

Table - 3 : Common Course Structure for **P.G. Degree Programme in Science – M.Sc. (General)** #

(with effect from the academic year 2017-2018 onwards)
M.Sc. Bio Chemistry

Sem. (1)	Sub. No. (2)	Subject Status (3)	Subject Title (4)	Contact Hrs./ Week (5)	Credits (6)
I	1	Core - 1	Biomolecules	6	4
	2	Core - 2	Molecular Cell biology	6	4
	3	Core - 3	Genetics	5	4
	4	Core - 4	Bio statistics	5	4
	5	Core - 5 Practical - 1	Biochemical, biophysical and physiological techniques	4	2
	6	Core - 6 Practical – 2	Cell biology, genetics and biostatistics	4	2
Subtotal				30	20
II	7	Core - 7	Physiology	5	4
	8	Core - 8	Enzymes and enzyme technology	5	4
	9	Core - 9	Metabolism and regulation	4	4
	10	Core - 10	Muscle biochemistry and biomembranes	4	4
	11	Core - 11	Field work	4+	3
	12	Core - 12 Practical - 3	Enzymes and enzyme techniques	4	2
	13	Core - 13 Practical - 4	Enzyme kinetics	4	2
Subtotal				30	23

#	1.) Bio-Chemistry	2.) Biotechnology
	3.) Botany	4.) Dietics and Food Management
	5.) Electronics	6.) Electronics & Communication
	7.) Geology	
	8.) Hotel Management and Catering Science and Applied Nutrition	
	9.) Nutrition and Dietics	10.) Physics
	11.) Zoology	

Sem.	Sub. No.	Subject Status	Subject Title	Contact Hrs./ Week	Credits
(1)	(2)	(3)	(4)	(5)	(6)
III	14	Core - 14	Immunology and immunotechniques	6	4
	15	Core - 15	Nutritional biochemistry	6	4
	16	Core - 16	Biotechnology	5	4
	17	Core - 17	Research methodology	5	4
	18	Core - 18 Practical - 5	Clinical analysis-I	4	2
	19	Core - 19 Practical - 6	Immunology, microbial and molecular techniques	4	2
				Subtotal	30
IV	20	Core - 20	Molecular endocrinology	5	4
	21	Core - 21	Clinical biochemistry	5	4
	22	Core - 22	Molecular biology	4	4
	23	Core - 23 Practical - 7	Clinical analysis-II	4	2
	24	Core - 24 Practical - 8	Clinical enzymology and nutritional biochemistry	4	2
	25	Elective - 1	Elective / field work / study tour	3+	3
	26	Core - 25	Project	5+	8
			Subtotal	30	27
			Total	120	90

+ Extra hours for the Project

For the Project, flexible credits are b/w 5 – 8 & Hours per week are b/w 10 - 16.

Total number of credits \geq 90	:	90
Total number of Core Courses	:	25 (15 T + 8 P + 1 Prj. + 1 FW.)
Total number of Elective Courses / F.W. / S.T.	:	1
Total hours	:	120

FIRST SEMESTER
Core Subject-1
BC 1.1 – BIOMOLECULES

Total Hours :80

16 Hrs

Unit -1

Structure and biological importance of sugar derivatives, Phosphate esters, NTPs, Amino Sugars, derivatives, Sugar acids, lactones, deoxy sugars and glycosides. Polysaccharides: homopolysaccharides – occurrence, Structure and biological functions of cellulose, chitin, Starch and glycogen. Heteropolysaccharides – structure and biological role of glycosaminoglycans, Proteoglycans, blood group and bacterial cell wall polysaccharides. Glyco proteins: general introduction. O-linked and N-linked oligosaccharides – lectins.

Unit -2

16 Hrs

Classification of amino acids and general properties. The peptide bond-Ramachandran plot. Chemical Synthesis of peptides- Merrifield method. Proteins – Classification, denaturation and renaturation. Orders of protein structure- secondary structure – α helix, β pleated sheet and β turns. Protein sequencing. Pauling and Corey model for fibrous proteins. Collagen triple helix. Methods of isolation, characterization and purifications. Protein crystallization. XRD and Maldi Toff Analysis

Unit – 3

16 Hrs

Super secondary structure – helix-loop helix, the hairpin β motif and the β α β motif. Forces stabilizing tertiary and quaternary structure. Structure of haemoglobin – oxygen binding and changes in conformation. Structure of lysozyme and myoglobin.

Unit-4

16 Hrs

Essential fatty acids, Structure and biological functions of phospholipids, sphingolipids, glycolipids, Composition of lipoproteins. Steroids – structure, properties, functions of cholesterol, Structures of ergosterol, phytosterol. Prostaglandins, thromboxanes and leukotrienes – Structure and biological role.

Unit -5

16 Hrs

Structure of purines, pyrimidines, nucleosides and nucleotides. DNA double helical structure. A, B and Z forms of DNA. Triple and quadruple structures. DNA supercoiling and linking number. Properties of DNA: buoyant density, viscosity, hypochromicity, denaturation and renaturation – the cot curve. DNA sequencing – chemical and enzymatic methods. Chemical synthesis of DNA. RNA – major classes and biological role. Structure of tRNA.

Text Books Recommended

1. Biochemistry Zubay, 4th edition 1998, William C. Brown Publication.
2. Harper's Biochemistry, 25th edition, McGraw Hill.
3. Biochemistry, Stryer, 4th edition, Freeman.
4. Principles of Biochemistry. Lehninger Nelson Cox Macmillan worth Publishers, 2008.
5. Biochemistry, Davidson and Sittmann, NMS 4th ed. Lippincott Williams and Wilkins. 1999.
6. Biochemistry – Voet and Voet.
7. Biochemistry – David Rawn.

Core Subject – 2

BC 1.2 – MOLECULAR CELL BIOLOGY

Unit – 1

16 Hrs

Cell and Tissue organization:

Molecular Organization of prokaryotic and eukaryotic cells. Structure and function of mitochondria, Chloroplasts, Endoplasmic reticulum, Golgi apparatus, lysosomes and peroxisomes. The cytoskeleton-microtubules, microfilaments and intermediate filaments. The nucleus: nucleoli, Chromatin, Chromosomes.

Types of tissues. Salient features of epithelial organization. The basement membrane and extracellular matrix.

Unit-2

16 Hrs

Membranes:

Membranes assembly- importins and exportins. membrane transport: Diffusion(passive and facilitated).Active transport-Symport, antiport, Na⁺ k⁺ ATPase. Ion gradients, ion selective channels group translocation, porins. Endocytosis and exocytosis.

Unit -3

16 Hrs

Cellular Communication, cell cycle, cell death:

Intercellular communication through gap junctions, tight junctions and desmosomes. Brief account of cell division (mitosis and meiosis) and cell differentiation.The cell cycle –phase, regulation by cyclins and cyclin dependent kinases.

Cell death-necrosis and apoptosis

Unit -4

16 Hrs

Cell Signaling

Fundamental Concepts and definitions of signal, ligands and receptors, Endocrine, Paracrine and autocrine signaling. Receptors and signaling pathways – cell surface receptors ion channels, G-protein coupled receptors, receptor kinases(tyr, ser, thr).Signal transduction through cytoplasmic and nuclear receptors.The Rasraf-map kinase cascade.Second Messengers-cyclic nucleotides, lipids and calcium ions. Crosstalk in signaling pathways.

Unit-5

16 Hrs

Techniques in cell Biology:

Microscopy-Basic principles. Light, bright field, phase-Contrast and fluorescence Microscopy. Electron Microscopy-preparation of specimens. TEM and SEM. Confocal microscopy. Microtome-Fixation and staining. Flow cytometry.

Text Books Recommended

1. De Robertis and De Robertis. Cell and Molecular Biology. Lea and Febiger. 8th ed.
2. Karp G. Cell and Molecular Biology. 3rd ed. John Wiley and sons. 2002.
3. Darnell, Lodish and Baltimore. Molecular Cell Biology. Scientific American 2000.
4. Twyman. Advanced Molecular Biology. Viva books 2nd ed (for Unit 4)
5. Wilson and Walker. Practical Biochemistry. Cambridge University Press. 2000 (Unit 5)
6. Alberts et al. Molecular Biology of the Cell. 4th ed. Garland Sci. 2002.
7. Murray et al. Harper's Biochemistry. 25th ed. Mc Graw Hill. 2000 (For unit 2)
8. Murphy. Fundamentals of Light Microscope and Electron Imaging. Wiley-Liss, 2001 (Unit 5)

Core Subject-3
BC 1.3- GENETICS

Total Hours:80

16 Hrs

Unit - 1

Introduction to Genetics – Science of Heredity – Historical milestones – Classical, Molecular and Evolutionary Genetics. Preformation, Epigenesis, Pangenesis, Germplasm theory. Cell – Overview, Cell cycle – Stages of Mitosis and Meiosis. Chromosome – Structure, Variation in structure, number of chromosomes (Haploid and Diploid), Variation in number. Mutation and various DNA repair mechanisms.

Unit

16 Hours

Classical Genetics – Introduction to Mendelism – discovery and rediscovery of Mendelism. Mendel's experiment – Monohybrid cross- Law of dominance, Principle of segregation, Phenotype and genotype. Dihybrid test – Principle of independent assortment, Polyhybrid cross. Monohybrid Test cross, Dihybrid test cross. Epistasis – dominant and recessive epistasis

Unit -3

16 Hours

Sex Determination –Chromosome theory of sex determination, X – body, sex chromosome. XO method of sex determination, XY method of sex determination. Sex determination in Drosophila, sex determination in man. Abnormal sexes – Turner's syndrome, Klinefelter's syndrome. Sex linked inheritance - sex linked inheritance in Drosophila – Eye colour, sex linked inheritance in man – colour blindness and haemophilia. Y linked inheritance in man. X linked dominant genes.

Unit - 4

16 Hours

Linkage and Crossing over – Coupling and Repulsion. Morgan's experiment. Chromosome theory of Linkage. Crossing over – Mechanism of crossing over – Classical theory, Partial chiasma type theory, Belling Hypothesis, Crossing over in maize, crossing over in Drosophila. Factors affecting crossing over. Significance of crossing over.

Unit – 5

16 Hours

Population and Evolutionary Genetics – Hardy Weinberg equilibrium, natural selection Mutation – Fluctuation test, point mutation (frame shift, back mutation and suppression), chemical Mutagenesis and Ames test, Role of Mutation in evolution & Speciation, Altruism, mimicry, Kin selection & Industrial Melanism.

References

1. Principles of genetics – Tamrine
2. Principles of genetics – Gardner
3. Molecular Biology of the gene – Watson
4. Molecular and cell biology – Lodish, Baltimore
5. Genes VII (2000) Benjamin Lewin, Oxford University press

Core – 4 - BIOSTATISTICS

Total hours:80

16 Hrs

Unit-1

Matrices:-Matrix Algebra,Types of Matrices,Determinant of a matrix,Rank of a matrix,Singular and Non singular Matrices.Inverse of matrices.Solving system of linear equations using matrix method

Unit-2

16 Hrs

Nature of biological and clinical experiments-collection of data in experiments-primary and secondary data. Methods of data collection. Classification and Tabulation. Diagrams and graphs of data.

Unit-3

16 Hrs

Measure of Averages-Mean,Median and Mode.Use of these measures in biological studies. Measures of Dispersion for biological characters-Quartile Deviation, mean Deviation and standard deviation and coefficient of variation. Measures of skewness and kurtosis. Correlation and Regression-Rank Correlation-Regression equations. Simple Problems based on biochemical data.

Unit-4

16 Hrs

Basic Concepts of sampling-simple random sample,stratified and systematic sampling.Sample Statistics.Sampling distribution and standard error.Test of significance based large samples.Test for mean,difference of means,Proportions and equality of proportions

Unit -5

16 Hrs

Small sample tests-Students 't' test for mean,difference of two means, test for correlation and regression coefficients. Chi Square test for goodness of a non independence of attributes. F test for equality of variances.

Text Books Recommended

- 1.Sundar Rao,Jesudian Richard-An introduction to bio-Statistics
- 2.Alwi E Lewis.Biostatistics,East West Press
- 3.S.P.Gupta-Fundamentals of statistics,Sultan Chand.

Core - 5

PRACTICAL-1

BCP 1.6-BIOCHEMICAL, BIOPHYSICAL AND PHYSIOLOGICAL TECHNIQUES

1. Estimation of DNA by Diphenylamine method.
2. Estimation of RNA by Orcinol method.
3. Estimation of phosphorous content of nucleic acids by Fiske and Subbarow method.
4. Separation and Identification of amino acids by paper chromatography
5. Separation of plant pigments by column chromatography.
6. Determination of bleeding time and clotting time.
7. Enumeration of RBC
8. Enumeration of WBC
9. Identification of blood group
10. Total leukocyte count
11. Absolute Eosinophil count
12. Estimation of Hb by Drabkin's method
13. Determination of ESR

Core - 6

PRACTICAL 2: CELL BIOLOGY, GENETICS AND BIOSTATISTICS

1. Isolation of Chloroplast.
2. Isolation of DNA from animal tissue.
3. Identification of cell division by mitosis from onion root tip.
4. Calculation of central tendency-Mean, Geometric mean, Harmonic mean, median
5. Preparation of bar diagram, line diagram and pie diagram
6. Monohybrid experiment
7. Dihybrid experiment
8. Observation of polygenic inheritance in man- height and weight.

SECOND SEMESTER
Core subject-7 BC 2.1-PHYSIOLOGY

Total Hours:80

Unit-1

16Hrs

Blood-Composition and functions of plasma, erythrocytes, leucocytes and thrombocytes and plasma proteins in health and disease.

Blood groups –ABO and Rhesus systems. Blood coagulation-machanism and regulation. Fibrinolysis.

Unit-2

16Hrs

Composition, functions and regulation of saliva, gastric, pancreatic, intestinal and bile secretions.

Digestion and absorption of carbohydrates, lipids, proteins and nucleic acids.

Unit-3

16Hrs

Stucture of neuron- Divisions of the nervous system-central nervous system and peripheral nervous system. Receptors-conduction of nerve impulse-neurotransmitters. CSF-composition and clinical significance.

Structure of skeletal muscle-Muscle proteins-myosin,actin, troponin and tropomyosin- Mechanism and regulation of muscle contraction and relaxation.

Unit-4

16Hrs

Transport of oxygen and carbon dioxide in blood, lungs and tissue. Role of 2,3, BPG, Bohr effect and chloride shift.

Hydrogen ion homeostasis- factors regulating blood pH-buffers, respiratory regulation. Acid-base imbalance-causes and biochemical findings in metabolic and respiratory acidosis and alkalosis.

Unit-5

16Hrs

Structure of nephron.Formation of urine-glomerular filtration, tubular reabsorption of glucose, water and electrolytes-countercurrent exchange and multiplication, tubular secretion.

Renal threshold, Glomerular filtration rate. Renal regulation of acid-base balance.

Text Books recommended

- 1.Harpers Biochemistry-Murray et al.25th ed.2000,Mc Graw Hill.
- 2.Principles of Biochemistry-Mammalian Biochemistry-Smith et al. Mc Graw Hill.7th ed.
3. Human Physiology-Guyton, Saunders
4. Human Pysiology Chatterjee 11th edition 1997 Medical Allied Agency.

5. Human physiology-Vander et al 4th Mc Graw Hill.
6. Review of Medical physiology-Ganong,Appleton and Lange.
7. Physiology Best and Taylor

Core Subject-8

BC 2.2-ENYMES AND ENZYME TECHNOLOGY

Total Hours:80

16 Hrs

Unit-1

Enzymes-general characteristics,classification and nomenclature,methods of enzyme isolation and purification.Methods of enzyme assay,Enzyme units,Katal, Specific activity and turnover number. Active site – investigation of active site structure.A brief account of non account of non protein enzymes – ribozymes.

Unit-2

16 Hrs

Enzyme kinetics – general,pre steady state and steady state kinetics.Fst Kinetics and rate limiting steps(relaxation Methods) Effect of pH, Temperature,Enzyme and substrate concentration.Michaelis – Menten plot-linear transformation,Lineweaver – Burk plot,Eadie – Hofstee plot,and Hanes Woolf equations,significance of k_m and V_{max} .King –Altman procedure.

Hill's equation and co-efficient,sequential and non sequential bi substrate reactions.

Unit -3

16 Hrs

Enzyme inhibition – irreversible and reversible competitive,noncompetitive,uncompetitive,mixed inhibitionmkinetic differentiation and graphical methods.Mechanism of enzyme action-acid base catalysis,covalent catalysis,Strain,proximity and orientation effects.Mechanism of action of lysozyme,chymotrypsin,RNase.

Unit -4

16 Hrs

Coenzymes,multienzyme complexes.Metal dependent and metallo enzymes.Isoenzymes.Enzyme regulation: General mechanism of enzyme regulation,feed back inhibition and feed forward stimulation.Enzyme repression,induction and degradation, zymogens.

Unit-5

16 Hrs

Enzyme electrode,enzyme biosensors and their applications,ELISA,EMIT Enzymes of industrial and clinical significance,Sources of industrial enzymes,thermophilic enzymes,amylases,glucose isomerases,cellulose degrading,enzymes,pestic enzymes,lipase proteolytic enzymes in meat and leather industry,detergentsand cheese production.

Enzymes as thrombolytic agents,anti – inflammatory agents,debriding agents,digestive aids,therapeutic use of enzymes.

Text Books Recommended

1. T.Palmer,Understanding enzymes,Prentice Hall
2. Principles of Biochemistry – Zubay 4th ed 1998.William C.Brown Publ.
3. Ratledge and Kriostiansen.Basic Biotechnology.2nd ed.,Cambridge univ.Press
4. Dixon and webb.Enzymes 3rd edition Longmans,1979.
5. .Stryer.,Biochemistry 5th ed.Freeman, 2002
6. Whitehurst RJ.,Enzymes in food technology, CRC Press,2001
- 7 .Uhlig H.,Industrial enzymes and their applications.John Wiley,1998
8. Maragoni AG.,Enzyme Kinetics. Amodern approach., John Wiley and sons 2002
- 9 .Balasubramanian etal.,Concepts in Biotechnology Universities Press(India) Ltd.,1998

Core Subject-9

BC2.3-METABOLISM AND REGULATION

Total Hours:80

Unit-1

16Hrs

Bioenergetics:

Free energy and entropy. Laws of thermodynamics. Enzymes involved in redox reactions. The electron transport chain-organization and role in electron capture.

Oxidative Phosphorylation-electron transfer reactions in mitochondria. F1F0 ATPase-structure and mechanism of action. The chemiosmotic theory.

Inhibitors of respiratory chain and oxidative Phosphorylation-uncouplers, ionophores.Regulation of oxidative Phosphorylation.

Mitochondrial transport systems-ATP/ADP exchange, malate/glycerophosphate shuttle.

Unit-2

16Hrs

Carbohydrate metabolism:

Glycolysis and gluconeogenesis-pathway, key enzymes and co-ordinate regulation. The citric acid cycle and its regulation. The pentose phosphate pathway. Metabolism of glycogen and regulation. Glucuronic acid pathway.

Unit-3

16Hrs

Lipid metabolism:

Oxidation of fatty acids - β , α and omega oxidation. Metabolism of ketone bodies-formation, utilization, excretion and clinical significance. Biosynthesis of fatty acids. A brief account of the metabolism of triglycerides, phospholipids and cholesterol. Details of lipoprotein metabolism.

Unit-4

16Hrs

Metabolism of aminoacids, purines and pyrimidines:

Overview of biosynthesis of nonessential amino acids. Catabolism of amino acid nitrogen-transamination, deamination, ammonia formation, the urea cycle. Catabolism of carbon skeletons of amino acids-overview only.

Digestion and absorption of nucleoproteins, Metabolism of purines- de novo and salvage pathways for purine biosynthesis, purine catabolic pathway. Metabolism of pyrimidines-biosynthesis and catabolism.

Unit-5

16Hrs

Metabolic integration and hormonal regulation:

Interconversion of major foodstuffs, metabolic profile of the liver, adipose tissue and brain.

General principles of metabolic regulation and enzymic control. Hormonal regulation of metabolism-role of epinephrine, glucagons, cortisol and insulin. Brief account of leptin.

Text Book Recommended

- 1.Stryer.Biochemistry,Freeman 5th ed.2002
- 2.Murray et al.Harper's Biochemistry.5th ed.Mc.Graw Hill,2000
- 3.Nelson Cox.Lehninger's Principles of biochemistry.3rd ed.Mc Millan Worth,2000
- 4.Donald Voet,J.G.Voet,John Wiley,Biochemistry.1995
- 5.Kuchel and Ralston.Biochemistry 2nd ed.Schaum's Outlines Mc Graw Hill,1998
- 6.Davidson and sittman.Biochemistry NMS 4thed.Lippincott.Willams & Wilkins,1999
- 7.Campbell and Farrell.Biochemistry 4th ed.Brooks/Cole Pub Co.2002.

Core – 10 -MUSCLE BIOCHEMISTRY AND BIOMEMBRANES

Total Hours:80

16 Hrs

Unit-1

Muscle Biochemistry:

Skeletal Muscle Structure,biochemical Characterization of the extracellular matrix, plasmalemma, transverse tubular system, Sarcoplasmic reticulum and myofibrils.

Actin, myosin, tropomyosin, troponin, Z disc and H line components. The sliding filament mechanism and subcellular ion movements during the contraction cycle in skeletal muscle, length tensions relationship.

Unit-2

16 Hrs

Metabolic and functional classification of skeletal muscle fibers(types 1,2A,2B).Twitch speeds and myosin ATPase activities. Oxidative and anaerobic-metabolism. Enzyme, histochemical and immunofluorescence characterization of muscle fibers.The motor unit and differentiation following cross insertion effect of aging and thyroid states. Skeletal muscles diseases. Specialized metabolism in cardiac and smooth muscle. All or none versus graded responses. Thick filament regulation.

Unit -3

16 Hrs

Cyclic AMP and Hormonal sensitivity.Role of calmodulin,Phospholamban,Cardiac troponin 1,Slow Ca⁺⁺ Channel Phosphorylation.Depolarization induced and calcium induced release from S.R.I,Calcium export from muscle cells.Role of sodium,effects of ouabain,Stimulation frequency and verapanil.

Unit-4

16 Hrs

Bio-membranes:-

Biological membranes and transport. Physicochemical Properties of cell membranes, molecular constituents of membranes-supra molecular architecture of membranes-asymmetrical organization of lipids and proteins.

Solute Transport across membranes: Fick's law, Types of Transport-simple diffusion, passive-facilitated diffusion. Active Transport-primary & secondary group translocation. Transport by ATPases

Unit-5

16 Hrs

Molecular models of transport mechanism: Mobile carrier and pores mechanisms. Transport by vesicle formation: Endocytosis, exocytosis

Intercellular communication through junctions- gap junction, tight junction, desmosomes.

Membrane biogenesis and regulation of cell membrane components; cell-cell interaction, Artificial membranes-transport studies.

Text Books Recommended

1. Biochemistry Zubay, 4th edition 1998 William C. Brown Publication.
2. Harper's Biochemistry, 25th edition McGraw Hill.
3. Biochemistry, Stryer, 4th edition Freeman.
4. Principles of Biochemistry. Lehninger Nelson Cox Macmillan Worth Publishers, 2000
5. Biochemistry. Davidson and Sittmann, NMSS 4th ed. Lippincott Williams and Wilkins, 1999.
6. Biochemistry- Voet and Voet.

Core - 11

PRACTICAL-3

ENZYMES AND ENZYME TECHNIQUES

1. Determination of total activity of salivary amylase.
2. Determination of specific activity of salivary amylase
3. Time course of enzyme reactions.
4. Estimation of Acid phosphatase activity from greengram
5. Estimation of peroxidase activity from horse radish.
6. Estimation of the activity of arginase from animal tissue
7. Estimation of the activity of hexokinase from animal tissue.
8. Estimation of ALP from plant source

Core -12

PRACTICAL 4: ENZYME KINETICS

1. Effect of pH, temperature, enzyme concentration and substrate concentration on enzyme activity (Trypsin/LDH)
2. Effect of pH, temperature, enzyme concentration and substrate concentration on enzyme activity (Urease/ALP) and determination of activation energy.
3. Effect of inhibitor(s) on activity of any one enzyme (Trypsin/LDH).
4. Effect of activator(s) on activity of any one enzyme (Trypsin/LDH).