroscopic Techniques :-	25
	4.11	Electrophoresis : Principles of electrophoresis, Factors affecting the rate of migration of sample in electric field	
	4.12	Supporting media - paper, cellulose acetate, agar, agarose and polyacrylamide.	

4.13	Discontinuous electrophoresis – Native, PAGE.
4.14	Application of electrophoresis - Separation of proteins and nucleic acids.(one staining method each).Molecular weight determination using PAGE.
4.15	Isoelectric focusing
4.21	Centrifugation : Definition of RCF and RPM, derivation of equation relating RCF and RPM, Nomogram
4.22	Types of centrifuges - Clinical, High Speed, Ultra – preparative and Analytical
4.23	Components and working of - Analytical Ultracentrifuge – (with diagram).
4.24	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.
4.25	Use of Analytical Ultracentrifugation in the determination of molecular weights (sedimentation velocity method), conformational studies and purity of a sample.
4.26	Numerical problems based on above concepts
4.31	Spectroscopy : Definition , derivation and limitations of Beer-Lambert Law. Concepts of Lambda max, Definition and determination of molar extinction coefficient.
4.32	Construction and working of simple colorimeter (single beam) and a spectrophotometer.
4.33	Application of Beer Lambert Law in estimation Of proteins (Biuret method), Sugars (DNSA method).
4.34	Numerical problems based on above concepts

**PAPER II : METABOLISM, NUTRITION AND ADVANCED
BIOCHEMICAL CONCEPTS
(MARKS 100)**

Topic No.	Contents	NOL
1.0	Carbohydrate metabolism (Animals and Plants), Bioenergetics :-	25
1.11	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.	
1.12	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.	
1.13	Anaplerotic reactions – Definition, Role of Pyruvate carboxylase, PEP carboxykinase, Malic enzyme.	
1.21	Plants : Photosynthesis - Light and Dark reactions, Z-scheme and electron carriers, photophosphorylation (linear and cyclic), Calvin cycle (schematic representation only)	
1.31	Bioenergetics : 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.	
1.32	Definition of Oxidative Phosphorylation, Structure of ATPase (F_0F_1 ATPase), Chemiosmotic hypothesis, Proton motive force.	
2.0	Lipid Metabolism, Amino acid and Protein Metabolism, Endocrinology -	25
2.11	Lipid Metabolism : Catabolism - Knoop's experiment, Beta – Oxidation of even –Carbon saturated fatty acids and its energetics from C4 to C20	

2.12	Anabolism - Fatty acid biosynthesis (only Plamitic acid) and role of fatty acyl synthetase complex. Ketone bodies formation, utilization, and physiological significance in Diabetes mellitus, starvation, alcoholism and pregnancy.	
2.21	Amino acids and Protein Metabolism : Catabolism - reactions of amino acids –Tranamination (GOT/GPT and mechanism of transamination), Decarboxylation (His, Trp, Glu and mechanism of decarboxylation). Deamination (Oxidative – Glu, Tyr & Nonoxidative – Asp, Cys, Ser).	
2.22	Urea Cycle - Cellular location, sequence of reactions, labeling of N-atom, formation and transport of ammonia.	
2.31	Endocrinology : Definition of Hormone, hormone receptor, classification of hormone on the basis of chemistry, Hierarchial organisation. Chemistry, synthesis, secrtion and metabolic effects of throxine, 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).	
3.0	Nutrition, Immunology, Biostatistics :-	25
3.11	Nutrition : Definition-Calorie and Joule	
3.12	Food calorimetry-Calorific Value by Bomb calorimeter, calorific values of proximate principles, concept of BMI, BV and PER.	
3.13	BMR- definition, factors affecting BMR, significance of BMR in clinical diagnosis.	
3.14	SDA - General concept and significance, energy requirement of individuals for various activities-sedentary, moderate and heavy.	
3.15	Nutritional significance of carbohydrates, protein, lipids, vitamins, minerals and water.	
3.16	Numerical problems based on above concepts	
3.2	Immunology :-	
3.21	Definition of immunity, types of immunity, definition of antigen,	

		hapten and antibody.	
	3.22	Cells and organs of immune system.	
	3.23	Immunoglobulins basic structure, Classes and sub-classes-their structure and functions..	
		Antigen- antibody reactions - Precipitation, agglutination.	
	3.3	Biostatistics	
	3.31	Data-collection and presentation.	
	3.32	Frequency distribution, normal distribution	
	3.33	Measures of central tendency - Mean (Arithmetic), Median and Mode.	
	3.34	Measures of variation - Range, Variance and Standard deviation	
	3.35	Numerical problems based on above concepts to the biological data.	
IV	4.0	Genetics, Biotechnology and Bioinformatics :-	25
	4.11	Genetics : Replication of DNA - mechanism of replication, modes of DNA replication, semi-conservative replication, discontinuous DNA synthesis, termination of replication.	
	4.12	Transcription of DNA - in prokaryotes, prokaryotic RNA polymerases, synthesis of RNA species and their processing, concept of split genes, Reverse transcription.	
	4.13	Translation (protein biosynthesis) in prokaryotes - activation of amino acids, chain initiation, chain elongation, chain termination, post translational modifications of proteins.	
	4.2	Biotechnology	
	4.21	Fermentation processes - Basic components of a typical fermenter, fermentation process for alcohol production.	
	4.22	Plant tissue culture - definition of totipotency, callus regeneration, protoplast fusion and application of plant tissue culture in brief.	
	4.23	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).	
	4.3	Bioinformatics	
	4.31	Definition, Aims and History of Bioinformatics	

4.32	Applications of Bioinformatics in – Sequence analysis, Molecular modeling and drug designing, Phylogeny/evolution, Ecology & population studies, Medical informatics and agriculture.	
4.33	Genomics and Proteomics – Explanation in brief.	
4.34	Databases- Definition & types – Public domain database, Sequence database, Structural database, Motif database, Genome database, Proteom database, Annotated sequence database. Full form & function in brief of - GenBank, EMBL, PIR, SWISS PROT, PDB,GDB.	
4.35	Sequence analysis Tools - Explain the following terms in brief - RI,AST, FASTA, I,-ALIGN. CLUSTAL- X & W, RASMOL, Softwares for protein sequencing - PROPECT , AMMP, COPIA (Explanation of the terms in brief).	
4.36	Micro-array analysis-concept and applications.	

PRACTICALS
(MARKS 100)

Experiments	Marks
Chromatography techniques:-	10
Separation by Circular Paper Chromatography of: 1. Amino acids 2. Sugars	
Colorimetry:-	10
1. Proteins by Biuret method 2. Proteins by Folin-Lowry method 3. RNA by Orcinol method 4. Glucose by Folin -Wu method 5. Maltose by DNSA method	
Volumetry:-	10
1. Lactose by Cole's method 2. vitamin C by Iodometric method 3. Glucose by Benedict's method	
Qualitative Analysis:-	10
1. Carbohydrates - Glucose, Fructose, Maltose, Lactose, Sucrose, Starch, Dextrin. 2. Proteins - Albumin, Casein, Gelatin, Peptone.	
Preparation:-	10
1. casein from milk 2. Starch from potato.	
Enzymes:-	15
A) AMYLASE : 1. Preparation of amylase extract from sweet potato and qualitative test of action. 2. Optimum pH of amylase 3. Km of amylase B) UREASE : 1. Preparation of urease extract from jackbean meal and qualitative test of	

	action. 2. Optimum pH of Urease 3. Km of Urease	
	Minerals Estimation :-	10
	1. Calcium by EDTA method 2. Magnesium by Titan Yellow method 3. Iron by Wong method 4. Phosphorus by Fiske-Subbarow method	
II	Assignment / Project / Industrial Visit or Study tour :-	05
	T.Y.B.Sc. students of Biochemistry are required to do and submit either an assignment based on fundamental concepts / topics covered in theory and practicals or do a small research project or may be taken for a visit to a research laboratory or an industry - preferably be manufacturing units of pharmaceuticals, bulk chemicals, biochemicals, food and food processing, beverages, oils etc. The detailed summary of the visit can be entered in the journal.	
X	Viva- Voce :-	10
	Based on fundamental concepts covered in practicals.	
X	Journal:-	10
	Duly signed by the Teacher –in –charge and certified by the - Head of the department.	
I	Demonstration Experiments:-	NIL
	(To be entered in the Journal but not to be asked in the university Practical Examination) 1. TLC of oils and plant pigments 2. Column chromatography - separation of chlorophylls 3. Agar/Agarose/PAGE gel electrophoresis of serum proteins 4. Preparation of buffers and use of pH meter	

SCHEME OF EXAMINATION

Biochemistry, as an interdisciplinary subject, consists of 03 (Three) Units of T.Y.B.Sc. carrying 300 marks as follows :

Paper	Title of Paper			Total Marks
I	Bio-organic and Biophysical Chemistry			100
II	Metabolism, Nutrition and Advance Biochemical concepts			100
-	Practicals	Practical I	Practical II	100
		50	50	
Total				300

THEORY :

There shall be two theory papers of 100 marks each. Each theory paper shall be of 03 (Three) hours duration.

Each theory paper shall be divided in 4 units.

Pattern of Theory Paper :

- ▶ All questions shall be compulsory with internal options provided.
- ▶ There shall be 5 (Five) questions of 20 marks each.
- ▶ Q.1 will be Objective type questions (ie subquestions of 2 marks each) and will be based on all the four units in that paper.
- ▶ However, Q.2, Q.3, Q.4, Q.5 will be based on Units I ,II,III, and IV respectively and will be descriptive type. However, the marks for a single undivided question shall not exceed 10.

PRACTICALS :

There shall be University Practical Examination of 100 marks to be conducted on two days

Each day of University Practical Examination shall consist of two sessions of 3 hours 30 minutes each.

Total time required to conduct University Practical Examination shall be 14 hours for each batch of candidates.

Distribution of experiments of Practical-I and Practical-II on days 1 and 2 respectively shall be as follows :

Day	Experiments	Marks
Practical-I on Day-1	a. Chromatography Technique	10
	b. Colorimetry	10
	c. Volumetry	10
	d. Qualitative Analysis	10
	e. Certified Journal*	10
Practical-II on Day-2	a. Preperation / Isolation	10
	b. Enzymes	15
	c. Minerals Estimation	10
	d. Assignment / Project / Industrial Visit or Study tour report	05
	e. Viva-Voce	10

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