

PDM UNIVERSITY

Faculty of Life Sciences

Department of Biochemistry

B.Sc. (Hons.) Biochemistry

THREE YEAR FULL TIME PROGRAMME



**PDM UNIVERSITY BAHADURGARH
DELHI- NCR**



Note: Syllabi applicable for students seeking admission in the B.Sc. (Hons.) Biochemistry Course from the academic year 2018

Details of Course: B.Sc. (Hons.) Biochemistry

Course Structure Credits (Theory + Practical)

I Core Courses (14 Papers)	14 x 04 = 56
Core Course Practicals	14 x 02 = 28
Minor projects	01 x 02 = 02
Major Projects	01 x 04 = 04
II Elective Courses (08 Papers)	
a. Discipline Specific Electives DSE (03 Papers)	03 x 04 = 12
Discipline Specific Electives Practicals	03 x 02 = 06
b. Generic Electives / Interdisciplinary (04 Papers)	04 x 04 = 16
Generic Electives / Interdisciplinary Practicals	04 x 02 = 08
III Ability Enhancement Courses (AEC)	
a. English	01 x 02 = 02
b. Environmental Sciences	01 x 02 = 02
c. Foreign Language	02 x 02 = 04
d. Yoga	01 x 01 = 01
e. Aptitude	02 x 02 = 04
f. Professional Communications	02 x 02 = 04
g. Value Education	01 x 02 = 02
IV Skill Enhancement Course	02 x 02 = 04

Total Credits = 155

B.Sc. (Hons.) Biochemistry
Department of Biochemistry
Faculty of Life Sciences, PDMU

PROGRAMME STRUCTURE

	Module Code	Module Type	Module Name	Marks			Credits
				Internal	External	Total	
1st Sem	BIOC1101	Core I	Molecules Of Life	50	100	150	4
	BIOC1102	Core I (P)	Molecules Of Life Lab	25	50	75	2
	BIOC1103	Core II	Cell Biology	50	100	150	4
	BIOC1104	Core II (P)	Cell Biology Lab	25	50	75	2
	STAT0301	Generic Elective I	Descriptive Statistics	50	100	150	4
	STAT0302	Generic Elective I (P)	Descriptive Statistics Lab	25	50	75	2
	ENGL0103	AEC	English Communications	25	50	75	2
	LANF0101 LANF0102 LANF0103	AEC	Foreign Language-I French German Spanish	25	50	75	2
			Total	275	550	825	22
2nd Sem	BIOC1105	Core III	Proteins	50	100	150	4
	BIOC1106	Core III (P)	Proteins Lab	25	50	75	2
	BIOC1107	Core IV	Enzymes	50	100	150	4
	BIOC1108	Core IV (P)	Enzymes Lab	25	50	75	2
	STAT0303	Generic Elective II	Biostatistics	50	100	150	4
	STAT0304	Generic Elective II (P)	Biostatistics Lab	25	50	75	2
	ENVS0101	AEC	Environmental Science	25	50	75	2
	LANF0104 LANF0105 LANF0106	AEC	Foreign Language-II French German Spanish	25	50	75	2
			Total	275	550	825	22
3rd Sem	BIOC2101	Core V	Metabolism Of Carbohydrates And Lipids	50	100	150	4
	BIOC2102	Core V (P)	Metabolism Of Carbohydrates And Lipids Lab	25	50	75	2
	BIOC2103	Core VI	Membrane Biology And Bioenergetics	50	100	150	4
	BIOC2104	Core VI (P)	Membrane Biology And Bioenergetics Lab	25	50	75	2
	BIOC2105	Core VII	Metabolism Of Amino Acids And Nucleotides	50	100	150	4
	BIOC2106	Core VII (P)	Metabolism Of Amino Acids And Nucleotides Lab	25	50	75	2
	STAT0301	Generic Elective III	Computational statistics	50	100	150	4
	STAT0302	Generic Elective III (P)	Computational statistics Lab	25	50	75	2
	MGMT0103	SEC I	New Venture planning- Entrepreneurship	25	50	75	2
	VALU0118	AEC	Yoga	25	25	50	1
			Total	350	675	1025	27
4th Sem	BIOC2107	Core VIII	Human Physiology	50	100	150	4
	BIOC2108	Core VIII (P)	Human Physiology Lab	25	50	75	2

	BIOC2109	Core IX	Gene Organisations, Replication And Repair	50	100	150	4
	BIOC2110	Core IX (P)	Gene Organisations, Replication And Repair Lab	25	50	75	2
	BIOC2111	Core X	Hormone : Biochemistry And Function	50	100	150	4
	BIOC2112	Core X (P)	Hormone : Biochemistry And Function Lab	25	50	75	2
	STAT0303	Generic Elective IV	Applied Statistics	50	100	150	4
	STAT0304	Generic Elective IV (P)	Applied Statistics Lab	25	50	75	2
	VALU0109	AEC	Value Education	25	50	75	2
	CSEN0103	SEC II	Basics of Information Technology	25	50	75	2
			Total	350	700	1050	28
5th Sem	BIOC3101	Core XI	Concept In Genetics	50	100	150	4
	BIOC3102	Core XI (P)	Concept In Genetics Lab	25	50	75	2
	BIOC3103	Core XII	Gene Expression	50	100	150	4
	BIOC3104	Core XII (P)	Gene Expression Lab	25	50	75	2
	BIOC3105	Core	Minor Group Project	50	50	100	2
	BIOC3201	DSE I	Nutritional Biochemistry	50	100	150	4
	BIOC3202	DSE I (P)	Nutritional Biochemistry Lab	25	50	75	2
	BIOC3203	DSE II	Basic Microbiology	50	100	150	4
	BIOC3204	DSE II (P)	Basic Microbiology Lab	25	50	75	2
	VALU0119	AEC	Aptitude-I	25	50	75	2
	VALU0123	AEC	Professional Communications-I	25	50	75	2
				Total	400	750	1150
6th Sem	BIOC3106	Core XIII	Genetic Engineering And Biotechnology	50	100	150	4
	BIOC3107	Core XIII (P)	Genetic Engineering And Biotechnology Lab	25	50	75	2
	BIOC3108	Core XIV	Immunology	50	100	150	4
	BIOC3109	Core XIV (P)	Immunology Lab	25	50	75	2
	BIOC3110	Core	Major Individual Project	100	100	200	4
	BIOC3205	DSE III	Advanced Cell Biology	50	100	150	4
	BIOC3206	DSE III (P)	Advanced Cell Biology Lab	25	50	75	2
	VALU0136	AEC	Aptitude-II	25	50	75	2
	VALU0140	AEC	Professional Communications-II	25	50	75	2
				Total	375	650	1025
			Grand Total after six semesters	2025	3875	5900	155

List of Core Modules (Each Module consist of 6 credits. Theory + Practicals)

BIOC1101 & BIOC1102: Molecules of Life & Lab
BIOC1103 & BIOC1104: Cell Biology & Lab
BIOC1105 & BIOC1106: Proteins & Lab
BIOC1107 & BIOC1108: Enzymes & Lab
BIOC2101 & BIOC2102: Metabolism Of Carbohydrates And Lipids & Lab
BIOC2103 & BIOC2104: Membrane Biology And Bioenergetics & Lab
BIOC2105 & BIOC2106: Metabolism Of Amino Acids And Nucleotides & Lab
BIOC2107 & BIOC2108: Human Physiology & Lab
BIOC2109 & BIOC2110: Gene Organisations, Replication And Repair & Lab
BIOC2111 & BIOC2112: Hormone : Biochemistry And Function & Lab
BIOC3101 & BIOC3102: Concept In Genetics & Lab
BIOC3103 & BIOC3104: Gene Expression & Lab
BIOC3106 & BIOC3107: Genetic Engineering And Biotechnology & Lab
BIOC3108 & BIOC3109: Immunology & Lab

List of Generic elective modules (The student has to take 04 papers of any one discipline Each module consist of 6 credits, Theory + Practicals)

GE-I to GE-IV

Statistics & Lab

STAT0301 & STAT0302: Descriptive statistics & Lab
STAT0303 & STAT0304: Biostatistics & Lab
STAT0305 & STAT0306: Computational statistics & Lab
STAT0307 & STAT0308: Applied statistics & Lab

Physics & Lab

PHYS4201 & PHYS4202: Mechanics & Lab
PHYS4203 & PHYS4204: Electricity & Magnetism & Lab
PHYS4205 & PHYS4206: Thermal Physics & Lab
PHYS4207 & PHYS4208: Waves & Optics & Lab
PHYS4209 & PHYS4210: Digital, Analog & Instrumentation & Lab
PHYS4211 & PHYS4212: Embedded Systems & Lab

Chemistry & Lab

CHEM4201 & CHEM4202: Atomic Structure, Bonding & General Organic Chemistry & Lab
CHEM4203 & CHEM4204: Chemical Energetics & Lab
CHEM4205 & CHEM4206: Transition Metal Chemistry & Lab
CHEM4207 & CHEM4208: Organometallic Chemistry & Bioinorganic Chemistry & Lab
CHEM4209 & CHEM4210: Molecules of Life & Lab
CHEM4211 & CHEM4212: Chemistry of Main Group Elements & Lab

Computer Science & Lab

COMP4201 & COMP4202: Computer Fundamentals & Lab
COMP4203 & COMP4204: Introduction to Database & Lab
COMP4205 & COMP4206: Introduction to Programming & Lab
COMP4207 & COMP4208: Computer Network & Internet & Lab
COMP4209 & COMP4210: Multimedia & Lab

Microbiology & Lab

MICR4201 & MICR4202: Introduction & Scope of Microbiology & Lab

MICR4203 & MICR4204: Bacteriology & Virology & Lab

MICR4205 & MICR4206: Industrial Food Microbiology & Lab

MICR4207 & MICR4208: Microbes in Environment & Lab

MICR4209 & MICR4210: Genetic Engineering & Biotechnology & Lab

List of Discipline Specific Elective modules (Each module consists of 6 credits, Theory + Lab)**Choose four of the following (DSE-I to DSE-IV)**

BIOC3201 & BIOC3202: Nutritional Biochemistry & Lab

BIOC3203 & BIOC3204: Basic Microbiology & Lab

BIOC3205 & BIOC3206: Advanced cell biology & Lab

BIOC3207 & BIOC3208: Molecular basis of non-infectious human diseases & Lab

BIOC3209 & BIOC3210: Molecular basis of infectious diseases & Lab

BIOC3211 & BIOC3212: Plant Biochemistry & Lab

List of Skill Enhancement Modules (SEC-I & SEC-II) Choose any 2

CSEN0103: Basics of Information Technology

SKIL1002: Competitive Examination Preparedness

SKIL1003: Business Communication & Creative Writing

SKIL1004: Finance & Accounting Skills

MGMT0103: New Venture Planning :Entrepreneurship

SKIL1006: Personality Development

SKIL1007: Basic Workshop

SKIL1008: Electrical Circuits & Network

SKIL1009: Mobile Application Development

SKIL1010: E-Commerce (Principles & Practices)

SKIL1011: Leadership Strategy & Organizational Behavior

Course Code: BIOC401

Course Title: Molecules of Life (Theory)

Unit 1 The foundations of biochemistry

Cellular and chemical foundations of life

Unit 2 Water

Unique properties, weak interactions in aqueous systems, ionization of water, buffers, water as a reactant and fitness of the aqueous environment.

Unit 3 Carbohydrates and glycobiology

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 nonreducing 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 4 Lipids

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 sterols. Lipids as signals, cofactors and pigments

Unit 5 Amino acids

Structure and classification, physical, chemical and optical properties of amino acids

Unit 6 Nucleic 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 7 Vitamins

Structure and active forms of water soluble and fat soluble vitamins, deficiency diseases and symptoms, hypervitaminosis

Course Code: BIOC1102
Course Title: Molecules of Life (Practicals)

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 tests for carbohydrates, lipids, amino acids, proteins and nucleic acids.
6. Separation of amino acids/ sugars/ bases by thin layer chromatography.
7. Estimation of vitamin C.

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:10:1-42923414-8.
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.

Course Code: BIOC1103
Course Title: Cell Biology (Theory)

Unit 1 Introduction to cell biology

Prokaryotic (archaea and eubacteria) and eukaryotic cell (animal and plant cells), cells as experimental models.

Unit 2 Tools of cell biology

Light microscopy, phase contrast microscopy, fluorescence microscopy, confocal microscopy, electron microscopy, FACS. Centrifugation for subcellular fractionation.

Unit 3 Structure of different cell organelles

Structure of nuclear envelope, nuclear pore complex. ER structure. Organization of Golgi. Lysosome. Structure and functions of mitochondria, chloroplasts and peroxisomes. Zellweger syndrome.

Unit 4 Protein trafficking

Selective transport of proteins to and from the nucleus. Targeting proteins to ER, Protein sorting and export from Golgi. Protein import and mitochondrial assembly, protein export from mitochondrial matrix. Import and sorting of chloroplast proteins.

Unit 5 Cytoskeletal proteins

Structure and organization of actin filaments. Treadmilling and role of ATP in microfilament polymerization, organization of actin filaments. Non-muscle myosin. Intermediate filament proteins, assembly and intracellular organization. Assembly, organization and movement of cilia and flagella.

Unit 6 Cell wall and extracellular matrix

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 7 Cell cycle, cell death and cell renewal

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

Course Code: BIOC1103
Course Title: Cell Biology (Practical)

1. Visualization of animal and plant cell by methylene blue.
2. Identification of different stages of mitosis in onion root tip.
3. Identification of different stages of meiosis in grasshopper testis.
4. Micrographs of different cell components (dry lab).
5. Sub-cellular fractionation.
6. Visualization of nuclear fraction by acetocarmine stain.
7. Staining and visualization of mitochondria by Janus green stain.

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:978-0-87893300-6. 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:13:9781-4641-0981-2 / ISBN:10: 1-4641-0981-8.
2. 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.

Course Code: BIOC1105
Course Title: Proteins (Theory)

Unit 1 Introduction to amino acids, peptides and proteins

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

Unit 2 Extraction of proteins for downstream processing

Solubilization of proteins from their cellular and extracellular locations. Use of simple grinding methods, homogenization, ultrasonication, French press and centrifugation.

Unit 3 Separation techniques

Ammonium sulphate fractionation, solvent fractionation, dialysis and lyophilization. Ionexchange chromatography, molecular sieve chromatography, hydrophobic interaction/reverse phase chromatography, affinity chromatography, HPLC and FPLC

Unit 4 Characterization of proteins

Determination of purity, molecular weight, extinction coefficient and sedimentation coefficient, IEF, SDS-PAGE and 2-D electrophoresis.

Unit 5 Covalent structure of proteins

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, tandem MS. Solid phase peptide synthesis

Unit 6 Three dimensional structures of proteins

Nature of stabilizing bonds - covalent and non covalent. Importance of primary structure in folding. The peptide bond - bond lengths and configuration. Dihedral angles psi and phi. Helices, sheets and turns. Ramachandran map. Techniques used in studying 3-D structures - X-ray diffraction and NMR. Motifs and domains. Tertiary and quaternary structures. Structures of myoglobin and haemoglobin

Unit 7 Protein folding and conformational diseases

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 8 Introduction to protein structure databases

Protein sequence and structure databases (PDB). Use of sequence and domain information. Viewing protein structures using *in silico* tools.

Unit 9 Myoglobin and haemoglobin

Oxygen binding curves, influence of 2,3-BPG, CO₂ and Cl⁻. Hill plot. Cooperativity between subunits and models to explain the phenomena - concerted and sequential models. Haemoglobin disorders.

Unit 10 Specialized proteins - antibodies and actin-myosin motors

Antibody structure and binding to antigens. ATP activated actin - myosin contractions.

Unit 11 Membrane proteins

Integral and membrane associated proteins. Hydropathy plots to predict transmembrane domains. Significance of membrane proteins - bacteriorhodopsin.

Course Code: BIOC1106
Course Title: Proteins (Practical)

1. Estimation of proteins using UV absorbance and Biuret method.
2. Microassay of proteins using Lowry/Bradford method.
3. Isoelectric pH of casein.
4. Ammonium sulphate fractionation of serum proteins.
5. Separation of albumin from serum using anion-exchange chromatography.
6. SDS-PAGE analysis of proteins.

SUGGESTED READINGS

7. 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:10:1-42923414-8.
8. Physical Biochemistry (2009) 2nd ed., Sheehan, D., Wiley-Blackwell (West Sussex), ISBN: 9780470856024 / ISBN: 9780470856031.
9. The Tools of Biochemistry (1977; Reprint 2011) Cooper, T.G., Wiley India Pvt. Ltd. (New Delhi), ISBN: 978-81-265-3016-8.

Course Code: BIOC1107
Course Title: Enzymes (Theory)

Unit 1 Introduction to enzymes

Nature of enzymes - protein and non-protein (ribozyme). Cofactor and prosthetic group, apoenzyme, holoenzyme. IUBMB classification of enzymes./

Unit 2 Features of enzyme catalysis

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.

Unit 3 Enzyme kinetics

Relationship between initial velocity and substrate concentration, steady state kinetics, equilibrium constant - monosubstrate reactions. Michaelis-Menten equation, LineweaverBurk 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 Bisubstrate reactions

Types of bi bi reactions (sequential – ordered and random, ping pong reactions). Differentiating bi substrate mechanisms (diagnostic plots, isotope exchange).

Unit 5 Enzyme inhibition

Reversible inhibition (competitive, uncompetitive, non-competitive, mixed and substrate). Mechanism based inhibitors - antibiotics as inhibitors.

Unit 6 Mechanism of action of enzymes

General features - proximity and orientation, strain and distortion, acid base and covalent catalysis (chymotrypsin, lysozyme). Metal activated enzymes and metalloenzymes, transition state analogues.

Unit 7 Regulation of enzyme activity

Control of activities of single enzymes (end product inhibition) and metabolic pathways, feedback inhibition (aspartate transcarbamoylase), reversible covalent modification phosphorylation (glycogen phosphorylase). Proteolytic cleavage- zymogen. Multienzyme complex as regulatory enzymes. Occurrence and isolation, phylogenetic distribution and properties (pyruvate dehydrogenase, fatty acyl synthase) Isoenzymes - properties and physiological significance (lactate dehydrogenase).

Unit 8 Involvement of coenzymes in enzyme catalysed reactions

TPP, FAD, NAD, pyridoxal phosphate, biotin, coenzyme A, tetrahydrofolate, lipoic acid.

Unit 9 Applications of enzymes

Application of enzymes in diagnostics (SGPT, SGOT, creatine kinase, alkaline and acid phosphatases), enzyme immunoassay (HRPO), enzyme therapy (Streptokinase). Immobilized enzymes.

Course Code: BIOC1108
Course Title: Enzymes (Practical)

1. Partial purification of acid phosphatase from germinating mung bean.
2. Assay of enzyme activity and specific activity, e.g. acid phosphatase.
3. Effect of pH on enzyme activity
4. Determination of K_m and V_{max} using Lineweaver-Burk graph.
5. Enzyme inhibition - calculation of K_i for competitive inhibition.
6. Continuous assay of lactate dehydrogenase.
7. Coupled assay of glucose-6-phosphate dehydrogenase.

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:10:1-42923414-8.
2. Biochemistry (2011) 4th ed., Donald, V. and Judith G.V., John Wiley & Sons Asia Pvt. Ltd. (New Jersey), ISBN:978-1180-25024.
3. Fundamentals of Enzymology (1999) 3rd ed., Nicholas C.P. and Lewis S., Oxford University Press Inc. (New York), ISBN:0 19 850229 X.

Course Code: BIOC2101

Course Title: Metabolism Of Carbohydrates And Lipids (Theory)

Unit 1 Basic design of metabolism

Autotrophs, heterotrophs, metabolic pathways, catabolism, anabolism, ATP as energy currency, reducing power of the cell.

Unit 2 Glycolysis

Glycolysis - a universal pathway, reactions of glycolysis, fermentation, fates of pyruvate, feeder pathways for glycolysis, galactosemia.

Unit 3 Gluconeogenesis and pentose phosphate pathway

Synthesis of glucose from non-carbohydrate sources, reciprocal regulation of glycolysis and gluconeogenesis, pentose phosphate pathway and its importance.

Unit 4 Glycogen metabolism

Glycogenesis and glycogenolysis, regulation of glycogen metabolism, glycogen storage diseases.

Unit 5 Citric acid cycle

Production of acetyl CoA, reactions of citric acid cycle, anaplerotic reactions, amphibolic role, regulation of citric acid cycle, glyoxalate pathway, coordinated regulation of glyoxalate and citric acid pathways.

Unit 6 Synthesis of carbohydrates

Calvin cycle, regulation of calvin cycle, photorespiration, C₄ and CAM pathways.

Unit 7 Fatty acid oxidation

Digestion, mobilisation and transport of cholesterol and triacyl glycerols, fatty acid transport to mitochondria, β oxidation of saturated, unsaturated, , regulation of fatty acid oxidation, peroxisomal oxidation, , ketone bodies metabolism.

Unit 8 Fatty acid synthesis

Fatty acid synthase complex. Synthesis of saturated, unsaturated, even chain fatty acids and regulation.

Unit 9 Biosynthesis of eicosanoids, cholesterol, steroids and isoprenoids

Synthesis of prostaglandins, leukotrienes and thromboxanes. Synthesis of cholesterol, regulation of cholesterol synthesis.

Unit 10 Biosynthesis of membrane lipids

Synthesis of membrane phospholipids in prokaryotes and eukaryotes, biosynthesis of triacylglycerol,.

Unit 11 Starve-feed cycle

Well-fed state, early fasting state, fasting state, early re-fed state, energy requirements, reserves and caloric homeostasis, five phases of glucose homeostasis.

Course Code: BIOC2102
Course Title: Metabolism Of Carbohydrates And Lipids (Practicals)

1. Estimation of blood glucose.
2. Sugar fermentation of microorganisms.
3. Assay of salivary amylase.
4. Isolation of lecithin, identification by TLC, and its estimation.
5. Isolation of cholesterol from egg yolk and its estimation.

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:10:1-46410962-1.
2. Textbook of Biochemistry with Clinical Correlations (2011) 7th ed., Devlin, T.M., John Wiley & Sons, Inc. (New Jersey), 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:10:1-4292-2936-5, ISBN:13:978-1-4292-2936-4.

Course Code: BIOC2103
Course Title: Membrane Biology and Bioenergetics (Theory)

Unit 1 Introduction to biomembranes

Composition of biomembranes - prokaryotic, eukaryotic, neuronal and subcellular membranes. Study of membrane proteins. Fluid mosaic model with experimental proof. Monolayer, planer bilayer and liposomes as model membrane systems.

Unit 2 Membrane structures

Polymorphic structures of amphiphilic molecules in aqueous solutions - micelles and bilayers. CMC, critical packing parameter. Membrane asymmetry. Macro and micro domains in membranes. Membrane skeleton, lipid rafts, caveolae and tight junctions. RBC membrane architecture.

Unit 3 Membrane dynamics

Lateral, transverse and rotational motion of lipids and proteins. Techniques used to study membrane dynamics - FRAP, TNBS labeling etc. Transition studies of lipid bilayer, transition temperature. Membrane fluidity, factors affecting membrane fluidity.

Unit 4 Membrane transport

Thermodynamics of transport. Simple diffusion and facilitated diffusion. Passive transport - glucose transporter, anion transporter and porins. Primary active transporters - P type ATPases, V type ATPases, F type ATPases. Secondary active transporters - lactose permease, Na⁺-glucose symporter. ABC family of transporters - MDR, CFTR. Group translocation. Ion channels - voltage-gated ion channels (Na⁺/K⁺ voltage-gated channel), ligand-gated ion channels (acetyl choline receptor), aquaporins, bacteriorhodopsin. Ionophores - valinomycin, gramicidin.

Unit 5 Vesicular transport and membrane fusion

Types of vesicle transport and their function - clathrin, COP I and COP II coated vesicles. Molecular mechanism of vesicular transport. Membrane fusion. Receptor mediated endocytosis of transferrin.

Unit 6 Introduction to bioenergetics

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, other phosphorylated compounds and thioesters. Redox reactions, standard redox potentials and Nernst equation. Universal electron carriers.

Unit 7 Oxidative phosphorylation

Mitochondria. Electron transport chain - its organization and function. Inhibitors of ETC and uncouplers. Peter Mitchell's chemiosmotic hypothesis. Proton motive force. F₀F₁ATP synthase, structure and mechanism of ATP synthesis. Metabolite transporters in mitochondria. Regulation of oxidative phosphorylation. ROS production and antioxidant mechanisms. Thermogenesis. Alternative respiratory pathways in plants.

Unit 8 Photophosphorylation

General features of photophosphorylation, historical background, Hills reaction, photosynthetic pigments, light harvesting systems of plants and microbes and resonance energy transfer. Bacterial photophosphorylation in purple bacteria, Green sulfur bacteria and Halobacterium salinarum. Photophosphorylation in plants - structure of chloroplast, molecular architecture of Photosystem I and Photosystem II, Z-scheme of photosynthetic electron flow, oxygen evolving complex and action of herbicides. Cyclic photophosphorylation and its significance. Photo inhibition. Evolution of oxygenic photosynthesis.

Course Code: BIOC2104
Course Title: Membrane Biology And Bioenergetics (Practicals)

1. Effect of lipid composition on the permeability of a lipid monolayer.
2. Determination of CMC of detergents.
3. RBC ghost cell preparation and to study the effect of detergents on membranes.
4. Separation of photosynthetic pigments by TLC.
5. Isolation of mitochondria from liver and assay of marker enzyme SDH.
6. Study photosynthetic O₂ evolution in hydrilla plant.
7. Isolation of chloroplast from spinach leaves, estimation of chlorophyll and photosynthetic activity.

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:10:1-46410962-1.
2. 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.
3. Biochemistry (2010) 4th ed., Garret, R. H. and Grisham, C.M., Cengage Learning (Boston), ISBN-13:978-0-495-11464-2.
4. 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

Course Code: BIOC2105

Course Title: Metabolism of Amino Acids and Nucleotides (theory)

Unit 1 Overview of amino acid metabolism

Nitrogen cycle, incorporation of ammonia into biomolecules. Metabolic fates of amino groups. Protein calorie malnutrition - Kwashiorkar and Marasmus. Nitrogen balance, transamination, role of pyridoxal phosphate, glucose-alanine cycle, Kreb's bicycle, urea cycle and inherited defects of urea cycle.

Unit 2 Catabolism of amino acids

Catabolic pathways of individual amino acids. Glucogenic and ketogenic amino acids. Disorders of amino acids metabolism, phenylketonuria, alkaptonuria, maple syrup urine disease, methylmalonic acidemia (MMA), homocystinuria and Hartnup's disease.

Unit 3 Biosynthesis of amino acids

Overview of amino acid synthesis. Biosynthesis of non-essential amino acids and its regulation.

Unit 4 Precursor functions of amino acids

Biosynthesis of creatine and creatinine, polyamines (putresine, spermine, spermidine), catecholamines (dopamine, epinephrine, norepinephrine) and neurotransmitters (serotonin, GABA). Porphyrin biosynthesis, catabolism and disorders of porphyrin metabolism.

Unit 5 Biosynthesis of purine and pyrimidine nucleotides

De novo synthesis of purine and pyrimidine nucleotides, regulation and salvage pathways.

Unit 6 Deoxyribonucleotides and synthesis of nucleotide triphosphate

Biosynthesis of deoxyribonucleotides and its regulation, conversion to triphosphates.

Unit 7 Degradation of purine and pyrimidine nucleotides

Digestion of nucleic acids, degradation of purine and pyrimidine nucleotides. Inhibitors of nucleotide metabolism. Disorders of purine and pyrimidine metabolism – Lesch-Nyhan syndrome, Gout, SCID, adenosine deaminase deficiency.

Unit 8 Integration of metabolism

Integration of metabolic pathways (carbohydrate, lipid and amino acid metabolic pathways), tissue specific metabolism (brain, muscle, and liver).

Course Code: BIOC2106
Course Title: Metabolism Of Amino Acids And Nucleotides (Practical)

1. Assay of serum transaminases – SGOT and SGPT.
2. Estimation of serum urea.
3. Estimation of serum uric acid.
4. Estimation of serum creatinine.

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:10:1-46410962-1.
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: 978-0-47060152-5.

Course Code: BIOC2107
Course Title: Human Physiology (Theory)

Unit 1 Homeostasis and the organization of body fluid compartments

Homeostasis, control system and their components. molecular mechanism of blood coagulation, role of vitamin K in coagulation, Anemias, polycythemia, haemophilia and thrombosis.

Unit 2 Cardiovascular physiology

Anatomy of heart. Physiology of the cardiac muscle, relationship between cardiac cycle, heart sound, ventricular volumes and the ECG, control of cardiac function and output. The arterial system, venous system. Portal circulations. Arterial pressure and its regulation. Hypertension, congestive heart disease, atherosclerosis and myocardial infarction.

Unit 3 Respiration

Organization of the pulmonary system. Mechanism of respiration, pulmonary ventilation and related volumes, pulmonary circulation. Principles of gas exchange and transport. Regulation of respiration. Pulmonary oedema and regulation of pleural fluid. Hypoxia, hypercapnea, pulmonary distress, emphysema, ARDS.

Unit 4 Renal physiology

Anatomy of the kidney and the nephron. Cell biology of the Bowmans' capsule. Physiology of glomerular filtration and GFR. Tubular processing of the glomerular filtrate. Micturition reflex and voluntary control of micturition. Regulation of ECF electrolyte and water content, blood volume and long term blood pressure.. Acidosis and alkalosis. Glomerular nephritis, renal failure, dialysis and diuretics.

Unit 5 Gastrointestinal and hepatic physiology

Histology of the gastrointestinal tract. Propulsion and motility of food and digested material., secretory functions of the gastrointestinal tract, digestion and absorption of macro and micronutrients. Peptic ulcer, Sprue, celiac disease, IBD, regurgitation, diarrhoea and constipation. Anatomy of the hepatic lobule and blood flow into the liver. Formation and secretion of bile. metabolic importance of liver. Jaundice, liver cirrhosis and fatty liver.

Unit 6 Musculoskeletal system

Physiology of muscle contraction in striated and non-striated muscle.

Unit 7 Reproductive physiology

Female and male reproductive systems. Spermatogenesis, capacitation and transport of sperm, blood testis barrier. Ovarian function and its control. Uterine changes, fertilization and implantation. Placenta as a feto-maternal unit, gestation and parturition.

Unit 8 Neurochemistry and neurophysiology

Central Nervous system. Peripheral Nervous system. Blood brain barrier and CSF. Membrane potentials. Synaptic transmission. Neurotransmitters. EEG, sleep, coma, learning and memory.

Course Code: BIOC2108
Course Title: Human Physiology (Practicals)

1. Hematology.
2. RBC and WBC counting
3. Differential leucocyte count.
4. Clotting time.
5. Estimation of haemoglobin.
6. Separation of plasma proteins.

SUGGESTED READINGS

1. Vander's Human Physiology (2008) 11th ed., Widmaier, E.P., Raff, H. and Strang, K.T., McGraw Hill International Publications (New York), ISBN: 978-0-07-128366-3.
2. Harper's Biochemistry (2012) 29th ed., Murray, R.K., Granner, D.K., Mayes and P.A., Rodwell, V.W., Lange Medical Books/McGraw Hill. ISBN:978-0-07-176-576-3.
3. Textbook of Medical Physiology (2011) 10th ed., Guyton, A.C. and Hall, J.E., Reed Elseviers India Pvt. Ltd. (New Delhi). ISBN: 978-1-4160-4574-8.
4. Fundamental of Anatomy and Physiology (2009), 8th ed., Martini, F.H. and Nath, J.L., Pearson Publications (San Francisco), ISBN: 10:0-321-53910-9 / ISBN: 13: 978-032153910-6.

Course Code: BIOC2109
Course Title: Gene Organization, Replication and Repair (Theory)

Unit 1 Structure of DNA

DNA structure, features of the double helix, various forms of DNA, denaturation and reassociation of DNA.

Unit 2 Genes and genomic organization

Genome sequence and chromosome diversity, definition of a gene, organization of genes in viruses, bacteria, animals and plants. Nucleosome structure and packaging of DNA into higher order structures.

Unit 3 Replication of DNA

The chemistry of DNA synthesis, DNA polymerase, the replication fork, origin of replication, enzymes and proteins in DNA replication, various modes of replication, stages of replication of *E. coli* chromosome, relationship between replication and cell division, replication in eukaryotes. Comparison of replication in prokaryotes and eukaryotes. Inhibitors of DNA replication and applications in medicine. Supercoiling of DNA and its importance, topoisomerases, critical role of topoisomerases in cell, topoisomerase inhibitors and their application in medicine.

Unit 4 Recombination and transposition of DNA

Homologous recombination, proteins and enzymes in recombination, site-specific recombination, serine and tyrosine recombinases, biological roles of site-specific recombination, transposition, three classes of transposable elements, importance of transposable elements in horizontal transfer of genes and evolution.

Unit 5 Molecular basis of mutations

Importance of mutations in evolution of species. Types of mutations - transition, transversions, frame shift mutations, mutations induced by chemicals, radiation, transposable elements, Ames test.

Unit 6 Various modes of DNA repair

Replication errors and mismatch repair system, repair of DNA damage, direct repair, base excision repair, nucleotide excision repair, recombination repair, translesion DNA synthesis.

Course Code: BIOC2110
Course Title: Gene Organization, Replication and Repair (Practicals)

1. Verification of Chargaff's rule by paper chromatography.
2. Ultraviolet absorption spectrum of DNA and RNA.
3. Determination of DNA and RNA concentration by $A_{260\text{nm}}$.
4. Determination of the melting temperature and GC content of DNA.
5. To study the viscosity of DNA solutions.
6. Isolation of chromosomal DNA from *E. coli* cells.

SUGGESTED READINGS

1. Molecular Biology of the Gene (2008) 6th ed., Watson, J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M. and Losick, R., Cold Spring Harbor Laboratory Press, Cold spring Harbor (New York), ISBN:0-321-50781 / ISBN:978-0-321-50781-5.
2. Lehninger: Principles of Biochemistry (2013) 6th ed., Nelson, D.L. and Cox, M.M., W. H. Freeman & Company (New York), ISBN:13: 978-1-4292-3414-6 / ISBN:10-14641-0962-1.
3. Principles of Genetics (2010) 5th ed., Snustad, D.P. and Simmons, M.J., John Wiley & Sons Asia, ISBN:978-0-470-39842-5.

Course Code: BIOC2111
Course Title: Hormone: Biochemistry & Function (Theory)

Unit 1 Introduction to endocrinology

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.

Unit 2 Hormone mediated signaling

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 cross talk.

Unit 3 Hypothalamic and pituitary hormones

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.

Unit 4 Thyroid hormone

Thyroid gland. Biosynthesis of thyroid hormone and its regulation; its physiological and biochemical action. Pathophysiology - Goiter, Graves disease, cretinism, myxedema, Hashimoto's disease.

Unit 5 Hormones regulating Ca₂₊ homeostasis

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

Unit 6 Pancreatic and GI tract hormones

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.

Unit 7 Hormones of adrenals

Aldosterone, renin angiotensin system, cortisol, epinephrine and norepinephrine. Fight or flight response, stress response. Pathophysiology - Addison's disease, Conn's syndrome, Cushing syndrome.

Unit 8 Reproductive hormones

Male and female sex hormones. Interplay of hormones during reproductive cycle, pregnancy, parturition and lactation. Hormone based contraception.

Unit 9 Growth factors

PDGF, EGF, IGF-II, and erythropoietin.

Course Code: BIOC2112
Course Title: Hormone : Biochemistry & Function (Practicals)

1. Glucose tolerance test.
2. Estimation of serum Ca^{2+} .
3. Estimation of serum T4.
4. HCG based pregnancy test.
5. Estimation of serum electrolytes.
6. Case studies.

SUGGESTED READINGS

1. Lehninger: Principles of Biochemistry (2013) 6th ed., Nelson, D.L. and Cox, M.M. W.H. Freeman & Company (New York), ISBN:13: 978-1-4641-0962-1 / ISBN:10-14641-0962-1.
2. 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.
3. Endocrinology (2007) 6th ed., Hadley, M.C. and Levine, J.E. Pearson Education (New Delhi), Inc. ISBN: 978-81-317-2610-5.
4. The Cell: A Molecular Approach (2009) 5th Ed. Cooper, G.M. and Hausman, R.E. ASM Press & Sunderland, (Washington DC), Sinauer Associates. (MA). ISBN:978-0-87893300-6.

Course Code: BIOC3101
Course Title: Concepts In Genetics (Theory)

Unit 1 Introduction to model organisms and Mendelism

Model organisms: *Escherichia coli*, *Saccharomyces cerevisiae*, *Drosophila melanogaster*, *Caenorhabditis elegans*, *Danio rerio* and *Arabidopsis thaliana*, Basic principles of heredity.

Unit 2 Applications of Mendel's principles & chromosomal basis of heredity

Laws of probability & binomial expansion, formulating and testing genetic hypothesis, chromosomal basis of Mendelism -Sutton and Boveri hypothesis with experimental evidences.

Unit 3 Extensions of Mendelism

Allelic variation and gene function - dominance relationships, multiple alleles, lethal alleles and null alleles. Pleiotropy gene interaction - epistatic and non epistatic, interaction between gene(s) and environment. Penetrance and expressivity, norm of reaction and phenocopy.

Unit 4 Genetic definition of a gene

Complementation test, limitations of *cis-trans* test, intragenic complementation, rII locus of phage T₄ and concept of cistron

Unit 5 Genetics of bacteria and viruses

Mechanism of genetic exchange - conjugation, transformation and transduction. Gene mapping in bacteria.

Unit 6 Linkage, crossing over and mapping techniques

Linkage and crossing over, genetic mapping in eukaryotes, centromere mapping with ordered tetrads, cytogenetic mapping with deletions and duplications in *Drosophila*, detection of linked loci by pedigree analysis in humans and somatic cell hybridization for positioning genes on chromosomes.

Unit 7 Human pedigree analysis

Pedigree conventions, characteristics of dominant and recessive inheritance. Applications of pedigree analysis.

Unit 8 The genetic control of development and sex determination

Model organism for genetic analysis, *Drosophila* development, maternal effect genes, morphogens and zygotic gene activity in development, sex chromosomes and sex determination, dosage compensation of X-linked genes.

Unit 9 Organelle heredity and epigenetics

Extra nuclear inheritance, tests for organelle heredity and maternal effect, epigenetic mechanisms of transcriptional regulation & genomic imprinting.

Unit 10 Chromosomal aberrations

Variations in chromosome number- monosomy and trisomy of sex and autosomes. Variations in chromosome structure - inversions, deletions, duplications and translocations.

Unit 11 Inheritance of complex traits & population genetics

Inheritance of complex trait, analysis of quantitative traits, narrow and broad sense heritability, quantitative trait loci (QTL) and their identification. Hardy-Weinberg law, predicting allele and genotype frequencies and exceptions to Hardy-Weinberg principle.

Unit 12 Evolutionary genetics

Molecular evolution - analysis of nucleotide and amino acid sequences, molecular phylogenies, homologous sequences, phenotypic evolution and speciation.

Course Code: BIOC3102
Course Title: Concepts In Genetics (Practicals)

1. Squash preparation of salivary glands of Dipteran larva to observe polytene chromosomes.
2. Induction of polyploidy in onion roots.
3. Smear technique to demonstrate sex chromatin in buccal epithelial cells.
4. Monohybrid crosses in *Drosophila* for studying autosomal and sex linked inheritance.
5. PTC testing in a population and calculation of allele and genotype frequencies.
6. Study of abnormal human karyotype and pedigrees (dry lab)
7. Conjugation in bacteria

SUGGESTED READINGS

1. Genetics (2012) 6th ed., Snustad, D.P. and Simmons, M.J., John Wiley & Sons. (Singapore), ISBN: 978-1-118-09242-2.
2. Genetics - A Conceptual Approach (2012), 4th ed., Pierce, B.A., W.H. Freeman & Co. (New York), ISBN:13:978-1-4292-7606-1 / ISBN:10:1-4292-7606-1.
3. An Introduction to Genetic Analysis (2010), 10th ed., Griffiths, A.J.F, Wessler, S. R, Carroll, S. B. and Doebley, J., W.H. Freeman & Company (New York), ISBN:10: 14292-2943-8.

Course Code: BIOC3103
Course Title: Gene Expression (Theory)

Unit 1 Biosynthesis of RNA in prokaryotes

RNA polymerases, transcription cycle in bacteria, sigma factor, bacterial promoters, identification of DNA binding sites by DNA footprinting, the three stages of RNA synthesis, initiation, elongation and termination, rho-dependent and rho-independent termination. Inhibitors of transcription and applications as anti-microbial drugs.

Unit 2 Biosynthesis of RNA in eukaryotes

Comparison between prokaryotic and eukaryotic transcription. Transcription by RNA polymerase II, RNA polymerase II core promoters, general transcription factors, various types of RNA processing, transcription by RNA polymerase I and III. Inhibitors of eukaryotic transcription and their applications. Comparison of fidelity of transcription and replication.

Unit 3 RNA splicing

Chemistry of RNA splicing, the spliceosome machinery, splicing pathways, group I and group II introns, alternative splicing, exon shuffling, RNA editing.

Unit 4 The genetic code

Degeneracy of the genetic code, wobble in the anticodon, features of the genetic code, nearly universal code.

Unit 5 Biosynthesis of proteins

Messenger RNA, transfer RNA, attachment of amino acids to tRNA, the ribosome - initiation, elongation and termination of translation, regulation of translation. Comparison of prokaryotic and eukaryotic protein synthesis. Use of antibiotics in understanding protein synthesis and applications in medicine.

Unit 6 Protein targeting and degradation

Post translational modifications, glycosylation, signal sequences for nuclear transport, bacterial signal sequences, import of proteins by receptor mediated endocytosis, specialized systems for protein degradation.

Unit 7 Regulation of gene expression in prokaryotes

Principles of gene regulation, negative and positive regulation, concept of operons, regulatory proteins, activators, repressors, DNA binding domains, regulation of lac operon and trp operon, induction of SOS response, synthesis of ribosomal proteins, regulation by genetic recombination, transcriptional regulation in λ bacteriophage.

Unit 8 Regulation of gene expression in eukaryotes

Heterochromatin, euchromatin, chromatin remodeling, regulation of galactose metabolism in yeast, regulation by phosphorylation of nuclear transcription factors, regulatory RNAs, riboswitches, RNA interference, synthesis and function of miRNA molecules, phosphorylation of nuclear transcription factors.

Course Code: BIOC3104
Course Title: Gene Expression (Practicals)

1. Extraction of total nucleic acids from plant tissue.
2. Diauxic growth curve effect.
3. Isolation of mRNA from yeast by affinity chromatography.
4. Effect of inhibitors on protein synthesis.
5. Accumulation of protein due to proteasome inhibitors.

SUGGESTED READINGS

1. Lehninger: Principles of Biochemistry (2013) 6th ed., Nelson, D.L. and Cox, M.M., W.H. Freeman & Company (New York), ISBN:13: 978-1-4292-3414-6 / ISBN:10-14641-0962-
- 1.
2. Molecular Biology of the Gene (2008) 6th ed., Watson, J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M. and Losick, R., Cold Spring Harbor Laboratory Press, Cold Spring Harbor (New York), ISBN:0-321-50781 / ISBN: 978-0-321-50781-5.

Course Code: BIOC3106
Course Title: Genetic Engineering & Biotechnology (Theory)

Unit 1 Introduction to recombinant DNA technology

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.

Unit 2 Cloning vectors for prokaryotes and eukaryotes

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.

Unit 3 Joining of DNA fragments

Ligation of DNA molecules. DNA ligase, sticky ends, blunt ends, linkers and adapters. Synthetic oligonucleotides, synthesis and use.

Unit 4 Introduction of DNA into cells and selection for recombinants

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 phages. Introduction of DNA into animal cells, electroporation.

Unit 5 Methods for clone identification

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 6 Polymerase chain reaction

Fundamentals of polymerase chain reaction, designing primers for PCR. Studying PCR products. Cloning PCR products. Real time PCR.

Unit 7 DNA sequencing

DNA sequencing by Sanger's method, modifications based on Sanger's method. Automated DNA sequencing. Pyrosequencing.

Unit 8 Expression of cloned genes

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.

Unit 9 Applications of genetic engineering in Biotechnology

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.

Course Code: BIOC3107
Course Title: Genetic Engineering & Biotechnology (Practicals)

Practical

1. Isolation of plasmid DNA from *E. coli* cells.
2. Digestion of plasmid DNA with restriction enzymes.
3. Amplification of a DNA fragment by PCR.
4. Transformation of *E. coli* cells with plasmid DNA.
5. Hyper expression of poly histidine-tagged recombinant protein and purification using Ni affinity resin.

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: 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).

Course Code: BIOC3108
Course Title: Immunology (Theory)

Unit 1 Cells and organs of the immune system

Hematopoiesis, cells of the immune system, primary and secondary lymphoid organs and tissues (MALT).

Unit 2 Innate immunity and leukocyte extravasation

Anatomical barriers, cell types of innate immunity, soluble molecules and membrane associated receptors (PRR), connections between innate and adaptive immunity, cell adhesion molecules, chemokines, leukocyte extravasation, localized and systemic response.

Unit 3 Immunogens and antigens

Antigens and haptens, factors that dictate immunogenicity, B and T cell epitopes.

Unit 4 Antibody structure and function

Structure and distribution of classes and subclasses of immunoglobulins (Ig), Ig fold, effector functions of antibody, antigenic determinants on Ig and Ig super family.

Unit 5 Generation of receptor diversity

Dreyer- Bennett hypothesis, multigene organization of Ig locus, mechanism of V region DNA rearrangement, ways of antibody diversification.

Unit 6 Biology of the B lymphocyte

Antigen independent phase of B cell maturation and selection, humoral response – Tdependent and T-independent response, anatomical distribution of B cell populations.

Unit 7 Complement system

Complement activation by classical, alternate and MB lectin pathway, biological consequences of complement activation, regulation and complement deficiencies.

Unit 8 MHC complex and antigen presentation

General organization and inheritance of MHC, structure, distribution and role of MHC class I and class II proteins, linkage disequilibrium, pathways of antigen processing and presentation.

Unit 9 Biology of the T lymphocyte

Structure and role of T cell receptor, and co-receptor, T cell development, generation of receptor diversity, selection and differentiation.

Unit 10 Cell mediated cytotoxic responses

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

Unit 11 Tolerance, autoimmunity and hypersensitivity

Organ specific and systemic autoimmune diseases, possible mechanisms of induction of autoimmunity, Gell and Coombs classification, IgE mediated (Type I) hypersensitivity, antibody mediated cytotoxic (Type II) hypersensitivity, immune complex mediated (type III) hypersensitivity and delayed type (Type IV) hypersensitivity.

Unit 12 Transplantation immunology and vaccines

Immunological basis of graft rejection, clinical manifestations, immunosuppressive therapy and privileged sites. Vaccines - active and passive immunization, types of vaccines.

Course Code: BIOC3109
Course Title: Immunology (Practicals)

1. Isolation of lymphocytes from blood and macrophages from peritoneal cavity or spleen.
2. Purification of immunoglobulins.
3. Assays based on precipitation reactions - Ouchterlony double diffusion (ODD) and Mancini radial immunodiffusion.
4. Assays based on agglutination reactions - Blood typing (active) & passive agglutination.
5. Enzyme linked immune-sorbent assay (ELISA).

SUGGESTED READINGS

1. 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.
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. 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.

Course Code: BIOC3201
Course Title: Nutritional Biochemistry (Theory)

Unit 1 Introduction to Nutrition and Energy Metabolism

Defining Nutrition, role of nutrients. Unit of energy, Biological oxidation of foodstuff. measurement of energy content of food, Physiological energy value of foods, SDA. Measurement of energy expenditure. Direct and Indirect Calorimetry, factors affecting thermogenesis, energy utilization by cells, energy output – Basal and Resting metabolism, physical activity, factors affecting energy input - hunger, appetite, energy balance Energy expenditure in man. Estimating energy requirements, BMR factors Recommended Nutrient Intakes (RNI) and Recommended Dietary Allowances for different age groups.

Unit 2 Dietary carbohydrates and health

Review 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 3 Dietary lipid and health

Review of classification, sources, functions, digestion, absorption, utilization and storage. Essential Fatty Acids; Functions of EFA, RDA, – excess and deficiency of EFA. Lipotropic factors, 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, Combination ratios of n6 and n3, MUFA, PUFA and SFA.

Unit 4 Dietary Proteins and health

Review of functions of proteins in the body, Digestion and absorption. Essential and Nonessential amino acids. Amino Acid Availability Antagonism, Toxicity and Imbalance, Amino acid Supplementation. Effects of deficiency. Food source and Recommended Dietary Allowances for different age group. Amino acid pool. NPU, Biological Value, Nitrogen balance. PEM and Kwashiorkor.

Unit 5 Fat and water soluble Vitamins

Vitamin A, C, E, K and D Dietary sources, RDA, Adsorption, Distribution, Metabolism and excretion (ADME), Deficiency. Role of Vitamin A as an antioxidant, in Visual cycle, dermatology and immunity. Role of Vitamin K in Gamma carboxylation. Role of Vitamin E as an antioxidant. Extra-skeletal role of Vitamin D and its effect on bone physiology. Hypervitaminosis. Vitamin C role as cofactor in amino acid modifications. Niacin-Metabolic interrelation between tryptophan, 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 6 Minerals

Calcium, Phosphorus and Iron - Distribution in the body digestion, Absorption, Utilization, Transport, Excretion, Balance, Deficiency, Toxicity, Sources, RDA. Calcium: Phosphorus ratio, Role of iron in prevention of anemia. Iodine and iodine cycle. Iodine, Fluoride, Mg, Cu, Zn, Se, Manganese, Chromium, Molybdenum Distribution in the human body, Physiology, Function, deficiency, Toxicity and Sources

Unit 7 Assessment of Nutritional status

Anthropometric measurements; Z scores, BMI, skinfold, circumference ratios. Biochemical assessment; Basal metabolic panel, Comprehensive metabolic panel, CBC, Urine Analysis, Assessment of Anemia, ROS assessment, GTT and glycosylated Hb, Differential diagnosis of B12 and folate.

Unit 8 Food and drug interactions and Nutraceuticals

Nutrient interactions affecting ADME of drugs, Alcohol and nutrient deficiency, Antidepressants, psychoactive drugs and nutrient interactions, Appetite changes with drug intakes and malnutrition. Food as medicine.

Course Code: BIOC3202
Course Title: Nutritional Biochemistry (Practical)

1. Bioassay for vitamin B12/B1.
2. Homocystiene estimation.
3. Serum/ urine MMA estimation.
4. Anthropometric identifications for Kwashiorkor, Marasmus and Obesity.
5. Determination of oxidative stress: TBARS, antioxidant enzymes in hemolysate.
6. Vitamin A/E estimation in serum.
7. Bone densitometry /bone ultrasound test demonstration (visit to a nearby clinic)

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.

Course Code: BIOC3203
Course Title: Basic Microbiology (Theory)

Unit 1 History of Development of Microbiology

Development of microbiology as a discipline, Spontaneous generation vs. biogenesis. Contributions of Anton von Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister, Alexander Fleming. Establishment of fields of medical microbiology and immunology through the work of Paul Ehrlich, Elie Metchnikoff, Edward Jenner

Unit 2 Diversity of Microbial world

Binomial Nomenclature. Difference between prokaryotic and eukaryotic microorganisms. General characteristics of different groups: acellular microorganisms (Viruses, Viroids, Prions) and Cellular microorganisms (Bacteria, Algae, Fungi and Protozoa) with emphasis on distribution and occurrence, morphology, mode of reproduction and economic importance.

Unit 3 Viruses, viroids and prions

An introduction to viruses with special reference to the structure and replication of the following: Poliovirus, HIV, T4 and λ phage, lytic and lysogenic cycles.

Unit 4 Bacteria

An account of typical eubacteria, chlamydiae & rickettsiae (obligate intracellular parasites), mycoplasma, and archaeobacteria (extremophiles). Applications of bacteria in industry, environment and food.

Unit 5 Algae

History of phycology; General characteristics of algae including occurrence, thallus organization, algae cell ultra structure, pigments, flagella, eyespot food reserves and vegetative, asexual and sexual reproduction. Applications of Algae in agriculture, industry, environment and food.

Unit 6 Fungi

Historical developments in the field of Mycology, significant contributions of eminent mycologists. General characteristics of fungi including habitat, distribution, nutritional requirements, fungal cell ultra-structure, thallus organization and aggregation, fungal wall structure and synthesis, asexual reproduction, sexual reproduction, heterokaryosis, heterothallism and parasexual mechanism. Economic Importance of Fungi in Agriculture, environment, Industry, medicine, food, biodeterioration, mycotoxins

Unit 7 Protozoa

General characteristics with special reference to Amoeba

Course Code: BIOC3204

Course Title: Basic Microbiology (Practicals)

1. Microbiology Laboratory Practices and Biosafety.
2. To study the principle and applications of important instruments (biological safety cabinets, autoclave, incubator, BOD incubator, hot air oven, light microscope, pH meter)
3. Preparation and sterilization of culture media for bacterial cultivation
4. Study of different shapes of bacteria, fungi, algae, protozoa using permanent slides/ pictographs
5. Staining of bacteria using Gram stain
6. Isolation of pure cultures of bacteria by streaking method.
7. Estimation of CFU count.

SUGGESTED READINGS

1. Atlas RM. (1997). Principles of Microbiology. 2nd edition. W M.T. Brown Publishers.
2. Pelczar MJ, Chan ECS and Krieg NR. (1993). Microbiology. 5th edition. McGraw Hill Book Company

Course Code: BIOC3205
Course Title: Advanced Cell Biology (Theory)

Unit 1 Plasma Membrane and Nuclear Transport

Properties and Composition of Cell Membrane; Structure of Nuclear Envelope; Nuclear Pore Complex; Transport Across Nuclear Envelope; Regulation of Nuclear Protein Import and Export.

Unit 2 Cell-Cell Interaction

Cell-Cell Interactions and Cell-Matrix Interactions; Components of Extracellular Matrix: Collagen and Non-Collagen Components; Tight Junctions; Gap Junctions; Desmosomes; Hemidesmosomes; Focal Adhesions And Plasmodesmata; Cell Wall; Role Of Cell Interaction In Development.

Unit 3 Cell Cycle and Programmed Cell Death

Overview of The Cell Cycle; Eukaryotic Cell Cycle; Events Of Mitotic Phase; Cytokinesis; Events Of Meiosis And Fertilization; Regulation Of Cell Division And Cell Growth; Apoptosis And Necrosis, Stem Cells And Maintenance of Adult Tissues, Hematopoiesis, Embryonic Stem Cells and Therapeutic Cloning.

Unit 4 Cancer Biology

Development and causes Of Cancer; Genetic Basis of Cancer; Oncogenes, Tumor Viruses; Molecular Approach to Cancer Treatment.

Unit 5 Advanced Methods in Cell Biology

Ultracentrifugation, Fluorescence Microscopy- FACS, Confocal Microscopy, Electron Microscopy, Plant and Animal Cell Culture, Immunohistochemistry.

Course Code: BIOC3206
Course Title: Advanced Cell Biology (Practicals)

Practical

1. Isolation of organelles by sub-cellular fractionation.
2. Study of cell viability /death assay by use of trypan blue and MTT assay.
3. Study of apoptosis through analysis of DNA fragmentation patterns in mitochondria.
4. Identification and study of cancerous cells using permanent slides and photomicrographs.

SUGGESTED READINGS

1. Cooper, G.M. and Hausman, R.E. 2009 The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
2. Karp, G. 2010 Cell and Molecular Biology: Concepts and Experiments. 6 edition. John Wiley & Sons. Inc.
3. Alberts, B., Johnson, A., Lewis, J., and Enlarge, M. 2008 Molecular Biology of the Cell. 5th ed., Garland Science (Princeton),
4. Lodish, H., Berk, A., Zipursky, S.L., Matsudaira, P., Baltimore, D. and Darnell. J. 2012. Molecular Cell Biology. 7th ed., W.H. Freeman & Company (New York), 5. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009 The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco.

Course Code: BIOC3207
Course Title: Molecular Basis Of Non-Infectious human

Unit 1 Nutritional disorders

Overview of major and minor nutrient components in the diet. Balanced diet and the concept of RDA. Nutrient deficiencies; Kwashiorkor and Marasmus, Scurvy, beri beri, pellagra and B12 deficiency, Xerophthalmia and Night blindness, Vitamin D deficiency, Vitamin K deficiency. Discuss with relation to biochemical basis for symptoms.

Unit 2 Metabolic and Lifestyle disorders

Obesity and eating disorders like Anorexia nervosa and Bulimia. Diabetes mellitus A metabolic syndrome and the relationship with hypertension, obesity, hypothyroidism and stress. Cardio vascular disorders and Atherosclerosis -defining the broad spectrum of ailments that fall in this category, understanding the factors that contribute to the syndrome, stages of disorder and the management of the condition. Irritable bowel syndrome- biochemistry behind the disorder and the influence of diet, stress and environment on the condition.

Unit 3 Multifactorial complex disorders and Cancer

Understanding the definition of multifactorial diseases. Polygenic diseases and the relationship of environmental factors and genetic makeup in the onset of diseases.

Cancer: characteristics of a transformed cell, causes and stages of Cancer, molecular basis for neoplastic growth and metastasis, Proto-oncogenes and tumor suppressor genes; Cancer causing mutations; Tumor viruses; Biochemical analysis of cancer; Molecular approaches to cancer treatment.

Disorders of mood : Schizophrenia, dementia and anxiety disorders. Polycystic ovarian syndrome, Parkinson's disease, ALS.

Unit 4 Diseases due to misfolded proteins

Introduction to protein folding and proteasome removal of misfolded proteins; etiology and molecular basis for Alzheimer's, Prion diseases, Huntington's Chorea, sickle cell anemia, Thalassemia.

Unit 5 Monogenic diseases

In born errors in metabolism: PKU, Alkaptonuria, Maple syrup urine disease; Receptor and transport defects: Cystic fibrosis, Long QT syndrome, familial hypercholesterolemia, Achondroplasia. Hemoglobinopathies and clotting disorders.

Course Code: BIOC3208
Course Title: Molecular Basis Of Non-Infectious Human

1. Anthropometric measurements for normal and high risk individuals and identifications for Kwashiorkor, Marasmus and Obesity
2. Estimation of homocysteine levels in serum
3. Estimation of glycosylated hemoglobin
4. Permanent slides for different types of cancer
5. Diagnostic profile for assessment of CVS and Diabetes mellitus using case studies.
6. Bone densitometry test demonstration (visit to a nearby clinic)

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. Introduction to Human Physiology (2013) 8th edition; Lauralee Sherwood. Brooks/Cole, Cengage Learning.
3. The World of the cell, 7th edition (2009)
4. Genetics (2012) Snustad and Simmons,
5. Cooper, G.M. and Hausman, R.E. 2009 The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.

Course Code: BIOC3209
Course Title: Molecular Basis Of Infectious Diseases
(Theory)

Unit 1 Classification of infectious agents

Bacteria, Viruses, protozoa and fungi. Past and present emerging and re-emerging infectious diseases and pathogens. Source, reservoir and transmission of pathogens, Antigenic shift and antigenic drift. Host parasite relationship, types of infections associated with parasitic organisms. Overview of viral and bacterial pathogenesis. Infection and evasion.

Unit 2 Overview of diseases caused by bacteria

Detailed study of tuberculosis: History, causative agent, molecular basis of host specificity, infection and pathogenicity, Diagnostics, Therapeutics, inhibitors and vaccines. Drug resistance and implications on public health. Other bacterial diseases including Typhoid, Diphtheria, Pertussis, Tetanus, Typhoid and Pneumonia.

Unit 3 Overview of diseases caused by Viruses

Detailed study of AIDS, history, causative agent, pathogenesis, Diagnostics, Drugs and inhibitors. Other viral diseases including hepatitis, influenza, rabies, chikungunya and polio.

Unit 4 Overview of diseases caused by Parasites

Detailed study of Malaria, history, causative agents, Vectors, life cycle, Host parasite interactions, Diagnostics, Drugs and Inhibitors, Resistance, Vaccine development. Other diseases including leishmaniasis, amoebiasis.

Unit 5 Overview of diseases caused by other organisms

Fungal diseases, General characteristics. Medical importance of major groups, pathogenesis, treatment.

Course Code: BIOC3210
Course Title: Molecular Basis Of Infectious Diseases (Practicals)

1. Permanent slides of pathogens. Mycobacterium tuberculosis, Leishmania, Plasmodium falciparum
2. WIDAL test
3. Gram staining
4. Acid fast staining
4. PCR based diagnosis
5. Dot Blot ELISA

SUGGESTED READINGS

1. Prescott, Harley, Klein's Microbiology (2008) 7th Ed., Willey, J.M., Sherwood, L.M., Woolverton, C.J. Mc Graw Hill International Edition (New York) ISBN: 978-007126727.
2. Mandell, Douglas and Bennett.S, Principles and practices of Infectious diseases, 7th edition, Volume, 2. Churchill Livingstone Elsevier.
3. Sherris Medical Microbiology: An Introduction to Infectious Diseases by Kenneth J. Ryan, C. George Ray, Publisher: McGraw-Hill
4. Medical Microbiology by Patrick R. Murray, Ken S. Rosenthal, Michael A. Pfaller, Elsevier Health Sciences

Course Code: BIOC3211
Course Title: Plant Biochemistry (Theory)

Unit 1 Introduction to Plant cell structure

Plasma membrane, Vacuole and tonoplast membrane, cell wall, plastids and peroxisomes.

Unit 2 Photosynthesis and Carbon assimilation

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 3 Respiration

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.

Unit 4 Nitrogen metabolism

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 5 Regulation of plant growth

Introduction to plant hormones and their effect on plant growth and development, Regulation of plant morphogenetic processes by light.

Unit 6 Secondary metabolites

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.

Unit 6 Plant tissue culture

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.

Course Code: BIOC3212
Course Title: Plant Biochemistry (Practicals)

1. Induction of hydrolytic enzymes proteinases /amylases/lipase during germination
2. Extraction and assay of Urease from Jack bean
3. Estimation of carotene/ascorbic acid/phenols/tannins in fruits and vegetables
4. Separation of photosynthetic pigments by TLC
5. Culture of plant plants (explants).

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