

UNIVERSITY OF MUMBAI



**Syllabus for the S.Y.B.Sc.
Program: B.Sc.
Course: Biochemistry**

(Credit Based Semester and Grading System with
effect from the academic year 2012–2013)

S.Y.B.Sc. Bio-Chemistry Syllabus
Credit Based and Grading System
To be implemented from the Academic year 2012-2013

SEMESTER III

Course Code	UNIT	TOPICS	Credits	L / Week
USBCH 301	I	Enzymes and coenzymes	2	1
	II	Hormones and Plant Growth substances		1
	III	Acids, Bases, Buffers and Ionic Equilibria		1
USBCH 302	I	Genetics : I	2	1
	II	Genetics : II		1
	III	Transport mechanisms		1
USBCH 303	I	Introduction to Microbiology and Cell culture	2	1
	II	Fermentation and Downstream processing		1
	III	Industrial Biotechnology		1
USBCH P3	Practicals based on both courses in theory		3	9

SEMESTER IV

Course Code	UNIT	TOPICS	Credits	L / Week
USBCH 401	I	Physicochemical Principles	2	1
	II	Biochemical Investigation		1
	III	Microscopy		1
USBCH 402	I	Locomotion / Movement	2	1
	II	Neurophysiology		1
	III	Body Fluids :Fluid compartments of the body – ICF and ECF		1
USBCH 403	I	Trends in Biotechnology	2	1
	II	Introduction to Pharmacology		1
	III	Resource management		1
USBCH P4	Practicals based on both courses in theory		3	9

Course Code	Title	Credits
USBCH 301	Biomolecules : Structure, Function and Basic Principles involved in Investigation.	2 Credits (45 lectures)
Unit I : Enzymes and Coenzymes 1.1 Definition – Enzyme, Apoenzyme, Holoenzyme, Prosthetic group, Active site , Enzyme specificity, Turnover number, Specific activity, Katal, IU, Coenzyme and Cofactor 1.2 IUB / EC classification upto one digit. Enzyme specificity : Fischer's „lock & key“ and Koshland's „induced fit“ theories 1.3 Activation energy, Mechanism of Enzyme action (concept of active site, single and bi- substrate reaction), Factors affecting enzyme activity – substrate concentration, pH, temperature 1.4 Enzyme Kinetics – Derivation of Michaelis - Menten equation and Lineweaver Burke plot for monosubstrate reactions and numerical problems based on them 1.5 Enzyme inhibition – Reversible and Irreversible; Competitive and Non competitive , one example of each Problems on entire Unit I		15 Lectures
Unit II : Hormones and Plant Growth substances 2.1 Definition of Hormones, hormone receptor, endocrine & exocrine glands 2.2 Classification of hormones on the basis of: I)Distance of target tissue- autocrine, paracrine, endocrine ii) Chemistry - One example for each sub class. Hierarchal organization of the mammalian endocrine system 2.1and 2.2- 4 lectures 2.3 Chemistry & physiological role of thyroxine, oxytocin & vasopressin, Physiological role of glucocorticoids, FSH, LH, Estrogen , Progesterone (Reproductive cycle) Mode of action of steroid hormones and epinephrine. (amplification cascade Only till the level of protein kinase A) G protein not to be covered. 7 lectures 2.4 Plant Growth Substances- Structure and Function of- Auxins, Gibberllins, Cytokininis, Ethylene and Abscissic Acid		15 Lectures
Unit III : Acids, Bases, Buffers and Ionic Equilibria 3.1 Definition – pH, pK, pKw, Isoelectric pH, Buffer, Buffering Capacity 3.2 Derivations : Ionic product of water, Hendersen–Hasselbalch equation, Relation between pI, pKa1 and pKa2 for a neutral, acidic and basic amino acid 3.3.1 Titration and Ionization of Glycine, Lysine and Aspartic acid; pKa , pHM, and pI values of these amino acids 3.3.2 Sorensen's reaction and Formal titration of amino acids 3.4 Physiological Buffers : (Hb-HHb, Carbonate-Bicarbonate, Phosphate, and Protein 3.5 Numericals on above concepts		15 Lectures

Course Code	Title	Credits
USBCH 302	Fundamentals of Genetics and Physiology	2 Credits (45 lectures)
Unit I : Genetics : I 1.1 Mendelian genetics: Mendels experiments, Laws of inheritance 1.2 Incomplete dominance Co-dominance; Epistasis, Maternal effects 1.3 Numericals on above concepts		15 Lectures
Unit II : Genetics : II 2.1.1 Prokaryotic Genome: Circularity; Single origin 2.1.2 Eukaryotic chromosomes: Organization of DNA into chromosomes (upto Solenoid structure), DNA supercoiling, Topoismerase, Chromatin structure, Euchromatin, Heterochromatin, structure of condensed chromatin, Nucleosomes,[Centromere, kinetochome, telomere], Comparison of chromosomal structure in prokaryotes and eukaryotes 2.2.1 Transformation : Definition and transformation in S.pneumoniae 2.2.2 Transduction : Definition ; Explain general features with one example 2.2.3 Conjugation : Mechanism , F ⁺ , F ⁻ and Hfr strain 2.3 Cell cycle regulation		15 Lectures
Unit III : Transport mechanisms 3.1 <i>Across Cell Membrane -5 lectures</i> 3.1.1 Channel proteins and Carrier proteins 3.1.3 Active transport (primary – Na ⁺ & K ⁺ pump ; secondary – Glucose) & Passive transport (simple and facilitated diffusion) with suitable examples ; concept of symport and antiport Endocytosis and Exocytosis – with one example each. 3.2 In blood- 10 lectures 3.2.1 Gases- CO ₂ and O ₂ - modes of transport, factors affecting the transport, O ₂ dissociation curves, Chloride shift 3.2.2 Metabolites: lipids- Fatty Acids, Other lipids (lipoprotein-formation, transport, function and degradation) role of plasma proteins in transport. 3.2.3 Ions : Fe- Ferritin and Transferrin Ca – bound		15 Lectures

Course Code	Title	Credits
USBCH 303	Fundamentals of Microbiology, Virology, Biotechnology and Resource Management	3 Credits (45 lectures)
<p>Unit I : Introduction to Microbiology and Cell culture</p> <p>1.1 Sterilization and disinfection techniques 1.2 Construction of growth media (Natural and Synthetic) 1.3 An introduction to air , water, soil and food microbiology 1.4 An introduction to Virology : types , structure of genome, plant and animal viruses 1.5 <i>Animal Tissue Culture</i>: Introduction, Requirements, Culture techniques (Contamination and Sterilization); Culture media: Stem cell culture; Advantages; Applications-Hybridomas, vaccines 1.6 <i>Plant Tissue-culture</i>: Introduction; Plant breeding; Techniques for maintenance; Genetic culture techniques: Callus regeneration, mutant selection from culture; Protoplast fusion, Transformation: Applications</p>		15 Lectures
<p>Unit II : Fermentation and Downstream processing</p> <p>2.1 <i>Basics</i>: Primary and secondary screening, preparation of inoculum, and fermentation media 2.2 <i>Fermentors</i>: Types (Batch, Continuous and fluidized bed) and its construction and accessory equipment; Operation of a fermentor; sterilization, inoculation, aeration, agitation; 2.3 <i>Down-stream processing</i>: Introduction, Separation of particles (solid-liquid), Cell disruption, extraction methods, concentration, Purification and resolution of mixtures, drying</p>		15 Lectures
<p>Unit III : Industrial Biotechnology</p> <p>3.1 <i>Industrial synthesis</i> : Penicillin, Vit B₁₂, Cheese, Amylase / Protease ; Ethanol 3.2 <i>Immobilized enzymes</i>: Introduction; Methods of immobilization (entrapment, adsorption, covalent binding, microencapsulation, cross-linking); Stabilization of soluble enzymes: Solvent and substrate stabilization, Enzyme stabilization by polymer, salts, and Chemical modification; Applications and Problems 3.3 <i>Biosensors</i>: Features of biosensors; Types: Electrochemical, Thermometric, Optical, Piezoelectric, Whole cell, Immunobiosensor; Construction and development, Applications 3.4 <i>Single cell proteins</i>: Introduction; Bacterial proteins; Yeast proteins; fungal proteins; algal proteins; Economic aspect; Applications</p>		15 Lectures

Practical Syllabus USBCHP3

P3 (301)

- 1) a] Preparation of beta Amylase / Urease / Invertase extract demonstration of the activity Qualitatively.
b] Determination of the Achromic point of Salivary Amylase. Yes salivary amylase
- 2) Preparation of Buffers and measurement of pH using pH papers and pH meter.
- 3) Acid – Base titration of a polyprotic acid [H_2CO_3 / H_3PO_4 / Glycine hydrochloride]
- 4) A study of some methods of cell rupture :
 - i) effect of hypo, hyper and isotonic solutions on cells of the onion peel./plant cell (Hydrilla/ Vallisneria/ Spirogyra)
 - ii) Effect of organic solvents on cell rupture
- 5) Determination of the Viscosity of sucrose solution using Ostwald's Viscometer.
- 6) Demonstration of Osmosis through a semi permeable membrane. Potato Osmometer

P3 (302)

- 1) Mendel's Laws : i] Problems based on the laws
ii] case studies based on the laws
- 2) A study of Human Karyotypes.
- 3) Isoelectric precipitation of Casein using an indicator.
- 4) Industrial visit /Assignment for vermiculture, organic farming, composting, biogas plant followed by a detailed report of at least one[the visit is recommended with the report, but in case it is not possible an assignment is mandatory]

P3 (303)

- 1) Demonstration of the working of an autoclave and a hot air oven.
- 2) Optimization of curd – a demonstration.
- 3) Sterility testing of air by plate exposure technique. [in sterile zone, in lab, breathed on]
- 4) A study of various culture inoculation methods . (streak plate , pour plate and spread plate methods).
- 5) Cell count in a culture medium using optical density
- 6) Determination of the zone of inhibition of microorganisms using the agar well method and disc method.
- 7) Flow sheet diagrams of industrial preparation of : a vitamin, an antibiotic, a food item, an enzyme and an alcohol .

References:

Semester III

1. Textbook of Medical Physiology Gyton and Hall , Elsevier publishers
2. David L. Nelson, Michal M. Cox, Lehninger Principles of Biochemistry, W. H. Freeman & company, New york, 4th edition
3. . Murry, R. K. & other, Harper"s Biochemistry, Appleton & Lange , california, 21st edition
4. J.. L. Jain, Fundamentals of Biochemistry, S. Chand & company, 2005 edition
5. Dr. A.C. Deb, Fundamentals of Biochemistry, New central book agency (P) Ltd., 8th edition
6. U. Satyanarayanan, Biochemistry, Books & allied (P) Ltd., Kolkata, 3rd edition
7. Murry, R. K. & other, Harper"s Biochemistry, Appleton & Lange , california, 21st edition.
8. J.B.Russel , Genetics
9. Benamin Lewin, Gene VII , Oxford University Press
10. M.W. Strickberger, Genetics
11. William & Wilson
Dr. A.C. Deb, Fundamentals of Biochemistry, New central book agency (P) Ltd., 8th edition

SEMESTER IV

Course Code	Title	Credits
USBCH 401	Biomolecules : Structure, Function and Basic Principles involved in Investigation.	2 Credits (45 lectures)
<p>Unit I : Physicochemical Principles</p> <p>1.1 <i>Diffusion and Osmosis</i></p> <p>1.1.1 Explanation of : solute concentration (ways of expressing it- mole, molal , normal, percent), activity & ionic strength,</p> <p>1.1.2 Diffusion & definition of diffusion coefficient (factors affecting solute diffusion in solution)</p> <p>1.1.3 Osmosis- Vant Hoff's law of osmotic pressure (state law & write mathematical expression- no derivation), mechanism of osmosis, Role of osmosis in physiology. Eg. Renal dialysis. Distribution of solute between two immiscible solvents</p> <p>1.2 <i>Colloids and Viscosity</i></p> <p>1.2.1 Colloidal state in relation to surface forces , surface area, electrical charge, precipitation and flocculation.</p> <p>1.2.2 Surface tension and its measurement, factors affecting surface tension Eg . Role of bile in digestion</p> <p>1.2.3 Viscosity – definition , measurement; Donnan membrane equilibrium, relation between Donnan equilibrium and osmotic pressure</p>		15 Lectures
<p>Unit II : Biochemical Investigation</p> <p>2.1 Approaches to and levels of biochemical investigations</p> <p>2.2 Whole animal and plant studies – the advantages and disadvantages of any four model systems for biochemical investigation (e.g. <i>E.coli</i>, yeast, Dictyostelium, <i>C. elegans</i>, <i>Drosophila</i>, <i>Arabidopsis</i>)</p> <p>2.3 Organ & Tissue studies</p> <p>2.4 Isolated and cultured tissue and cell techniques : isolation, culture and counting of cells</p> <p>2.5 <i>Cell Fractionation</i> :</p> <p>2.5.1 Cell rupture – solid shear, liquid shear, high pressure, ultrasound, osmotic shock, chemical treatment (enzyme, organic solvent), temperature</p> <p>2.5.2 Choice of suspension medium (isotonic & hypotonic solution, PBS) and separation methods</p>		15 Lectures
<p>Unit III : Microscopy</p> <p>3.1 History , Basic principles of microscopy, Concepts of light and colour</p> <p>3.2 Dissecting and Compound microscope. Construction and parts of a microscope, function of each part , Levels of magnification, Concept of refractive index and role and RI of oil</p> <p>3.3 Specialized Microscopy – Differential interference contrast, (DIC), Phase contrast, Dark Field</p> <p>3.4 Specialized Microscopy – (Fluorescence) : Simple fluorescence, Time–lapse fluorescence, Confocal microscopy, Fluorescence resonance energy transfer, Electron microscopy (Scanning & Transmission) and Electron microscope.</p>		15 Lectures

Course Code	Title	Credits
USBCH 402	Fundamentals of Genetics and Physiology	2 Credits (45 lectures)
<p>Unit I : Locomotion / Movement</p> <p><i>1.1</i> Muscle contraction</p> <p>1.1.1 .Structural organization of a muscle fibre, myofibril.</p> <p>1.1.2 Contraction and Relaxation of Muscles ; - mechanisms, Other types of contractions – eg twitch, tetanus, Isotonic, Isometric Regulation of Muscle contraction</p> <p><i>1.2</i> Movements in Plants</p> <p>1.2.1 Movements of Locomotion Spontaneous: Ciliary, Amoeboid, Cyclosis (Rotation, Circulation) Induced : Chemotaxis, Phototaxis, Thermotaxis</p> <p>1.2.2 Movements of Curvature : Mechanical : hygroscopic movements Vital : i) Spontaneous – movements of growth (nutation, circumutation, Hyponasty, epinasty) ; movements of variation ii) Induced – Tropic - hpto/ geo / hydro tropism ; Nastic – seimonasty , Nyctynasty</p>		15 Lectures
<p>Unit II : Neurophysiology</p> <p>2.1 Nervous System – Classification :CNS , PNS ; Components : Neurons (3 types) and Neuroglia (6 types) – structure and function , Axonal transport</p> <p>2.2 Resting Membrane Potential, ion channels [voltage and ligand gated], Action Potential (depolarization, polarization and refraction period), propagation of action potential (salutatory & continuous conduction)</p> <p>2.3 Physiological anatomy of a synapse ; Transmission at synapses – Electrical & Chemical synapses, Excitatory & Inhibitory post synaptic potentials, Agonists & Antagonists, Removal of Neurotransmitters</p> <p>2.4 Neurotransmitters- acetylcholine and Catecholamines, GABA, Glutamate & Aspartate – structure and function</p>		15 Lectures
<p>Unit III : Body Fluids</p> <p>Fluid compartments of the body – ICF and ECF</p> <p>3.1 Blood : Composition, characteristics and function ; role of plasma proteins, Starling's hypothesis; blood clotting and factors involved [no pathway]</p> <p>3.2 Bile : Composition, characteristics and function ; storage</p> <p>3.3 Urine : Composition – normal and abnormal constituents; Formation of Urine – concentrated and dilute</p> <p>3.4 Lymph : Composition , Formation and Circulation</p>		15 Lectures

Course Code	Title	Credits
USBCH 403	Fundamentals of Microbiology, Virology, Biotechnology and Resource Management	2 Credits (45 lectures)
<p>Unit I : Trends in Biotechnology:</p> <p>1.1 <i>Bioremediation:</i> Introduction; Factors affecting bioremediation; Types; Types of reactions (Aerobic, anaerobic, sequential); Biodegradation of – hydrocarbons, Pesticides and herbicides, heavy metals (Uranium) contaminated soil and waste land; Genetically Engineered Microbes in bioremediation.</p> <p>1.2 <i>Biopesticides:</i> Introduction; Types of biological control (inundation and augmentation); Study related to any two examples from each- viruses, bacteria, fungi and protozoa</p> <p>1.3 <i>Biofungicide:</i> herbicides and agricultural antibiotics: Introduction to the terms and any two examples of each</p> <p>1.4 <i>Biofertilizers</i></p>		15 Lectures
<p>Unit II : Introduction to Pharmacology</p> <p>2.1 Scope of pharmacology</p> <p>2.2 Sources, Classification and Nomenclature of drugs</p> <p>2.3 Dosage forms and routes of drug administration; Novel Drug delivery System [NDDS]; Factors affecting dosage and drug delivery</p> <p>2.4 Pharmacokinetics : LD 50 , ED 50 Half Life, Loading dose, Maintenance dose (Explanation of terms only) Novel is right</p>		15 Lectures
<p>Unit III : Resource management</p> <p>3.1 <i>Solid Waste:</i> Types of waste, Treatments, Recycling</p> <p>3.2 <i>Waste water - Sewage :</i></p> <p>3.2.1 Composition of sewage; Types of sewage; Detection of pathogenic organisms of sewage; Preliminary treatment: Primary treatment ; Secondary treatment; Tertiary treatment</p> <p>3.2.2 Disinfection</p> <p>3.2.3 Sludge treatment and disposal Waste water collection vs Sewage treatment in developing countries;</p> <p>3.3 <i>Biomass and Bioenergy production:</i></p> <p>3.3.1 <i>Biofuel and Biomass:</i> Fossil fuel; Energy rich crops (sugar & starch; wood-rich; petroleum plants); Animal energy ;Sources of biofuel, its cultivation and extraction process</p> <p>3.3.2 <i>Biogas: Production, Composition, Applications, Gobar gas.</i> [MSW and LFG, Renewable natural gas, NG vehicle]</p>		15 Lectures

Practical Syllabus USBCHP4

P4 (401)

- 1) Parts and maintenance of a microscope.
- 2) A study of electron micrographs of cell organelles.
- 3) Permanent slides of Muscle tissue
- 4) Recrystallization of Benzoic acid and determination of its yield.

P4 (402)

- 1) Blood Experiments :
 - i] Determination of total RBC count
 - ii] Determination of total WBC count
 - iv] Bleeding time
 - v] Clotting time
- 2) Urine Analysis :
 - i] Normal constituents - Urea, Uric acid, Chloride
 - ii] Abnormal constituents – Glucose, Protein
 - iii] Titratable acidity [using neutral red or phenol red]
- 3) Bile :
 - i] Detection of Bilirubin [Iodine test / Gmelin's Nitric acid test / Fouchet's test]
 - ii] Detection of Bile salt [Pettenkofer's test. Hays sulphur test)] was unable to check
- 4) Assay / Detection of a neurotransmitter
- 5) Demonstration of plant movement. [A project to be handled in a group. Each group to plan and execute the experiment in any way they choose. Results to be presented to the class during a practical turn.]

P4 (403)

- 1) Isolation of DNA from Onions
- 2) Determination of the Minimum Inhibitory Concentration of any one disinfectant .
- 3) Determination of the potability of water by conducting a coliform count. [MPN]
- 4) Gram stain of sewage.
- 5) Determination of the Chemical Oxygen demand of an effluent / sewage.
- 6) Preparation of immobilized yeast and its use in determination of invertase activity.

References:

Semester IV

- 1) Microbiology by Stanier
- 2) Stanier, Microbiology Pelzer, Essentials of Microbiology
- 3) Friedfielder, Microbial genetics
- 4) A. H. Patel, Industrial microbiology, Macmillan India Ltd.
- 5) L. E. Casida, Industrial microbiology, New age international publishers
- 6) F.S.K Brar, Essentials of Pharmacology, S . Chand Publisher
- 7) Upadhyay, Biophysical chemistry, Himalayan Publisher
- 8) Keith Wilson & John Walker, Practical Biochemistry, principle and technique, Cambridge University, 5th edition
- 9) Biotechnology, by Primrose , Dube
- 10) Biotechnology, Jodgan
- 11) U. Satyanarayanan, Biotechnology, Books & allied (P) Ltd., Kolkata