KURUKSHETRA UNIVERSITY, KURUKSHETRA

Curriculum for B.Sc. (Biochemistry)

(Semester System)

Scheme of Examination (w.e.f. 2011-12)

Class	Semester	Paper No.	Title of paper	Max. Marks	Internal Assessment	Total Marks
B.Sc. – I	I	I	Biomolecules – 1	40	10	50
		II	Biomolecules – 2	40	10	50
		III	Lab Course – 1	-	-	-
	II	IV	Enzymology – 1	40	10	50
		V	Enzymology – 2	40	10	50
		VI	Lab Course – 2	100	-	100
B.Sc. – II	III	VII	Intermediary Metabolism – 1	40	10	50
		VIIII	Intermediary Metabolism – 2	40	10	50
		IX	Lab Course – 3	-	-	-
	IV	X	Molecular Biology – 1	40	10	50
		XI	Molecular Biology – 2	40	10	50
		XII	Lab Course –4	100	-	100
B.Sc.- III	V	XIII	Plant Biochemistry	40	10	50
		XIV	Clinical Biochemistry	40	10	50
		XV	Lab Course – 5	-	-	50
	VI	XVI	Immunology	40	10	50
		XVII	Biochemical Techniques	40	10	50
		XVIII	Lab Course – 6	100	-	100

Note: Practical examinations will be held at the end of even semesters. So in B.Sc.-I the marks for practical paper are for both Lab Courss 1&2. Similarly, in B.Sc.-II the marks for practical paper are for both Lab Courss 3&4. In B.Sc.-III, the marks for practical paper are for both Lab Courss 5&6.

B.Sc. - I (Biochemistry) Semester-I
Paper – I (Biomolecules-1)

Max. Marks: 40
Int Assessment: 10
Time: 3 hours

NOTE: Seven questions will be set in all. Question No.1 comprising of objective/short answer type questions from the entire syllabus, will be compulsory. The remaining six questions will be set taking three questions from each section. The candidates will be required to attempt Q.No.1 & four others selecting two questions from each section. All questions carry equal marks.

SECTION -A

Water and Buffers: Structure, hydrogen bonding, solvent properties, and ionization. Fitness of the aqueous environment for living organisms. Weak acids and bases, pH, buffers, Henderson-Hasselbalch equation and physiological buffers.

Carbohydrates: Definition and classification. Monosaccharides: Structure, occurrence and biological importance of common monosaccharides; Stereoisomerism of sugars; Mutarotation; Reactions: oxidation, reduction, periodic acid oxidation, reactions with hydrazine, hydroxylamine, action of acids & alkalies, formation of glycosides and esters. Important derivatives of monosaccharides: deoxy sugars and amino sugars. Structure, occurrence and functions of important di- and trisaccharides. Polysaccharides: Structure, occurrence and biological importance of starch, glycogen, cellulose, chitin, pectins & proteoglycans.

SECTION – B

Lipids: Definition and classification. Fatty acids: introduction, classification, nomenclature, structure and properties of saturated and unsaturated fatty acids. Essential fatty acids. Triacylglycerols: physical and chemical properties. Characterization of fats: Saponification values, iodine value, rancidity of fats, Reichert-Meissel number, peroxide value. Reactions of glycerol. Biological significance of fats. Structure & biological functions of glycerophospholipids (lecithin, cephalin, phosphatidylserine, phosphatidylinositol, plasmalogens), sphingolipids and glycolipids (cerebrosides and gangliosides). Structure, properties and functions of isoprenoids (β-carotene, α-carotene), bile acids, sterols and prostaglandins.

Suggested reading

1. Lehninger: Principles of Biochemistry, 3rd edition, by David L. Nelson and M.M. Cox (2000) Maxmillan/ Worth publishers.
2. Fundamentals of Biochemistry by Donald Voet and Judith G Voet (1999). John Wiley & Sons, NY
3. Biochemistry, 2nd edition, by R.H. Garrett and C.M. Grisham (1999). Saunders College Publishing, NY.
4. Outlines of Biochemistry by E.E.Conn, P.K.Stumpf, G. Bruenimg and Ray H.Doi (1987), John Wiley
5. Biochemistry, 2nd edition, by Laurence A. Moran, K.G. Scrimgeour, H. R. Horton, R.S. Ochs and J. David Rawn (1994), Neil Patterson Publishers Prentice H.
6. Introductory Biochemistry by S.K.Singla & O.P.Chauhan (1995) Kalyani Publishers, New Delhi.
7. Biochemistry by J.L. Jain, S. Chand & Co.

B.Sc. - I (Biochemistry) Semester-I

Paper – II (Biomolecules - 2)

Max. Marks: 40
Int Assessment: 10
Time: 3 hours

NOTE: Seven questions will be set in all. Question No.1 comprising of objective/short answer type questions from the entire syllabus, will be compulsory. The remaining six questions will be set taking three questions from each section. The candidates will be required to attempt Q.No.1 & four others selecting two questions from each section. All questions carry equal marks.

SECTION – A

Proteins: Introduction, classification based on solubility, shape, composition and functions. Amino acids: common structural features, stereoisomerism and RS system of designating optical isomers, classification and structures of standard amino acids as Zwitter ion in aqueous solutions, physical and chemical properties, titration of amino acids, essential amino acids and non protein amino acids. Peptides: structure of peptide bond, Merrifield solid-phase synthesis of polypeptides. Determination of the amino acid sequence of a polypeptide chain. Protein structure: levels of structure in protein architecture (Primary, secondary, tertiary and quaternary structures of proteins) and forces stabilizing these structures. . Denaturation and renaturation of proteins. Salting-in and salting-out of proteins.

SECTION – B

Nucleic acids: Structures of purines pyrimidines,nucleosides and nucleotides in RNA and DNA, generalized structural plan of nucleic acids, nomenclature used in writing structure of nucleic acids, features of DNA double helix and forces stabilizing DNA double helix. A, B and Z-DNAs. Chargaffs rules. Denaturation (T_m and buoyant density and their relationship with G-C content in DNA) and annealing of DNA. Structure and roles of different types of RNA. Central dogma of molecular biology.

Porphyrins: Porphyrin nucleus and classification of porphyrins. Important metalloporphyrins occurring in nature. Bile pigments- chemical nature and their physiological significance.

Suggested reading

1. Lehninger: Principles of Biochemistry, 3rd edition, by David L. Nelson and M.M. Cox (2000) Maxmillan/ Worth publishers.
2. Fundamentals of Biochemistry by Donald Voet and Judith G Voet (1999). John Wiley & Sons, NY
3. Biochemistry, 2nd edition, by R.H. Garrett and C.M. Grisham (1999). Saunders College Publishing, NY.
4. Biochemistry, 4th edition, by L. Stryer (1995). W.H. Freeman & Co.,NY.
5. Outlines of Biochemistry by E.E.Conn, P.K.Stumpf, G. Bruenimg and Ray H.Doi (1987), John Wiley & sons.
6. Harper's Biochemistry, 25th edition, by R.K.Murray, P.A.Hayes, D.K.Granner, P.A. Mayes and V.W.Rodwell (2000) Prentice Hall International.
7. Biochemistry, 2nd edition, by Laurence A. Moran, K.G. Scrimgeour, H. R. Horton, R.S. Ochs and J. David Rawn (1994), Neil Patterson Publishers Prentice Hall.
8. Introductory Biochemistry by S.K.Singla & O.P.Chauhan (1995) Kalyani Publishers, New Delhi.

B.Sc. –I (Biochemistry) Semester-I
Paper- III (Lab Course-1)

1. Preparation of normal, molar and percent solutions.
2. Preparation of buffer solutions and determination of their pH.
3. Qualitative tests for Carbohydrates
4. Qualitative tests for lipids
5. Determination of acid value
6. Determination of saponification value
7. Qualitative tests for amino acids and Proteins
8. Preparation of casein from milk and determination of its isoelectric point.
9. Verification of Beer- Lambert's Law.

Suggested reading

1. Introductory Practical Biochemistry by S.K.Sawhney & R. Singh (2000). Narosa Publishers
2. Practical Biochemistry by David Plummer (1990). Tata Mc-Graw Hill
3. Biochemical Methods by Sadasivam & Manickam (1996) New Age International (P) Ltd.
4. Modern Experimental Biochemistry, 3rd edition, by R. Boyer (2002) Addison-Wesley Longman.
5. A Lab. Manual in Biochemistry by J. Jayaraman (1996) New Age International (P) Ltd.

B.Sc. - I (Biochemistry) Semester-II

Paper – IV (Enzymology-1)

Max. Marks: 40
Int Assessment: 10
Time: 3 hours

NOTE: Seven questions will be set in all. Question No.1 comprising of objective/short answer type questions from the entire syllabus, will be compulsory. The remaining six questions will be set taking three questions from each section. The candidates will be required to attempt Q.No.1 & four others selecting two questions from each section. All questions carry equal marks.

SECTION - A

Enzymes: Historical perspectives, general characteristics, nomenclature & classification, significance of numbering system, holoenzyme, apoenzyme, coenzymes, cofactors, activators, inhibitors, active site, metallo-enzymes, isoenzymes, monomeric enzymes, oligomeric enzymes, multifunctional enzyme and multi-enzyme complexes. Enzyme specificity. Measurement and expression of enzyme activity: Enzyme assay, enzyme units, enzyme turn over number and specific activity.

Role of cofactors in enzyme catalysis: NAD/NADP, FMN/FAD, coenzyme A, biocytin, Vitamin B_{12} Coenzyme, lipoamide, TPP, pyridoxal phosphate, tetrahydrofolate and metal ions with special emphasis on coenzyme functions

SECTION - B

Enzyme catalysis: Reaction co-ordinate diagram, transition state, Acid-base catalysis, covalent catalysis, proximity and orientation effects, strain and distortion theory. Mechanism of action of chymotrypsin, carboxypeptidase,and ribonuclease.

Enzyme Purification: Methods of isolation of enzymes, purification of enzymes - ammonium sulfate precipitation, molecular-sieving, ,ion-exchange chromatography, affinity chromatography, criteria of homogeneity and determination of molecular weight of enzyme.

Suggested reading

1. Enzymes: Biochemistry, Biotechnology and Clinical Chemistry by Trevor Palmer (2001) Horwood Publishing.
2. Fundamentals of Enzymology, 3rd edition, by Nicholas C. Price and Lewis Stevens (1999) Oxford U.
3. The Chemical Kinetics of Enzyme action by K.J. Laidler and P.S. Bunting, Oxford University Press London.
4. Structure and mechanism in Protein Science, 2nd edition, by Alan Fersht (1999). W.H. Freeman and Co., NY

BSc. - I (Biochemistry) Semester-II
Paper – V (Enzymology-2)

Max. Marks: 40
Int Assessment: 10
Time: 3 hours

NOTE: Seven questions will be set in all. Question No.1 comprising of objective/short answer type questions from the entire syllabus, will be compulsory. The remaining six questions will be set taking three questions from each section. The candidates will be required to attempt Q.No.1 & four others selecting two questions from each section. All questions carry equal marks.

SECTION-A

Enzyme Kinetics: Factors affecting enzyme activity- enzyme concentration, substrate concentration, pH and temperature. Derivation of Michaelis - Menten equation for uni-substrate reactions. K_m and its significance. Lineweaver-Burk plot. Importance of K_{cat}/K_m. Bi-substrate reactions- brief introduction of sequential and ping-pong mechanisms with examples. Reversible (competitive, non-competitive and uncompetitive inhibitions) and irreversible inhibition. Determination of K_m & V_{max} in the presence and absence of inhibitor.

SECTION-B

Enzyme regulation: Feed back inhibition, Allosteric enzymes. Covalently modulated enzymes. Zymogen activation.

Immobilized enzymes: Advantages, methods of immobilization - Adsorption, ionic binding, covalent coupling, cross-linking, entrapment, microencapsulation etc. Applications of immobilized enzymes (A brief account).

Industrial applications of enzymes (Production of glucose from starch, cellulose and dextran; use of lactase in dairy industry; production of glucose-fructose syrup from sucrose; use of protease in food, detergent and leather industry).

Suggested reading

1. Enzymes: Biochemistry, Biotechnology and Clinical Chemistry by Trevor Palmer (2001) Horwood Publishing.
2. Fundamentals of Enzymology, 3rd edition, by Nicholas C. Price and Lewis Stevens (1999) Oxford University Press.
3. The Chemical Kinetics of Enzyme action by K.J. Laidler and P.S. Bunting, Oxford University Press London.

B.Sc. –I (Biochemistry) Semester-II

Paper – VI (Lab Course-2)

Max. Marks: 100 (for both Lab Courses – 1&2)
Time allowed: 4 hours (one session**)**

1. Estimation of protein by biuret / Lowry method
2. Assay of acid phosphatase activity from germinating mungbean seeds.
3. Calculation of specific activity of acid phosphatase .
4. Effect of enzyme concentration on enzyme activity.
5. Effect of substrate concentration on acid phosphatase activity and determination of its Km value.
6. Effect of pH on enzyme activity and determination of optimum pH.
7. Effect of Temperature on Enzyme acti.vity.
8. Partial purification of enzyme by ammonium sulphate fractionation.
9. Inhibition of Acid phosphatase by EDTA.

Suggested reading:

1. Introductory Practical Biochemistry by S.K.Sawhney & R. Singh (2000). Narosa Publishers
2. Practical Biochemistry by David Plummer (1990). Tata Mc-Graw Hill
3. Biochemical Methods by Sadasivam & Manickam (1996) New Age International (P) Ltd.
4. Modern Experimental Biochemistry, 3rd edition, by R. Boyer (2002) Addison-Wesley Longman.
5. A Lab. Manual in Biochemistry by J. Jayaraman (1996) New Age International (P) Ltd.

BSc. - II (Biochemistry) Semester-III

Paper – VII (Intermediary Metabolism-1)

Max. Marks: 40
Int Assessment: 10
Time: 3 hours

NOTE: Seven questions will be set in all. Question No.1 comprising of objective/short answer type questions from the entire syllabus, will be compulsory. The remaining six questions will be set taking three questions from each section. The candidates will be required to attempt Q.No.1 & four others selecting two questions from each section. All questions carry equal marks.

SECTION –A

Bioenergetics: Concept of free energy, standard free energy, relation between equilibrium constant and standard free energy change and coupled reactions. Biological oxidation-reduction : redox potentials, relation between standard reduction potentials and free energy change (derivations and numericals included). High-energy compounds: phosphate group transfer potential, free energy of hydrolysis of ATP, PEP and other sugar phosphates along with reasons for high ΔG.

Carbohydrate Metabolism: Reactions and energetics of glycolysis. Alcoholic and lactic acid fermentations. Feeder pathways, Entry of fructose, galactose, mannose etc into glycolysis. Reactions and energetics of TCA cycle. Regulation of glycolysis and TCA cycle. Gluconeogenesis.

SECTION- B

Glycogenesis and glycogenolysis. Regulation of glycogen metabolism. Reactions and physiological significance of pentose phosphate pathway. Glyoxylate cycle**.**

Electron Transport Chain and Oxidative Phosphorylation: Structure of mitochondria, organization and sequence of electron carriers, sites of ATP production, inhibitors of electron transport chain. Oxidative phosphorylation: chemiosmotic theory, structure of ATP synthase, binding change mechanism for proton driven ATP sysnthesis, Inhibitors and uncouplers of oxidative phosphorylation. Transport of reducing equivalents from cytosol into mitochondria.

Suggested reading:

1. Lehninger: Principles of Biochemistry, 3rd edition, by David L. Nelson and M.M. Cox (2000) Maxmillan/ Worth publishers.
2. Fundamentals of Biochemistry by Donald Voet and Judith G Voet (1999). John Wiley & Sons, NY
3. Biochemistry, 2nd edition, by R.H. Garrett and C.M. Grisham (1999). Saunders College Publishing, NY.
4. Outlines of Biochemistry by E.E.Conn, P.K.Stumpf, G. Bruenimg and Ray H.Doi (1987). John Wiley & Sons, NY
5. Biochemistry, 2nd edition, by Laurence A. Moran, K.G. Scrimgeour, H. R. Horton, R.S. Ochs and J. David Rawn (1994), Neil Patterson Publishers Prentice Hall.

BSc. - II (Biochemistry) Semester-III
Paper – VIII (Intermediary Metabolism-2)

Max. Marks: 40
Int Assessment: 10
Time: 3 hours

NOTE: Seven questions will be set in all. Question No.1 comprising of objective/short answer type questions from the entire syllabus, will be compulsory. The remaining six questions will be set taking three questions from each section. The candidates will be required to attempt Q.No.1 & four others selecting two questions from each section. All questions carry equal marks.

SECTION- A

Lipid Metabolism: Introduction, hydrolysis of triacylglycerols, activation of fatty acids, transport of fatty acyl CoA into mitochondria, beta-oxidation of saturated, unsaturated and odd chain fatty acids;alpha & omega oxidation of fatty acids. ATP yield from fatty acid oxidation. Biosynthesis of saturated fatty acids. Metabolism of ketone bodies. Biosynthesis of triglycerides ,phospholipids and sphingolipids.

SECTION- B

Amino acid Metabolism: General reactions of amino acid metabolism: transamination, oxidative and non-oxidative deamination and decarboxylation. Urea cycle. Glycogenic and ketogenic amino acids. Biosynthesis of aromatic amino acids . Glucose-Alanine cycle.

Nucleotide Metabolism: Sources of the atoms in the purine and pyrimidine molecules, *denovo* biosynthesis and degradation of purine and pyrimidine nucleotides, Regulation of purine and pyrimidine biosynthesis. Salvage pathways of purines and pyrimidines .

Porphyrin Metabolism: Biosynthesis & degradation of heme.

Suggested reading:

1. Lehninger: Principles of Biochemistry, 3rd edition, by David L. Nelson and M.M. Cox (2000) Maxmillan/ Worth publishers.
2. Fundamentals of Biochemistry by Donald Voet and Judith G Voet (1999). John Wiley & Sons, NY
3. Biochemistry, 2nd edition, by R.H. Garrett and C.M. Grisham (1999). Saunders College Publishing, NY.
4. Outlines of Biochemistry by E.E.Conn, P.K.Stumpf, G. Bruenimg and Ray H.Doi (1987). John Wiley & Sons, NY
5. Biochemistry, 2nd edition, by Laurence A. Moran, K.G. Scrimgeour, H. R. Horton, R.S. Ochs and J.David Rawn (1994), Neil Patterson Publishers Prentice Hall.

B.Sc. –II (Biochemistry) Semester-III

Paper – IX (Lab Course- 3)

1. Estimation of nitrogen by micro-Kjeldahl metho**d.**
2. Estimation of blood glucose colorimetrically.
3. Estimation of ascorbic acid by titrimetric method.
4. Preparation of starch from potato and its hydrolysis by salivary amylase
5. Determination of achromatic point for salivary amylase.
6. Isolation of total lipids by Folch method.
7. Titration of amino acids and determination of pK value

Suggested reading:

1. Introductory Practical Biochemistry by S.K.Sawhney & R. Singh (2000). Narosa Publishers
2. Practical Biochemistry by David Plummer (1990). Tata Mc-Graw Hill
3. Biochemical Methods by Sadasivam & Manickam (1996) New Age International (P) Ltd.
4. Modern Experimental Biochemistry, 3rd edition, by R. Boyer (2002) Addison-Wesley Longman.

BSc. - II (Biochemistry) Semester-IV

Paper – X (Molecular Biology-1)

Max. Marks: 40
Int Assessment: 10
Time: 3 hours

NOTE: Seven questions will be set in all. Question No.1 comprising of objective/short answer type questions from the entire syllabus, will be compulsory. The remaining six questions will be set taking three questions from each section. The candidates will be required to attempt Q.No.1 & four others selecting two questions from each section. All questions carry equal marks.

SECTION - A

Basic Concepts of Genetic Information: Nucleic acids as genetic information carriers: experimental evidences e.g. bacterial genetic transformation, Hershey-Chase experiment, TMV reconstitution experiment. Central dogma of molecular genetics: current version. Salient features of prokaryotic, eukaryotic and viral genomes. Histons and nucleosomes. Highly repetitive, moderately repetitive and unique DNA sequences, telomeres, SINES, LINES, c-value paradox, satellite DNA.

DNA Supercoiling: A brief account of DNA supercoiling and topoisomerases**.**

DNA Sequencing: Sequencing of DNA by chemical cleavage and dideoxy methods.

Nucleases: Important DNases and RNases including restriction endonucleases.

SECTION – B

DNA Replication: DNA replication in prokaryotes-conservative, semiconservative and dispersive types, experimental evidence for semiconservative replication. Enzymes and protein factors involved in replication, mechanism of replication and inhibitors of DNA replication.

Mutations and DNA Repair: Mutations: Types of mutations, Physical and chemical mutagens, Molecular basis of mutation and Ames test of carcinogenicity. DNA Repair: UV repair systems in *E. coli*, base-excision repair, nucleotide-excision repair & significance of thymine in DNA.

Suggested reading:

1. Biochemistry, 4th edition, by L.Stryer (1995). W.H.Freeman & Co.,NY.
2. Fundamentals of Biochemistry by Donald Voet and Judith G Voet (1999) , John Wiley & Sons, NY
3. Lehninger: Principles of Biochemistry, 3rd edition, by David L. Nelson and M.M. Cox (2000). Worth Publishers
4. Molecular Cell Biology, 4th edition, by Harvey Lodish et al. (2000) W.H Freeman & Company, NY
5. Molecular Biology of the Gene, 4th edition, by J.D. Watson, N.H. Hopkins, J.W.Roberts, J..P.Stertz, A.M.Weiner (1987) W.H.Freeman & Company.
6. Genes VII by B. Lewin (2000), Oxford University Press.
7. Biochemistry, 2nd edition, by Laurence A. Moran, K.G. Scrimgeour, H. R. Horton, R.S. Ochs and J. David Rawn (1994), Neil Patterson Publishers Prentice Hall.

BSc. - II (Biochemistry) Semester-IV
Paper – XI (Molecular Biology-2)

Max. Marks: 40
Int Assessment: 10
Time: 3 hours

NOTE: Seven questions will be set in all. Question No.1 comprising of objective/short answer type questions from the entire syllabus, will be compulsory. The remaining six questions will be set taking three questions from each section. The candidates will be required to attempt Q.No.1 & four others selecting two questions from each section. All questions carry equal marks.

SECTION – A

Transcription: Transcription in prokaryotes: RNA polymerase, promoters, initiation, elongation and termination of RNA synthesis, inhibitors of transcription. Reverse transcriptase and a brief account of post-transcriptional processing of RNA.

Translation: Genetic code- Basic features of genetic code, biological significance of degeneracy, Wobble hypothesis, split genes and overlapping genes. Mechanisms of translation: Ribosome structure; Activation of amino acids; initiation, elongation and termination of translation and Inhibitors of translation.

SECTION-B

Regulation of Gene Expression in prokaryotes: Enzyme induction and repression, Lac operon.

Recombinant DNA Technology: Introduction, steps of gene cloning, cloning vectors: features of an ideal cloning vector; plasmids, phages and cosmids as cloning vectors; ligation of insert DNA with vector; transformation of recombinant into host; selection and screening of recombinants; gene library and cDNA library.

Suggested reading:

1. Biochemistry, 4th edition, by L.Stryer (1995). W.H.Freeman & Co.,NY.
2. Fundamentals of Biochemistry by Donald Voet and Judith G Voet (1999) , John Wiley & Sons, NY
3. Lehninger: Principles of Biochemistry, 3rd edition, by David L. Nelson and M.M. Cox (2000). Worth Publishers
4. Molecular Cell Biology, 4th edition, by Harvey Lodish et al. (2000) W.H Freeman & Company, NY
5. Molecular Biology of the Gene, 4th edition, by J.D. Watson, N.H. Hopkins, J.W.Roberts, J..P.Stertz, A.M.Weiner (1987) W.H.Freeman & Company.
6. Genes VII by B. Lewin (2000), Oxford University Press.
7. Biochemistry, 2nd edition, by Laurence A. Moran, K.G. Scrimgeour, H. R. Horton, R.S. Ochs and J. David Rawn (1994), Neil Patterson Publishers Prentice Hall.
8. Gene Cloning and DNA Analysis-An Introduction,Brown, T.A. , 4th edition, Blackwell Publishers.

B.Sc. – II (Biochemistry) Semester-IV

Paper – XII (Lab Course- 4)

Max. Marks: 100 (for both Lab Courses- 3&4)
Time allowed: 4 hours (one session)

1. Estimation of DNA by diphenylamine method.
2. Estimation of RNA by orcinol method.
3. Separation of DNA fragments by Agarose gel electrophoresis
4. Estimation of calcium in serum.
5. Estimation of phosphorus in serum.
6. Estimation of lactose in milk.

Suggested reading:

1. Introductory Practical Biochemistry by S.K.Sawhney & R. Singh (2000). Narosa Publishers
2. Practical Biochemistry by David Plummer (1990). Tata Mc-Graw Hill
3. Biochemical Methods by Sadasivam & Manickam (1996) New Age International (P) Ltd.
4. Modern Experimental Biochemistry, 3rd edition, by R. Boyer (2002) Addison-Wesley Longman.

B.Sc. - III (Biochemistry) Semester-V
Paper – XIII (Plant Biochemistry)

Max. Marks: 40
Int Assessment: 10
Time: 3 hours

NOTE: Seven questions will be set in all. Question No.1 comprising of objective/short answer type questions from the entire syllabus, will be compulsory. The remaining six questions will be set taking three questions from each section. The candidates will be required to attempt Q.No.1 & four others selecting two questions from each section. All questions carry equal marks.

SECTION-A

Photosynthesis: Photosynthetic pigments, Pigment system I and II, Mechanism of pigment system function, Generation of NADPH and ATP by non-cyclic electron flow; cyclic electron flow; Reagents which affect photosynthetic electron flow. Photosynthetic CO_2 Assimilation: Calvin cycle including its regulation, Photorespiration, Hatch & Slack pathway of CO_2 fixation and CAM pathway.

Electron transport Chain and energy coupling in plant mitochondria.

SECTION –B

Nitrate Assimilation: Nitrate uptake, structure and function of nitrate reductase and nitrite reductase; Regulation of nitrate assimilation.

Sulphate assimilation: Sulphate uptake; assimilation of sulphate into cysteine.

Biological N_2-fixation: N_2 . fixing organisms, structure and mechanism of action of nitrogenase, strategies for protection of nitrogenase from inhibition by oxygen; role of leghaemoglobin; Ammonia assimilation.

Plant Hormones: Physiological functions of Auxins, Gibberellins, Cytokinins, Ethylene and Abscisic acid.

Suggested Reading:

1. Biochemistry and Molecular Biology of Plants by Bob, B. Buchanan, W. Gruissen and R.L.Jones (2000). Published by American Society of Plant Physiologists and distributed by Panima Educational Book Agency, New Delhi.
2. Plant Biochemistry and Molecular Biology, 2nd edition, by Peter J. Lea and Richard C. Leegood (1999). John Wiley and Sons.
3. Plant Biochemistry & Molecular Biology, 3rd ed., by Hans –Walter Heldt (2005), Academic Press.
4. Plant physiology, 2nd edition, by L. Taiz and E-Zeigler (1998), Sinauer Associates, Inc., Publishers.

B.Sc. - III (Biochemistry) Semester-V

Paper – XIV (Clinical Biochemistry)

Max. Marks: 40
Int Assessment: 10
Time: 3 hours

NOTE: Seven questions will be set in all. Question No.1 comprising of objective/short answer type questions from the entire syllabus, will be compulsory. The remaining six questions will be set taking three questions from each section. The candidates will be required to attempt Q.No.1 & four others selecting two questions from each section. All questions carry equal marks.

SECTION – A

Hormones: General characteristics, classes with examples, major endocrine systems and their target tissues, physiological roles of hormones, Role of cyclic nucleotides and calcium in hormones action; Mechanism of action of epinephrin and steroid hormones. Biochemical aspects of diabetes mellitus.

Minerals: Functions of various major and trace minerals.

SECTION-B

Collection and preservation of biological fluids (blood, serum, plasma, urine and CSF). Normal and abnormal constituents of blood and urine. Plasma proteins. Mechanism of blood coagulation.

Metabolic Disorders: Metabolic disorders of carbohydrate (Hypo- and hyper-glycemia, galactosemia, lactose intolerance, glycogen storage diseases), lipid (Sphingolipidosis, atherosclerosis, lipoproteinemia), protein (Phenylketonuria, alkaptonuria, tyrosenimea, maple syrup urine disease, Hartnup's disease, homocysteinuria etc.) and nucleic acids (Gout, Lesch-Nyhan syndrome).

Clinical enzymology: Definition of functional and non-functional plasma enzymes. Enzyme and isoenzyme pattern in health and disease with special mention of plasma lipase, amylase, SGOT, SGPT, LDH, CPK, alkaline phosphatase and acid phosphatase.

Detoxification mechanism of the body: Phase I and phase II pathways.

Acid- Base balance

Suggested reading:

1. Tietz Fundamental of Clinical Chemistry, 4th edition, by Carl A. Burtis and E.R. Ashwood (1996). W.B. Saunders Company.
2. Human Nutrition and Dietetics, 8th edition, by S. Davidson and J. R. Passmore (1982). ELBS, Zurich.
3. Textbook of Biochemistry with Clinical Correlations, 5th edition, by Thomas M. Devlin (2002). Wiley-liss, Inc.
4. Harper's Biochemistry, 25th edition, by R.K.Murray, P.A.Hayes, D.K.Granner, P.A. Mayes and V.W.Rodwell
5. Biochemistry by U. Satyanarayana (1999). Books and Allied (P) Ltd.
6. Lehninger: Principles of Biochemistry, 3rd edition, by David L. Nelson and M.M. Cox (2000) Maxmillan/ Worth publishers.
7. Text Book of Biochemistry and Human Biology by G.P. Talwar et al.

B.Sc. –III (Biochemistry) Semester- V
Paper – XV (Lab Course- 5)

1. Separation of serum from blood.
2. Qualitative analysis of sugar, protein, ketone bodies and bile pigments in urine.
3. Determination of serum alkaline phosphatase.
4. Determination of blood urea and uric acid.
5. Determination of blood creatinine.
6. Estimation of blood cholesterol.
7. Estimation of chlorophyll content of leaves using acetone.

Suggested reading:

1. Introductory Practical Biochemistry by S.K.Sawhney & R. Singh (2000). Narosa Publishers
2. Practical Biochemistry by David Plummer (1990). Tata Mc-Graw Hill
3. Biochemical Methods by Sadasivam & Manickam (1996) New Age International (P) Ltd.
4. Modern Experimental Biochemistry, 3rd edition, by R. Boyer (2002) Addison-Wesley Longman.

BSc. - III (Biochemistry) Semester-VI

Paper – XVI (Immunology)

Max. Marks: 40
Int Assessment: 10
Time: 3 hours

NOTE: Seven questions will be set in all. Question No.1 comprising of objective/short answer type questions from the entire syllabus, will be compulsory. The remaining six questions will be set taking three questions from each section. The candidates will be required to attempt Q.No.1 & four others selecting two questions from each section. All questions carry equal marks.

SECTION –A

Introduction to immune system: Components of immunity: Innate immunity- Anatomic, physiological, phagocytiv and inflammatory barriers; Adaptive immunity- Cells and organs of the immune system. A brief account of the functions of Humoral and cell-mediated immune responses. Primary and secondary immune responses.

Antigens: Immunogenicity versus antigenicity, factors influencing immunogenicity; Adjuvants; Epitopes (properties of B-Cell and T-cell epitopes); Haptens.

Immunoglobulins: Structure, classification & physicochemical properties of different classes of immunoglobulins.

Monoclonal Antibodies: Introduction, formation and selection of hybrid cells**,** their production and applications.

SECTION –B

Antigen–antibody interactions: Antibody affinity, antibody avidity, Agglutination & Precipitation reactions; Immunodiffusion; Radio immunoassay & ELISA.

Major Histocompatibility Complex (MHC): Location and function of MHC regions; Structure of class I & II MHC molecules; Role of MHCs.

Antigen Processing & Presentation: A brief account of antigen processing and presentation pathways.

Complement system: Components, activation and functions.

Suggested Reading:

1. A Short Course in Immunology by Benjamini
2. Kuby Immunology, 4rd ed. by R.A. Goldsby et al, W.H. Freeman & Co.
3. Immunology, 4th ed. by Roitt et al., Mosby Publications

BSc. - III (Biochemistry) Semester-VI

Paper – XVII (Biochemical techniques)

Max. Marks: 40
Int Assessment: 10
Time: 3 hours

NOTE: Seven questions will be set in all. Question No.1 comprising of objective/short answer type questions from the entire syllabus, will be compulsory. The remaining six questions will be set taking three questions from each section. The candidates will be required to attempt Q.No.1 & four others selecting two questions from each section. All questions carry equal marks.

SECTION - A

Measurement of pH: Principles of glass and reference electrodes.

Hydrodynamic Methods: Sedimentation: sedimentation velocity including factors affecting it, preparative and analytical centrifugation techniques, ultracentrifugation, determination of molecular weight by hydrodynamic methods (derivations excluded and numericals included).

Chromatographic techniques- General principles and applications of adsorption, ion-exchange, molecular-sieve, thin layer, hydrophobic, affinity & paper chromatography.

SECTION - B

Electrophoresis- Basic principles of electrophoresis; Native & SDS-PAGE; Agarose gel electrophoresis and Isoelectric focussing.

Radioisotopic Techniques: Types of radiations, radioactive decay, units of radioactivity, detection and measurement of radioactivity (methods based on gas ionization and liquid scintillation counting) and Quenching. Autoradiography: overview, nuclear emulsions used in biological studies, isotopes commonly used in biochemical studies (^{32}P, ^{35}S, ^{14}C and ^{3}H), track length of emitted particles and physical arrangements between emitting source and emulsion. Biological hazards of radiations and safety measures in handling radioisotopes. Biological applications of radioisotopes.

Spectroscopic Techniques
Beer-Lambert law, light absorption and its transmittance, extinction coefficient, a brief account of instrumentation and applications of visible and UV spectroscopic techniques (structure elucidation excluded).

Suggested reading;

1. Physical Biochemistry, 2nd edition, by D Friefelder (1983). W.H. Freeman & Co., U.S.A.
2. Biophysical Chemistry: Principles and Techniques, 2nd edition, by A. Upadhyay, K. Upadhyay and N.Nath. (1998). Himalaya Publishing House, Delhi.
3. Principles & Techniques of Practical Biochemistry, 5th edition, by Keith Wilson and John Walker (2000). Cambridge University Press.
4. Introductory Practical Biochemistry by S.K. Sawhney and Randhir Singh (2000). Narosa Publishing House, New Delhi.

B.Sc. –III (Biochemistry) Semester-VI

Paper – XVIII (Lab Course- 6)

Max. Marks: 100 (for both Lab Courses – 5&6)
Time allowed: 4 hours (one session)

1. Separation and identification of amino acids \lipids by TLC.
2. Separation and identification of amino acids \ sugars by paper chromatography.
3. Separation of proteins by SDS-PAGE.
4. Estimation of serum protein and determination of albumin\ globulin ratio.
5. Demonstration of immunodiffusion
6. Identification of blood group
7. Estimation of haemoglobin

Suggested reading

1. Introductory Practical Biochemistry by S.K.Sawhney & R. Singh (2000). Narosa Publishers
2. Practical Biochemistry by David Plummer (1990). Tata Mc-Graw Hill