Choice based Credit System

Examination Scheme of MSc Biochemistry (Semester System) w.e.f. the academic session 2011-12.

(Semester I)

SL. No	Course no.	Title of Paper	Type	L-T-P	Credits	Evaluation Scheme		
						Theory	IA	Total Marks
1	BC 101	Bio Molecules	PC	4-0-0	4	80	20	100
2	BC 102	Cell Biology	PC	4-0-0	4	80	20	100
3	BC 103	Enzymology	PC	4-0-0	4	80	20	100
4	BC 104	Human Physiology	PC	4-0-0	4	80	20	100
5	BC 105	Biochemical Toxicology	PE	3-1-0	4	80	20	100
6	BC106	LAB COURSE 1		0-0-20	10			100

Total Credits: 30
Total Marks: 600

Semester –II

SL. No	Course no.	Title of Paper	Type	L-T-P	Credits	Evaluation Scheme		
						Theory	IA	Total Marks
1	BC 201	Metabolism	PC	4-0-0	4	80	20	100
2	BC 202	Advanced Molecular Biology	PC	4-0-0	4	80	20	100
3	BC 203	Biophysical and Biochemical Techniques	PC	4-0-0	4	80	20	100
4	BC 204	Immunology	PC	4-0-0	4	80	20	100
5	BC 205	Genetics for Biologist or	PE	3-1-0	4	80	20	100
6	BC 206	Biosafety and Ethics in Science	PE	3-1-0	4	80	20	-
7	BC 207	LAB COURSE II		0-0-20	10	-	-	100
8	BC 208	Seminar		0-0-0	1	50	-	50

Total Credits: 31
Total Marks: 650

Semester -III

SL. No	Course no.	Title of Paper	Type	L-T-P	Credits	Evaluation Scheme		
						Theory	IA	Total Marks
1	BC 301	Plant Biochemistry	PC	4-0-0	4	80	20	100
2	BC 302	Nutritional Biochemistry	PC	4-0-0	4	80	20	100
3	BC 303	Clinical Biochemistry	PC	4-0-0	4	80	20	100
4	BC 304	Microbial Biochemistry	PC	4-0-0	4	80	20	100
5	BC 305	Communication skills in Science	OE	2-1-0	3	40	10	50
6	BC 306	LAB COURSE III		0-0-20	10	-	-	100
7	BC307	Seminar		0-0-0	1	50	-	50

Total Credits: 30
Total Marks: 600

Semester -IV

SL. No	Course no.	Title of Paper	Type	L-T-P	Credits	Evaluation Scheme		
						Theory	IA	Total Marks
1	BC 401	Research Methodolgy and Biostatistics	PC	4-1-0	5	80	20	100
2	BC 402	Basic Computers and Bioinformatics	PC	4-1-0	5	80	20	100
3	BC 403	Methods in Molecular Biology	PE	3-1-0	4	80	20	100
4	BC 404	Self Study Paper*	PC	0-2-0	2	-	-	Qualifying
5	BC 405	Dissertation [a](Continued from 3rd semester)	PC	0-0-48	24	-	-	300

Total Credits: 40
Total Marks: 600

***: Grading: Excellent, Very Good, Good, Satisfactory and Unsatisfactory**

b: *i*) The topic of the dissertation report and the faculty under which a student will have to complete the **dissertation shall be decided by completely random lottery draw system**. This draw should be held within the first month of the third semester itself.

(ii) The candidate shall be required to submit two copies of his/her Dissertation report. The last date for receipt of dissertation report shall be 15th April.

(iii) The written part of Dissertation report shall account for 70% of marks and the viva-voce to be conducted by a duly constituted Board of Examiners for the remaining 30% of marks

(iv) Dissertation report will be evaluated on the basis of below given criteria:

Performance Evaluation Parameter	Score
Writing Quality	15%
Novelity/Scientific Significance of Aim	15%
Project Design	15%
Publication Potential	15%
Aim-Results Concurrence	10%

(v) The Viva-voce of the Dissertation report shall be conducted by the following board of examiners: 1. HOD of the concerned department or internal faculty member as its nominee; 2: One external examiner (to be appointed by the Vice-Chancellor out of the panel approved by the PGBOS). The Project Report /Training Report shall be evaluated jointly by the external and the internal examiners.

BC 101: Bio Molecules

Note: Que. 1 will be compulsory and will cover the entire syllabus in the form of short questions. Que. 2 to 9 will include two questions from each unit and candidate will have to attempt one question from each unit. Overall, five questions to be attempted. All questions to carry equal marks.

Max. Marks: 80 Max. Time: 3 hrs

UNIT 1

Introduction: Introduction to Biochemistry, water as biological solvent, weak acids and bases, pH, buffers, Handerson-Hasselbalch equation, physiological buffers.
Carbohydrates: Classification, structure, occurrence and biological functions. Glycoproteins. Physicochemical properties of monosaccharides.

UNIT 2

Lipids: Classification, structure, occurrence and biological functions of lipids. Nomenclature and properties of fatty acids and triglycerides, saponification number, acid number, Reichert-Meissel number, rancidity of fats. Composition and types of lipoproteins. Steroids and carotenoids of biological origin, liposomes.

UNIT 3

Amino acids: Nomenclature, classification and chemical structure of amino acids. Physicochemical properties of amino acids with their titration curve, reaction with ninhydrin, amino acids as zwitterions and isoelectric point.
Proteins: Classification, structure (primary, secondary, tertiary and quaternary; structure of peptide bond, Ramachandran Plot), properties and biological functions of proteins. Protein denaturation, renaturation. Methods to determine amino acid sequence- N- and C-terminal amino acid identification, amino acid sequencing of small peptides and overlapping. Chemical synthesis of polypeptides, salting in and salting out of proteins.

UNIT 4

Nucleic acids: Nature of genetic material, properties of DNA insolution, evidence of DNA as genetic material and evidence for semi-conservative nature, Composition of RNA and DNA, generalized structure plan of nucleic acids, nomenclature in structure of nucleic acids, features of DNA double helix, denaturation and annealing of DNA. Structure and roles of different types of DNAs and RNAs. Genetic code, genome.
Porphyrins: Porphyrin nucleus and classification of prophyrins, important metalloporphyrins occurring in nature, Chemical nature and significance of bile pigments.

Suggested Readings: .

1. Lehninger Principles of Biochemistry 4th Ed ***By*** David L. Nelson and Michael M. Cox, WH Freeman and Company.
2. Chemistry of Biomolecules: an Introduction (Paperback) ***By*** Richard J. Simmonds. Publisher: Royal Society of Chemistry

3. Principles of Biochemistry (Hardcover) ***By*** Geoffrey Zubay. Publisher: McGraw Hill College.

4. Biochemistry ***By*** Lubert Stryer. WH Freeman and Co.

5. Biochemistry: The Molecular Basis of Life (Paperback) ***By*** Trudy McKee and James R McKee. Publisher: McGraw-Hill Higher education.

6. Biochemistry and Molecular biology ***By*** William H. Elliott and Daphne C. Elliott. Oxford University Press.

7. Biochemistry (Hardcover) 3rd Ed**.** ***By*** Donald J. Voet and Judith G. Voet. John Wiley and Sons.

8. Biochemistry: Biomolecules, Mechanisms of Enzyme Action and Metabolism Vol 1 (Hardcover) ***By*** D Voet. John Wiley and Sons.

9. Fundamentals of Biochemistry: Life at the Molecular Level [Import] (Hardcover) ***By*** Donald Voet, Judith G. Voet and Charlotte W. Pratt. Publisher: Wiley.

10. Principles of Biochemistry (Paperback) ***By*** Robert Horton, Laurence A Moran, Gray Scrimgeour, Marc Perry and David Rawn. Pearson Education.

11. Biochemistry ***By*** U. S. Satyanarayana

12. Outlines of Biochemistry ***By*** Eric C Conn, PK Stumpf, G Bruening and Ray H. Doi. John Wiley & Sons.

BC 102: Cell Biology

Note: Que. 1 will be compulsory and will cover the entire syllabus in the form of short questions. Que. 2 to 9 will include two questions from each unit and candidate will have to attempt one question from each unit. Overall, five questions to be attempted. All questions to carry equal marks.

Max. Marks: 80 Max. Time: 3 hrs

UNIT 1

The ultra structure and functions of nucleus, mitochondria (organization of ETC), endo plasmic reticulum, Golgi apparatus, lysosomes end peroxisomes. Processing of proteins in ER and Golgi. Ultrastructure of cell membrane with reference to RBC.

The epithelial apices- glycocalyx and microvilli. The basement membrane- structural features and characteristics. The extracellular matrix- collagen, elastin, fibrillin, fibronectin, laminin and proteoglycans.

UNIT 2

The cytoskeleton: microtubules and microfilaments, functions of motor proteins in microtubules. Secretary pathways in cell, cell-cell interactions (cadherins, integrins, IgSF, selectins, tight/gap junctions),

Transport proteins in cell membrane (channel proteins, passive carrier proteins, coupled transporters and ATP-driven pumps). Cell cycle- phases and regulation. Tissues, Classification and role of various type of tissues, organization of various tissues in organs.

UNIT 3

Chemical structure of gene and chromosome. Replication, transcription and translation (with regulation) in *eukaryotes*, Activators, repressors and insulators of transcription. Post-transcriptional modifications of mRNA and processing of pre-tRNA & pre-rRNA. Transport of processed mRNA. Inhibitors of replication, transcription and translation.
Turnover of RNA, protein targeting and degradation, Gene regulation in eukaryotes and prokaryotes, Operon concept, *Lac* operon, *Arab* operon and *Trp* operon, Mutations in DNA, mutagenicity testing and DNA repair mechanisms.

UNIT 4

Receptors, Types of receptors, role of receptors in signal transduction, Mechanisms of signal transduction, Role of GTP in signal transductions, Metabolic disorders due to non functional signal transduction in cells.

Role of signal transduction in immunological mechanisms. Biochemistry of cancer – carcinogenesis, characteristics of cancer cell, Prognosis of cancer, Classification of carcinogens, agents promoting carcinogenesis, Cancer preventive mechanisms, bio chemical markers in cancer.

Suggested Readings: .

1. Molecular Cell Biology 4th Ed ***By*** James E. Darnell, Harvey Lodish, Arnold Berk, and Lawrence Zipursky, W.H. Freeman and Co.
2. Molecular Biology of the Cell 4th Ed ***By*** Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts and Peter Walter. Garland Publishers.
3. Cell Biology (Hardcover) ***By*** Thomas D. Pollard and William C. Earnshaw. Publisher: Saunders.
4. Cell and Molecular Biology: Concepts and Experiments (Hardcover) 5th Ed ***By*** Gerald Karp. John Wiley and Sons.
5. Cell and Molecular Biology ***By*** EDP de Robertis and EMF de Robertis (Jr.). Lippincott Williams & Wilkins, Philadelphia.
6. The Biochemistry of Cell Signalling ***By*** Ernst JM Helmreich, Oxford University Press.
7. Signal Transduction (Modular Texts in Molecular and Cell Biology) (Paperback) ***By*** C.H. Heldin, Carl-Heldin Heldin and Mary Purton. Bios Scientific Publishers Ltd.
8. Fundamental Neuroscience 2nd Edition ***By*** Larry Squire, James Roberts, Nicholas Spitzer, Michael Zigmond. Academic Press

BC 103: Enzymology

Note: Que. 1 will be compulsory and will cover the entire syllabus in the form of short questions. Que. 2 to 9 will include two questions from each unit and candidate will have to attempt one question from each unit. Overall, five questions to be attempted. All questions to carry equal marks.

Max. Marks: 80 Max. Time: 3 hrs

Unit 1

Introduction: History, general characteristics, nomenclature, IUB classification, definitions with examples of holoenzyme, apoenzyme, coenzymes, prosthetic groups, cofactors, activators, inhibitors, active site, metalloenzymes, isozymes, monomeric enzymes, oligomeric enzymes and multienzyme complexes. Units of enzyme activity (definition of IU, Katal), specific activity of enzyme, measurement of enzyme activity, enzyme turnover. Ribozymes and abzymes.

Enzyme Catalysis: Role of enzymes in energy of activation, factors of affecting action of enzymes- proximity and orientation, strain and distortion, acid base catalysis and covalent catalysis. Determination of active site. Mechanism of action of chymotrypsin, ribonuclease, carboxypeptidase and lysozyme.

Unit 2

Enzyme kinetics: Factors affecting enzyme activity- pH, temperature, time of incubation, enzyme concentration and substrate concentration. Derivation of Michaelis-Menten equation for unisubstrate reaction, K_{cat}/K_m and its significance, Lineweaver-Burk plot and its limitations; Eadie-Hofstee Plot, Eadie Plot, Hanes plot and Eisenthal-Cornish-Bowden plot. Significance and calculation of energy of activation from Arrhenius plot. Reversible and irreversible inhibition; competitive, non-competitive and uncompetitive inhibitions with determination of K_m and V_{max} in presence of reversible inhibitor. Derivation of K_i and Dixon plot.

Kinetics of multisubstrate reactions, introduction to sequential and ping-pong mechanisms and their classifications & double reciprocal plots with examples.

Unit 3

Protein-ligand binding, cooperativity phenomenon, Hill and Scatchard plots. Allosteric enzymes: Sigmoidal kinetics and their physiological importance, symmetric and sequential modes for action of allosteric enzymes and their significance.

Immobilization of enzymes: Introduction, classification, various methods of immobilization, kinetics of immobilized enzymes and its significance, applications of immobilized enzymes in analysis of biological materials, food industry and medicine.

Unit 4

Enzyme Regulation: Reversible and irreversible covalent modification, feedback inhibition, control of enzyme by products, substrates and adenylate energy charge, monocyclic and multicyclic cascade systems. Enzyme activation, induction and repression.

Coenzymes: Structure and biological functions of NAD, NADP, FAD, FMN, TPP, THF, biotin, Coenzyme Q, ascorbic acid, lipoic acid and PLP.

Suggested Readings: .

1. Fundamentals of Enzymology: Cell and Molecular Biology of Catalytic Proteins (Paperback) ***By*** Nicholas C. Price and Lewis Stevens. Oxford University Press.
2. Advances in Enzymology: v. 47 (Hardcover) ***By*** Alton Meister. John Wiley and Sons Inc.
3. Lehninger Principles of Biochemistry 4th Ed ***By*** David L. Nelson and Michael M. Cox, WH Freeman and Company.
4. Principles of Biochemistry (Hardcover) ***By*** Geoffrey Zubay. Publisher: McGraw Hill College.
5. Biochemistry: Biomolecules, Mechanisms of Enzyme Action and Metabolism Vol 1 (Hardcover) ***By*** D Voet. John Wiley and Sons.
6. Basic Biochemical Laboratory Procedures and Computing ***By*** R. Cecil Jack, Oxford University Press.
6. Enzyme Kinetics: Principles and Methods (Hardcover) ***By*** Hans Bisswanger. Publisher: Wiley VCH.
7. Enzymatic Reaction Mechanisms (Hardcover) ***By*** Perry A. Frey and Adrian D. Hegeman. Oxford University Press.
8. Comprehensive Enzyme Kinetics (Hardcover) ***By*** Vladimir Leskovac. Publisher: Kluwer Academic / Plenum Publishers.
9. Enzyme Kinetics: A Modern Approach (Hardcover) ***By*** Alejandro G. Marangoni. Publisher: WileyBlackwell.
10. Enzyme Kinetics and Mechanisms (Hardcover) ***By*** Kenneth B. Taylor. Kluwer Academic Publishers.
11. Nature of Enzymology ***By*** RL Foster
12. A textbook of enzyme biotechnology ***By*** Alan Wiseman.
13. Enzymes: Biochemistry, Biotechnology and Clinical Chemistry By Trevor Palmer.
14. Enzymes ***By*** M Dixon and EC Webb. EC Longmans, London.
15. The chemical kinetics of enzyme action ***By*** KJ Laidler and PS Bunting. Oxford University Press, London.

BC 104: Human Physiology

Note: Que. 1 will be compulsory and will cover the entire syllabus in the form of short questions. Que. 2 to 9 will include two questions from each unit and candidate will have to attempt one question from each unit. Overall, five questions to be attempted. All questions to carry equal marks.

Max. Marks: 80 Max. Time: 3 hrs

UNIT 1

Blood- Composition and functions of plasma, hemopoiesis, erythrocytes including Hb, leukocytes and thrombocytes, plasma proteins and their role. Blood coagulation - mechanism and regulation, Fibrinolysis, Blood groups and Rh factor. Transfers of blood gases - oxygen and carbon dioxide. Role of 2, 3-BPG, Bohr effect and chloride shift. Regulation of respiration. Pulmonary circulation

Digestive system- Composition, functions and regulation of salivary, gastric, pancreatic, intestinal and bile secretions. Digestion and absorption of carbohydrates, lipids, proteins, nucleic acids, minerals and vitamins. Role of peristalsis and large intestine in digestion.

UNIT 2

Resting potentials and action potentials of excitable cells, contraction of skeletal, cardiac and smooth muscles. Neurophysiology: Types of neurons and synapses and transmission of nerve impulse across them, Neurochemistry of vision, gestation, olfaction and hearing. Sensory receptors in skin and muscles.

Endocrinology- Secretion, mechanisms of action and effects of hormones of hypothalamus, pituitary, thyroid, adrenal gland and pancreas. Synthesis and functions of testosterone and ovarian hormones.

UNIT 3

Rhythmical excitation of heart, basic theory of circulatory function, blood flow and resistance, function of arterial and venous systems. Microcirculation and lymphatic system, control of blood flow, regulation of arterial pressure, cardiac output.

Spinal cord and motor functions, role of brain stems in controlling motor functions, functions of cerebellum, functions of cortical areas, the limbic system and cerebrospinal fluid system.

UNIT 4

Excretory system- Structure of nephron, formation of urine (glomerular filtration, tubular reabsorption of glucose, water and electrolytes), tubular secretion, role of kidneys regulation of blood pressure.

Control of body temperature, effect of low oxygen pressure on body, effects of acceleratory forces on body, effects of high partial pressures of gases on body

Suggested Readings: .

1. Textbook of Medical Physiology 10th Ed ***By*** Arthur C. Guyton and John E. Hall, Harcourt Asia Pte Ltd.
2. Essential Medical Physiology 3rd Ed ***By*** Leonard R. Johnson, Elsevier Academic Press.
3. Endocrinology: An Integrated Approach ***By*** SS Nussey and SA Whitehead. BIOS Scientific Publishers
4. Physiology 3rd Ed, ***By*** Linda Costanzo, Saunders Publishers.
5. Principles of Anatomy and Physiology 10th Edition ***By*** Gerard J. Tortora and Sandra Grabowski. Publisher: John Wiley and Sons.
6. Principles of Human Physiology (Paperback) ***By*** Cindy L. Stanfield and William J. Germann. Publisher: Pearson Education.
7. Samson Wright's Applied Physiology 13th Ed. CA Keele, E Neil & N Joels. Oxforf University Press.
8. Principles of Biochemistry: Mammalian Biochemistry ***By*** Emil Smith. McGraw Hill Publications.
9. Human Physiology: The Mechanisms of Body Function (Paperback) ***By*** Arthur J. Vander, James Sherman, Dorothy S. Luciano, Eric P. Widmaier, Hershel Raff and Hershal Strang. McGraw Hill Education.
10. Medical Physiology: Principles for Clinical Medicine 3rd Ed. ***By*** Rodney R. Rhoades and David R. Bell. Lippincott Williams & Wilkins.

BC 105: Biochemical Toxicology

Note: Que. 1 will be compulsory and will cover the entire syllabus in the form of short questions. Que. 2 to 9 will include two questions from each unit and candidate will have to attempt one question from each unit. Overall, five questions to be attempted. All questions to carry equal marks.

Max. Marks: **80** Max. Time: **3 hrs**

UNIT 1

Definition and Scope of Toxicology: Dose-response relationship, synergism and antagonism, determination of ED50 & LD50, acute and chronic exposure; clinical signs of systemic toxicity.

Xenobiotic metabolism: absorption & distribution, phase I reactions; oxidation, reduction, hydrolysis and hydration; phase II reactions/conjugation; methylation, glutathione and amino acid conjugations, detoxification.

UNIT 2

Biochemical basis of toxicity: mechanism of toxicity: distribution of excitable membrane functions; altered calcium homeostasis; genotoxicity;

Toxicity testing: genetic toxicity testing & mutagenesis assays-*in vitro* test systems-bacterial mutation tests, reversion test, ames test and fluctuation tests; *in vivo* mammalian mutation tests-host mediated assay & dominant lethal test.

UNIT 3

Pesticide toxicity: Insecticides-organochlorines, anti-cholinesterases-organophosphates and carbomates; biopesticides

Metal toxicity: toxicity of arsenic, mercury, lead and cadmium, environmental factors affecting metal toxicity-light, temperature & pH.

UNIT 4

Food toxicology: Role of diet in cardio-vascular diseases and cancer; Toxicology of food additives

Diagnosis of toxic changes in liver and kidney: metabolism of haloalkanes, haloalkenes and paracetamol with their toxic effects on tissues.

Suggested reading:-

1. General and applied toxicology, 1995 by Marrs and Turner Macmillan Press Ltd
2. Basic environmental toxicology 1994 by Lorris G. Corkerhem and Barbara SS Shane CRP Press Inc.
3. Introduction to food technology Takayurki Shibamato & leonard F. Bzeldaanes

Molecular biotechnology 2nd Ed 1994 by Barnard R Glick & JJ Pasternak

BC 106: Lab Course I

Max. Marks: 100 Max. Time: 6 hrs

1. Preparation of buffers and measurement of pH
2. Determination of acid value of lipid samples
3. Determination of saponification of lipid samples
4. Determination of iodine number of lipid samples
5. Determination of protein in given sample by Lowry method
6. Formol titration of Glycine
7. Qualitative and quantitative analysis of sugars
8. Separation of sugar mixture by paper chromatography
9. Separation of amino acids by ascending paper chromatography
10. Determination of RNA by orcinol method
11. Determination of DNA by diphenylamine method
12. Estimation and comparison of Vitamin C in fruit juices
13. Estimation of phosphorus content in food sample
14. Estimation of iron in food stuff by dipyridyl method
15. Estimation of copper in serum by diethyldithiocarbamate method.

BC 201: Metabolism

Note: Que. 1 will be compulsory and will cover the entire syllabus in the form of short questions. Que. 2 to 9 will include two questions from each unit and candidate will have to attempt one question from each unit. Overall, five questions to be attempted. All questions to carry equal marks.

Max. Marks: 80 Max. Time: 3 hrs

UNIT 1

Introduction: Concept of metabolism, experimental approaches to study metabolism- use of intact organisms, bacterial mutants, tissue slices and radioisotopes.

ETC and Oxidative phosphorylation: Sequence of electron carriers, sites of ATP production, inhibitors of ETC, mechanism and regulation of mitochondrial oxidative phosphorylation, ATP synthase (mitochondrial vs. bacterial), uncouplers of oxidative phosphorylation, transport of reducing potential and ions across mitochondrial membrane, phosphor-rylation potential, reversed and microsomal electron transfers, generation of super-oxides in mitochondria.

UNIT 2

Carbohydrate Metabolism: Reactions and energetics of glycolysis. Alcoholic and lactic fermentations, entry of fructose, mannose and galactose. Reactions and energetics of TCA cycle, gluconeogenesis, glycogenesis and glycogenolysis. Reactions and physiological significance of HMP pathway, regulation of glycolysis and gluconeogenesis, cataplerosis and anaplerosis, biosynthesis of starch and oligosaccharides, regulation of blood glucose. Uronic acid pathway and glyoxylate cycle.

Lipid metabolism: Transport and mobilization of lipids, oxidation of saturated fatty acids, oxidation of unsaturated and odd-chain fatty acids, role of carnitine in transport of fatty acid, energetics of oxidation reactions, metabolism of ketone bodies and its biological significance.

UNIT 3

Lipid metabolism (contd.): Biosynthesis of saturated and unsaturated fatty acids. Biosynthesis of triglycerides, phospholipids, sphingolipids and cholesterol. Regulation of cholesterol metabolism. Metabolism of lipoproteins. Biosynthesis of prostaglandins.
Amino acid metabolism: General reactions of amino acid metabolism- transamin-ation, deamination and oxidative decarboxylation. Biosynthesis and degradation of amino acids and their regulation. Feedback regulation of amino acid biosynthesis. Urea cycle and its regulation.

UNIT 4

Nucleic acid Metabolism: Sources of atoms in purine and pyrimidine molecules, biosynthesis and degradation of purines and pyrimidines, regulation of purine and pyrimidine biosynthesis, structure and regulation of ribonucleotide reductase. Biosynthesis of ribonucleotides, deoxyribonucleotides and polynucleotides. Inhibitors of nucleic acid biosynthesis. Porphyrin Metabolism: Biosynthesis and degradation of porphyrins, production of bile pigments.

Suggested Readings: .

1. Lehninger Principles of Biochemistry 4th Ed ***By*** David L. Nelson and Michael M. Cox, WH Freeman and Company.
2. Principles of Biochemistry (Hardcover) ***By*** Geoffrey Zubay. Publisher: McGraw Hill College.
3. Harper's Biochemistry (Lange Medical Books) (Paperback) ***By*** Robert K. Murray, Daryl K. Granner, Peter A. Mayes and Victor W. Rodwell. Publisher: Appelton and Lange.
4. Bioenergetics ***By*** David G. Nicholls and Stuart J. Ferguson. Academic Press.
5. Bioenergetics at a Glance: An Illustrated Introduction (At a Glance) (Paperback) ***By*** D. A. Harris. Publisher: Wiley Blackwell
6. Bioenergetics: 0 (Paperback) ***By*** Lars Garby and Poul S. Larsen. Cambridge University Press.
7. Fundamentals of Biochemistry: Life at the Molecular Level [Import] (Hardcover) ***By*** Donald Voet, Judith G. Voet and Charlotte W. Pratt. Publisher: Wiley.
8. Biochemistry (Hardcover) 3rd Ed. ***By*** Donald J. Voet and Judith G. Voet. John Wiley and Sons.
9. Biochemistry of Lipids, Lipoproteins and Membranes (4th Ed.) D.E. Vance and J.E. Vance. Pub: Elsevier Science B.V
10. Medical Biochemistry 4th Ed. by NV Bhagavan. Pub: Elsevier India Pvt. Ltd.
11. Biochemistry: Biomolecules, Mechanisms of Enzyme Action and Metabolism Vol 1 (Hardcover) ***By*** D Voet. John Wiley and Sons.
12. Biochemistry ***By*** Lubert Stryer. WH Freeman and Co.
13. Principles of Biochemistry (Paperback) ***By*** Robert Horton, Laurence A Moran, Gray Scrimgeour, Marc Perry and David Rawn. Pearson Education.
14. Harper's Biochemistry ***By*** RK Murray, DK Granner, PA Mayes and VW Rodwell. Appelton and Lange, Stanford.
15. Biochemistry ***By*** U. S. Satyanarayana
16. Outlines of Biochemistry ***By*** Eric C Conn, PK Stumpf, G Bruening and Ray H. Doi. John Wiley & Sons.

BC 202: Advanced Molecular Biology

Note: Que. 1 will be compulsory and will cover the entire syllabus in the form of short questions. Que. 2 to 9 will include two questions from each unit and candidate will have to attempt one question from each unit. Overall, five questions to be attempted. All questions to carry equal marks.

Max. Marks: 80 Max. Time: 3 hrs

UNIT 1

Enzymes used in molecular cloning (restriction enzymes, DNA-Polymerases, ligases, kinases, phosphatases, and nucleases); methods of production of recombinant DNA; construction of DNA libraries- genomic vs. cDNA library; Screening methods for genomics/cDNA libraries, chemical synthesis of gene; cloning vectors for DNA transfer--phage, plasmids (Ri, Ti, pGEM3Z, pBR322, pUC18, BAC), M-13 phage and cosmid. Shuttle vectors, vectors for yeast (YRp, YEp, YAC, YIp), and expression vectors (pET, pGEX,pBAD, pMAL, pRIT, PinPoint).

Proteins production in *E. coli* & yeast. Applications of recombinant DNA, Site directed mutagenesis, RAPD, RFLP & DNA finger printing, DNA Foot Printing, Mobility shift assay, Reporter assay, Yeast Two hybrid systems, antisense-RNA technology, chromosomal walking, gene therapy and recombinant vaccines.

UNIT 2

Rapid DNA sequencing techniques: Sanger's dideoxynucleotide, Maxam and Gilbert's method, pyrosequencing and single molecule sequencing with exonuclease. Analysis of DNA by Southern hybridization

Extraction, purification and analysis of mRNA from eukaryotic cells; RNA sequencing techniques (Direct chemical sequencing, enzymatic sequencing and sequencing of HMW RNAs by reverse transcriptase). Analysis of RNA by Northern Hybridization

UNIT 3

Somatic cell culture- animal cell & organ, plant callus/anther/ meristem/embryo. Protoplast isolation, protoplast fusion & protoplast culture. Micropropagation- Stages, shoot culture, node culture, multiple shoots from seeds, floral meristems, direct/indirect organogenesis, limitations.

Genetic transformation- production of gene constructs, various methods of gene transfer (viral vectors, transfection/direct gene transfer, agrobacterium mediated gene transfer, targeted gene transfer). Uses of transgenics- products of animal cell cultures, development of insect and virus resistance in plants.

UNIT 4

Primary and secondary metabolites in biotechnology, continuous and batch type culture techniques, general design of fermentor with principle types. *Fermentation processes*-brewing (Beer & Wine) and production of single cell proteins.

Production strategies for antibiotics (penicillin, streptomycin, cephalosporin & tetracycline) and other organic compounds (acetic acid, lactic acid, citric acid, ascorbic acid, B_{12}, riboflavin, glutamic acid, lysine & tryptophan).

Suggested Readings: .

1. Basic Biotechnology (Paperback) ***By*** Colin Ratledge and Bjorn Kristiansen. Cambridge University Press.
2. Introduction to Biotechnology (Paperback) ***By*** William J. Thieman and Michael A. Palladino. Benjamin Cummings; US Ed edition.
3. DNA Repair and Mutagenesis, ***By*** Errol C. Friedberg, Graham C. Walker, Wolfram Siede. ASM Press.
4. Recombinant DNA Principles and Methodologies ***By*** James Joseph Greene, CRC Press.
5. Molecular Biotechnology: Principles and Applications of Recombinant DNA (Paperback) ***By*** Bernard J Glick and Jack J Pasternak. Publisher: American Society for Microbiology.
6. Molecular Cloning: a laboratory manual (Vol 1, 2 & 3) **3rd Ed.** ***By*** J. Sambrook and DW Russel. Cold Spring Harbor Laboratory Publications, NY
7. Laboratory Techniques in Biochemistry and Molecular Biology; DNA sequencing (Vol 10). ***By*** J Hindley. Elsevier Biomedical.
8. Methods of DNA and RNA sequencing. ***By*** Sherman M. Weissman. Pub: Praeger
9. RNA isolation and analysis ***By*** P. Jones, J Qiu and D. Rickwood. Bios Scientific Publishers.
10. Advanced Organic Chemistry of Nucleic Acids (Paperback) ***By*** Zoe A. Shabarova and Alexey A. Bogdanov. Pub: VCH Publishers, Inc., New York, NY (USA).
11. Analytical Techniques in DNA sequencing By Brian Nunnally. Pub: Taylor and Francis.
12. Gene Cloning and DNA Analysis: An Introduction (Paperback) ***By*** Terence. A. Brown. WileyBlackwell.
13. Gene Cloning: An Introduction (Paperback) ***By*** Terence A. Brown. Nelson Thornes Ltd.
14. Principles of Gene Manipulation and Genomics, ***By*** S.B. Primrose & Richard M. Twyman, Blackwell Publishing.
15. Principles of Fermentation Technology (Paperback) ***By*** P F Stanbury, A. Whitaker and S. Hall. Publisher: Butterworth-Heinemann.
16. Biochemical Engineering and Biotechnology ***By*** Ghasem D. Najafpour. Publisher: Elsevier Science
17. Plant Propagation by Tissue Culture 'Vol 1' ***By*** Edwin George, Michael Hall and GJ de Klerk, Pub: Springer.
18. Biotechnology: A textbook of Industrial Microbiology, ***By*** Wulf Crueger and Thomas D. Brock. Sinauer Assoc.
19. Molecular Biology of the gene ***By*** J Watson, NH Hopkin, JW Roberts, JP Stertz and AM Weiner. WH Freeman and Co., San Fransisco.
20. Gene IX ***By*** Benjamin Lewin. Oxford University Press.
21. Biotechnology: Expanding Horizons ***By*** B. D. Singh, Kalyani Publishers.

22. Textbook of Biotechnology ***By*** PK Gupta, Rastogi Publications.
23. Biotechnology ***By*** U. Satyanarayana.
24. Advances in Biotechnology ***By*** Prof. SN Jogdand, Himalaya Publishing House.

BC 203: Biophysical and Biochemical Techniques

Note: Que. 1 will be compulsory and will cover the entire syllabus in the form of short questions. Que. 2 to 9 will include two questions from each unit and candidate will have to attempt one question from each unit. Overall, five questions to be attempted. All questions to carry equal marks.

Max. Marks: 80 Max. Time: 3 hrs

UNIT 1

Bioenergetics: Laws of thermodynamics, concept of free energy, determination of G, relation between equilibrium constant and standard free energy change, biological oxidation and reduction reactions, energy rich compounds, thermodynamics of ion gradients.

Radioisotope techniques: Nature of radioactivity, properties of rays. Measurement of radioactivity, uses of radioisotopes in research. In vivo and in vitro labeling techniques-double labeling, quenching, internal standard, channel ratio, external standard ratio and emulsion counting. Autoradiography.

UNIT 2

Viscosity & Centrifugation: Measurement of viscosity (Ostwald's viscometer, Reynolds number), viscosity and sedimentation of macromolecules. Centrifugation techniques and their applications- differential and density gradient centrifugation. Subcellular fractionation.

Electrophoretic techniques: Theory of electrophoresis; continuous and discontinuous PAGE, SDS-PAGE. Other electrophoretic methods- isoelectric focusing, 2-dimen-sional gel electrophoresis, capillary electrophoresis and PFGE.

UNIT 3

Chromatography: Adsorption vs. partition chromatography. Paper, TLC, ion exchange, reverse phase, gel filtration, affinity, HPLC and gas chromatographic techniques.

Spectroscopy: Basic concepts and applications of x-ray diffraction, NMR, ESR, UV, IR, fluorescence, Raman, CD and ORD spectroscopic techniques. Mass spectrometry in structure determination of organic and biomolecules.

UNIT 4

Microscopy: Light, electron (scanning and transmission), phase contrast and fluorescence microscopies. Preparation of specimen for electron microscopy, specific staining of organelles by marker enzymes.

Biosensor Technology: Concept and design of biosensors, types and uses of biosensors. Principle and applications of biosensors for glucose, triglyceride, uric acid, cholesterol, and oxalate.

Suggested Readings:

1. Bioenergetics, 3rd Edition, ***By*** David G. Nicholls and Stuart J. Ferguson. Publisher: Academic Press.
2. Biophysics, 5th Edition, ***By*** R. Glaser, Springer, Netherlands

3. Principles and Techniques of Biochemistry and Molecular Biology **6th Ed**. Keith Wilson & John Walker, Cambridge University Press

4. Encyclopedia of Spectroscopy and Spectrometry (3-Volume Set with Online Version) (Hardcover) ***By*** George E. Tranter, John L. Holmes and John C. Lindon, Academic Press

5. Methods in Modern Biophysics, 2nd Edition, ***By*** Bengt Nolting, Springer Netherlands

6. Biophysical Chemistry: Principles & Techniques Handbook ***By*** Avinash Upadhyay, Kakoli Upadhyay and Nirmalendu Nath, Himalaya Publishing House.

7. Microbiology (Hardcover) ***By*** Lansing M. Prescott, John P Harley and Donald A. Klein. Publisher: McGraw Higher Education.

8. Chromatography: Concepts and Contrasts (Hardcover) ***By*** James M. Miller, Wiley, Interscience

9. Modern Experimental Biochemistry 3rd Edition, ***By*** Rodney Boyer, Benjamin Cummings Press.

10. Methods in Molecular Biology: Organelle proteomics, ***By*** Delphine Pflieger and Jean Rossier. Publisher: Humana Press

11. Biochemical Techniques: Theory and Practice ***By*** John F Roby. Publisher: SOS Free Stock.

12. Introduction to Electron Microscopy for Biologists: Methods in Cell Biology (Hardcover) ***By*** Terry D. Allen. Academic Press.

13. Enzyme and Microbial Biosensors: Techniques and Protocols (Methods in Biotechnology) (Hardcover) ***By*** Ashok Mulchandani. Humana Press Inc., U.S.

BC 204: Immunology

Note: Que. 1 will be compulsory and will cover the entire syllabus in the form of short questions. Que. 2 to 9 will include two questions from each unit and candidate will have to attempt one question from each unit. Overall, five questions to be attempted. All questions to carry equal marks.

Max. Marks: 80 Max. Time: 3 hrs

UNIT 1

Introduction to Immune System: Innate and acquired immunity, active and passive immunity, Immunological memory, self vs non-self discrimination, adjuvants in immune response. Cells & organs Involved in Immune Responses: Phagocytic cells and their killing mechanisms; T and B lymphocytes; Differentiation of lymphoid cells. Structure and functions of primary and secondary lymphoid organs.

Nature of Antigen and Antibody: Antigen vs Immunogen, Haptens; General organization of immunoglobulin, properties and functions of various types of immunoglobulins. Isotypic, allotypic and idiotypic variations of immunoglobulins.

UNIT 2

Generation of Diversity in Immune System: Clonal selection theory. Organization and expression of immunoglobulin genes: generation of antibody diversity. T cell receptor diversity.

Humoral and Cell Mediated Immune Responses: Kinetics of primary and secondary immune response. Complement activation and its biological consequences. Antigen processing and presentation. Cytokines and costimulatory molecules: Role in immune responses. T and B cell interactions.
Major Histocompatibility Complex (MHC) Genes and Products: Role of MHC antigens in immune responses. MHC antigens in transplantation.

UNIT 3

Antigen-Antibody Interactions. Nature and kinetics of antigen-antibody interactions. *Applications*: Production of monoclonal antibodies, agglutination and precipitation techniques, radioimmunoassay, ELISA, Western blotting and imunoflourescence. Flow cytometry of cells complexed with tagged antibodies. Immunoelectron microscopy.
Tolerance vs Activation of Immune System: Immunotolerance, Immunosuppression, Hypersensitivity (Types I, II, Ill and IV).

UNIT 4

Immune Responses in Diseases: Immune responses to infectious diseases: viral, bacterial and protozoal. Cancer and immune system. Immunodeficiency disorders. Autoimmunity.
Immunization: Active immunization (immunoporphylaxis), Passive immunization (Immunotherapy) and role of vaccines in the prevention of diseases.

Suggested Readings: .

1. Fundamental Immunology (Hardcover) ***By*** William E. Paul. Publisher: Lippincott Williams and Wilkins.
2. Immunology: International Edition (Paperback) ***By*** Janis Kuby, Thomas J. Kindt, Barbara A. Osborne and Richard A. Goldsby. WH Freeman and Co. Ltd.
3. Immunology (Paperback) ***By*** Richard A. Goldsby, Thomas J. Kindt, Barbara A. Osborne and Janis Kuby. WH Freeman and Co. Ltd.
4. Immunology (Paperback) ***By*** Ivan M. Roitt, Jonathan Brostoff and David Male. Publisher: Mosby.
5. Introduction to Medical Immunology ***By*** Gabriel Virella, Marcel Dekker Inc.
6. Roitt's Essential Immunology ***By*** Ivan M. Roitt and Peter J. Delves, Blackwell Publishing
7. Understanding Immunology (Cell and Molecular Biology in Action) (Paperback) ***By*** Peter Wood. Publisher: Prentice hall.
8. Basic Immunology: The Functions of the Immune System (Paperback) ***By*** Abul K. Abbas and Andrew H. Lichtman. Publisher: Saunders.
9. A Handbook of Practical Immunology, ***By*** G. P. Talwar, Pub: Vikas Publishing House.
10. Fundamental Immunology (Hardcover) ***By*** Robert M. Coleman and M.F. Lombard. Publisher: Brown (William C.) Co , U.S.
11. Atlas of Immunology (Hardcover) ***By*** J.M. Cruse (Author), Robert E. Lewis. CRC Press Inc.
12. Immunology ***By*** Edwards S Golub. Sinauer Associate, Sunderland.

BC 205: Genetics for Biologists

Note: Que. 1 will be compulsory and will cover the entire syllabus in the form of short questions. Que. 2 to 9 will include two questions from each unit and candidate will have to attempt one question from each unit. Overall, five questions to be attempted. All questions to carry equal marks.

Max. Marks: 80 Max. Time: 3 hrs

UNIT 1

Mendel and his laws, Applications of laws and probability tests. Chi-square test and its application in the analysis of genetic data. Pattern of inheritance, Dominant and recessive inheritance. Multiple alleles, lethal alleles, penetrance and expressivity.
Inheritance of genes. Pleiotropy, Sex linked inheritance, Sex chromosomes, Sex determination,Multiple sex chromosomes, Sex linked and sex- limited traits.

UNIT 2

Genetic counseling, Possible approaches for tracing genetic disorders, diagnosis of genetic defects, Eugenics, Principles of animal/plant breeding, techniques of plant breeding, goal objectives of plant /plant breeding, methods for crop and livestock improvements, Applied genetics, achievements of applied genetics.

UNIT 3

Speciation concept, modes of speciation, Molecular clock and evolution, Allele and genetic variations, Sources of variations: Hardy-Weinberg principles and its applications.
Pattern of changes in nucleotide and aminoacid sequences, Basic attributes and polymorphic structures in human protein coding genes. Mitochondrial DNA polymorphism. Y-chromosome polymorphism and Single nucleotide polymorphism (SNP)

UNIT 4

Physical and genetic mapping, Gene mapping by in-situ hybridization, Isolation of individual chromosomes, Linkage analysis and genetic maps, Linkage equilibrium and disequilibrium.
Heritable chromosomal abnormalities, Incidence of chromosome aberrations, Disorders of autosomes, Disorders of sex chromosomes, Disorders of sexual differentiation, Chromosome breakage syndromes.

Suggested Readings:

1. Tom Strachan & Andrew P.Read 1999. Human Molecular Genetics (2nd Edition), John Wiley & Sons.
2. Ricki Lewis, 1998. Human Genetics-Concepts & Applications (3rd Edition), McGraw-Hill.
3. T. A. Brown, 1999. Genomes, John Wiley & Sons (Asia) PTE Ltd.

4 . Scott Freeman & Jon C. Herron, 2001. Evolutionary Analysis (2nd Edition), Prentice Hall.
5. Derek A. Roff, 1997. Evolutionary Quantitative Genetics, Chapman & Hall.
6. R.S.Singh & C. Krimbas, 2000. Evolutionary Genetics- From Molecules to Morphology,
Cambridge University Press.
7.Garner E.J, Simmons, M.J. & Snustad, D.P.1991. Principles of Genetics, John Wiley & Sons Inc, N.Y
8.Watson, J.D., Hopkins, N. H., Roberts, J. W. Steitz & Weiner, A. M., 1987. Molecular Biology of the Genes, The Benjamin/Cummings Publishing Company Inc., Tokyo.
9. William S. Klug & Michael R. Cummings 1996. Essentials of Genetics, 2nd Ed, Prentice Hall Internationals
10. Daniel L. Hartl & Elizabeth W. Jones, 1999. Essential Genetics, 2nd Ed., Jones & Bartlett Publishers

BC 206: Biosafety and Ethics in Science

Note: Que. 1 will be compulsory and will cover the entire syllabus in the form of short questions. Que. 2 to 9 will include two questions from each unit and candidate will have to attempt one question from each unit. Overall, five questions to be attempted. All questions to carry equal marks.

Max. Marks: 80 Max. Time: 3 hrs

UNIT1

Properties of Radiation, Mechanism of Radioactive Decay, Beta & Gamma emission, Interactions of beta and gamma radiation with matter, electron capture, Decay schemes and energy level diagrams. The laws of Radioactive Decay. Physical, biological and effective half lives, Radionuclide hazards.

UNIT 2

Radiation measurement – monitoring, Personal monitoring: TLD's film. Contamination monitoring: Survey instruments, wipe tests, Accidents and emergencies, Spills & Personnel contamination.

UNIT 3

Medical emergencies: including death of patient, Loss of radioactive sources. Internal exposure – contamination control; External exposure – shielding, distance, time; Safe handling of radioactive sources. Activity in body fluids – urine, blood, breast, milk, etc.

UNIT 4

Ethical: somatic and germ line gene therapy, clinical trials, the right to information,ethics committee function. Biosafety containment facilities, biohazards, genetically modified organisms (GMOs), living modified organisms (LMOs)

Suggested Readings:-……..

1. Radioisotope Gauges for Industrial Process Measurements (Measurement Science and Technology) by Geir Anton Johansen and Peter Jackson (Jul 26, 2004).

2. Radioisotope Laboratory Techniques by R. A. Faires, etc. and G. G. J. Boswell (Dec 1980).

3. Radiotherapy in Practice: Radioisotope Therapy by Peter J. Hoskin (Mar 22, 2007).

4. Radioisotopes in Biology (Practical Approach Series) by Robert J. Slater (Feb 1, 2002).

5. Clinical Use of Radioisotopes by william beierwaltes (1957) .

6. Biological Safety: Principles And Practices (Biological Safety: Principles & Practices) by Diane O., Ph.D. Fleming and Debra Long Hunt (Aug 30, 2006).
7. Biosafety in the Laboratory: Prudent Practices for Handling and Disposal of Infectious Materials by National Research Council (U. S.) (Dec 1989) .
8. Genetically Modified Organisms: A Guide to Biosafety (Cabi) by George T Tzotzos (May 1995).
9. Biotechnology, Biosafety, and Biodiversity: Scientific and Ethical Issues for Sustainable Development by Sivramiah Shantharam, Jane F. Montgomery and Satellite Symposium on Biotechnology and Biodiversity (Apr 1999).

BC 207: Lab Course II

Max. Marks: 100 Max. Time: 6 hrs

1. DNA isolation from blood, plant material and microbes.
2. To perform the agarose gel electrophoresis of isolated DNA
3. RFLP and restriction digestion analysis of DNA
4. Isolation of Plasmid and PCR analysis
5. Antigen-antibody assay,
6. Immunoelectrophoresis
7. To perform ELISA
8. SDS-PAGE and Western Blotting of proteins
9. Study of effect of pH on the activity of alkaline phosphatase
10. Study of effect of temperature on the activity of alkaline phosphatase and estimation of E_a of its reaction
11. Study of effect of time of incubation on the activity of alkaline phosphatase
12. Study of effect of conc. of alkaline phosphatase on its activity
13. Study of effect of activator conc. on the activity of alkaline phosphatase
14. Study of effect of substrate conc. on the activity of alkaline phosphatase and determine K_m & V_{max} from various plots.
15. Study of effect of inhibitor conc. on the activity of alkaline phosphatase and determine K_i from various plots.

BC 301: Plant Biochemistry

Note: Que. 1 will be compulsory and will cover the entire syllabus in the form of short questions. Que. 2 to 9 will include two questions from each unit and candidate will have to attempt one question from each unit. Overall, five questions to be attempted. All questions to carry equal marks.

Max. Marks: 80 Max. Time: 3 hrs

Unit 1

Structure and functions of plant cell (including cell wall, plasmodesmata, vacuoles & secretory systems). Isolation of cell organelles with assessment of chloroplast fraction purity. Absorption and transport of water and ions in plants. Evapotranspiration.

Photosynthesis:Overview of organelles involved in photosynthesis in plants and bacteria (including light receptors, chlorophyll, light harvesting complex). Bacteriorhodopsin as ion pump. Quantum yield, quantum efficiency and energy efficiency of photosynthesis.

Photosystems I & II- their location. Mechanism of quantum capture and energy transfer in photosystems- roles of ferredoxin, plastocyanin, plastoquinone, carotenoids. The Hill reaction and photophosporylation. Reduction of carbon dioxide: C3, C4 and CAM metabolism with regulation (light activation of enzymes in them). Starch and sucrose metabolism. Role of inhibitors (DCMU) in photosynthetic electron transport. Photorespiration and its efficiency.

Unit 2

Biological nitrogen fixation and ammonia assimilation. Importance of Hup^+ symbionts. Structure and properties of symbiotic nodules. Nitrate and sulfate reduction and their incorporation in amino acids. Electron allocation coefficient of nitrogen.

Functions of important growth regulating substances- brassinosteroids, jasmonic acid, oligosaccharines and polyamines. Functions and molecular mechanisms of auxins, gibberellins, abscisic acid and cytokinins. Role of ethylene in fruit ripening.

Unit 3

Photoperiodism- phytochromes and their physiological significance. Physiology of senescence.Biochemistry of seed development (including starch synthesis). Dormancy- its mechanism and uses. Biochemistry of fruit ripening. Artificial seeds-preparation and uses.

Unit 4

Defense system in plants against biotic stresses- roles of phytoanticipins, NADPH oxidase, defense proteins, NO, phenolic compounds, jasmonic acid, ethylene and phytoalexins. Genetic basis of pathogen resistance and effects of phytotoxins on plants. Biochemistry of herbicide action.

Biochemistry of plant under various abiotic stress conditions- salinity, water deficit, oxygen deficit, oxidative stress and temperature stress.

Suggested Readings: .

1. Biochemistry and molecular biology of plants ***By*** Bob B. Buchanan, Wilhelm Gruissem and Russel L. Jones, IK International Pvt. Ltd.

2. Plant Physiology, 4th Ed., ***By*** Lincoln Taiz and Eduardo Zeiger, Sinauer Associates Inc.
3. Introduction to Plant Physiology (Hardcover) ***By*** William G. Hopkins, Wiley Interscience.
4. Advances in Plant Physiology Series (Volumes 1-25), Pub: Springer Science
5. Plant Toxicology ***By*** Bertold Hock and Erich Elstner, Marcel Dekker.
6. Plant Hormone Signaling ***By*** Peter Hedden and Stephen Thomas, Blackwell Publishing.
7. Integrative Plant Biochemistry: 40 (Recent Advances in Phytochemistry) (Hardcover) ***By*** John Romeo. Elsevier Science.
8. Plant Biochemistry (Paperback) ***By*** PM Dey and JB Harborne. Academic Press Inc., US.
9. Plant Physiology, Biochemistry and Molecular Biology (Hardcover) ***By*** David T. Dennis and David H. Turpin. Publisher: Longman
10. Plant Biochemistry and Molecular Biology (Hardcover) ***By*** Hans-Walter Heldt. Oxford University Press.
11. Physiology and Molecular Biology of Stress Tolerance in Plants (Hardcover) ***By*** K.V. Rao Madhava, A.S. Raghavendra and K. Janardhan Reddy. Kluwer Academic Publishers.
12. Plant Biochemistry (Paperback) ***By*** Caroline Bowsher, Martin Steer and Alyson Tobin. Garland Publishing Inc., US.
13. Plant Physiology and Biochemistry (Paperback) ***By*** H.S. Srivastava and N. Shankar. Rastogi Publications.
14. Textbook of Plant Physiology, Biochemistry and Biotechnology (Paperback) ***By*** S. Verma and Mohit Verma. S. Chand and Co.
15. Plant Biochemistry (Hardcover) ***By*** Hans-Walter Heldt. Academic Press.

BC 302: Nutritional Biochemistry

Note: Que. 1 will be compulsory and will cover the entire syllabus in the form of short questions. Que. 2 to 9 will include two questions from each unit and candidate will have to attempt one question from each unit. Overall, five questions to be attempted. All questions to carry equal marks.

Max. Marks: 80 Max. Time: 3 hrs

UNIT 1

Basic concepts: Composition of human body, Energy content of foods, Measurement of energy expenditure- Direct and indirect calorimetry. Prediction of BMR by Harris-Benedict, Robertson-Reid, Fleisch and Mifflin *et al* equations. Definition of BMR and SDA and factors affecting them. Thermogenic effects of foods. Energy requirements of man & woman and factors affecting them. Antinutrients.

Carbohydrates: Dietary requirements and sources of available and unavailable carbohydrates. Physico-chemical properties and physiological actions of unavailable carbohydrates (dietary fibers). Storage carbohydrates.

Proteins: Protein reserves of human body. Nitrogen balance studies and factors influencing nitrogen balance. Essential amino acids and concept of protein quality (importance of casein). Cereal proteins and their limiting amino acids. Protein requirement at different stages of development.

UNIT 2

Lipids: Major classes of dietary lipids, metabolism of plasma lipoproteins. Essential fatty acids and their physiological functions.

Electrolytes and pH balance: Electrolyte concentrations of body fluids, acid-base regulation in human body. Concept of metabolic and respiratory acidosis and alkalosis.

Minerals: Nutritional significance of dietary calcium, phosphorus, magnesium, iron, iodine, zinc and copper.

UNIT 3

Vitamins: Dietary sources, biochemical functions and specific deficiency diseases associated with fat and water soluble vitamins. Hypervitaminosis symptoms of fat-soluble vitamins. Nutritional requirements of vitamins for infants & children and during pregnancy and lactation.

Protein Energy Malnutrition (PEM): Etiology, clinical features, metabolic disorders and management of Marasmus and Kwashiorkor.

Starvation: Techniques for study of starvation. Protein metabolism in prolonged fasting. Protein sparing treatments during fasting. Basic concept of high protein, low calorie weight reduction diets (balanced diets).

UNIT 4

Obesity: Definition and classification. Genetic and environmental factors leading to obesity. Obesity related diseases and management of obesity. Role of leptin in regulation of body mass. Clinical nutrition: Causes and role of nutrition in prevention & treatment of dental caries, renal failure, hyperlipidemia, atherosclerosis, cholelithiasis, rheumatic disorders and inherited metabolic disorders (Phenylketonuria, MSUD, homocystinuria,

galactosemia, gout, diabetes insipidus and diabetes mellitus). Eating disorders (Anorexia Nervosa, Bulimia Nervosa, Binge-Eating Disorder).

Suggested Readings: .

1. Textbook of Medical Biochemistry ***By*** MN Chatterjea and Rana Shinde, Jaypee Brothers.
2. Essentials of Food and Nutrition Vol I & II, ***By*** M. Swaminathan. Bangalore Printing and Publishing Co. Ltd.
3. Modern Nutrition in Health and Diseases, ***By*** Maurice E Shils and Vernon Robert Young, 7th Ed., Pub: Lea & Febiger.
4. Handbook of Nutrition and Food 2nd Ed., ***By*** Carolyn Berdanier, Johanna Dwyer and Elaine Feldman, CRC Press
5. Nutritional Biochemistry (Hardcover) ***By*** Tom Brody. Academic Press.
6. Nutritional Biochemistry (Paperback) ***By*** S Ramakrishnan and S. Venkat Rao. TR Publications
7. Food and Nutrition ***By*** Anita Tull. Oxford University Press.
8. Nutritional Biochemistry and Metabolism: With Clinical Applications (Hardcover) ***By*** Maria C. Linder. Publisher: Appelton and Lange
9. Introduction to Nutrition and Metabolism (Paperback) ***By*** David A. Bender. CRC Press Inc.
10. Principles of Human Nutrition ***By*** Martin Eastwood. Publisher: Wiley Blackwell.
11. Human Nutrition with CD-ROM (Paperback) ***By*** Catherine Geissler and Hilary Powers. Publisher: Churchill Livingstone.
12. Food Science: The Biochemistry of Food and Nutrition (Hardcover) ***By*** Kay Yockey Mehas and Sharon Lesley Rodgers. Publisher: McGraw-Hill/Glencoe.
13. Lehninger Principles of Biochemistry 5th Ed ***By*** David L. Nelson and Michael M. Cox, WH Freeman and Company.

BC 303: Clinical Biochemistry

Note: Que. 1 will be compulsory and will cover the entire syllabus in the form of short questions. Que. 2 to 9 will include two questions from each unit and candidate will have to attempt one question from each unit. Overall, five questions to be attempted. All questions to carry equal marks.

Max. Marks: 80 Max. Time: 3 hrs

UNIT 1

Disorders of carbohydrate metabolism: Diabetes mellitus, glycohemoglobins, hypoglycemias, galactosemia and ketone bodies. Various types of glucose tolerance tests. Glycogen storage diseases.

Lipidosis and multiple sclerosis. Causes and diagnosis of the disorders of HDL-cholesterol, LDL-cholesterol and triglycerides.

Inborn errors of metabolism:

a) ***Disorders of amino acid metabolism***- Phenylalanemia, homocystinuria, tyrosinemia, MSUD, phenylketonuria, alkaptonuria, albinism and animoacidurias.

b) ***Disorders of nucleic acid metabolism***- Disorders in purine/ pyrimidine metabolism.

UNIT 2

Evaluation of organ function tests: Clinical assessment of renal, hepatic, pancreatic, gastric, intestinal and thyroid functions. Clinical importance of bilirubin.

Diagnostic enzymes: Principles of diagnostic enzymology. Clinical significance of aspartate aminotransferase, alanine aminotransferase, creatine kinase, aldolase and lactate dehydrogenase. Enzyme tests in determination of myocardial infarction. Enzymes of pancreatic origin and biliary tract.

UNIT 3

Hormonal disturbances: Protein hormones (anterior pituitary hormones, posterior pituitary hormones), steroid hormones, adrenocorticosteroids, and reproductive endocrinology. Disturbances in thyroid function.

Disorders of mineral metabolism: Hyper/Hypokalemia, Hyper/Hyponatremia, Hypercalcaemia, hypocalcaemia, hypophosphataemia and hyperphosphataemia.

UNIT 4

Biochemical aspects of hematology: Disorders of erythrocyte metabolism, hemoglobinopathies, thalassemias, thrombosis, porphyrias and anemias. Laboratory tests to measure coagulation and thrombolysis.

Detoxification in the body: enzymes of detoxification, polymorphism in drug metabolizing enzymes. Mechanism of drug action and channels of its excretion. Disorders of trace elements.

Suggested Readings: .

1. Textbook of Medical Biochemistry ***By*** MN Chatterjea and Rana Shinde, Jaypee Brothers.
2. Lehninger Principles of Biochemistry 5th Ed ***By*** David L. Nelson and Michael M. Cox, WH Freeman and Company.
3. Davidson's Principles and Practice of Medicine: A Textbook for Students and Doctors (Hardcover) 15th Ed ***By*** LSP Davidson, J MacLeod and CRW Edwards. Publisher: Churchill Livingstone.
4. Medical Biochemistry (Paperback) ***By*** John W. Baynes and Marek Dominiczak. Publisher: Mosby.
5. Clinical Biochemistry: An Illustrated Colour Text (Paperback) 3rd Ed ***By*** Allan Gaw, Michael Murphy, Robert Cowan, Denis O'Reilly, Michael Stewart and James Shepherd. Publisher: Churchill Livingstone.
6. Review of Medical Physiology (Lange Basic Science) (Paperback) ***By*** William F. Ganong. Publisher: McGraw-Hilll Medical
7. Harper's Biochemistry (Lange Medical Books) (Paperback) ***By*** Robert K. Murray, Daryl K. Granner, Peter A. Mayes and Victor W. Rodwell. Publisher: Appelton and Lange.
8. Clinical Biochemistry ***By*** Richard Luxton. Scion Publishing Ltd.
9. Principles of Medical Biochemistry: With STUDENT CONSULT Online Access (Paperback) ***By*** Gerhard Meisenberg and William H. Simmons. Publisher: Mosby.

BC 304: Microbial Biochemistry

Note: Que. 1 will be compulsory and will cover the entire syllabus in the form of short questions. Que. 2 to 9 will include two questions from each unit and candidate will have to attempt one question from each unit. Overall, five questions to be attempted. All questions to carry equal marks.

Max. Marks: 80 Max. Time: 3 hrs

UNIT1

Methods of classification of microorganisms, general characteristics of main groups of microorganisms. Mycoplasmas. Gram +ve and Gram –ve bacteria with structure and functions of paptidoglycan in them. Functions of polymeric components in outer membrane and acidic polymers in Gram –ve bacteria.

Different phases of microbial growth and physical conditions required. Culture media and isolation of pure bacterial cultures. Staining methods for bacteria. Quantitative measurement of bacterial growth.

UNIT 2

Genetic recombination in bacteria (Transformation, transduction and conjugation). Transcription and translation in bacteria. Synthesis of peptidoglycan. Mechanism of action of anti-bacterial antibiotics.

Biosynthesis of aspartate family amino acids, aromatic amino acids and histidine. Stickland reaction. Synthesis pathways of coenzyme A, folate, riboflavin, NAD(P) and cobalamins in bacteria.

UNIT 3

Protein export pathways, generation of energy (ETC in aerobic/sulfur bacteria, autotrophic CO_2 fixation pathways), Oxidative reactions in methylotrophs. Microbial stress responses (genetic response to osmolality, modifications by facultative microbes, formate nitrate regulation, oxidative/pH/thermal stresses).

Specific alternative carbohydrate pathways (Entner Duodoroff Pathway, phosphoketolase pathway and anaerobic TCA). Fermentation pathways, Utilization of galactose, maltose, sorbose & mannitol. Metabolism of aromatic hydrocarbons.

UNIT 4

Virus structure including viral proteins, virus classification and lytic/lysogenic life cycles in viruses. Virus-induced changes in cells, methods of assay of viruses.

Replication of RNA viruses- negative strand (VSV), positive strand (polio) and retroviruses. Replication of DNA viruses (Adenovirus or SV40).

Suggested Readings:

1. Microbiology: An Introduction, Eighth Edition ***By*** Gerard J. Tortora, Berdell R. Funke, Christine L. Case. Pearson Education.
2. Fundamentals of Microbiology ***By*** I. Edward Alcamo. Benjamin-Cummings Pub Co.

3. Microbial Life (Hardcover) ***By*** Jerome Perry, James Staley and Stephen Lory. Pub: Sinauer Associates Inc.
4. Microbiology: Concepts and Applications (Hardcover) ***By*** MJ Pelczar, ECS Chan and NR Krieg, McGraw-Hill.
5. Microbiology (Hardcover) ***By*** Lansing M. Prescott, John P Harley and Donald A. Klein. Publisher: McGraw Higher Education.
6. Principles of Microbiology ***By*** Ronald M. Atlas
7. Microbiology ***By*** BD Davis, R Delbecco, HM Eisent and HS Ginsberg. Medical Division, NY.
8. Microbial Biochemistry (Hardcover) ***By*** ML Srivastava, Alpha Science Intl Ltd.
9. Microbial Biochemistry (Hardcover) ***By*** GN Cohen, Publisher: Springer.
10. Microbial Physiology ***By*** Albert G. Moat, John Watkins Foster, Michael P. Spector. Publisher: John Wiley & Sons.
11. Cofactor Biosynthesis: A Mechanistic Perspective, Volume 61 (Vitamins and Hormones) (Hardcover) ***By*** Gerald Litwack, Tadgh Begley. Publisher: Academic Press.
12. Principles of Virology: Molecular Biology, Pathogenesis and Control. ***By*** SJ Flint, LW Enquist, RM Krug, VR Racaniello and AM Skalka. ASM Press.
13. Fundamentals of Molecular Virology ***By*** Nicholas H. Acheson. John Wiley & Sons.
14. Basic Virology (Paperback) ***By*** Edward K. Wagner (Author), Martinez J. Hewlett, David C. Bloom and David Camerini. Publisher: WileyBlackwell

BC 305: Communication skills in Science

Note: Que. 1 will be compulsory and will cover the entire syllabus in the form of short questions. Que. 2 to 9 will include two questions from each unit and candidate will have to attempt one question from each unit. Overall, five questions to be attempted. All questions to carry equal marks.

Max. Marks: 40 Max. Time: 1.5 hrs

Unit 1

Scientific and technical writing: Preparation of scientific report, Thinking and planning, Information, ideas, order of writing, Paragraph writing proper use of verb, Nouns, pronouns, tense, use of MS office, excel, powerpoints for preparing a scientific report.

Unit 2

Scientific presentation: Preparation of presentation, Order of material, Use of web information in presentation, Ethical/copyright issues in presentations, Title, objective, methodology and results presentation, Different ways to make impressive presentations.

Unit 3

Oral presentations: General gesture for presentations, Speed, loudness, clarity during presentations, use of appropriate vocabulary during presentation, General discussions, scientific presentation, Sharing view and ideas.

Unit 4

Use of web to collect specific informtaion, Scientific paper and review writing, Correspondence with editors and reviewers, appropriate citations, copyright and Ethical issues in paper drafting, Acknowledgment, Keywords, Use of appropriate citations, usage of different softwares for manuscript preparation, usage of line-,bar-graphs, charts to describe the results.

Suggested readings:.....

1. Rastogi, B.C., Bioinformatics, Concept, Skills & Applications, CBS Publications.
2. Richard Ellis, Communication Skills: Stepladders to sucess for professional,Gutenberg Press, Malta.
3. John W. Davis, Communication skills: aguide for engineering and applied science students, Prantics Hall, 2001.
4. Gupta S., Communication skills and Functional Grammer, University Science Press, New Delhi 110002.
5. Llyod M., Bor R., Communication skills for medicine, Elsevier press, Churchill Liverstone Elsevier.

BC 306: Lab Course III

Max. Marks: 100 Max. Time: 6 hrs

1. Sterilization of glassware, media, plating and inoculation
2. Gram staining of bacteria
3. Isolation of chloroplast from spinach
4. Bioassay of cytokinin
5. Estimation of phosphate in plant tissue
6. Estimation of amylase in germinated seeds
7. Assay of nitrate reductase in plant tissue
8. Enzymatic determination of 3-phophoglyceric acid in plant sample
9. Determination of aspartate content by enzymatic method
10. Estimation of blood creatinine
11. Estimation of Glucose and GTT in the given sample
12. Estimation of cholesterol in given sample
13. Estimation of ALP in serum
14. Estimation of Total protein by Biuret method in the given serum and urine sample
15. Estimation of blood urea
16. Estimation of blood uric acid
17. Estimation of serum and urine bilirubin

BC 401: Research Methodology and Biostatistics

Note: Que. 1 will be compulsory and will cover the entire syllabus in the form of short questions. Que. 2 to 9 will include two questions from each unit and candidate will have to attempt one question from each unit. Overall, five questions to be attempted. All questions to carry equal marks.

Max. Marks: 80 Max. Time: 3 hrs

UNIT 1

Research Methodology- Meaning of research, Objectives of research, Motivation in Research, Types of Research, Research approaches, Research methods vs. Research Methodology, Research process- scientific method, Criteria for good research, Defining the research problem. Research design- Meaning and need for research design, features of good design. Preparation of Scientific report, presentation of a review.

UNIT 2

Mechanical and stylistic aspects of scientific writing- Precision and clarity of language, writing style, writing process, presentation of numerical data and scientific figures. Constraints on scientific writing- audience, format and mechanics (grammar, word choice, punctuation, tenses).

Objectives and design of experiment- experimental unit, identifying variables, replications & controls, power analysis in planning experiments, treatment structure and design structure. Graphical analysis of data and presentation of results.

UNIT 3

Significance and limitations of statistical calculations**,** Sampling techniques. Probability theory, random variables and distribution functions, Point and interval estimation, linear regression**.** Statistical evaluation of results- Hypothesis testing, interpretation of statistic for analysis of error. Measures of central tendency and dispersion

UNIT 4

ANOVA, F-test, t-test, z-test, chi-square, correlation coefficient. Non-parametric tests- Wilcoxon signed rank test, Wilcoxon rank sum test (Mann-Whitney U test), Sing test, Runs test, Kruskal-Wallis H Test, Spearman's rank correlation and Tukey-Duckworth test.

Suggested Readings:

1. Research Methodology: Methods & Techniques ***By*** CR Kothari. Publisher: New Age International
2. From Research to Manuscript: A Guide to Scientific Writing (Paperback) ***By*** Michael Jay Katz. Publisher: Springer
3. The Craft of Scientific Writing (3rd Edition) ***By*** Michael Alley. Publisher: Springer-Verlag.
4. Writing Scientific Research Articles: Strategy and Steps (Hardcover) ***By*** Margaret Cargill and Patrick O.Connor. Publisher: WileyBlackewell.

5. The Mayfield Handbook of Technical and Scientific Writing ***By*** Leslie Perelman and Edward Barrett. McGraw-Hill NY
6. Scientific Style and Format: The CBE Manual for Authors, Editors, and Publishers (Hardcover) 6th Ed ***By*** Edward J. Huth. Publisher: Cambridge University Press.
7. The Handbook of Technical Writing, Eighth Edition (Handbook of Technical Writing Practices) (Hardcover) ***By*** Gerald J. Alred, Charles T. Brusaw and Walter E. Oliu, St. Martin's Press.
8. Science and Technical Writing: A Manual of Style (2nd Ed.) ***By*** Philip Rubens. Publisher: Routledge, London.
9. The Elements of Technical Writing (Elements of Series) (Paperback) ***By*** Gary Blake and Robert W. Bly. Publisher: Longman.
10. Technical Writing: Principles, strategies and readings (7th Edition) ***By*** Diana C. Reep. Publisher: Longman.
11. Biostatistics ***By*** PN Arora and PK Malhan, Himalaya Publishing House.
12. Experimental Design and Data Analysis for Biologists ***By*** Gerry P. Quinn and Michael J. Keough. Publisher: Cambridge University Press.
13. Principles of Biostatistics (with CD-ROM) (Hardcover) ***By*** Marcello Pagano and Kimberlee Gauvreau. Publishers: Duxbury Press
14. Biostatistics: Experimental Design and Statistical Inference (Hardcover) ***By*** James F. Zolman. Oxford University Press.
15. Intuitive Biostatistics ***By*** Harvey Motulsky. Publisher: Oxford University Press

BC 402: Basic Computers and Bioinformatics

Note: Que. 1 will be compulsory and will cover the entire syllabus in the form of short questions. Que. 2 to 9 will include two questions from each unit and candidate will have to attempt one question from each unit. Overall, five questions to be attempted. All questions to carry equal marks.

Max. Marks: 80 Max. Time: 3 hrs

UNIT 1

Computer peripherals and Hardware description – Computer system design, Recognition and structure of different components of a computer system and their respective usage. Input/output and storage devices. Introduction of internet and MS-Office 2003/2007.

UNIT 2

Types of computer networks and network topologies; overview of Windows. Number Systems and flow charts in computing language. Role of Bioinformatics in Biotechnology. The Virtual Library: Searching 'Medline' on PubMed system from NCBI.

UNIT 3

Patents and searching of patent databases. Introduction biological databases- types (relational & object-oriented). Primary, secondary & specialized databases**.** Types of databases- Nucleotide sequence database, EMBL, Genebank, Unigene, Genome biology, Protein dBase (Swiss-prot & Trembl and Motif) and 3D structure databases (PDB, SCOP, Cath, Genecards, SRS & Entrez) . Computational approaches for gene identification, ORF and Human Genome Project.

UNIT 4

Basics of sequence analysis- Dot matrix method, Needleman–Wunsch Algorithm and Smith-Waterman algorithm, Alignments using BLAST and FASTA, Multiple Sequence Alignment (CLUSTAL-X and CLUSTAL-W), Application of multiple sequence alignment (PSSM and Markov/Hidden Markov models. Analysis tools: Analysis by Tree-View, Genedoc and Lasergene. Protein Structure Prediction in Bioinformatics- Ab initio based methods, Homology based methods, prediction with neural networks, secondary structure prediction (helical membrane proteins, beta-barrel membrane proteins). Protein structure comparison- intermolecular and intramolecular methods Phylogenetics-construction by distance based methods, character based methods

Suggested Readings:

1. Computer Fundamentals: Concepts, Systems and Applications ***By*** PK Sinha. BPB Publications.
2. Computer Fundamentals and Programming in C ***By*** JB Dixit. University Science Press.
3. Computer fundamentals and programming in C ***By*** Amiya Kumar Rath, Alok Kumar Jagadev and Santosh Kumar Swain. Scitech Publications.
4. Computer Fundamentals (Paperback) ***By*** Ashok Arora, Shefali Bansai and Shefali Bansal. Publisher: Excel Books.

5. Discovering Computers: Fundamentals (Paperback) ***By*** Gary B. Shelly. Publisher: Course Technology.
6. Discovering Computers: Fundamentals, Fourth Edition (Shelly Cashman) (Paperback) ***By*** Gary B. Shelly Thomas J. Cashman and Misty E. Vermaat. Publishers: Course Technology
7. Computer Fundamentals: Architecture and Organization (Paperback) ***By*** B. Ram. Publisher: New Age Publications (Academic)
8. Essential Bioinformatics (Paperback) ***By*** Jin Xiong. Cambridge University Press.
9. Bioinformatics: Methods & Protocols ***By*** Stephen Misener and Stephen A. Krawetz, Humana Press.
10. Essentials of Bioinformatics ***By*** Irfan Ali khan and Atiya Khanum. Publisher: Ukaaz Publications.
11. Bioinformatics: Sequence and Genome Analysis (Hardcover) ***By*** David W. Mount. Cold Spring Harbor Laboratory Press
12. Introduction to Bioinformatics (Paperback) ***By*** Arthur M. Lesk. Oxford Univ Press.
13. Introduction to Bioinformatics: A Theoretical and Practical Approach (Paperback) ***By*** David Womble, Stephen A. Krawetz and David D. Womble. Humana Press Inc., U.S.
14. Applied Bioinformatics: An Introduction (Paperback) ***By*** Paul M. Selzer, Richard Marhofer and Andreas Rohwer. Publisher: Springer-Verlag Berlin and Heidelberg GmbH & Co. K.

BC 403 : Methods in Molecular Biology

Note: Que. 1 will be compulsory and will cover the entire syllabus in the form of short questions. Que. 2 to 9 will include two questions from each unit and candidate will have to attempt one question from each unit. Overall, five questions to be attempted. All questions to carry equal marks.

Max. Marks: 80 Max. Time: 3 hrs

Unit 1

Classes of DNA sequences: Methods of distinguishing double and single stranded DNA-SSB protein binding, S_1 nuclease digestion, ethidium bromide staining, silver staining and fluorescence.

Re-association kinetics: Cot values, experimental procedure, qualitative significance, use of Ag* cesium sulphate. Satellite DNA: Mechanical strength, gene library, suppressor mutation, centromeric DNA, split genes.

Unit 2

Chromatin: Histone and non-histone proteins, general properties of histones, packing density. Nucleosomes, size variable linker, role of H1. Transcriptionally active chromatin.

Movable genes: transposons and associated inverted repeats. The cassette model. Transforming DNA and plant genes. Retrovirus life cycle.

Unit 3

Strategies for cloning in plasmid vectors, features of commonly used vectors, their purification and characterization. Identification of bacterial colonies that contain recombinant plasmids. Bacteriophage vectors, Cloning in Bacteriophage vectors.

Cloning in cosmid vectors. Construction of Genomic DNA libraries in cosmid vectors. Enzymes used in molecular cloning, restriction enzymes, DNA-Polymerases, ligases, kinases, phosphatases, and nucleases. DNA binding proteins.

Unit 4

Agarose gel electrophoresis, detection and extraction of DNA from gels. Construction and analysis of cDNA- protocols and strategies for cDNA cloning. Analysis of Genomic DNA by Southern Hybridization. Amplification of DNA by the polymerase chain reaction.

Preparation of radiolabeled DNA and RNA probes. Synthetic oligonucleotides probes. Expression of cloned Genes in cultured cells. Screening expression with antibodies and oligonucleotides.

Suggested Readings: .

1. Molecular Cloning: a laboratory manual (Vol 1, 2 & 3) **2nd Ed.** ***By*** T. Maniatis, EF Fritsch and J. Sambrook. Cold Spring Harbor Laboratory Publications, NY.
2. Molecular Cloning: a laboratory manual (Vol 1, 2 & 3) **3rd Ed.** ***By*** J. Sambrook and DW Russel. Cold Spring Harbor Laboratory Publications, NY
3. Laboratory Techniques in Biochemistry and Molecular Biology; DNA sequencing (Vol 10). ***By*** J Hindley. Elsevier Biomedical.
4. Methods of DNA and RNA sequencing. ***By*** Sherman M. Weissman. Pub: Praeger
5. RNA isolation and analysis ***By*** P. Jones, J Qiu and D. Rickwood. Bios Scientific Publishers.
6. Advanced Organic Chemistry of Nucleic Acids (Paperback) ***By*** Zoe A. Shabarova and Alexey A. Bogdanov. Pub: VCH Publishers, Inc., New York, NY (USA).
7. Analytical Techniques in DNA sequencing By Brian Nunnally. Pub: Taylor and Francis.
8. Genomics: Fundamentals and Applications. ***By*** S Choudhuri and DB Carlson. Informa Healthcare.
9. Gene and Probes: A practical approach series ***By*** BD Hames and SJ Higgins. Oxford university Press.
10. Gel Electrophoresis of nucleic acids: A practical approach ***By*** D Rickwood and BD Hames. Oxford University Press.
11. Gene Cloning and DNA Analysis: An Introduction (Paperback) ***By*** T. A. Brown. WileyBlackwell.
12. Gene V ***By*** Benjamin Lewin. Oxford University Press.
13. Non-isotopic methods in Molecular Biology ***By*** ER Levy and CS Herrington. Oxford University Press.