AC 27/2/13
Item no. 4.48

UNIVERSITY OF MUMBAI

Syllabus for Sem V & VI
Program: B.Sc.
Course: Biochemistry (6 units)

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

T.Y.B.Sc. –BIOCHEMISTRY-(6 Units) Syllabus
Credit Based and Grading System
To be implemented from the Academic year 2013-2014

SEMESTER V
Theory

Course	UNIT	TOPICS	Credits	L / Week
USBCH501	**Metabolism & Analytical Techniques-I**		2.5	
	I	Carbohydrate Metabolism		1
	II	Bioenergetics & Oxidative Phosphorylation		1
	III	Chromatography		1
	IV	pH and Buffers & Vitamins		1
USBCH502	**Environmental Science**		2.5	
	I	Air		1
	II	Water & Water treatment		1
	III	Soil & Noise		1
	IV	Energy, Industrial Pollutants and Environmental Monitoring		1
USBCH503	**Advanced Genetics & RDT**		2.5	
	I	DNA Replication & Repair		1
	II	Transcription & Translation		1
	III	Recombinant DNA Technology (RDT)		1
	IV	RDT Recombinant DNA Technology (RDT) techniques		1
USBCH504	**Immunology and Pathophysiology- I**		2.5	
	I	Human immune system		1
	II	Antigen- Antibody interactions		1
	III	Metabolic disorders, Blood related diseases & Cardio Vascular System and related diseases		1
	IV	Cancer		1

Practicals

USBCHP05	Practicals of Course USBCH 501 + Course USBCH 502	3	8
USBCHP06	Practicals of Course USBCH 503 + Course USBCH 504	3	8

T.Y.B.Sc. –BIOCHEMISTRY-(6 Units) Syllabus
Credit Based and Grading System
To be implemented from the Academic year 2013-2014

SEMESTER VI
Theory

Course	UNIT	TOPICS	Credits	L / Week
USBCH601	**Metabolism & Analytical Techniques-II**		**2.5**	
	I	Lipid metabolism		**1**
	II	Amino acid and protein metabolism & Endocrinology		**1**
	III	Centrifugation and Spectroscopy		**1**
	IV	Electrophoresis		**1**
USBCH602	**Nutrition & Pharmacology**		**2.5**	
	I	Nutrition		**1**
	II	Diet Management		**1**
	III	Pharmacology		**1**
	IV	Mechanism of Drug Action and Therapeutic drugs		**1**
USBCH603	**Biostatistics &Bioinformatics**		**2.5**	
	I	Biostatistics and descriptive statistics		**1**
	II	Probability & bioinformatics		**1**
	III	Hypothesis testing		**1**
	IV	Hypothesis testing		**1**
USBCH604	**Immunology and Pathophysiology- II**		**2.5**	
	I	Antigen- Antibody interactions & Complement system		**1**
	II	Major histocompatibility complex &Transplant immunology		**1**
	III	Virology & AIDS		**1**
	IV	Endocrine Diseases & Ageing		**1**

Practicals

USBCHP07	Practicals of Course USBCH 601 + Course USBCH 602	**3**	**8**
USBCHP08	Practicals of Course USBCH 603 + Course USBCH 604	**3**	**8**

T.Y.B.Sc. – BIOCHEMISTRY USBCH501 METABOLISM & ANALYTICAL TECHNIQUES-I			
Unit No	**Topic No**	**Topics**	**NOS**
I	**1.0**	**Carbohydrate metabolism**	**15**
	1.1.	Catabolism – Cellular location, sequence of reactions, labelling of carbon atoms, and energetics of : Glycolysis (aerobic and anaerobic); Oxidation of pyruvate, Krebs cycle ; Glyoxylate pathway; Glycogenolysis – [schematic – no structures, but with enzymes and coenzymes]	
	1.2	Anabolism – HMP shunt (Cellular location, sequence of reactions, multifunctional nature) ; Gluconeogenesis, Glycogenesis – [schematic – no structures, but with enzymes and coenzymes]	
II	**2.0**	**Bioenergetics & Oxidative Phosphorylation**	**15**
	2.1	**Bioenergetics** Concept of free energy ; Respiratory electron transport chain – Carriers [basic chemistry, redox potentials, orientation on the membrane, sequence}; Q cycle in Complex III ; Inhibitors of electron transport – Antimycin A , Amytal, Rotenone, CN, Azide, CO Malate-Aspartate shuttle and Glycerol phosphate shuttle	
	2.2.	**Oxidative phosphorylation** –Chemiosmotic hypothesis, Proton motive force; Structure of ATP synthase , Uncoupler- of ETC and Oxidative phosphoryaltion [DNP]	
	2.3	**Photosynthesis** – Light and dark reactions, Z scheme and electron carriers, photophosphorylation [linear and cyclic]; Calvin cycle – schematic with enzymes	
III	**3.0**	**Chromatography**	**15**
	3.1 3.2	**Chromatography** Principle, Technique and Applications of the following kinds of chromatography : Partition chromatography (Paper), Adsorption Chromatography (TLC and column); Ion exchange chromatography and Gel filtration Principles of GLC, HPLC, Affinity chromatography	
IV	**4.0**	**pH and Buffers & Vitamins**	15
	4.1 4.1.1 4.1.2 4.1.3 4.1.4 4.1.5 4.2 4.2.1	**pH and Buffers** Derivation of Hendersen- Hasselbalch equation ; Numericals Ionization of Gly, Asp, Lys (pKa values required) Titration curve of Glycine , Valine and Lysine Derivation of the relationship between pI, pKa1 and pKa2 for Glycine pH meter and Glass electrode **Vitamins and Coenzymes** : Water soluble vitamins –Thiamin, Riboflavin, Niacin,	

	4.2.2	Pyridoxine, Biotin, Lipoic acid :- Chemistry of the Vitamin and its coenzyme form [structure not to be done, only group involved in its activity] and one biochemical role; Fat soluble vitamins A,D,E,K :- Vitamin A – Chemistry, Wald's Visual cycle and role of Rhodopsin (with structure), Transducin, cGMP in vision ; Vitamin D – role in Ca absorption and mobilization; Vit E and Vit K– physiological role (Vitamins D,E,K no structures)	

T.Y.B.Sc. – BIOCHEMISTRY USBCH502 ENVIRONMENTAL SCIENCE			
Unit No	**Topic No**	**Topics**	**NOS**
I	**1.0**	**Air**	**15**
	1.1 1.1.1 1.1.2 1.1.3	Atmosphere Composition and structure of atmosphere Particles , ions and radicals in the atmosphere Chemical and photochemical reactions in the atmosphere [reactions of oxygen, ozone, sulphur dioxide , nitrogen oxide and organic compounds]	
	1.2.1	Air Pollutants – CO, Oxides of Nitrogen, SO_2, hydrocarbons and photochemical smog, Green house gases, suspended particulate matter[sources and effect of] , depletion of ozone	
II	**2.0**	**Water & Water treatment**	**15**
	2.1 2.1.1	Water Hydrosphere- characteristics and the water cycle	
	2.2 2.2.1 2.2.2	Water Pollution Organic pollutants[pesticides, insecticides, detergents, oil spills, toxic organic chemicals] Inorganic pollutants [heavy metals – Hg, Pb, As, Cd] Thermal pollution of water	
	2.3 2.3.1 2.3.2	Water treatment Criteria for water purity, Water purification [preliminary, primary, secondary, tertiary- chlorination, ion exchange]	
III		**Soil & Noise**	15
	3.1 3.1.1 3.1.2 3.1.3	Soil Composition of soil, Nitrogen cycle Types of soil pollution – acidification, agrochemical pollution, salinization, and contamination by metalliferous wastes	
	3.2 3.2.1 3.2.2	Noise and its measurement Classification of Noise Causes and consequences of Noise pollution	
IV	**4.0**	**Energy, Industrial Pollutants and Environmental Monitoring**	**15**

	4.1 4.1.1 4.1.2 4.1.3 4.1.4 4.1.5	Energy Conventional Sources : Coal, Coke, Natural gas (CNG), Petroleum products (Petrol, Diesel, Kerosene, Oils, Naphtha) Non Conventional Sources : Solar , Geothermal, Tidal, Hydroelectric power, Nuclear energy, Biofuels , Natural gas (Synthetic Natural Gas)	
	4.2 4.2.1 4.2.2 4.2.3 4.2.4	Industrial pollutants (Sources and remedial measures) Polymers and Plastics Asbestos Poly Chlorinated Biphenyls Mining – Acid mine drainage	
	4.3 4.3.1 4.3.2	Environmental monitoring Approaches used to monitor the environment-air, water and soil. [Principles and Significance only. Protocols for each factor – not required] Remote Sensing	

T.Y.B.Sc. – BIOCHEMISTRY (6 units) USBCH503 GENETICS , ADVANCED GENETICS & RECOMBINANT DNA TECHNOLOGY			
Unit No.	**No**	**Contents**	**NOL**
I	**1.0**	**DNA Replication & Repair**	**15**
	1.1 **1.2**	**Replication of DNA (in prokaryotes) -** Models of DNA replication : Semi-conservative, Dispersive & Conservative; Modes of DNA replication: Theta & rolling circle; Enzymes (pol I, II and III) and accessory proteins; Mechanism of semi-conservative replication; **DNA repair**: Direct, Photoreactivation,O6 methyl guanine DNA methyl transferase, Excision repair, Mismatch repair, Recombination repair, SOS-error prone repair	
II		**Transcription & Translation**	**15**
	2.1	**Transcription** - in prokaryotes, prokaryotic RNA polymerase and promoter; mechanism of RNA transcription: Initiation, elongation and termination; processing of t RNA , r RNA, mRNA (prokaryotes and eukaryotes)- concept of split genes, reverse transcription. Role of Inhibitor- Rifampicin , Actinomycin D	
	2.2	**Translation (protein biosynthesis) in prokaryotes** – Genetic code, mechanism of translation: Activation of amino acids, chain initiation, elongation & termination: Post translational modifications of proteins Role of Inhibitor- Puromycin	
III	**3.0**	**Recombinant DNA Technology (RDT)**	**15**
	3.1	Introduction & Applications of RDT- Agriculture (Bt Cotton); Medicine (Insulin); GM food ;	

	3.2	Tools for RDT (a) Enzymes- Restriction endonucleases, ligases, terminal transferases, reverse transcriptase: (b) Cloning and Expression Vectors- Plasmid, pBR 322, PUC-19, Bacteriophage – Lambda phage; Cosmid; Artificial Chromosomes(BAC and YAC); Shuttle vectors; (c) Probes- DNA probes	
IV	**4.0**	**RDT Recombinant DNA Technology (RDT) techniques**	15
	4.1 4.2 4.3 4.4	Isolation of gene: Gene library and c-DNA library; Southern blot; Chimeric DNA Gene Transfer: Transformation, Transfection, Electroporation, Microinjection, Liposome, Microprojectile (in brief) Selection and screening- Antibiotic and colony hybridization DNA Amplification by PCR	

T.Y.B.Sc. – BIOCHEMISTRY (6 units) **USBCH504** **IMMUNOLOGY & PATHOPHYSIOLOGY –I**			
Unit No	**Topic No**	**Topics**	**NOS**
I	1.0	**Human immune system**	**15**
	1.1 1.1.1 1.1.2 1.1.3 1.1.4	Types of Immunity Innate immunity – Anatomical barriers, physiological barriers, Characteristics of Inflammation, phagocytosis [no mechanism] Adaptive immunity – Active & Passive Humoral & Cell mediated immunity	
	1.2 1.2.1 1.2.2	Organs of the immune system : Primary lymphoid organs: Thymus, Bone marrow Secondary lymphoid organs: Lymphatic system, Lymph nodes, Spleen, MALT.	
	1.3 1.3.1 1.3.2 1.3.3	Cells of the immune system: Lymphocytes – B cells and T cells , Natural killer cells – Mononuclear phagocytes, Granulocytes, Antigen presenting cells. Clonal selection & immunologic memory. Cytokines : biological functions of IL1 , tumor necrosis factor-alpha, interferon –alpha, IL2, interferon-gamma.	
II	2.0	**Antigen- Antibody interactions**	15
	2.1.1 2.1.2	Antigens: Antigenecity, immunogenecity, epitope, factors determining immunogenecity, Haptens. Antibodies : Fine structure of immunoglobulin, Antibody-mediated functions, Antibody classes, Monoclonal antibodies.	
	2.2 .1 2.2 .2 2.2 .3	Antibody diversity*:* Multigene organization of immunoglobulin genes – Lambda , kappa & heavy chain Light chain DNA – VJ rearrangements Heavy chain DNA - VDJ rearrangements	

III	3.0	**Metabolic disorders, Blood related diseases & Cardio Vascular System and related diseases**	15
	3.1 3.1.1 3.1.2 3.1.3 3.1.4	Metabolic disorder Inborn error: With respect to Etiology and Clinical manifestations Carbohydrate Metabolism: Glycogen storage disease Type 1. Protein Metabolism: Albinism. Lipid Metabolism: Tay Sach's disease.	
	3.2 3.2.1 3.2.2 3.2.3	Blood related diseases Iron deficiency anemia. Sickle cell anemia. Thalassemia.	
	3.3	Cardio Vascular System and related diseases*:* Atherosclerosis.	
IV	4.0	**Cancer**	**15**
	4.1 4.2 4.3 4.4 4.5 4.6	Biology of Cancer. Physiology of Cancer cells. Carcinogens: Types (Physical, Chemical and Biological); Environmental Factor. Causes of cancer. Genetics of cancer with reference to p53 and oncogenes. Cancer therapy (Chemo – purine, pyrimidine and folate analogs)	

PRACTICALS

USBCHP05

P05 (501)

1) Determination of the optimum pH of β-Amylase.
2) Determination of Km of β-Amylase from sweet potato.
3) Determination of the activity and specific activity of β-Amylase from sweet potato.
4) Effect of an inhibitor (eg. EDTA) on Amylase activity.
5) Estimation of glucose by Benedict's method.
6) Separation of sugars by circular paper chromatography

Demonstration Experiments

Separation of plant pigments by adsorption column chromatography (eg. Silica/Alumina)

P05 (502)

1) Determination of the pH of water/effluent/soil using a pH meter.
2) Determination of the conductance of water / effluent.
3) Estimation of organic content of soil –Diphenylamine method.
4) Estimation of lead by the EDTA method.
5) Estimation of copper by the Isoamyl alcohol method.
6) Determination of salinity of / chlorides in water - Silver nitrate method.
7) Determination of the Chemical Oxygen Demand of water/effluent by the potassium dichromate method

USBCHP06

P06 (503)

1) Estimation of glucose by DNSA method.
2) Estimation of glucose by the Folin Wu method.
3) Determination of the Hemoglobin content by the Sahli's hemoglobinometer.
4) Determination of blood groups.
5) Detection of Ca^{+2} and Mg^{+2} ions in by the Eriochrome Black T-EDTA method.
6) Estimation of phosphorus by Fiske and Subbarao method

P06 (504)

1) Isolation of starch from sweet potato.
2) Extraction of lipid from oil seeds by the cold percolation method.
3) Estimation of DNA by the Diphenylamine method
4) Isolation and spooling of DNA from onion / moong

SCHEME OF EXAMINATION

Biochemistry, as an interdisciplinary subject, consists of 06 (Six) Units of T.Y.B.Sc. Carrying 400 marks in Fifth Semester, as follows:

THEORY :				
COURSE CODE	**Title of Paper**	**Internal Assessment marks**	**Semester end Examination marks**	**Total Marks**
USBCH501	METABOLISM & ANALYTICAL TECHNIQUES	40	60	100
USBCH502	ENVIRONMENTAL SCIENCE	40	60	100
USBCH503	GENETICS , ADVANCED GENETICS & RECOMBINANT DNA TECHNOLOGY	40	60	100
USBCH504	IMMUNOLOGY & PATHOPHYSIOLOGY	40	60	100
	TOTAL			**400**

PRACTICALS :		
COURSE CODE	**Marks per course**	**Total per semester**
USBCHP05	100	
USBCHP06	100	
TOTAL		**200**

PRACTICALS: SEMESTER V

Day I **Total Marks 100**

Separation of mixtures using chromatography (P-I) (20 marks)+ Volumetry (P-II) (20 marks) + Enzymology (P-I) (30 marks) + pH/ Conductance of soil (P-II) (10 marks) + Journal (P-I) (05) + Journal (P-II) (05) + Viva (P-I) (05) + Viva (P-II) (05)

Day II **Total Marks 100**

Colorimetry (P-IV)(20 marks) + Volumetry (P-III) (20 marks) + An isolation (P-IV) (20 marks) + Haemotology (2 Experiments) (P-III) (20 marks)+ Journal* (P-III) (05) + Journal* (P-IV) (05) + Viva (P-III) (05) + Viva (P-IV) (05)

SCHEME OF EXAMINATION FOR PRACTICAL OF SEM V

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) Two days of 02 sessions on each day
   b) Total no. of sessions = 04
   c) Each session: 3 ½ hours.
   d) Morning session : 09.00 am to 12.30 pm
      Afternoon session: 01.00 pm to 04.30 pm.

   *Candidate without duly certified journals SHALL NOT be allowed to appear for the University practical examination.

T.Y.B.Sc. – BIOCHEMISTRY (6 units) USBCH601 METABOLISM & ANALYTICAL TECHNIQUES-II			
I	**1.0**	**Lipid metabolism**	**15**
	1.1	Lipid metabolism – , Catabolism - Knoop's experiment ; Beta oxidation of even carbon saturated fatty acids (C4 to C20) Energetics of fatty acid oxidation .	
	1.2	Anabolism – Fatty acid biosynthesis (palmitic acid) , Ketone body formation, utilization, and the physiological significance of Ketone bodies in Diabetes mellitus, Starvation, Pregnancy and Alcoholism.	
II	**2.0**	**Amino acid and protein metabolism & Endocrinology**	15
	2.1	Amino acid and protein metabolism – Reactions of amino acids – Transamination [GOT/GPT and mechanism of transamination] ; Decarboxylation [His, Trp, Glu, and mechanism of decarboxylation] , Deamination [oxidative – NAD(P) linked dehydrogenases and D & L - Amino acid oxidases, Non oxidative – Asp, Cys, Ser]	
	2.1.2	Urea cycle – Cellular location, sequence of reactions, Labeling of N atom, transport of NH_3	
	2.2 2.2.1	**Endocrinology** Chemistry, synthesis , secretion and physiological effects of Thyroxine and Insulin [synthesis from preproinsulin], Diabetes mellitus , Hypothyroidism [cretinism and myxedema], Hyperthyroidism [goiter – simple & toxic] Physiological role of Glucocorticoids, Oxytocin and ADH	
	2.2.2	Mode of action of steroid hormones, Effect of epinephrine on glycogen synthesis and breakdown [amplification cascade with G proteins, cAMP, adenylate cyclase, kinases]	
III	**3.0**	**Centrifugation and Spectroscopy**	**15**
	3. 1 3.1.1 3.1.2 3.1.3	**Centrifugation** RCF , RPM and derivation of an equation relating the two ; Nomogram ; Sedimentation coefficient Types and applications of centrifuges – Clinical, High speed, Ultra centrifuge - preparative and analytical. Types of centrifugation and its applications– Differential, Rate zonal, Isopycnic (Centrifugation with and without density gradients)	
	3.2 3.2.1. 3.2.2 3.2.3	**Spectroscopy** *:* Beer-Lambert law, derivation , limitations, application – estimation of sugar(DNSA) and protein(Biuret); concepts of Lambda max; determination of molar extinction coefficient Construction and working of a simple colorimeter and spectrophotometer Applications of Beer-Lambert law in the estimation of sugar[DNSA] and protein[Biuret]	

	3.2.4	Numericals based on the above concepts	
IV	**4.0**	**Electrophoresis**	15
	4.1 4.2 4.3 4.4	Principle ; Factors affecting the rate of migration of sample in an electric field Supporting media – paper, cellulose acetate, agar, agarose and polyacrylamide Discontinuous electrophoresis – Native PAGE Applications of electrophoresis - Separation of proteins and Nucleic acids with one staining method for each; molecular weight determination	

T.Y.B.Sc. – BIOCHEMISTRY (6 units) USBCH602 NUTRITION & PHARMACOLOGY			
I	**1.0**	**Nutrition**	**15**
	1.1 1.1.1 1.1.2 1.1.3	Principles of nutrition Nutrients [Proximate principles, vitamins and minerals(macro and micro- role of Ca, Mg, Na, K and Fe, Zn)] , dietary fibre. Nutritional status [malnutrition (protein energy and protein calorie) and over nutrition] Balanced diet	
	1.2.1 1.2.2 1.2.3	Energy Assessment - RQ, BMR ; Anthropometry – BMI, Waist:hip ratio ; Protein quality indices : Chemical score of amino acids, Protein Deficiency Corrected Amino Acid Score, Net Protein utilization	
II	**2.0**	**Diet Management**	15
	2.1	Dietary Management in :- Obesity, Diabetes Mellitus, Hypertension, Peptic ulcer , Obstructive Jaundice	
III	**3.0**	**Pharmacology**	**15**
	3.1 3.1.1 3.1.2 3.1.3 3.1.4	General pharmacology Pharmacodynamics, Physicochemical properties of drugs, Drug absorption : through-GIT, pulmonary, renal, placental and blood-brain barrier Bioavailability and Bioequivalence Drug Distribution, Metabolism and Excretion	
	3.2	Bioassays : Preclinical and clinical evaluation, Therapeutic drug monitoring	
	3.3	Pharmacokinetics : LD_{50}, ED_{50}, Half Life , Loading dose, Maintenance dose, Therapeutic dose, Therapeutic Index, Drug plasma concentration, Volume of distribution, Clearance	
IV	**4.0**	**Mechanism of Drug Action and Therapeutic drugs**	**15**
	4.1	Mechanism of action of drugs : i. Specific interaction – receptor mediated ii. Partially specific – drugs via enzymes	

		iii. Non specific interactions – antimetabolites and antiseptics iv. Through Antibodies v. Placebo effects	
	4.2	Therapeutic drugs *:* (Mechanism of action and adverse effects)	
	4.2.1	Anti inflammatory – non steroid anti inflammatory NSAID [Ibuprofen], Salicylates – [Aspirins]	
	4.2.2	Cardiovascular drugs- CVS [Ca channel blocker-Amlodipine, and Beta blocker – Proprenolol	
	4.2.3	Antibiotic – Penicillin and Sulphonamide	
	4.2.4	Antacid- Proton pump blocker –Omeprazole	
		T.Y.B.Sc. – BIOCHEMISTRY (6 units) **USBCH603** **BIOSTATISTICS &BIOINFORMATICS -**	
I	**1.0**	**BIOSTATISTICS AND DESCRIPTIVE STATISTICS**	15
	1.1	Introduction: scope and applications of biostatistics	
	1.2	Common statistical terms: Sources, nature and presentation of data; Measurement and scales of measurement	
	1.3	Descriptive statistics: Measures of central tendency- Mean, Median and mode	
	1.4	Measures of dispersion- Range, percentiles, variance, SD, Mean deviation,	
II	**2.0**	**PROBABILITY & BIOINFORMATICS**	15
	2.1	**Probability** Concept of probability: definition Probability distribution: normal distribution and normal curve, Asymmetric distribution Statistical problems based on the above concepts	
	2.2	**Bioinformatics:** Definition, Aims and History of Bioinformatics Applications of Bioinformatics in – Sequence analysis, Molecular modeling and drug designing, Phylogeny/evolution, Ecology & population studies, Medical informatics and agriculture. Introduction to Genomics and Proteomics 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. 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) Micro-array analysis-concept and applications	

III	**3.0** 3.1 3.2 3.3 3.4	**HYPOTHESIS TESTING** - Introduction; Single population mean, difference between population means Type I and Type II errors, One-tailed and two tailed tests Z-test Statistical problems based on the above concepts	15
IV	**4.0** 4.1 4.2	**HYPOTHESIS TESTING** t-test- Paired and unpaired Chi-square Statistical problems based on the above concepts	15

		T.Y.B.Sc. – BIOCHEMISTRY (6 units) **USBCH604-S** **IMMUNOLOGY & PATHOPHYSIOLOGY-II**	
I	**1.0**	**Antigen- Antibody interactions & Complement system**	**15**
	1.1 1.1.1 1.1.2 1.1.3 1.1.4 1.1.5	Antigen- Antibody interactions : Forces involved, antibody affinity, antibody avidity. Precipitation reactions – Oudins, Ouchterlony Agglutination reactions : Blood typing, bacterial agglutination, Passive agglutination, agglutination inhibition, Coomb's test. Immunoelectrophoresis ; Principles of Radioimmunoassay, ELISA, Immunofluorescence	
	1.2 1.2.1 1.2.2 1.2.3	Complement Components of complement; Complement activation – Classical & alternate pathway ; formation of membrane attack complex. Biological consequences of complement activation.[in brief]	
II	**2.0**	**Major histocompatibility complex &Transplant immunology**	**15**
	2.1. 2.1. 1 2.1.2	Major histocompatibility complex : MHC polymorphism & organization of MHC genes- classI & class II ; Cellular distribution & structure of class I & II molecules ; Self MHC restriction of Tcells. Role of antigen presenting cells.	
	2.2	Transplant immunology: Types of transplant ; immunological basis of allograft rejection.	
	2.3	Autoimmunity *:* Organ specific –Myasthenia gravis ; Systemic – Rheumatoid arthritis (immunological basis of these autoimmune diseases)	
III	**3.0**	**Virology & AIDS**	15
	3.1	General Structure of Virus	
	3.2	Structure and mechanism of replication in: 1. Vaccinia 2. Polio	

		3. Influenza	
	3.3	AIDS: Structure and genetics basis of AIDS virus. Replication of AIDS Virus. Symptoms and Causes of AIDS. AIDS Therapy.	
IV	**4.0**	**Endocrine Diseases & Ageing**	15
	4.1	Endocrine diseases*:* Diabetes mellitus. Diabetes insipidus.	
	4.2	Ageing: Definition of ageing. Molecular changes during ageing. Theories of Ageing.	
	4.3	Alzheimer's disease	

PRACTICALS - SEMESTER VI

USBCHP07

P07 (601)

1) Separation of amino acids by circular paper chromatography
2) Estimation of Ascorbic acid Iodometrically.
3) Determination of the optimum pH of Acid phospahatase / Urease.
4) Determination of the Km of Acid phospahatase / Urease..
5) Estimation of lactose by Cole's ferricyanide method
6) Estimation of glucose Iodometrically

Demonstration Experiments

Separation of plant pigments/ Oils by Thin Layer Chromatography

P07 (602)

1) Estimation of fluoride in water by the Alizarin red method
2) Determination of the Dissolved Oxygen content of water/effluent by the Winkler's Iodometric method - Azide modification.
3) Determination of the Biological Oxygen Demand of water/effluent
4) Determination of the acidity and alkalinity of water/ effluent.
5) Estimation of $CaCO_3$ of soil - Bromothymol Blue method
6) Immunoprecipitation reaction of antigen and antibody.
7) Diagnostic test for typhoid - Widal Qualitattive
8) Diagnostic test for typhoid - Widal Quantitative

USBCHP08

P08 (603)

1) Estimation of protein by the Folin-Lowry method.
2) Estimation of iron by Wong's method.
3) Monograph of acetyl salicylate (identification, assay and purity as per IP)
4) Monograph of sucrose (identification, assay and purity as per IP)

Demonstration Experiments

1. Separation of serum proteins by PAGE

P08 (604)

1) Biostatistics – Problems
2) Isolation of RNA yeast / liver
3) Isolation of casein from milk.
4) Estimation of RNA by Orcinol method.

Demonstration Experiment

1) Isolation of plasmids
2) Agarose gel electrophoresis
3) Chromosomal DNA and Plasmid DNA

SCHEME OF EXAMINATION

Biochemistry, as an interdisciplinary subject, consists of 06 (Six) Units of T.Y.B.Sc. carrying 400 marks in Sixth Semester, as follows :

THEORY :				
COURSE CODE	**Title of Paper**	**Internal Assessment marks**	**Semester end Examination marks**	**Total Marks**
USBCH601	METABOLISM & ANALYTICAL TECHNIQUES	40	60	100
USBCH602	NUTRITION & PHARMACOLOGY	40	60	100
USBCH603	BIOSTATISTICS &BIOINFORMATICS	40	60	100
USBCH604	IMMUNOLOGY & PATHOPHYSIOLOGY	40	60	100
	TOTAL			**400**

PRACTICALS :		
COURSE CODE	**Marks per course**	**Total per semester**
USBCHP07	100	
USBCHP08	100	
TOTAL		**200**

PRACTICALS: SEMESTER VI

Day I **Total Marks 100**

Separation of mixtures using chromatography (P-I) (20 marks) + Enzymology (P-I) (30 marks) + Immunology (P-II) (10 marks) + Volumetry (P-II) (20 marks) + + Journal* (P-I) (05) + Journal* (P-II) (05) + Viva (P-I) (05) + Viva (P-II) (05)

Day II **Total Marks 100**

Biostatistics (P-IV) (20 marks) + Monograph (P-III) (20 marks) + Colorimetry (P-III) (20 marks) + An isolation (P-IV) (20 marks) + Journal* (P-III) (05) + Journal* (P-IV) (05) + Viva (P-III) (05) + Viva (P-IV) (05)

Scheme of Examination for practical of SemIV

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
   a) Two days of 02 sessions on each day
   b) Total no. of sessions = 04
   c) Each session : 3 ½ hours.
   d) Morning session : 09.00 am to 12.30 am
      Afternoon session : 01.00 pm to 04.30 pm.

*Candidate without duly certified journals SHALL NOT be allowed to appear for the University practical examination.

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**	**40 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 actives	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	40 Marks	
2	Journal	10 Marks	
3	Viva	10 Marks	

SUGGESTED READING

1) Lehninger's- Principles of Biochemistry by David L. Nelson
2) Harper's Illustrated Biochemistry by Robert K. Murray
3) Biochemistry by Donald Voet
4) Biochemistry by Jeremy M. Berg
5) Biochemistry (2 Volume Set): The Chemical Reactions of Living Cells by David E. Metzler
6) Modern Experimental Biochemistry by Rodney F. Boyer
7) Basic Concepts in Biochemistry: A Student's Survival Guide by Hiram F. Gilbert
8) Analytical Biochemistry by David Holme
9) International Biochem by Stryer Tymoczko Berg
10) Biophysical Chemistry Upadhyay
11) Biochemistry by Dr. A.C. Deb
12) Essentials of Pharmacotherapeutics by FSK Brara
13) Textbook of Medical Biochemistry by M.N. Chatterjea & Ranashinde
14) Immunology by Goldsby and Kuby
15) iGenetics by Russel
16) Gene Biotechnology by Jogdand
17) Biostatistics by Arora
18) Methods in Biostatistics by Mahajan
19) General Principles of Biochemical Investigation by William & Wilson
20) Environmental Chemistry by A.K.De
21) Biotechnology by U.Satyanarayana
22) Advance in Biotechnology by Jogdand
23) Biochemical Calculation by Segel
24) Biochemical Methods by Sadashivam
25) Introductory Practical Biochemistry by Sawhney
26) Practical Biochemistry by David Plummer
27) Methods of biostatistics for medical students and research workers by Mahajan, B.K.; Jaypee brothers publishers.
28) Bioinformatics- Concepts, Skill and applications by Rastogi, S.C.; Mendiratta, Namita and Rastogi, Parag; C.B.S. Publishers & Distributors
29) Genes VIII by Lewin, Benjamin; Pearson Prentice and Hall publishers
30) Human nutrition and dietetics by Davidson, S. *etal.*; Churchill Livingstone Publishers.
31) Nutrition and dietetics by Joshi, Shubhangini A.; Tata Mc Graw and Hill publishers
32) Nutrition Science by Srilakshmi, B.; New Age International publishers
33) Introductory practical biochemistry by Sawhney, S.K. and Singh, Randhir; Narosa Publishing House
34) Biochemical calculation by Segel, Irwin H.; John Wiley & Sons publishers
35) Text book of Medical physiology by Guyton, Arthur C. and Hall, John E.; Harcourt Brace & Company Asia Pvt Ltd