

CENTRAL UNIVERSITY OF HARYANA
Master of Science in Biochemistry (Semester-wise structure)

The structure recommended by the committee is as follows.

Semester I

S.No.	Course code	Course title	L	T	P	Credit
1.	SIAL BC 1 1 01 C 5005	Biomolecules	5	0	0	5
2.	SIAL BC 1 1 02 C 5005	Cell Biology	5	0	0	5
3.	SIAL BC 1 1 03 C 5005	Tools and Techniques in Biochemistry	5	0	0	5
4.	SIAL BC 1 1 04 C 0084	Practical I	0	0	8	4
5.		<i>To be taken from other department</i>	4	0	0	4

Semester II

1.	SIAL BC 1 2 05 C 5005	Proteins and Enzymes	5	0	0	5
2.	SIAL BC 1 2 06 C 5005	Bioenergetics and Metabolism	5	0	0	5
3.	SIAL BC 1 2 07 C 5005	Immunology	5	0	0	5
4.	SIAL BC 1 2 08 C 0084	Practical II	0	0	8	4
5.	SIAL BC 1 2 02 GE 2103	Bioinformatics (compulsory)	0	3	0	3
6.	SIAL BC 1 2 DCEC -----	<i>Any one of the following three courses</i>	4	0	0	4
	SIAL BC 1 2 01 DCEC 4004	Plant Biochemistry				
	SIAL BC 1 2 02 DCEC 4004	Nutritional Biochemistry				
	SIAL BC 1 2 03 DCEC 4004	Biochemical Correlation in Disease				

Semester III

1.	SIAL BC 1 3 09 C 5005	Molecular Biology	5	0	0	5
2.	SIAL BC 1 3 10 C 5005	Genetic Engineering and Biotechnology	5	0	0	5
3.	SIAL BC 1 3 11 C 0084	Practical III	0	0	8	4
4.	SIAL BC 1 3 12 DCEC 0202	Seminar Paper (compulsory)	0	2	0	2
5.		<i>To be taken from other</i>	4	0	0	4

		<i>department</i>				
6.		Any one of the following two courses	5	0	0	5
	SIAL BC 1 3 05 DCEC 4004	Human Physiology and Hormone Biochemistry				
	SIAL BC 1 3 06 DCEC 4004	Advances in Genomics and Proteomics				

Semester IV

Skill Enhancement Elective Course (Compulsory and exclusively for Biochemistry students)

S.No.	Course code	Course title	L	T	D	Credit
1.	SIAL BC 1 4 01 SEEC 0066	Dissertation	0	0	24	24

List of Generic Elective Course (GEC) offered by the department to students of other departments

S.No.	Course code	Course title	L	T	P	Credit
Offered in Semester I						
1.	SIAL BC 1 1 01 GE 4004	Cell Biology	4	0	0	4
2.	SIAL BC 1 1 02 GE 4004	Principles of Biochemistry	4	0	0	4
Offered in Semester III						
3.	SIAL BC 1 3 03 GE 4004	Proteins and Enzymes	4	0	0	4
4.	SIAL BC 1 3 04 GE 4004	Molecular Biology	4	0	0	4
5.	SIAL BC 1 3 05 GE 4004	Biochemical correlations in Diseases	4	0	0	4

CENTRAL UNIVERSITY OF HARYANA
Master of Science in Biochemistry (Semester-wise structure)

The meeting of the Expert Committee was held on 25th June 2015 at 12.00 Noon at University of Delhi South Campus to discuss and finalize the structure of the syllabus of M.Sc. Biochemistry. The following members were present in the meeting.

1. Prof. Vijay K. Chaudhary, Dept. of Biochemistry, UDSC
2. Prof. V.K. Gupta, Dept. of Biochemistry, KUK
3. Dr. Amita Gupta, Dept. of Biochemistry, UDSC
4. Prof. S.K. Khare, IIT, Delhi

Prof. C.S. Pundir, Emeritus Scientist, MDU, Rohtak could not attend the meeting due to prior commitments.

The structure recommended by the committee is as follows.

Semester I

S.No.	Course code	Course title	L	T	P	Credit
1.	SIAL BC 1 1 01 C 5005	Biomolecules	5	0	0	5
2.	SIAL BC 1 1 02 C 5005	Cell Biology	5	0	0	5
3.	SIAL BC 1 1 03 C 5005	Tools and Techniques in Biochemistry	5	0	0	5
4.	SIAL BC 1 1 04 C 0084	Practical I	0	0	8	4
5.		<i>To be taken from other department</i>	4	0	0	4

Semester II

1.	SIAL BC 1 2 05 C 5005	Proteins and Enzymes	5	0	0	5
2.	SIAL BC 1 2 06 C 5005	Bioenergetics and Metabolism	5	0	0	5
3.	SIAL BC 1 2 07 C 5005	Immunology	5	0	0	5
4.	SIAL BC 1 2 08 C 0084	Practical II	0	0	8	4
5.	SIAL BC 1 2 02 GE 2103	Bioinformatics (compulsory)	0	3	0	3
6.	SIAL BC 1 2 DCEC -----	<i>Any one of the following three courses</i>	4	0	0	4
	SIAL BC 1 2 01 DCEC 4004	Plant Biochemistry				
	SIAL BC 1 2 02 DCEC 4004	Nutritional Biochemistry				

	SIAL BC 1 2 03 DCEC 4004	Biochemical Correlation in Disease				
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Semester III

1.	SIAL BC 1 3 09 C 5005	Molecular Biology	5	0	0	5
2.	SIAL BC 1 3 10 C 5005	Genetic Engineering and Biotechnology	5	0	0	5
3.	SIAL BC 1 3 11 C 0084	Practical III	0	0	8	4
4.	SIAL BC 1 3 12 DCEC 0202	Seminar Paper (compulsory)	0	2	0	2
5.		To be taken from other department	4	0	0	4
6.		Any one of the following two courses	5	0	0	5
	SIAL BC 1 3 05 DCEC 4004	Human Physiology and Hormone Biochemistry				
	SIAL BC 1 3 06 DCEC 4004	Advances in Genomics and Proteomics				

Semester IV

Skill Enhancement Elective Course (Compulsory and exclusively for Biochemistry students)

S.No.	Course code	Course title	L	T	D	Credit
1.	SIAL BC 1 4 01 SEEC 0066	Dissertation	0	0	24	24

List of Generic Elective Course (GEC) offered by the department to students of other departments

S.No.	Course code	Course title	L	T	P	Credit
Offered in Semester I						
1.	SIAL BC 1 1 01 GE 5005	Cell Biology	4	0	0	5
2.	SIAL BC 1 1 02 GE 5005	Principles of Biochemistry	4	0	0	5
Offered in Semester II						
3.	SIAL BC 1 3 03 GE 5005	Proteins and Enzymes	4	0	0	5
4.	SIAL BC 1 3 04 GE 5005	Molecular Biology	4	0	0	5
5.	SIAL BC 1 3 05 GE 5005	Biochemical correlations in Diseases	4	0	0	5

Prof. Vijay K. Chaudhary

Prof. V.K. Gupta

Dr. Amita Gupta

Prof. S.K. Khare

M.Sc. BIOCHEMISTRY
SIAL BC 1 1 01 C 5005: BIOMOLECULES (THEORY)
SEMESTER - I

TOTAL HOURS: 75

CREDITS: 5

Unit 1 The foundations of biochemistry; Water; Vitamins

No. of Hours: 16

The cellular basis of life. Cellular structures – prokaryotes and eukaryotes. Chemical principles in biomolecular structure. Major classes of biomolecules. Unique properties, weak interactions in aqueous systems, ionization of water, buffers, water as a reactant and fitness of the aqueous environment. Structure and active forms of water soluble and fat soluble vitamins, deficiency diseases and symptoms, hypervitaminosis

Unit 2 Carbohydrates and Glycobiology

No. of Hours: 20

Monosaccharides - structure of aldoses and ketoses, ring structure of sugars, conformations of sugars, mutarotation, anomers, epimers and enantiomers, structure of biologically important sugar derivatives, oxidation of sugars. Formation of disaccharides, reducing and non-reducing disaccharides. Polysaccharides – homo- and heteropolysaccharides, structural and storage polysaccharides. Structure and role of proteoglycans, glycoproteins and glycolipids (gangliosides and lipopolysaccharides). Carbohydrates as informational molecules, working with carbohydrates

Unit 3 Lipids; Amino Acids, Nucleic Acids

No. of Hours: 22

Building blocks of lipids - fatty acids, glycerol, ceramide. Storage lipids - triacyl glycerol and waxes. Structural lipids in membranes – glycerophospholipids, galactolipids and sulpholipids, sphingolipids and sterols, structure, distribution and role of membrane lipids. Plant steroids. Lipids as signals, cofactors and pigments; Structure and classification, physical, chemical and optical properties of amino acids; Nucleotides - structure and properties. Nucleic acid structure – Watson - Crick Model of DNA. Structure of major species of RNA - mRNA, tRNA and rRNA. Nucleic acid chemistry - UV absorption, effect of acid and alkali on DNA. Other functions of nucleotides - source of energy, component of coenzymes, second messengers.

Unit 4 Signalling molecules

No. of Hours: 17

Second messengers - cAMP, cGMP, IP₃, diacyl glycerol, Ca²⁺, NO. Brief account of their importance and role in signalling and signal transduction.

SUGGESTED READINGS

1. Lehninger: Principles of Biochemistry (2013) 6th ed., Nelson, D.L. and Cox, M.M., W.H. Freeman and Company (New York), ISBN:13: 978-1-4641-0962-1 / ISBN:10:1-4292-3414-8.
2. Textbook of Biochemistry with Clinical Correlations (2011) 7th ed., Devlin, T.M., John Wiley & Sons, Inc. (New York), ISBN:978-0-470-28173-4.
3. Biochemistry (2012) 7th ed., Berg, J.M., Tymoczko, J.L. and Stryer, L., W.H Freeman and Company (New York), ISBN: 13:978-1-4292-7635-1.

M.Sc. BIOCHEMISTRY
SIAL BC 1 1 02 C 5005: CELL BIOLOGY (THEORY)
SEMESTER - I

TOTAL HOURS: 75

CREDITS: 5

Unit 1 Introduction to cell biology, Structure of different cell organelles

No. of Hours: 18

Prokaryotic (archaea and eubacteria) and eukaryotic cell (animal and plant cells), cells as experimental models. Structure of nuclear envelope, nuclear pore complex. Nuclear protein import and export. ER structure. Targeting proteins to ER, smooth ER. Organization of Golgi. Lysosome. Structure and functions of mitochondria, chloroplasts and peroxisomes. Overview of protein sorting to cell cellular organelles. Endocytosis, Pinocytosis and phagocytosis.

Unit 2 Cytoskeletal proteins, Cell wall and extracellular matrix **No. of Hours: 18**

Introduction to cytoskeletal proteins. Organization of cytoskeletal protein RBC and smooth muscle and skeletal muscles. Structure of cilia and flagella. Prokaryotic and eukaryotic cell wall, cell matrix proteins. Cell-matrix interactions and cell-cell interactions. Adherence junctions, tight junctions, gap junctions, desmosomes, hemidesmosomes, focal adhesions and plasmodesmata.

Unit 3 Protein trafficking **No. of Hours: 21**

Selective transport of proteins to and from the nucleus. Regulation of nuclear protein import and export. Targeting proteins to ER, smooth ER and lipid synthesis. Export of proteins and lipids from ER and into ER. Lipid and polysaccharide metabolism in Golgi. Protein sorting and export from Golgi. Mechanism of vesicular transport, cargo selection, coat proteins and vesicle budding, vesicle fusion. Protein import and mitochondrial assembly, protein export from mitochondrial matrix. Import and sorting of chloroplast proteins.

Unit 4 Cell cycle, cell death and cell renewal **No. of Hours: 18**

Eukaryotic cell cycle, restriction point, and checkpoints. Cell division. Apoptosis and necrosis - brief outline. Salient features of a transformed cell.

SUGGESTED READINGS

1. The Cell: A Molecular Approach (2009) 5th ed., Cooper, G.M. and Hausman, R.E., ASM Press & Sunderland (Washington DC), Sinauer Associates, MA, ISBN:978-0-87893-300-6.
2. Molecular Cell Biology (2012) 7th ed., Lodish, H., Berk, A., Zipursky, S.L., Matsudaira, P., Baltimore, D. and Darnell, J., W.H. Freeman & Company (New York), ISBN:13:978-1-4641-0981-2 / ISBN:10: 1-4641-0981-8.
3. Molecular Biology of the Cell (2008) 5th ed., Alberts, B., Johnson, A., Lewis, J., and Enlarge, M., Garland Science (Princeton), ISBN:0-8153-1619-4 / ISBN:0-8153-1620-8.

M.Sc. BIOCHEMISTRY

SIAL BC 1 1 03 C 5005: TOOLS AND TECHNIQUES IN BIOCHEMISTRY (THEORY) SEMESTER - I

TOTAL HOURS: 75

CREDITS: 5

Unit 1 Biochemical reagents and solutions; Sterilization and Disinfection

No. of Hours: 20

Safety practices in the laboratory. Preparation and storage of solutions. Concepts of solution concentration and storing solutions. Quantitative transfer of liquids. Concept of a buffer, Henderson-Hasselbach equation, working of a pH meter. Dry Heat Sterilization (Hot Air Oven), Moist Heat Sterilization (Autoclaving), Pasteurisation, Tyndallization, HEPA filters, Cold Sterilization (Irradiation by Ultraviolet rays and γ -rays, Membrane Filtration, Desiccation, Fumigation, Refrigeration, Lyophilization, Cryopreservation, use of chemicals and gases (ethylene oxide and β -propiolactone) for sterilization and disinfection

Unit 2 Spectrophotometric techniques; Microscopy

No. of Hours: 18

Principle and instrumentation of UV-visible and fluorescence spectroscopy. Principle of microscopy, Different types of microscopes, Principle and Applications of Compound Microscopy, Dark Microscopy, Fluorescent Microscopy, Phase Contrast Microscopy, Confocal Microscopy, Atomic Force Microscopy and Electron Microscopy (SEM, TEM, STEM).

Unit 3 Chromatography

No. of Hours: 18

Paper Chromatography (Ascending and Descending, 2-Dimensional), Principle and Applications of Thin Layer Chromatography (TLC), Column Chromatography (Gel Filtration, Ion Exchange and Affinity Chromatography), High Performance Liquid Chromatography (HPLC) and Gas Liquid Chromatography (GLC).

Unit 4 Electrophoresis; Centrifugation; Autoradiography and Scintillation Counting

No. of Hours: 19

Agarose Gel Electrophoresis, Polyacrylamide Gel Electrophoresis (Native PAGE and SDS-PAGE), Isoelectric Focussing (IEF), 2-Dimensional Gel Electrophoresis. Differential Centrifugation, Density Gradient Centrifugation and Ultracentrifugation. Principle and instrumentation, applications

SUGGESTED READINGS

1. Physical Biochemistry: Principles and Applications (2010) 2nd ed., Sheehan, D., Wiley Blackwell (West Sussex), ISBN:978-0-470-85602-4 / ISBN:978-0-470-85603-1.
2. Physical Biochemistry: Applications to Biochemistry and Molecular Biology (1982) 2nd ed., Freifelder, D., W.H. Freeman and Company (New York), ISBN:0-7167-1315-2 / ISBN:0-7167-1444-2.
3. An Introduction to Practical Biochemistry (1998) 3rd ed., Plummer D. T., Tata McGraw Hill Education Pvt. Ltd. (New Delhi), ISBN:13: 978-0-07-099487-4 / ISBN:10: 0-07-099487-0.

M.Sc. BIOCHEMISTRY
SIAL BC 1 1 04 C 0084: PRACTICALS I
SEMESTER - I

TOTAL HOURS: 120

CREDITS: 4

1. Safety measures in laboratories.
2. Preparation of normal and molar solutions.
3. Preparation of buffers.
4. Determination of pKa of acetic acid and glycine.
5. Qualitative and quantitative tests for carbohydrates, lipids, amino acids, proteins and nucleic acids.
6. Separation of amino acids/ sugars/ bases by thin layer chromatography.
7. Determination of the absorption maxima and molar extinction coefficient (of a relevant organic molecule).
8. Determination of concentration of a protein solution by Lowry/Bradford method.
9. Demonstration of light microscopy; Study of live and fixed cells
10. Visualization of animal and plant cell by methylene blue.
11. Identification of different stages of mitosis in onion root tip.
12. Gram staining
13. Micrographs of different cell components (dry lab).
14. Sub-cellular fractionation.
15. Agarose Gel Electrophoresis to resolve DNA.
16. Purification and characterization of a protein from a complex mixture (native or heterologously expressed) involving various chromatography techniques and SDS-PAG electrophoresis.

SUGGESTED READINGS

1. Physical Biochemistry: Principles and Applications (2010) 2nd ed., Sheehan, D., Wiley Blackwell (West Sussex), ISBN:978-0-470-85602-4 / ISBN:978-0-470-85603-1.
2. An Introduction to Practical Biochemistry (1998) 3rd ed., Plummer D. T., Tata McGraw Hill Education Pvt. Ltd. (New Delhi), ISBN:13: 978-0-07-099487-4 / ISBN:10: 0-07-099487-0.
3. Practical Biochemistry : Principles and Techniques (2000) 5th edition, Wilson and Walker, Cambridge University Press, UK.

M.Sc. BIOCHEMISTRY
SIAL BC 1 2 05 C 5005: PROTEINS AND ENZYMES (THEORY)
SEMESTER - II

TOTAL HOURS: 75

CREDITS: 5

Unit 1 Introduction to amino acids, peptides and proteins, Covalent structure of proteins **No. of Hours: 18**

Amino acids and their properties - hydrophobic, polar and charged. Biologically important peptides - hormones, antibiotics and growth factors. Multimeric proteins, conjugated proteins and metallo proteins. Diversity of function, Organization of protein structure into primary, secondary, tertiary and quaternary structures. N-terminal and C-terminal amino acid analysis. Sequencing techniques - Edman degradation. Generation of overlap peptides using different enzymes and chemical reagents. Disulfide bonds and their location. Mass spectrometric analysis, Solid phase peptide synthesis

Unit 2 Three dimensional structures of proteins, Protein folding and conformational diseases **No. of Hours: 18**

Nature of stabilizing bonds - covalent and non covalent. Importance of primary structure in folding. The peptide bond - bond lengths and configuration. Helices, sheets and turns. Ramachandran map. Techniques used in studying 3-D structures - X-ray diffraction and NMR. Tertiary and quaternary structures. Structures of myoglobin and haemoglobin, Denaturation and renaturation of Ribonuclease A. Introduction to thermodynamics of folding and molten globule. Assisted folding by molecular chaperones, chaperonins and PDI. Defects in protein folding. Diseases –Alzheimer's and Prion based.

Unit 3 Introduction to enzymes, Features of enzyme catalysis, Enzyme kinetics

No. of Hours: 18

Nature of enzymes - protein and non-protein (ribozyme). Cofactor and prosthetic group, apoenzyme, holoenzyme. IUBMB classification of enzymes. Factors affecting the rate of chemical reactions, collision theory, activation energy and transition state theory, catalysis, reaction rates and thermodynamics of reaction. Catalytic power and specificity of enzymes (concept of active site), Fischer's lock and key hypothesis, Koshland's induced fit hypothesis. Relationship between initial velocity and substrate concentration, steady state kinetics, equilibrium constant - monosubstrate reactions. Michaelis-Menten equation, Lineweaver-Burk plot, Eadie-Hofstee and Hanes plot. K_m and V_{max} , K_{cat} and turnover number. Effect of pH, temperature and metal ions on the activity of enzyme.

Unit 4 Enzyme inhibition, Mechanism of action of enzymes, Regulation of enzyme activity, Applications of enzymes **No. of Hours: 21**

Reversible inhibition (competitive, uncompetitive, non-competitive, mixed and substrate). Mechanism based inhibitors - antibiotics as inhibitors. General features - acid base and covalent catalysis (chymotrypsin, lysozyme). Metal activated enzymes and metalloenzymes, transition state analogues. Control of activities of single enzymes (end product inhibition) and metabolic pathways, feedback inhibition, reversible covalent modification phosphorylation, zymogen. Multienzyme complex as regulatory enzymes. Application of enzymes in diagnostics (SGPT, SGOT, creatine kinase, alkaline and acid phosphatases), enzyme immunoassay (HRPO), enzyme therapy (Streptokinase). Immobilized enzymes.

SUGGESTED READINGS

1. Lehninger: Principles of Biochemistry (2013) 6th ed., Nelson, D.L. and Cox, M.M., W.H. Freeman and Company (New York), ISBN:13: 978-1-4641-0962-1 / ISBN:10:1-4292-3414-8.
2. Physical Biochemistry (2009) 2nd ed., Sheehan, D., Wiley-Blackwell (West Sussex), ISBN: 9780470856024 / ISBN: 9780470856031.
3. The Tools of Biochemistry (1977; Reprint 2011) Cooper, T.G., Wiley India Pvt. Ltd. (New Delhi), ISBN: 978-81-265-3016-8.
4. Fundamentals of Enzymology (1999) 3rd ed., Nicholas C.P. and Lewis S., Oxford University Press Inc. (New York), ISBN:0 19 850229 X.

M.Sc. BIOCHEMISTRY
SIAL BC 1 2 06 C 5005: BIOENERGETICS AND METABOLISM
(THEORY)
SEMESTER - II

TOTAL HOURS: 75

CREDITS: 5

Unit 1 Introduction to bioenergetics, Basic design of metabolism, Glycolysis, Gluconeogenesis, Pentose phosphate pathway, Glycogen metabolism

No. of Hours: 20

Laws of thermodynamics, state functions, equilibrium constant, coupled reactions, energy charge, ATP cycle, phosphorylation potential, phosphoryl group transfers. Chemical basis of high standard energy of hydrolysis of ATP, PEP, 1,3 BPG and thioesters. Redox reactions, standard redox potentials and Nernst equation. Universal electron carriers. Autotrophs, heterotrophs, metabolic pathways, catabolism, anabolism, ATP as energy currency, reducing power of the cell. Glycolysis - a universal pathway, reactions of glycolysis, fermentation, fates of pyruvate, feeder pathways for glycolysis, galactosemia. Synthesis of glucose from non-carbohydrate sources, reciprocal regulation of glycolysis and gluconeogenesis, pentose phosphate pathway and its importance. Glycogenesis and glycogenolysis, regulation of glycogen metabolism, glycogen storage diseases.

Unit 2 Citric acid cycle, Synthesis of carbohydrates, Fatty acid oxidation, Fatty acid synthesis

No. of Hours: 22

Production of acetyl CoA, reactions of citric acid cycle, anaplerotic reactions, amphibolic role, regulation of citric acid cycle, glyoxalate pathway. Calvin cycle, regulation of calvin cycle, regulated synthesis of starch and sucrose, photorespiration, C₄ and CAM pathways, synthesis of cell wall polysaccharides, integration of carbohydrate metabolism in plant cell. Digestion, mobilisation and transport of cholesterol and triacyl glycerols, fatty acid transport to mitochondria, β oxidation of saturated, unsaturated, odd and even numbered and branched chain fatty acids, regulation of fatty acid oxidation, peroxisomal oxidation, ω oxidation, ketone bodies metabolism, ketoacidosis. Fatty acid synthase complex. Synthesis of saturated, unsaturated, odd and even chain fatty acids and regulation.

Unit 3 Biosynthesis of steroids and isoprenoids, Oxidative phosphorylation, Integration of metabolism

No. of Hours: 18

Synthesis of prostaglandins, leukotrienes and thromboxanes, cholesterol, regulation of cholesterol synthesis. Synthesis of steroids and isoprenoids. Mitochondria. Electron transport chain - its organization and function. Inhibitors of ETC and uncouplers. Proton motive force. F₀ F₁ATP synthase, structure and mechanism of ATP synthesis. Regulation of oxidative phosphorylation. Alternative respiratory pathways in plants, photophosphorylation. Integration of metabolic pathways (carbohydrate, lipid and amino acid metabolic pathways), tissue specific metabolism (brain, muscle, and liver).

Unit 4 Amino acid metabolism, Metabolism of purine and pyrimidine nucleotides

No. of Hours: 15

Nitrogen cycle, incorporation of ammonia into biomolecules. Metabolic fates of amino groups. Digestion and absorption of dietary proteins. Protein calorie malnutrition. Nitrogen balance, transamination, role of pyridoxal phosphate, glucose-alanine cycle, Krebs's bicycle, urea cycle and inherited defects of urea cycle. Catabolic pathways of individual amino acids. Glucogenic and ketogenic amino acids. Metabolism of one carbon units. Disorders of amino

acids metabolism, Overview of amino acid synthesis. Biosynthesis of non-essential amino acids and its regulation. *De novo* synthesis of purine and pyrimidine nucleotides, regulation and salvage pathways. Digestion of nucleic acids, degradation of purine and pyrimidine nucleotides. Inhibitors of nucleotide metabolism. Disorders of purine and pyrimidine metabolism

SUGGESTED READINGS

1. Lehninger: Principles of Biochemistry (2013) 6th ed., Nelson, D.L. and Cox, M.M., W.H. Freeman and Company (New York), ISBN:13:978-1-4641-0962-1 / ISBN:10:1-4641-0962-1.
2. Textbook of Biochemistry with Clinical Correlations (2011) 7th ed., Devlin, T.M., John Wiley & Sons, Inc. (New York), ISBN: 978-0-470-28173-4 / BRV ISBN: 978-0-470-60152-5.
3. Molecular Cell Biology (2013) 7th ed., Lodish, H., Berk, A., Kaiser, C.A., Krieger, M., Bretscher, A., Ploegh, H., Amon, A. and Scott, M.P., W.H. Freeman & Company (New York), ISBN:13:978-1-4641-0981-2.
4. Biochemistry (2010) 4th ed., Garret, R. H. and Grisham, C.M., Cengage Learning (Boston), ISBN-13:978-0-495-11464-2.
5. Principles of Biochemistry (2008) 3rd ed., Voet, D.J., Voet, J.G. and Pratt, C.W., John Wiley & Sons, Inc. (New York), ISBN:13: 978-0470-23396-2

M.Sc. BIOCHEMISTRY
SIAL BC 1 2 07 C 5005: IMMUNOLOGY (THEORY)
SEMESTER - II

TOTAL HOURS: 75

CREDITS: 5

Unit 1 Cells and organs of the immune system, Innate immunity, Immunogens and antigens
No. of Hours: 18

Hematopoiesis, cells of the immune system, primary and secondary lymphoid organs and tissues (MALT). Anatomical barriers, cell types of innate immunity, soluble molecules and membrane associated receptors (PRR), connections between innate and adaptive immunity, chemokines. Antigens and haptens, factors that dictate immunogenicity, B and T cell epitopes.

Unit 2 Antibody structure and function, Generation of receptor diversity, Biology of the B lymphocyte
No. of Hours: 18

Structure and distribution of classes and subclasses of immunoglobulins (Ig), Ig fold, effector functions of antibody, antigenic determinants on Ig and Ig super family. Multigene organization of Ig locus, mechanism of V region DNA rearrangement, ways of antibody diversification. Antigen independent phase of B cell maturation and selection, humoral response – T-dependent and T-independent response.

Unit 3 Complement system, MHC complex and antigen presentation, Biology of the T lymphocyte
No. of Hours: 20

Complement activation by classical, alternate and MB lectin pathway, biological consequences of complement activation, regulation and complement deficiencies. General organization and inheritance of MHC, structure, distribution and role of MHC class I and class II proteins, pathways of antigen processing and presentation. Structure and role of T cell receptor, and co-receptor, T cell development, generation of receptor diversity, selection and differentiation.

General properties of effector T cells, cytotoxic T cells (T_c), natural killer cells; NKT cells and antibody dependent cellular cytotoxicity (ADCC).

Unit 4 Tolerance, autoimmunity and hypersensitivity, Transplantation immunology and vaccines
No. of Hours: 19

Mechanism of tolerance, Organ specific and systemic autoimmune diseases, possible mechanisms of induction of autoimmunity, IgE mediated (Type I) hypersensitivity, antibody mediated cytotoxic (Type II) hypersensitivity, immune complex mediated (type III) hypersensitivity and delayed type (Type IV) hypersensitivity. Immunological basis of graft rejection, clinical manifestations, immunosuppressive therapy and privileged sites. Vaccines - active and passive immunization, types of vaccines.

SUGGESTED READINGS

4. Kuby Immunology (2007) 6th ed., Kindt, T.L., Goldsby, R.A. and Osborne, B.A., W.H Freeman and Company (New York), ISBN:13: 978-0-7167-8590-3 / ISBN: 10:0-7617-8590-0.
5. Immunology: A Short Course (2009) 6th ed., Coico, R and Sunshine, G., John Wiley & sons, Inc (New Jersey), ISBN: 978-0-470-08158-7.

6. Janeway's Immunobiology (2012) 8th ed., Murphy, K., Mowat, A., and Weaver, C.T., Garland Science (London & New York), ISBN: 978-0-8153-4243-4.

M.Sc. BIOCHEMISTRY
SIAL BC 1 2 08 C 0084: PRACTICALS II
SEMESTER - II

TOTAL HOURS: 120

CREDITS: 4

1. Estimation of proteins using UV absorbance and Biuret method.
2. Ammonium sulphate fractionation of serum proteins.
3. Column chromatography for purification of proteins.
4. SDS-PAGE analysis of proteins.
5. Partial purification of acid phosphatase from germinating mung bean.
6. Assay of enzyme activity and specific activity.
7. Determination of K_m and V_{max} using Lineweaver-Burk graph
8. Study photosynthetic O_2 evolution in hydrilla plant.
9. Estimation of blood glucose.
10. Sugar fermentation by microorganisms.
11. Assay of salivary amylase.
12. Isolation of cholesterol from egg yolk and its estimation.
13. Estimation of serum urea/ uric acid.
14. Assays based on agglutination reactions - Blood typing (active) & passive agglutination.
15. Enzyme linked immune-sorbent assay (ELISA).
16. DOT blot
17. Immunoblot

SUGGESTED READINGS

4. Physical Biochemistry: Principles and Applications (2010) 2nd ed., Sheehan, D., Wiley Blackwell (West Sussex), ISBN:978-0-470-85602-4 / ISBN:978-0-470-85603-1.
5. An Introduction to Practical Biochemistry (1998) 3rd ed., Plummer D. T., Tata McGraw Hill Education Pvt. Ltd. (New Delhi), ISBN:13: 978-0-07-099487-4 / ISBN:10: 0-07-099487-0.
6. Practical Biochemistry: Principles and Techniques (2000) 5th edition, Wilson and Walker, Cambridge University Press, UK.

M.Sc. BIOCHEMISTRY
SIAL BC 1 2 01 DCEC 4004: PLANT BIOCHEMISTRY (THEORY)
SEMESTER - II

TOTAL HOURS: 60

CREDITS: 4

Unit 1 Introduction to Plant cell structure, Photosynthesis and Carbon assimilation

No. of HOURS: 18

Plasma membrane, Vacuole and tonoplast membrane, cell wall, plastids and peroxisomes. Structure of PSI and PSII complexes, Light reaction, Cyclic and non cyclic photophosphorylation, Calvin cycle and regulation; C₄ cycle and Crassulacean acid metabolism (CAM), Photorespiration.

Unit 2 Respiration, Regulation of plant growth

No. of HOURS: 16

Overview of glycolysis, Alternative reactions of glycolysis, Regulation of plant glycolysis, Translocation of metabolites across mitochondrial membrane, TCA cycle, Alternative NAD(P)H oxidative pathways; Cyanide resistant respiration. Introduction to plant hormones and their effect on plant growth and development, Regulation of plant morphogenetic processes by light.

Unit 3 Nitrogen metabolism

No. of HOURS: 14

Biological Nitrogen fixation by free living and in symbiotic association, structure and function of enzyme Nitrogenase. Nitrate assimilation: Nitrate and Nitrite reductase. Primary and secondary ammonia assimilation in plants; ammonia assimilation by Glutamine synthetase-glutamine oxoglutarate amino transferase (GS-GOGAT) pathway. Seed storage proteins in legumes and cereals.

Unit 4 Secondary metabolites, Plant tissue culture

No. of HOURS: 12

Representatives alkaloid group and their amino acid precursors, function of alkaloids, Examples of major phenolic groups; simple phenylpropanoids, Coumarins, Benzoic acid derivatives, flavonoids, tannins and lignin, biological role of plant phenolics, Classification of terpenoids and representative examples from each class, biological functions of terpenoids. Cell and tissue culture techniques, types of cultures: organ and explants culture, callus culture, cell suspension culture and protoplast culture. Plant regeneration pathways: organogenesis and somatic embryogenesis. Applications of cell and tissue culture and somoclonal variation.

SUGGESTED READINGS

1. Plant Biochemistry (2008), Caroline Bowsher, Martin steer, Alyson Tobin, Garland science ISBN 978-0-8153-4121-5
2. Biochemistry and molecular Biology of plant-Buchanan. (2005) 1 edition. Publisher: I K International. ISBN-10: 8188237116, ISBN-13: 978-8188237111.
3. Plant Biochemistry by P.M Dey and J.B. Harborne (Editors) (1997) Publisher: Academic Press ISBN-10:0122146743, ISBN-13:978-0122146749

M.Sc. BIOCHEMISTRY
SIAL BC 1 2 02 DCEC 4004: NUTRITIONAL BIOCHEMISTRY
(THEORY)
SEMESTER - II

TOTAL HOURS: 60

CREDITS: 4

Unit 1 Introduction to Nutrition and Energy Metabolism, Dietary carbohydrates and health **No. of HOURS: 18**

Definition of Nutrition, role of nutrients. Unit of energy, Biological oxidation of foodstuff. Physiological energy value of foods, SDA. Recommended Nutrient Intakes (RNI) and Recommended Dietary Allowances for different age groups. Functions of carbohydrates. Digestion, absorption, utilization and storage, hormonal regulation of blood glucose. Dietary requirements and source of carbohydrates, Dietary fiber, role of fibre in lipid metabolism, colon function, blood glucose level and GI tract functions.

Unit 2 Dietary lipid and health **No. of HOURS: 10**

Classification, sources, functions, digestion, absorption, utilization and storage. Essential Fatty Acids; Functions of EFA, RDA, – excess and deficiency of EFA, role of saturated fat, cholesterol, lipoprotein and triglycerides. Importance of the following: a) Omega – fatty acids. Omega 3/ omega 6 ratio b) Phospholipids c) Cholesterol in the body d) Mono, Polyunsaturated and Saturated Fatty Acids. Dietary implications of fats and oils, MUFA, PUFA and SFA.

Unit 3 Dietary Proteins and health, Fat and water soluble Vitamins

No. of HOURS: 16

Functions of proteins in the body, Digestion and absorption. Essential and Non-essential amino acids, Toxicity and Imbalance, Amino acid Supplementation. Effects of deficiency. Food source and Recommended Dietary Allowances. Nitrogen balance. Vitamin A, D, E, K Dietary sources, RDA, Adsorption, Distribution, Metabolism and excretion(ADME), Deficiency. Role of Vitamin A as an antioxidant,. Role of Vitamin K. Role of Vitamin E as an antioxidant. Extra-skeletal role of Vitamin D. Hypervitaminosis. Vitamin C role as cofactor. Niacin and NAD/ NADP. Vitamin B6-Dietary source, RDA, conversion to Pyridoxal Phosphate. Role in metabolism, Biochemical basis for deficiency symptoms. Vitamin B12 and folate; Dietary source, RDA, absorption, metabolic role, Biochemical basis for deficiency symptoms.

Unit 4 Minerals, Assessment of Nutritional status **No. of HOURS: 16**

Calcium, Phosphorus, Iodine, Fluoride, Mg, Cu, Zn, Se, Manganese, Chromium, Molybdenum and Iron - Distribution in the body digestion, Absorption, Utilization, Transport, Excretion, Balance Anthropometric measurements. Biochemical assessment. ROS assessment, GTT and glycosylated Hb, Differential diagnosis of B12 and folate.

SUGGESTED READINGS

1. Textbook of Biochemistry with Clinical Correlations (2011) Devlin, T.M. John Wiley & Sons, Inc. (New York), ISBN: 978-0-4710-28173-4.
2. Nutrition for health, fitness and sport (2013) ; Williams.M.H,Anderson,D.E, Rawson,E.S. McGraw Hill international edition. ISBN-978-0-07-131816-7.
3. Krause's Food and Nutrition Care process.(2012); Mahan, L.K Strings,S.E, Raymond,J. Elsevier's Publications. ISBN- 978-1-4377-2233-8.
4. The vitamins, Fundamental aspects in Nutrition and Health (2008); G.F. Coombs Jr. Elsevier's Publications. ISBN-13- 978-0-12- 183493-7.
5. Principles of Nutritional Assessment (2005) Rosalind Gibson. Oxford University Press. ISBN: 9780195171693

M.Sc. BIOCHEMISTRY
SIAL BC 1 2 03 DCEC 4004: BIOCHEMICAL CORRELATIONS IN
DISEASE (THEORY)
SEMESTER - II

Total HOURS: 60

CREDITS: 4

Unit 1 Inborn errors of metabolism, Nutritional deficiency based diseases

No. of HOURS: 16

Alkaptonuria, Phenylketonuria, Glycogen and Lipid storage diseases, SCID, Clotting disorders. Kwashiorkar, Marasmus, Beri-beri, Scurvy, Pellagra, Anaemia, Night blindness, Rickets, Osteomalacia, Osteoporosis, Wilson's disease.

Unit 2 Life style diseases, Hormonal Imbalances

No. of HOURS: 14

Obesity, Cardiovascular diseases, Atherosclerosis, Diabetes mellitus-II. Inflammatory Bowel Disease (IBD). Outline of hormone action and imbalances leading to disease - precocious puberty, hyper and hypopituitarism. Hyper and hypothyroidism.

Unit 3 Autoimmune diseases, Diseases caused due to misfolded proteins

No. of HOURS: 14

Concepts in immune recognition - self and non self discrimination, organ specific autoimmune diseases – Hashimoto's thyroiditis, Grave's disease, Myasthenia Gravis;. Systemic diseases - SLE, rheumatoid arthritis; Diabetes Mellitus-I. Alzheimer's, Huntington's disease, Kuru, Creutzfeldt-Jakob disease, Sickle cell anaemia, Thalessemia.

Unit 4 Infectious diseases

No. of HOURS: 16

Viral infection (polio, measles, mumps, influenza, HIV); Bacterial infections (tetanus, diphtheria, tuberculosis, typhoid, cholera); Protozoan (*Plasmodium* and *Trypanosoma*) and parasitic infections. Vaccines against diseases. General strategies in the design and development of vaccines.

SUGGESTED READINGS

1. Textbook of Biochemistry with Clinical Correlations (2011) Devlin, T.M. John Wiley & Sons, Inc. (New York), ISBN: 978-0-4710-28173-4.
2. Immunology: A Short Course (2009) 6th ed., Coico, R and Sunshine, G., John Wiley & sons, Inc (New Jersey), ISBN: 978-0-470-08158-7
3. Biochemistry (2012) 7th ed., Berg, J.M., Tymoczko, J.L. and Stryer, L., W.H Freeman and Company (New York), ISBN: 13:978-1-4292-7635-1.
4. Genetics (2012) 6th ed., Snustad, D.P. and Simmons, M.J., John Wiley & Sons. (Singapore), ISBN: 978-1-118-09242-2.

M.Sc. BIOCHEMISTRY

SIAL BC 1 2 02 GE 2103: BIOINFORMATICS (TUTORIAL) SEMESTER - II

TOTAL HOURS: 45

CREDITS: 3

Unit 1 Introduction to bioinformatics

No. of HOURS: 9

Computer fundamentals- programming languages in bioinformatics, role of supercomputers in biology. Historical background. Scope of bioinformatics - genomics, proteomics, computer aided drug design (structure based and ligand based approaches) and Systems Biology. Applications of bioinformatics.

Unit 2 Biological databases and data retrieval

No. of HOURS: 12

Introduction to biological databases - primary, secondary and composite databases, NCBI, nucleic acid databases (GenBank, EMBL, DDBJ, NDB), protein databases (PIR, Swiss-Prot, TrEMBL, PDB), metabolic pathway database (KEGG, EcoCyc, and MetaCyc), small molecule databases (PubChem, Drug Bank, ZINC, CSD). Structure viewers (Ras Mol, J mol), file formats.

Exercises

- Sequence retrieval (protein and gene) from NCBI.
- Structure download (protein and DNA) from PDB.
- Molecular file formats - FASTA, GenBank, Genpept, GCG, CLUSTAL, Swiss-Prot,.

Unit 3 Sequence alignment

No. of HOURS: 12

Similarity, identity and homology. Alignment – local and global alignment, pairwise and multiple sequence alignments, alignment algorithms, amino acid substitution matrices (PAM and BLOSUM), BLAST and CLUSTALW.

Exercises

- BLAST suite of tools for pairwise alignment.
- Multiple sequence alignment using CLUSTALW.

Unit 4 Phylogenetic analysis, Protein structure prediction and analysis

No. of HOURS: 12

Construction of phylogenetic tree, dendrograms, methods of construction of phylogenetic trees - maximum parsimony, maximum likelihood and distance methods.

Exercise

- Generating phylogenetic tree using PHYLIP.

Levels of protein structure. Protein tertiary structure prediction methods - homology modeling, fold recognition and *ab-initio* methods. Significance of Ramachandran map.

Exercises

- Primary sequence analyses (Protparam).
- Secondary structure prediction (GOR, nnPredict).

SUGGESTED READINGS

1. Bioinformatics: Sequence and Genome Analysis (2001), 1st ed., Mount, D.W. Cold Spring Harbor Laborator Press (New York), ISBN: 0-87969-608-7.
2. Bioinformatics and Functional Genomics (2003), 1st ed., Pevsner, J., John Wiley & Sons, Inc. (New Jersey), ISBN: 0-47121004-8.
3. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins (2005), 3rd ed., Baxevanis, A.D. and Ouellette, B.F., John Wiley & Sons, Inc. (New Jersey), ISBN: 0-47147878-4.
4. Bioinformatics – Principles and Applications (2008), 1st ed. Ghosh, Z. and Mallick, B., Oxford University Press (India), ISBN: 9780195692303.

M.Sc. BIOCHEMISTRY
SIAL BC 1 3 09 C 5005: MOLECULAR BIOLOGY (THEORY)
SEMESTER - III

TOTAL HOURS: 75

CREDITS: 5

Unit 1: Nucleic Acid

No. of Hours: 17

DNA as genetic material; Primary, secondary and three-dimensional structures of DNA; Super coiling; Forms of DNA; Polytene and lamp brush chromosomes; Properties of DNA in solution; Denaturation and renaturation; Reassociation reactions; COT curves; Types of RNAs and their primary and secondary structure; Role of RNA; Unusual bases in RNA.

Unit 2: Replication; Transcription

No. of HOURS: 20

Replication of DNA and synthesis of RNA; Central dogma of molecular biology; DNA and RNA polymerases and other enzymes involved in replication; mechanisms of replication; inhibitors of transcription; proof reading function and fidelity of DNA replication; possible modes of DNA replication; theta model and rolling circle model of DNA replication; replication of DNA in eukaryotes; role of methylation; replication of viral RNA; reverse transcriptase. Prokaryotic and eukaryotic gene structure; transposable elements in bacteria; mobile elements in eukaryotes; regulatory region and transcriptional unit of gene; post transcriptional processing of RNA: splicing, cap addition and polyadenylation polynucleotide phosphorylase; classification and molecular basis of mutation; Ames test and other testing systems; repair mechanism in prokaryotes and eukaryotes; site directed mutagenesis.

Unit 3: Gene expression and its regulation, Translation and its control, Translation and its control

No. of HOURS: 20

Gene expression in prokaryotes; enzyme induction and repression; negative and positive control; concept of operon; catabolite repression; transcriptional termination control via mRNA alternative conformations; regulation of gene expression in eukaryotes; promoters, enhancers and response elements; regulation at transcriptional level: Britten Davidson Model; control by steroid hormones. Translation; adapter role of RNA in protein synthesis; size of the code; methods of deciphering the genetic code; code word dictionary; general features of the genetic code; identification of anticodons; wobble hypothesis; ribosome as the site of protein synthesis; polysomes; activation of amino acids; initiation, elongation and termination of protein synthesis in prokaryotes and eukaryotes

Unit 4: Posttranslational modifications, Mutation and the DNA Damage and Repair System

No. of HOURS: 18

Control of translation: role of guanine nucleotides; post-translational processing of the polypeptide chains; acetylation, methylation, phosphorylation by protein kinases; sulfation; glycosylation; role of vitamins; role of chromatin structure in gene expression; cytoplasmic regulation of gene expression; organelle genome; epigenetics. Mutation. Various types of mutations. Spontaneous mutation and induced mutation. Reversion of mutations. Conditional mutation. Induced mutations. Radiation induced mutation. Effect of UV. Chemically induced mutation. Mutagenesis. Site directed mutagenesis. Oligonucleotide directed site mutagenesis. Mutagenicity of a chemical substance. Ames Test. DNA damage and repair. Types of DNA damage. Deamination. Depurination. Thymine dimer formation. Basic pathways for DNA repair. Direct repair. Excision repair. Mismatch repair. Error prone repair of DNA. Other mechanisms of DNA repair. DNA modification.

SUGGESTED READINGS

1. D.L. Nelson, M.M. Cox. (2013). Lehninger Principles of Biochemistry (6th Edition), W.H. Freeman and Company, New York, USA.
2. J.M. Berg, J.L. Tymoczko, L. Stryer. (2012) Biochemistry (7th Edition), W.H. Freeman and Company; New York, USA.
3. Principles of Biochemistry (2008) 3rd ed., Voet, D.J., Voet, J.G. and Pratt, C.W., John Wiley & Sons, Inc. (New York), ISBN:13: 978-0470-23396-2
4. B. Lewin, J. Krebs, S.T. Kilpatrick, E.S. Goldstein (2011). Genes X, (10th Volume) Jones and Bartlett Publishers, Sudbury, Massachusetts, USA.
4. J.D. Watson, T.A. Baker, S.P. Bell, A. Gann, M. Levin, R. Losick. (2013). Molecular Biology of the Gene (7th edition). Benjamin Cummings, San Francisco, USA.
5. R.F. Weaver (2007). Molecular Biology. (4th edition). McGraw Hill. New York. USA.

M.Sc. BIOCHEMISTRY
SIAL BC 1 3 10 C 5005: GENETIC ENGINEERING AND
BIOTECHNOLOGY (THEORY)
SEMESTER - III

TOTAL HOURS: 75

CREDITS: 5

Unit 1: Introduction to recombinant DNA technology, Cloning vectors for prokaryotes and eukaryotes, Joining of DNA fragments **No. of Hours: 21**

Overview of recombinant DNA technology. Restriction and modification systems, restriction endonucleases and other enzymes used in manipulating DNA molecules, separation of DNA by gel electrophoresis. Extraction and purification of plasmid and bacteriophage DNA. Plasmids and bacteriophages as vectors for gene cloning. Cloning vectors based on *E. coli* plasmids, pBR322, pUC8, pGEM3Z. Cloning vectors based on M13 and λ bacteriophage. Vectors for yeast, higher plants and animals. Ligation of DNA molecules. DNA ligase, sticky ends, blunt ends, linkers and adapters. Synthetic oligonucleotides, synthesis and use.

Unit 2: Introduction of DNA into cells and selection for recombinants, Methods for clone identification **No. of Hours: 18**

Uptake of DNA by cells, preparation of competent cells. Selection for transformed cells. Identification for recombinants - insertional inactivation, blue-white selection. Introduction of phage DNA into bacterial cells. Identification of recombinant phases. Introduction of DNA into animal cells, electroporation. The problem of selection, direct selection, marker rescue. Gene libraries, identification of a clone from gene library, colony and plaque hybridization probing, methods based on detection of the translation product of the cloned gene.

Unit 3: Polymerase chain reaction, DNA sequencing **No. of Hours: 16**

Fundamentals of polymerase chain reaction, designing primers for PCR. Studying PCR products. Cloning PCR products. Real time PCR. DNA sequencing by Sanger's method, modifications based on Sanger's method. Automated DNA sequencing. Pyrosequencing.

Unit 4: Expression of cloned genes, Applications of genetic engineering in Biotechnology **No. of Hours: 20**

Vectors for expression of foreign genes in *E. coli*, cassettes and gene fusions. Challenges in producing recombinant protein in *E. coli*. Production of recombinant protein by eukaryotic cells. Fusion tags and their role in purification of recombinant proteins. Site-directed mutagenesis and protein engineering. Applications in medicine, production of recombinant pharmaceuticals such as insulin, human growth hormone, factor VIII. Recombinant vaccines. Gene therapy. Applications in agriculture - plant genetic engineering, herbicide resistant crops, problems with genetically modified plants, safety concerns.

SUGGESTED READINGS

1. Gene Cloning and DNA Analysis (2010) 6th ed., Brown, T.A., Wiley-Blackwell publishing (Oxford,

UK), ISBN: 978-1-4051-8173-0.

2. Principles of Gene Manipulation and Genomics (2006) 7th ed., Primrose, S.B., and Twyman, R. M., Blackwell publishing (Oxford, UK) ISBN:13: 978-1-4051-3544-3.
3. Molecular Biotechnology: Principles and Applications of Recombinant DNA (2010) 4th ed., Glick B.R., Pasternak, J.J. and Patten, C.L., ASM Press (Washington DC), ISBN: 978-1-55581-498-4 (HC).
4. Brown T.A. (2006), Genomes 3, Garland science, Taylor & Francis, New York.
5. Dale J.W., Schantz M.V. and Plant N. (2011), From Genes to Genomes: Concepts and Applications of DNA Technology, Wiley-Blackwell.
6. Saldana H. A. (2014), Genetic Engineering: Basics, New Applications And Responsibilities, Intech publishers.

M.Sc. BIOCHEMISTRY
SIAL BC 1 3 12 DCEC 0202: SEMINAR PAPER
SEMESTER - III

TOTAL HOURS: 30

CREDITS: 2

Seminar Paper

This course is aimed at to inculcate in student the habit of reading, thinking, planning, developing ideas, search literature and retrieve information, preparation of scientific reports, and order of paragraph writing, besides the proper use of nouns, pronouns, articles, tenses and spelling, and preparation of presentation and delivering seminar with clarity of objectives, design, parameters, data interpretation ,summary and conclusion.

The course content Student under the mentorship of a teacher would be asked to identify a research publication on the topic of his choice published in a high impact factor journal, understand it and present the findings in her/his own way. Seminar will be delivered using Power Point, and the contents of the lecture will be submitted to the department in the form of a report, and will be evaluated by a committee constituted by the Head of the Department. At the end of the semester, student will be required to submit the technical report, which will be evaluated by an external examiner who will be called for the viva voce. Internal evaluation will be based on the presentation, content, time management and ability to respond to audience questions as well as attendance and ability to question while attending seminars of other students in the presence of teachers of the department.

In this paper, students would present open seminars on important scientific topics assigned to them, which would be collectively evaluated by the departmental faculty.

M.Sc. BIOCHEMISTRY
SIAL BC 1 3 05 DCEC 4004: HORMONE BIOCHEMISTRY (THEORY)
SEMESTER - III

TOTAL HOURS: 60

CREDITS: 4

Unit 1: Introduction to Endocrinology, Hormone mediated signalling

No. of Hours: 20

Functions of hormones and their regulation. Chemical signalling - endocrine, paracrine, autocrine, intracrine and neuroendocrine mechanisms. Chemical classification of hormones, transport of hormones in the circulation and their half-lives. Hormone therapy. General introduction to Endocrine methodology. Hormone receptors - extracellular and intracellular. Receptor - hormone binding, Scatchard analysis. G protein coupled receptors, G proteins, second messengers - cAMP, cGMP, IP₃, DAG, Ca²⁺, NO. Effector systems - adenylyl cyclase, guanylyl cyclase, PDE, PLC. Protein kinases (PKA, PKB, PKC, PKG). Receptor tyrosine kinases - EGF, insulin, erythropoietin receptor; ras - MAP kinase cascade, JAK - STAT pathway. Steroid hormone/ thyroid hormone receptor mediated gene regulation. Receptor regulation and crosstalk.

Unit 2: Hypothalamic and pituitary hormones, Thyroid hormone, Hormones of adrenals

No. of Hours: 20

Hypothalamic - pituitary axis. Study the physiological and biochemical actions of hypothalamic hormones, pituitary hormones - GH, prolactin, TSH, LH, FSH, POMC peptide family, oxytocin and vasopressin, feedback regulation cycle. Endocrine disorders - gigantism, acromegaly, dwarfs, pigmies and diabetes insipidus. Thyroid gland. Biosynthesis of thyroid hormone and its regulation; its physiological and biochemical action. Pathophysiology - Goiter, Graves disease, cretinism, myxedema, Hashimoto's disease. Aldosterone, renin angiotensin system, cortisol, epinephrine and norepinephrine. Fight or flight response, stress response. Pathophysiology – Addison's disease, Conn's syndrome, Cushing's syndrome.

Unit 3: Pancreatic and GI tract hormones, Reproductive hormones, Growth factors

No. of Hours: 10

Regulation of release of insulin, glucagon, gastrin, secretin, CCK, GIP, adipolectin, leptin and ghrelin. Summary of hormone metabolite control of GI function. Physiological and biochemical action. Pathophysiology - diabetes type I and type II. Male and female sex hormones . Interplay of hormones during reproductive cycle, pregnancy, parturition and lactation. Hormone based contraception. PDGF, EGF, IGF-II, and erythropoietin.

Unit 4: Hormones regulating Ca²⁺ homeostasis

No. of Hours: 10

PTH, Vitamin D and calcitonin. Mechanism of Ca²⁺ regulation and pathways involving bone, skin, liver, gut and kidneys. Pathophysiology - rickets, osteomalacia, osteoporosis.

SUGGESTED READINGS

1. Vander's Human Physiology (2008) 11th ed., Widmaier, E.P., Raff, H. and Strang, K.T. McGraw Hill International Publications, ISBN: 978-0-07-128366-3.
2. Endocrinology (2007) 6th ed., Hadley, M.C. and Levine, J.E. Pearson Education (New Delhi), Inc. ISBN: 978-81-317-2610-5.
3. The Cell: A Molecular Approach (2009) 5th Ed. Cooper, G.M. and Hausman, R.E. ASM Press & Sunderland, (Washington DC), Sinauer Associates. (MA). ISBN:978-0-87893-300-6

M.Sc. BIOCHEMISTRY
SIAL BC 1 3 06 DCEC 5005: ADVANCES IN GENOMICS AND
PROTEOMICS (THEORY)
SEMESTER - III

TOTAL HOURS: 60

CREDITS: 4

Unit-1: Origin and Evolution of genomics, Molecular maps of genomes and Comparative genomics, Structural and Functional Genomics

No. of Hours: 15

Origin of genomics, The first DNA genomes, Microcollinearity , DNA based phylogenetic trees, Genomes and human evolution, Evolution of nuclear and organellar (mitochondrial and Chloroplast) genome, The concept of minimal genome. Genetic maps, Physical maps, EST and transcript maps, Functional maps, Comparative genomics and colinearity/syntenly in maps. Whole genome shotgun sequencing, Clone-by-clone or 'hierarchical shotgun' Sequencing, Microbial genomes (including yeast), Plant genomes (Arabidopsis and rice), Animal genomes (fruit fly, mouse, human), Annotation of whole genome sequence and functional genomics, In silico methods, Insertion mutagenesis (T-DNA and transport insertion), TILLING, Management of data, Gene expression and transcript profiling, EST contigs and unigene sets, Use of DNA chips and Microarrays.

Unit-2: Pharmacogenomics

No. of Hours: 15

Use in biomedicine involving diagnosis and treatment of diseases, genomics in medical practice, personalized medicine, DNA polymorphism and treatment of diseases, use of SNP in pharmacogenomics, pharmacogenomics and industry.

Unit-3: Study and Scope of proteomics, Quantitative and Qualitative proteome analysis technique

No. of Hours: 15

Introduction, definition concepts and approaches of proteomics studies and activities. Separation technique- 2D PAGE, 2-DE (BN-PAGE), image analysis, Mass- spectrophotometry, LC-TMS, MALDI, and SALDI

Unit-4: Protein interaction and Protein complex, Drug Discovery and Development

No. of Hours: 15

Protein interaction, DNA- Protein interaction, Yeast two hybrid and 3-hybrid system and their applications. Current issues, drug targets, Drug efficacy, Drug toxicology, Protein chips and Antibody Microarray, proteomics in cancer research.

SUGGESTED READINGS

1. Leister D. (2005) Plant Functional Genomics , Taylor & Francis
2. Weckwerth W. (2006) Metabolomics :Methods and Protocols , Humana Press
3. Lodish H. Berk A. et al (2013) Molecular Cell Biology , W.H. Freeman and Company, New York
4. Primrose S.B. and Twyman R. (2009) Principles of Genome Analysis and Genomics. John Willey and Sons Ltd
5. Dubitzky W., Granzow M., Berrar D.P. (2007) Fundamentals of Data Mining in Genomics and Proteomics. Springer Science- Business Media
6. Lovric J. (2011) Introducing Proteomics: From concepts to sample separation, mass spectroscopy and data analysis. John Willey and Sons Ltd.
7. Mine Y., Miyashita K., Shahidi F. (2009) Nutrigenomics and Proteomics in Health and Disease: Food Factors and Gene Interaction. Wiley Blackwell

M.Sc. BIOCHEMISTRY
SIAL BC 1 3 11 C 0084: PRACTICALS III
SEMESTER - III

TOTAL HOURS: 120

CREDITS: 4

1. Genomic DNA isolation from plant/bacteria
2. Qualitative and quantitative analysis of DNA.
3. Preparation of culture media
4. Bacterial culture: establishing a pure culture; identification of bacteria; staining techniques; antibiotic sensitivity of bacteria
5. Isolation of plasmid DNA, and its digestion by restriction endonucleases and separation of restriction fragments by agarose gel electrophoresis
6. Isolation of RNA and separation on agarose gel
7. Quantitative estimation of RNA
8. DNA/RNA blotting techniques
9. Polymerase chain reaction
10. Green fluorescence protein (GFP) and bacterial transformation experiments
11. Electrophoresis and Western Blotting. SDS-PAGE analysis of proteins. Visualization of protein bands by Coomassie and Silver staining. Western blot analysis of the proteins using antibodies (immunoblotting), development by DAB/ECL

SUGGESTED READINGS

1. M.R.Green and J. Sambrook (2012) Molecular cloning, A Laboratory Manual Vol. I-III. (Fourth edition) Cold Spring Harbor Laboratory Press.
2. T.A. Brown. (2010) Gene Cloning and DNA Analysis. Wiley-Blackwell publishing (Oxford, UK).
3. Physical Biochemistry: Principles and Applications (2010) 2nd ed., Sheehan, D., Wiley Blackwell (West Sussex), ISBN:978-0-470-85602-4 / ISBN:978-0-470-85603-1.
4. An Introduction to Practical Biochemistry (1998) 3rd ed., Plummer D. T., Tata McGraw Hill Education Pvt. Ltd. (New Delhi), ISBN:13: 978-0-07-099487-4 / ISBN:10: 0-07-099487-0.
5. Practical Biochemistry : Principles and Techniques (2000) 5th edition, Wilson and Walker, Cambridge University Press, UK.

M.Sc. BIOCHEMISTRY
SIAL BC 1 4 01 SEEC 0066: DISSERTATION
SEMESTER - IV
CREDITS: 24

Each candidate have to carry out the dissertation work assigned to him/her and should submit bound copies of the research work performed by him/her duly certified by the guide/supervisor. The project report should include abstract, review of literature, introduction, materials and methods, observation & results, discussion, summary & conclusion followed by bibliography.