

SCIENCE FACULTY

NORTH MAHARASHTRA UNIVERSITY, JALGAON



SYLLABUS FOR

T.Y. B.Sc.

BIOCHEMISTRY

(WITH EFFECT FROM JUNE, 2014)

North Maharashtra University, Jalgaon.

Class:- T.Y. B.Sc. (Semester Pattern)

(w.e.f. June 2014)

BC YSC [BC for Biochemistry; Y for year; S for semester; and C for course number].

The Course Structure and title of the courses for T.Y. B.Sc. (Biochemistry) are as given below:

Course Title	Semester	Periods	Marks	
			Ext	Int
BC 311: Genetics	I	60	40	10
BC 312: Plant Biochemistry	I	60	40	10
BC 313: Clinical Biochemistry	I	60	40	10
BC 314: Metabolism	I	60	40	10
BC 315: Biophysical Chemistry	I	60	40	10
BC 316: Biotechnology	I	69	40	10
BC 321: Genetic Engineering	II	60	40	10
BC 322: Plant and Agro Biotechnology	II	60	40	10
BC 323: Immunology	II	60	40	10
BC 324: Enzymology	II	60	40	10
BC 325: Analytical Techniques	II	60	40	10
BC 326: Biostatistics and Bioinformatics	II	60	40	10
BC 307: Techniques in Molecular Biology	Annual	120	80	20
BC 308: Diagnostic Biochemistry	Annual	120	80	20
BC 309: Analytical Biochemistry and Enzymology	Annual	120	80	20

Note:-

1. A Study tour of minimum one day is compulsory for the T.Y. B.Sc. students. The students should submit their tour reports at the time of practical examination.
2. Each period is of 45 minutes duration.
3. Each course is having weightage four periods per week.
4. Each practical course is having weightage four periods per week.
5. Examination of practical course shall be held at the end of the academic year.

Chairman B.O.S.

Dean Sci. Faculty

BC-311 Genetics

UNIT-I Genetics

15 lectures; 10 Marks

- Mendel's law
 - Law of dominance
 - Law of segregation
 - Law of independent assortment
- Incomplete dominance
- Test cross, back cross
- Concept of multiple alleles
 - Characters, symbolism eg.ABO types
- Lethal gene

UNIT-II Chromosome and gene structure

15 lectures; 10 Marks

- Morphology, structure and types of chromosome
- Chromosome number and variation in chromosome number
- Karyotype & ideogram
- Euchromatin & heterochromatin
- Fine structure of gene
 - Cistron, muton, recon, intron, promotor, repressor, exon, regulator, operator etc
- Gene regulation
 - Operon concept, lac operon

UNIT-III A) Prokaryotic DNA replication

15 lectures; 10 Marks

- Types of replication-conservative, semi-conservative, dispersive
- Meselson & sathl experiment
- DNA replication in E coli
 - Replication origin, role of membrane, unwinding of the strand, superhelix relaxing protein, Template DNA, RNA primer, polymerization, replication fork, leading strand, lagging strand, okazaki fragment,
- Function of enzymes
 - DNA polymerase-I, II, III, helicase, ligase

B) Prokaryotic Transcription

- Transcription components- Template, activated precursors, divalent metal ions, RNA polymerase, sigma factor,
- Transcription process- initiation, elongation, termination
- Rho dependents & rho independents termination of RNA synthesis
- Post transcriptional modification in eukaryotic mRNA (poly A tail , 5' cap, splicing)

UNIT-IV Prokaryotic Translation and Mutations

15 lectures; 10 Marks

- Activation and transfer of amino acids to tRNA
- Translation- initiation, elongation, termination
- Post translational modification in eukaryotics

- Mutations- definition
- Gene mutations
 - Base pair substitutions- transition, transversion and inversion
 - Frameshift mutations- deletion and insertion
 - Missense mutation, nonsense mutations
 - Mutations in termination codons
 - Silent mutations
- Mutagens: definition
 - Chemical- base analogues, agents modifying purines and pyrimidines
 - Physical- radiations
- Chromosome mutations
 - Change in the number of chromosomes- Euploidy and Aneuploidy
 - Change in the structure of chromosomes-Loss or addition of segment, change in normal arrangement

References

- Lubert Stryer.(1995) Biochemistry, fourth edition, W.H.Freemant and Company, New York.
- Genes III--- Lewin B, Oxford University Press New York (2000)
- Principle of Genetics -Gardner/Simmons/Snustad (Eight edition)
- Genetics- P.K.Gupta, Rostogi publication meerut (2001)
- Genetics –strickberger M.W. Prantice Hall of India P.LTD New Delhi (2005)
- Biotechnology, U. Satyanarayana, Books and Allied (P) Ltd, Kolkata
- Textbook of Biochemistry, G.R. Agarwal, Kiran Agarwal, O.P. Agarwal, Goel Publishing House, Meerut
- Cell Biology, C.B. Powar, Himalaya Publishing House, Mumbai
- Biochemistry, C.B. Powar, G.R. Chatwal, Himalaya Publishing House, Mumbai

BC- 321 Genetic Engineering

Unit-I Introduction to Genetic Engineering

15 lectures; 10 Marks

- Concepts of Genetic engineering
- Enzymes involved in genetic engineering- restriction endonucleases, DNA ligases, Alkaline phosphatases, DNA modifying enzymes
- Prokaryotic and eukaryotic cells as hosts
- Vectors- Plasmids, Bacteriophages, Cosmids, Artificial chromosome vectors, Shuttle vectors
- Construction of rDNA- palindromes and staggered cleavage adding poly dA and poly dT tails, blunt end ligation
- Methods of gene transfer- transformation, conjugation, Electroporation, Liposome mediated gene transfer, transduction, direct transfer of DNA

Unit-II Gene Libraries

15 lectures; 10 Marks

- Concept of gene libraries
- Creation of human gene library, Use of long chain PCR for gene library construction
- cDNA libraries- cDNA synthesis, construction of cDNA libraries, RT-PCR for cDNA libraries
- Screening Strategies- screening by DNA hybridization, DNA probes, colony hybridization, PCR, immunological assay, protein function

Unit-III Techniques in Genetic Engineering

15 lectures; 10 Marks

- Blotting techniques- Types
 - Southern blotting
 - Northern blotting
 - Western blotting
 - Dot blotting
 - Autoradiography
 - Colony and Plaque blotting
- DNA Sequencing
 - Maxam Gilbert technique
 - Sanger's Dideoxynucleotide method
 - Pyrosequencing
 - DNA chip
- Polymerase Chain Reaction- principle, technique, applications of PCR in various fields

Unit-IV Human Genome Project

15 lectures; 10 Marks

- Initiation of Human Genome Project
- Approached for genome sequencing
- Major highlights of human genome
- Organisation of human genome
- Applications of human genome sequencing

References

- Recombinant DNA- J.D.Watson, Freeman (2001)
- Molecular biology and genetic engineering- P.K.Gupta, Rastogi pub. Meerut first edition 2005.
- Medical biotechnology – Jogdand, Himalaya pub. New Delhi.
- Biotechnology, U. Satyanarayana, Books and Allied (P) Ltd, Kolkata
- Elements of Biotechnology, P.K. Gupta, Rastogi Publications, Meerut
- Advances in Biotechnology, S.N. Jogdand, Himalaya Publishing House, Mumbai
- Cell Biology, C.B. Powar, Himalaya Publishing House, Mumbai

BC-312 Plant Biochemistry

Unit-I Photosynthesis

15 lectures; 10 Marks

- Definition of photosynthesis
- Ultra structure of chloroplast
- Chemistry of photosynthetic pigments: Chlorophyll, phycobilins and carotenoids
- Mechanism of Photosynthesis
 - Photosystem I and II
 - Light (Hill) and dark reaction
 - Cyclic and noncyclic photophosphorylation,
 - Significance of photosynthesis,
 - Factors affecting photosynthesis- external and internal,
- Kranz anatomy,
- C3 and C4 pathways,
- Comparison between C3 and C4 pathways,

Unit-II Respiration

15 lectures; 10 Marks

- Photorespiration:
 - Definition
 - Metabolism of Photorespiration
 - Significance of photorespiration
 - Differences between dark respiration and photorespiration
- Respiration:
 - Definition and types of respiration
 - Differences between respiration and photosynthesis
 - Differences between aerobic and anaerobic respiration
 - Differences between dark respiration and photorespiration
 - Factors affecting respiration- external and internal
- Electron transport chain:
 - Components of ETC
 - Oxidative phosphorylation,
 - Chemi-osmotic theory
 - Differences between oxidative phosphorylation and photophosphorylation

Unit-III Phytohormones

15 lectures; 10 Marks

- Definition and types of phytohormones
- Mechanism of action, physiological effect and applications of-
 - Auxins
 - Cytokinins
 - Gibberellins
 - Abscisic acid
- Seed dormancy and seed germination

Unit-IV Secondary Metabolites

15 lectures; 10 Marks

- Introduction and biosynthetic pathway of secondary metabolites
- Classification-
 - Isoprenoid /terpenoids: classification, chemistry, distribution and role of isoprenoids
 - Nitrogen containing secondary plant products: Classification
 - Alkaloids: chemistry distribution classification and physiological role
 - Cynogenic glycosides and glucosionolates: chemistry and functions
 - Non-protein amino acids: chemistry and functions
 - Plant phenolics: chemistry, biological functions, classification
 - Chemistry and functions of lignin, flavonoids and tannins

References

- Plant physiology –Narendra. K.Gupta, Sunita Gupta Oxford and IBH publishing Co.Pvt.ltd New Delhi 2005 Copyright reserved.
- Plant Physiology- Devlin, CBS Pub. New Delhi, latest Edition.
- Plant physiology- Salisbary and Ross.
- A Textbook of Plant Physiology, Biochemistry and Biotechnology, S.K. Verma, Mohit Verma, S. Chan and company ltd, New Delhi
- Biotechnology, U. Satyanarayana, Books and Allied (P) Ltd, Kolkata
- Fundamentals of Plant Physiology, V.K. Jain, S. Chan and company ltd, New Delhi
- Introduction to Plant Biotechnology, H.S. Chawla, Oxford and IBH Publishing Company Pvt Ltd, New Delhi

BC-322 Plant and Agro Biotechnology

Unit-I Plant Tissue Culture

15 lectures; 10 Marks

- Introduction to PTC
- PTC laboratory requirements
 - Laboratory space
 - Culture media composition
- Terms used in PTC
- Basic technique of plant tissue culture
- Types of cultures- Callus culture, Cell culture
- Protoplast isolation, fusion and culture
- Applications of PTC

Unit-II Micropropagation

15 lectures; 10 Marks

- Definition of micropropagation
- Technique of micropropagation
- Factors affecting micropropagation
- Applications and disadvantages of micropropagation
- Multiplication by axillary buds and apical shoots- meristem, shoot tip cultures and bud cultures
- Organogenesis- direct and indirect
- Somatic embryogenesis- direct and indirect
- Embryo culture

Unit-III Genetic Engineering of Plants

15 lectures; 10 Marks

- Agrobacterium mediated gene transfer
 - Organisation of Ti plasmid
 - T-DNA transfer and integration
 - Plant transformation techniques using Agrobacterium
 - Advantages and limitation of Agrobacterium mediated gene transfer
- Caulimovirus (CaMV) mediated gene transfer
 - CaMV virus
 - Its use in gene transfer
 - Limitations as vector
- Physical methods for gene transfer
 - Electroporation
 - Particle bombardment
 - Microinjection
 - Liposome mediated
 - Polyethylene glycol mediated

Unit-IV Biofertilizers

15 lectures; 10 Marks

- Biological nitrogen fixation
 - Nitrogen cycle
 - Symbiotic and asymbiotic nitrogen fixation
 - Mechanism of nitrogen fixation
- Genetic engineering- nitrogenase and hydrogenase gene

- Biofertilizers
 - Symbiotic nitrogen fixer
 - Asymbiotic nitrogen fixer
 - Phosphate solubilising bacteria
 - Organic fertilizers
 - Benefits and limitations of biofertilizers
- Composting – mixed culture composting, vermicomposting

References

- Elements of Biotechnology – P.K.Gupta, Rastogi, Pub. Meerut. 2001
- Applied plant biotechnology- Ignacimuthu.
- Plant biotechnology- K.G.Ramavat, S.Chand and Co., New Delhi.2001
- Molecular biology and genetic engineering- P.K.Gupta, Rastogi pub. Meerut first edition 2005.
- A Textbook of Plant Physiology, Biochemistry and Biotechnology, S.K. Verma, Mohit Verma, S. Chan and company ltd, New Delhi
- Biotechnology, U. Satyanarayana, Books and Allied (P) Ltd, Kolkata
- Fundamentals of Plant Physiology, V.K. Jain, S. Chan and company ltd, New Delhi
- Introduction to Plant Biotechnology, H.S. Chawla, Oxford and IBH Publishing Company Pvt Ltd, New Delhi
- Advances in Biotechnology, S.N. Jogdand, Himalaya Publishing House, Mumbai

BC-313 Clinical Biochemistry

Unit-I Haematology

15 lectures; 10 Marks

Classification of anaemias

- Anaemias due to impaired production of red cells
 - Stem cell defect
 - Regulatory defects
 - Defects in DNA synthesis
 - Vitamin B12 deficiency
 - Folic acid deficiency
 - Defects in haemoglobin synthesis
 - Defects in synthesis of haem
 - Defects in globin synthesis
- Anaemia due to excessive loss of red cells
 - Haemolytic anaemias
 - Intracorporeal defects
 - Extracorporeal defects
 - Haemorrhage

Unit-II Hepatic disorders

15 lectures; 10 Marks

- Liver function tests- tests and clinical significance of-
 - Tests related to protein metabolism
 - Tests related to carbohydrate metabolism
 - Tests related to lipid metabolism
 - Tests related to conjugation and excretion function
 - Tests related to bile pigment metabolism
 - Tests based on bile acid metabolism
 - Serum enzymes in liver disease
 - Some special investigations
- Gall stones
- Liver disorders: etiology and symptoms
 - Hepatitis
 - Jaundice
 - Cirrhosis

Unit-III Kidney, Lungs and Heart disorders

15 lectures; 10 Marks

- Renal/Kidney function tests- tests and clinical significance
 - Tests depending upon blood analysis
 - Tests depending upon urine analysis
 - Tests depending upon elimination of some substances
 - Clearance tests
- Glomerulonephritis- types, etiology and symptoms
- Acute renal failure
- Kidney stone
- Respiratory conditions
 - Hypoxia
 - Dyspnoea

- Dysbarism
- Asphyxia
- Hyperpnoea
- Pulmonary function test
- Congestive heart failure
- Myocardial infarction

Unit-IV Inborn Errors of Metabolism

15 lectures; 10 Marks

- Carbohydrate metabolism disorders
 - Lactose intolerance
 - Glycogen storage disease
 - Galactosurea.
- Protein metabolism disorders
 - Phenylketonuria
 - Alkaptonuria
 - Albinism
 - Maple syrup urine disease
- Lipids metabolism disorders
 - Gaucher's disease
 - Nieman Pick's disease
 - Tay Sach's disease.
- Nucleic acid metabolism disorders
 - Lesch – Nyhan syndrome
 - Gout

References:

- Satyanarayana (2006), textbook of Biochemistry, U.Staynarayana and U.Chakrapani edition third
- Text book of Medical Physiology Gayton, Harcot (2001) edition tenth
- Clinical Pathology-Manual for Undergraduates, Sabitri Sanyal, B.I. Churchill Living stone, Pvt Ltd, edition first
- Harper's book of Biochemistry edited by Murray and Granner, Appleton and Lange, latest edition.
- Clinical pathology- Sood.R, Jaypee Pub., New Delhi
- Textbook of Human Biochemistry by G.P. Talwar
- Human Physiology Vol I and II, C.C. Chatterjee, Medical Allied Agency, Calcutta
- Textbook of medical laboratory technology, P.B. Godkar, D.P. Godkar, Bhalani Publishing House, Mumbai

BC-323 Immunology

Unit-I Cells and organs of immune system

15 lectures; 10 Marks

- Hematopoiesis
- Cells of immune system
 - Lymphoid cells- T-cells, B-cells, Natural killer cells, dendritic cells
 - Granulocytes- Neutrophils, Eosinophils, Basophils, Monocytes, Macrophages, Mast cells
- Organs of immune system
 - Primary lymphoid organs
 - Thymus
 - Bone marrow
 - Lymphatic system
 - Secondary lymphoid organs
 - Lymph nodes
 - Spleen
 - MALT and GALT

Unit-II Immunity and Immune response

15 lectures; 10 Marks

- Immunity- definition and types
- Innate immunity
 - Factors influencing innate immunity
 - Mechanism of innate immunity
 - Cellular factor in innate immunity
- Adaptive/ acquired immunity
 - Active and passive immunity
- Immune response
 - Humoral immune response
 - Primary and secondary immune response
 - Antibody production
 - Factors affecting antibody production
 - Cell mediated immune response

Unit-III Antigen and Antibody

15 lectures; 10 Marks

- Antigen- definition
 - Basic terms- hapten, adjuvants, epitopes
 - Antigenicity and immunogenicity
 - Determinants of an antigenicity
- Basic structure of antibody
 - Classes of antibodies
 - IgG, IgA, IgM, IgD, IgE- structure and functions
 - Antigenic determinants on immunoglobulins
 - Isotype, Allotype and Idiotype

Unit-IV Immunochemistry

15 lectures; 10 Marks

- General features of antigen-antibody reactions
- Precipitation reaction- mechanism and applications
 - Flocculation reaction
 - Single diffusion
 - Double diffusion
 - Radial immunodiffusion
 - Immunoelectrophoresis
 - Crossover immunoelectrophoresis
 - Rocket immunoelectrophoresis
- Agglutination reaction
 - Slide and tube agglutination
 - Coombs test and passive agglutination
- Immunofluorescence
- Radio immuno assay
- ELISA- types

References

- Satyanarayana (2006), textbook of Biochemistry, U.Staynarayana and U.Chakrapani edition third
- Text book of Medical Physiology Gayton, Harcot (2001) edition tenth
- Clinical Pathology-Manual for Undergraduates, Sabitri Sanyal, B.I. Churchill Living stone, Pvt Ltd, edition first
- Harper's book of Biochemistry edited by Murray and Granner, Appleton and Lange, latest edition.
- Clinical pathology- Sood.R, Jaypee Pub., New Delhi
- Human Physiology Vol I and II, C.C. Chatterjee, Medical Allied Agency, Calcutta
- Textbook of Biochemistry and Human Biology, G.P. Talwar and L.M. Srivastava, Prentice-Hall of India Pvt. Ltd. New Delhi
- Principles of Immunology, N.V. Shastri, Himalaya Publishing House, Mumbai
- Kuby Immunology, T.J. Kindt, R.A. Goldsby, B.A.Osnorne, W.H. Freeman and Company, New York

BC-314 Metabolism

Unit-I Carbohydrate metabolism

15 lectures; 10 Marks

A. Catabolism:

- Glycolysis: steps; balance sheet; bioenergetics; fate of pyruvate; entry of other carbohydrates into glycolysis- glycogen, starch, sucrose, maltose, lactose, fructose, mannose
- Tricarboxylic acid cycle: oxidation of pyruvate to acetyl Co-A; steps of TCA cycle; balance sheet; bioenergetics; glyoxylate cycle
- HMP pathway: functions of HMP pathway; steps
- Glycogenolysis: steps of conversion of glycogen to glucose under the influence of epinephrine and glucagon

B. Anabolism:

- Gluconeogenesis: from pyruvate and amino acids; futile cycle
- Glycogen and starch biosynthesis: steps
- Biosynthesis of disaccharides: sucrose and lactose

Unit-II Protein metabolism

15 lectures; 10 Marks

A. Catabolism:

- Proteolysis: digestion of proteins; enzymes involved in digestion of protein
- Flow sheet of amino acid oxidation: pathways leading to acetyl Co-A: pathways to pyruvate, to acetoacetyl Co-A and to direct acetyl Co-A; - ketoglutarate pathway; succinate pathway; fumarate pathway; oxaloacetate pathway
- Transamination: Transamination of L-aspartate, L-alanine, L-leucine, and L-tyrosine; mechanism of the reaction
- Oxidative deamination: general reaction; oxidative deamination of glutamate
- Transmethylation: mechanism of transmethylation involving methionine as methyl group donor
- Decarboxylation: general reaction; decarboxylation of histidine, tryptophan and arginine
- Nitrogen excretory products: synthetic pathway; glutamine pathway; direct excretion; urea cycle; formation of uric acid; creatine and creatinine synthesis

B. Anabolism:

- Biosynthesis of essential and non-essential amino acids

Unit-III Lipid metabolism

15 lectures; 10 Marks

A. Catabolism:

- Activation of fatty acids and transportation into mitochondria
- -oxidation of saturated even carbon fatty acids: steps, balance sheet, bioenergetics
- -oxidation of saturated odd carbon fatty acids: steps, fate of propionyl Co-A
- -oxidation of unsaturated fatty acids: fatty acids having one and two double bonds

B. Anabolism:

- Biosynthesis of fatty acids: formation of malonyl Co-A; enzymes and functions of fatty acid synthetase complex; steps of fatty acid biosynthesis
- Elongation of saturated fatty acid and desaturation of fatty acids

- Biosynthesis of triacylglycerol: steps
- Biosynthesis of phosphoglycerides: phosphatidylinositol, phosphatidylcholine
- Biosynthesis of sphingolipid: ceramide and sphingomyelin
- Biosynthesis of cholesterol: steps
- Ketosis

Unit-IV Nucleic acid metabolism

15 lectures; 10 Marks

A. Anabolism:

- Biosynthesis of purine ribonucleotides: steps of AMP and GMP biosynthesis
- Regulation of purine nucleotide biosynthesis
- Biosynthesis of pyrimidine ribonucleotide: steps of UMP and CMP biosynthesis
- Regulation of pyrimidine biosynthesis
- Biosynthesis of Deoxyribonucleotides: conversion of ribose sugar to 2'deoxyribose sugar
- Formation of deoxythymidylic acid: steps
- Regulation of deoxyribonucleotide biosynthesis

B. Catabolism:

- Degradation of purines
- Salvage of purines
- Purine nucleotide cycle
- Pyrimidine degradation

References

- Biochemistry by A. L. Lehninger, Worth Publisher, New York
- Lubert Stryer.(1995) Biochemistry, fourth edition,W.H.Freemant and Company, NewYork.
- Satyanarayana (2006), textbook of Biochemistry, U.Staynarayana and U.Chakrapani edition third
- Textbook of Biochemistry and Human Biology, G.P. Talwar and L.M. Srivastava, Prentice-Hall of India Pvt. Ltd. New Delhi
- Textbook of Biochemistry, G.R. Agarwal, Kiran Agarwal, O.P. Agarwal, Goel Publishing House, Meerut
- Cell Biology, C.B. Powar, Himalaya Publishing House, Mumbai
- Biochemistry, C.B. Powar, G.R. Chatwal, Himalaya Publishing House, Mumbai

BC-324 Enzymology

Unit-I Basic concepts in enzymology

15 lectures; 10 Marks

- Definition of enzymes,
- Terminologies - intracellular enzymes, extracellular enzymes, holoenzymes, apoenzymes, prosthetic group, cofactor, coenzymes, isoenzymes, katal, international unit, turnover number and active site.
- Nomenclature and classification (IUB) of enzymes
- Factors affecting enzyme activity - effect of substrate concentration, enzyme concentration, product concentration, pH, temperature, activators, time, light and radiation.
- Specificity of enzyme action - absolute specificity, group specificity, optical specificity and geometrical specificity.
- Active site - definition and salient features of active site.

Unit-II Enzyme Kinetics and Inhibition

15 lectures; 10 Marks

- Mechanism of enzyme action – lowering of activation energy, lock and key model, induced fit model.
- Michaelis Menten Equation: derivation, K_m V_{max}
- Transformation of Michaelis –Menten equation: Lineweaver-Burk plot, Eadie-Hofstee plot
- Inhibition: Reversible inhibition- competitive, non-competitive and uncompetitive inhibition with examples.
- Factors contributing to the catalytic efficiency of enzymes: proximity and orientation of the substrate, covalent catalysis, acid-base catalysis, factor of strain in enzyme catalysis
- Reaction mechanism at enzyme active sites: chymotrypsin, lysozyme and carboxypeptidase

Unit-III Regulatory enzymes

15 lectures; 10 Marks

- Allosteric enzymes: definition, feedback inhibition, positive and negative modulator, heterotropic and homotropic control, mechanism of regulatory activity of allosteric enzymes- sequential and symmetry model, kinetics of allosteric enzymes, aspartate transcarbamoylase- kinetics and inhibition
- Covalently modulated enzymes: definition, explanation with example of glycogen phosphorylase enzyme
- Covalent activation of zymogen: pepsinogen, trypsinogen, chymotrypsinogen
- Classes of proteolytic enzymes: serine, aspartate, cysteine and metalloproteases

Unit-IV Enzyme technology

15 lectures; 10 Marks

- Technology of enzyme production: Selection of micro-organisms, formulation of medium, production process, Recovery and purification of enzymes
- Regulation of microbial enzyme production: Induction, feedback repression, nutrient repression
- Microbial production of proteases and amylases

- Enzyme Immobilization: methods of immobilization, adsorption, entrapment, micro-encapsulation, covalent binding, cross linking, stabilization of soluble enzyme, application of immobilized enzymes.

References

- Biochemistry by A. L. Lehninger, Worth Publisher, New York
- Lubert Stryer.(1995) Biochemistry, fourth edition,W.H.Freemant and Company, NewYork.
- Satyanarayana (2006), textbook of Biochemistry, U.Staynarayana and U.Chakrapani edition third
- Textbook of Biochemistry and Human Biology, G.P. Talwar and L.M. Srivastava, Prentice-Hall of India Pvt. Ltd. New Delhi
- Textbook of Biochemistry, G.R. Agarwal, Kiran Agarwal, O.P. Agarwal, Goel Publishing House, Meerut
- Cell Biology, C.B. Powar, Himalaya Publishing House, Mumbai
- Biochemistry, C.B. Powar, G.R. Chatwal, Himalaya Publishing House, Mumbai
- Industrial Microbiology, A.H. Patel, MacMillan India Ltd, New Delhi
- Biotechnology, U. Satyanarayana, Books and Allied (P) Ltd, Kolkata
- Elements of Biotechnology, P.K. Gupta, Rastogi Publications, Meerut
- D.L.Nelson and M.M.Cox (2005),Lehninger's Principle of Biochemistry, Publisher David N.Nelson, Michael Cox, edition fourth

BC-315 Biophysical Chemistry

Unit-I Acids and Bases

15 lectures; 10 Marks

- Properties of water in relation to life process
 - Expansion on freezing
 - Uniquely high surface tension
 - Uniquely high heat capacity
 - High solvent power
- Concept of Acid and Base
 - Arrhenius theory
 - Lewis acid and base
 - Lowry-Bronsted Theory
- Acid-Base equilibria in water
 - Law of Mass Action
 - Ionisation of water
 - Equilibrium constant and Ionisation constant of water
 - Concept of pH
- Buffers- Concept and definition
 - Henderson-Hasselbalch equation
- Biological buffer systems
 - Phosphate buffer system
 - Bicarbonate buffer system

Unit-II Diffusion, Osmosis and Colloidal phenomena

15 lectures; 10 Marks

- Diffusion- definition and types
 - Fick's laws of diffusion- first and second
 - Methods of determination of diffusion coefficient
 - Significance of diffusion coefficient
- Osmosis- definition
 - Osmotic pressure- definition and its measurement
 - Tonicity- types
 - Significance of osmosis in biology
- Colloids- concept
 - Classification of colloids- lyophilic and lyophobic colloids
 - Brownian movement
 - Tyndall effect
 - Donnan membrane equilibrium

Unit-III Viscosity, Surface tension and Adsorption 15 lectures; 10 Marks

- Viscosity- concept
 - Factors affecting viscosity
 - Measurement of viscosity
 - Capillary flow
 - Rotation of a cylinder immersed in solution
 - Rate of fall of a ball through solution
 - Applications of viscometry

- Significance of viscosity in biological systems
- Surface tension- concept
 - Factors affecting surface tension
 - Measurement of surface tension
- Adsorption- concept
 - Kinds of adsorption interactions
 - Characteristics of adsorption
 - Importance of adsorption phenomena

Unit-IV Bioenergetics

15 lectures; 10 Marks

- Energy, Free energy and Energetic coupling
- Energy rich compounds
 - ATP, causes of energy richness of ATP
 - Other energy rich compounds
- Thermodynamics- definition
 - First and second law of thermodynamics
 - Enthalpy
 - Entropy
 - Standard free energy change
 - Exergonic and endergonic reactions
- Redox potential and its measurement

References

- Physical biochemistry- Frifielder .D, W.H.Freeman and Co. New York, 1983 latest edition.
- Analytical biochemistry- Holmes and H.Peck, academic press, New York.
- Biophysical technique- Wilson and Goulding, ELBS edition, latest edition.
- Biophysical chemistry (principle and technique) – Upadhyay and Upadhyay and Nath Himalaya Pub. Nagpur, latest edition.
- Practical Biochemistry Principles and techniques, K. Wilson and J. Walker, Cambridge University press, UK
- Biotechnology, U. Satyanarayana, Books and Allied (P) Ltd, Kolkata
- Biochemistry, C.B. Powar, G.R. Chatwal, Himalaya Publishing House, Mumbai

BC-325 Analytical Techniques

Unit-I Spectrophotometry

15 lectures; 10 Marks

- Concept of electromagnetic radiations, electromagnetic spectrum
- Laws of absorption- Lambert and Beer Law
- Chromophore concept- auxochrome, various chromic shifts
- Instrumentation for UV-Visible and infra-red spectrophotometry
 - Applications of UV-Vis spectrophotometry
 - Theory and applications of infra-red spectroscopy
- Spectrofluorimetry
 - Fluorescence and phosphorescence
 - Theory and instrumentation of fluorimetry
 - Advantages, disadvantages and applications
- Flame spectrophotometry- concept
 - Instrumentation for emission flame photometry and atomic absorption spectrophotometry
 - Applications of both

Unit-II Chromatography

15 lectures; 10 Marks

- Concept of distribution coefficient
- Modes of chromatography
- Classification of chromatography
- Principle and applications of-
 - Paper chromatography
 - Thin layer chromatography
 - Gel filtration chromatography
 - Ion exchange chromatography
 - Affinity chromatography
 - Gas liquid chromatography
 - Liquid liquid chromatography

Unit-III Electrophoresis

15 lectures; 10 Marks

- Principle of electrophoresis
- Migration of an ion in an electric field
- Factors affecting electrophoretic mobility
- Principle and applications of-
 - Paper electrophoresis
 - Agarose gel electrophoresis
 - Polyacrylamide gel electrophoresis
 - SDS- Polyacrylamide gel electrophoresis
 - Isoelectric focussing
 - Capillary electrophoresis
 - Immunoelectrophoresis

Unit-IV Biosensors

15 lectures; 10 Marks

- Concept of biosensors, biochips and biofilms
- General features and principle of biosensor
- Types of biosensors
 - Electrochemical biosensors
 - Thermometric biosensors
 - Optical biosensors
 - Piezoelectric biosensors
 - Whole cell biosensors
 - Immunobiosensors
 - Applications of biosensors

References

- Physical biochemistry- Frifielder .D, W.H.Freeman and Co. New York, 1983 latest edition.
- Analytical biochemistry- Holmes and H.Peck, academic press, New York.
- Biophysical technique- Wilson and Goulding, ELBS edition, latest edition.
- Biophysical chemistry (principle and technique) – Upadhyay and Upadhyay and Nath Himalaya Pub. Nagpur, latest edition.
- Practical Biochemistry Principles and techniques, K. Wilson and J. Walker, Cambridge University press, UK
- Biotechnology, U. Satyanarayana, Books and Allied (P) Ltd, Kolkata
- Biochemistry, C.B. Powar, G.R. Chatwal, Himalaya Publishing House, Mumbai

BC-316 Biotechnology

Unit-I Basics of Fermentation Technology

15 lectures; 10 Marks

- Characteristic of industrial strain
- Screening of industrially important microbes: Primary & Secondary
- Fermentation media: Composition, Raw materials, screening of media, antifoam, buffer.
- Inoculum – stock, working culture
- Inoculum development
- Preservation methods for industrially important microbes
- Conventional Bioreactor- common features
- Batch fermentation
- Continuous fermentation:
 - Chemostat
 - Turbidostat.
- Synchronous culture and its applications.

Unit-II Downstream processing

15 lectures; 10 Marks

Stages in downstream processing

- Solid-liquid separation
 - Flotation
 - Flocculation
 - Filtration
- Release of intracellular products by cell disruption
 - Physical method
 - Chemical method
 - Enzymatic method
- Concentration
 - Evaporation
 - Liquid-liquid extraction
 - Membrane filtration
 - Precipitation
 - Adsorption
- Purification by chromatography
 - Gel-filtration chromatography
 - Ion-exchange chromatography
 - Affinity chromatography
- Formulation
- Drying

Unit-III Animal Biotechnology

15 lectures; 10 Marks

- Introduction
- Types of cell lines
- Maintenance of cell lines
- Culture media
- Stages of culturing continuous cell line
- Cell culturing in laboratory

- Large scale culturing
- Applications of Animal Cell Culturing

Unit-IV Biodegradation and Bioremediation

15 lectures; 10 Marks

- Biodegradation and bioremediation- concept
- Factors affecting biodegradation
- Enzyme systems for biodegradation
- Types of bioremediation
- Types of reactions in bioremediation
- Biodegradation of hydrocarbons, pesticides, herbicides, halogenated aromatic compounds, polychlorinated biphenyls, organo-nitro compounds
- Bioremediation of contaminated soil, waste land and ground water
- Genetic engineering for more efficient bioremediation

References

- Industrial Microbiology, A.H. Patel, MacMillan India Ltd, New Delhi
- A Textbook of Plant Physiology, Biochemistry and Biotechnology, S.K. Verma, Mohit Verma, S. Chan and company ltd, New Delhi
- Biotechnology, U. Satyanarayana, Books and Allied (P) Ltd, Kolkata
- Elements of Biotechnology, P.K. Gupta, Rastogi Publications, Meerut
- Introduction to Plant Biotechnology, H.S. Chawla, Oxford and IBH Publishing Company Pvt Ltd, New Delhi
- Advances in Biotechnology, S.N. Jogdand, Himalaya Publishing House, Mumbai

BC-326 Biostatistics and Bioinformatics

Unit I: Introduction to Biostatistics

15 lectures; 10 Marks

- Biostatistics: definition and application;
- Basic terms: Data- classification of data; Variables- discrete and continuous, variate, derived variables- ratio index and rates; Constant; Population and sample; Tabulation; Frequency table- relative and cumulative frequency distribution
- Sampling: concept, size of sample, types of sampling
- Diagrammatic representation of data: line diagram; bar diagram- simple, divided, percentage, multiple; Pie diagram, pictogram
- Significance and limitations of diagrammatic representation
- Graphical representation of data: Histogram, Frequency polygon, Frequency curve, Cumulative frequency curve
- Significance and limitations of graphic representation

Unit-II Central tendency and Probability

15 lectures; 10 Marks

- Measures of central tendency : definition, functions and properties
- Arithmetic mean: Calculation of mean in a series of individual observations, discrete, continuous; merits and demerits of mean
- Median: Calculation of median in a series of individual observations, discrete, continuous; merits and demerits of mean
- Mode: Calculation of mode in a series of individual observations, discrete, continuous; merits and demerits of mean
- Relationship between mean, median and mode
- Probability: definition, basic terms- random experiment or trial, event, permutation and combination
- Theorems of probability: addition rule and multiplication rule
- Probability distribution: Binomial, Poisson and normal
- Concept of multivariate statistics

Unit-III Introduction to Bioinformatics

15 lectures; 10 Marks

- Bioinformatics-definition, goals, scope applications and limitations
- Genomics: Genome, Genomics- Structural (genome mapping, sequencing and genome sequence assembly and genome annotation), functional (transcriptomics, proteomics and metabolomics), and comparative genomics
- Proteomics: Protein expression profiling, functional proteomics and structural proteomics, Identification of proteins- 2 DE, MS, ESI, MALDI, protein micro array

Unit-IV Sequence analysis and Microarray

15 lectures; 10 Marks

- Sequence analysis: sequence alignment and its types, Gaps and Gap penalties, Scoring schemes, PAM, BLOSUM, Methods of sequence alignment- dot plot, dot matrix, dynamic programming, Heuristic methods- FASTA and BLAST
- Phylogenetic analysis: Basic terms- dendrogram, cladogram, phylogram, monophyletic, paraphyletic, and polyphyletic group.

References

- Biostatics- P.N.Arora, P.K. Malhan, Himalaya publishing house, Nagpur, latest edition 2008
- Khan I.A. and Khanum A, Fundamentals of Biostatistics, Ukaaz-Pub.Hyderabad
- Essentials of Bioinformatics, Jin Xiong, Cambridge university press, first edition 2007
- Bioinformatics Theory and Practice, N.J. Chikhale, V.S. Gomase, Himalaya Publishing House, Mumbai
- A Textbook of Bioinformatics, V. Sharma, A. Munjal, A. Shanker, Rastogi Publications, Meerut.
- Biostatistics, W.W. Daniel, Wiley Dreamtech India (P) Ltd, New Delhi

TECHNIQUES IN MOLECULAR BIOLOGY

1. Isolation of DNA from *E. Coli*
2. Estimation of DNA by DPA method
3. Estimation of RNA by orcinol method
4. Quantitative determination of individual bases in DNA
5. Estimation of any one secondary metabolite
6. Preparation of manure by vermicomposting process
7. Determination of activity of Phosphate solubilizing bacteria.
8. Industrial production of alcohol/ citric acid
9. Preparation of ATC media
10. Isolation of cells from suitable animal tissue
11. Quantification of cell viability and cell counting
12. Analysis of waste water for BOD and COD
13. Restriction endonucleases digestion and separation of fragments by agarose gel electrophoresis.
14. Amplification of DNA fragment using PCR and separation of fragments by agarose gel electrophoresis.
15. Preparation of MS media for PTC
16. Somatic embryogenesis
17. Aseptic germination of seedling
18. Shoot tip culture
19. Callus culture
20. Isolation of protoplast

Reference

- Biochemical Methods: S.Sadasivam and A.Manikam
- Experiments in Microbiology, Plant Pathology and Biotechnology K.R.Aneja, Vishwa Prakshan
- Animal Tissue Culture, Freshney
- Introductory Practical Biochemistry, S.K. Sawhney, R. Singh, Narosa Publishing House, New Delhi
- Experimental Biochemistry A student companion, B.S. Rao, V. Deshpande, I.K. International Pvt. Ltd., Mumbai

DIAGNOSTICS BIOCHEMISTRY

1. Hb estimation by using haematometer its significance
2. SGPT estimation by 2, 4 DNPH method.
3. SGOT estimation by 2, 4 DNPH method.
4. Serum alkaline phosphatase estimation by colorimetric method.
5. Serum acid phosphatase estimation by colorimetric method.
6. Serum bilirubin estimation by Jendrassik Groff method.
7. Estimation of serum calcium
8. Estimation of serum urea by DAM reagent.
9. Estimation of serum uric acid.
10. Serum Creatinine estimation by colorimetric method
11. Detection of abnormal constituents of urine: - Sugar, protein, ketone bodies and bile pigments
12. Demonstration/Perform Pulmonary function test using spirometer
13. Estimation of cholesterol by colorimetric method.
14. Estimation of serum triglycerides.
15. Estimation of blood glucose in serum by GOD/POD method.
16. Estimation of proteins by Biuret method and albumins by Dumas method
17. Widal agglutination test (slide test method).
18. Demonstration of ELIZA and its significance.
19. Ag-Ab reaction by Ouchterlony double diffusion method
20. Immunoelectrophoresis

References

- Varley's Practical Clinical Biochemistry (sixth Edi, 1988) Ed.by A.H.Gowenlock, Heinemann, UK
- Laboratory manual in Biochemistry (1996), J.Jayaraman, Wiley Eastern Ltd.
- Clinical Biochemistry-Nanda Maheshwari (2008) Jaypee Brothers, Medical Publishers Pvt Ltd.
- Introductory Practical Biochemistry, S.K. Sawhney, R. Singh, Narosa Publishing House, New Delhi
- Experimental Biochemistry, B.S. Rao, V. Deshpande, I.K. Int Pvt. Ltd., Mumbai
- Textbook of medical laboratory technology, P.B. Godkar, D.P. Godkar, Bhalani Publishing House, Mumbai

ANALYTICAL BIOCHEMISTRY AND ENZYMOLOGY

1. Preparation of phosphate buffer of suitable pH and molarity
2. Determination of viscosity of suitable liquid by viscometer
3. Estimation of lambda max and extinction coefficient of given chromophore.
4. Purification of protein by salt precipitation and solvent fractionation procedure.
5. Quantitative estimation of protein by Lowry's method.
6. Separation of amino acids using Paper layer chromatography
7. Separation of amino acids using Thin layer chromatography
8. Separation of amino acids using paper electrophoresis
9. Separation of protein by SDS-PAGE
10. Demonstration of HPLC and GC
11. Demonstration of Atomic Absorption Spectroscopy (AAS) and infra-red spectroscopy
12. To determine the effect of enzyme-amylase concentration on the rate of reaction
13. To determine the effect of substrate concentration on the activity of amylase and determine K_m and V_{max} of the reaction
14. To determine the effect of pH on activity of amylase
15. To determine the effect of temperature on activity of amylase
16. Immobilisation of suitable enzyme/yeast cells
17. Alignment of protein/DNA sequence using BLAST
18. Preparation of phylogenetic tree
19. Representation of the given data in line/bar/pie diagram
20. Calculate mean/mode/median/probability of the given data

Reference

- Biochemical Methods: S.Sadasivam and A.Manikam
- Experiments in Microbiology, Plant Pathology and Biotechnology (second Ed.1996) K.R.Aneja, Vishwa Prakshan (New –Age International Pvt.Ltd).
- Animal Tissue Culture, Freshney
- Introductory Practical Biochemistry, S.K. Sawhney, R. Singh, Narosa Publishing House, New Delhi
- Experimental Biochemistry A student companion, B.S. Rao, V. Deshpande, I.K. International Pvt. Ltd., Mumbai

Skills to be acquired and job prospectus to the students

Biochemistry is the molecular basis of life. Degree programme in Biochemistry teaches students how inanimate, lifeless chemicals combine to produce a functional living organism. A significant attraction of the course is the ability to combine in-depth scientific knowledge with practical laboratory skills and the career opportunity in all sectors.

After successful completion of three years degree course in Biochemistry, student will be well versed with laboratory skills and transferable skills.

Laboratory Skills:

- Laboratory safety practices
- Accurate weighing and reagent preparation
- Skillful handling of basic and advanced instruments
- Calibration of basic instruments like pH meter, micropipettes etc
- Advanced techniques like-
 - Chromatography
 - Electrophoresis
 - Spectrometry
 - Polymerase Chain Reaction (PCR)
 - Plant Tissue Culture
 - Animal Tissue Culture
- Aseptic techniques
- Logical thinking
- Analysis and interpretation of results
- Collection, organization and presentation of data

Transferable Skills

During the course student will develop skills other than laboratory skills that are transferable across the number of career areas. These are:

- Analytical skill
- Report writing skill
- Presentation skill
- Time management
- Creative thinking
- Problem solving
- IT skills
- Planning
- Observational skill

Job Opportunities:

After successful completion of B.Sc. in Biochemistry, student may continue further studies like M.Sc. in Biochemistry and then Ph.D. in Biochemistry and make career in research field. Students have opportunities in private as well as public (Government) sectors.

Private Sector:

Biochemist can work in quality control, quality assurance and R & D divisions of companies like-

Biotech companies, Pharmaceutical companies, Chemical manufacturing companies, Food and Drink (includes brewing), Health and Beauty Care, Medical Instrument companies, Agricultural companies, Research Companies and Laboratories etc.

Public Sectors:

Blood Service, Cancer research institutes, Environmental Pollution Control, Forensic Science, Hospitals, National Blood Services, Overseas Development, Public Health Entities, Public Health Laboratories, Agriculture and fisheries etc.

Job profiles:

Biochemist, Biologist, Biomedical Scientist, Biotechnologist, Chemical Examiners, Chemist, Clinical Scientist, Food Scientist, Forensic Scientist, Laboratory Technician, Microbiologist, Research Associates, Research Officers, Research Scientist etc.