

COURSE STRUCTURE & SYLLABUS

(w.e.f. 2020)

M.Sc. Biochemistry (CBCS Pattern)

Department of Biosciences
Jamia Millia Islamia

SEMESTER – I		Credits
BCM-101 Organic Chemistry & Biomolecules	4 periods/wk Marks : 60*+40**=100	4
BCM-102 Cell Biology	4 periods/wk Marks : 60*+40**=100	4
BCM-103 Genetics	4 periods/wk Marks : 60*+40**=100	4
BCM-104 Microbiology (CBCS)	4 periods/wk Marks : 60*+40**=100	4
BCM-105 Lab Course-I	12 periods/wk Marks : 75*+75**=150	6

SEMESTER – II		Credits
BCM-201 Immunology	4 periods/wk Marks : 60*+40**=100	4
BCM-202 Intermediary Metabolism	4 periods/wk Marks : 60*+40**=100	4
BCM-203 Enzymology	4 periods/wk Marks : 60*+40**=100	4
BCM-204 Human Physiology (CBCS)	4 periods/wk Marks : 60*+40**=100	4
BCM-205 Biochemical Technique (SEC)	4 periods/wk Marks : 60*+40**=100	4
BCM-206 Lab Course-II	12 periods/wk Marks : 75*+75**=150	6

SEMESTER – III		Credits
BCM-301 Molecular Biology	4 periods/wk Marks : 60*+40**=100	4
BCM-302 Nutritional Biochemistry	4 periods/wk Marks : 60*+40**=100	4
BCM-303 Neurobiochemistry	4 periods/wk Marks : 60*+40**=100	4
BCM-304 Biochemical & Environmental Toxicology (CBCS)	4 periods/wk Marks : 60*+40**=100	4
BCM-305 Plant Biochemistry	4 periods/wk Marks : 60*+40**=100	4
BCM-306 Lab Course-III	16 periods/wk Marks : 100*+100**=200	8

SEMESTER – IV		Credits
BCM-401 Technical Writing & Seminar (AECC)	4 periods/wk Marks : 60*+40**=100	4
BCM-402 Bioinformatics & Biostatistics (CBCS)	4 periods/wk Marks : 60*+40**=100	4
BCM-403 Project & Dissertation	16 periods/wk Marks : 100*+100**=200	8

Total Credits = 92

***Semester End Examination**

****Internal Assessment**

BCM -101
ORGANIC CHEMISTRY AND BIOMOLECULES

Unit I

Electronic theory of valency, dipolar moments. Electronic displacements in a molecule: Inductive effect, resonance, the hydrogen bond, hydrophobic interactions. Atomic and molecular orbitals. Shapes of biomolecules, hybridization and tetravalency of carbon. Isomerism. Structural isomerism, stereoisomerism, geometrical isomerism (E & Z nomenclature) Types of organic reactions. Substitution, addition, elimination, rearrangement, condensation and polymerization. Free Radicals in biological systems. Oxygen as a free radical in the auto oxidation of fats. Antioxidants (Free radical inhibitors in the cells such as vitamin A, vitamin C, Se etc.) Mechanism of substitution in the benzene ring: o-, p- and m- directing groups. The concept of resonance with reference to benzene derivatives. Direct influence of substituents - electronic interpretation.

Unit II

Stereochemistry: Optical isomerism, optical activity, meso compounds, specific rotation, chirality, chiral center, enantiomers, diastereoisomers, D L, R S, threo erythro notations, conformation and configuration, dihedral angles, conformational analysis of ethane, n-butane, cyclohexane, mono- and di- substituted cyclohexane, monosachharides, boat and chair forms, eclipsed, gauche and staggered conformations, axial and equatorial bonds. Anomers and mutarotation, glycoside, epimers, glucopyranose, fructofuranose, periodic acid oxidation of sugars. Heterocyclic system occurring in living system: Numbering and properties of the ring; properties of pyran, furan, thiozole, indole, pyridine, pyrimidine, quinine, purine and pteridine.

Unit III

Carbohydrates: Classification, structure and occurrence of common monosaccharides, di-saccharides and polysaccharides. Glycosaminoglycans, Glycoprotiens, peptidoglycan, proteoglycan, N-linked and O-linked glycoproteins.

Unit IV

Proteins: Amino acids (structure and general properties), peptide bond. Primary structure of proteins (end groups analysis, peptide cleavage and sequence determination), secondary structure (peptide group, structural constraints on polypeptide chain, Ramachandran plot, helical structures, beta pleated sheets, other secondary structure), supersecondary structures. Tertiary structure. Quarternary structure. Lipids: Fatty acids, Triacylglycerols, phosphoglycerides, sphingolipids. Lipid aggregates, lipid linked proteins, Lipoproteins. Glycolipids.

Recommended Books

1. Nelson, David L., Albert L. Lehninger, and Michael M. Cox. Lehninger principles of biochemistry. Macmillan, 2008. Berg, Jeremy M., John L. Tymoczko, and Lubert Stryer. "Biochemistry 5th ed." (2002).
2. Voet, Donald, Judith G. Voet, and Charlotte W. Pratt. Fundamentals of Biochemistry 2002 Update. John Wiley & Sons, 2002.

**BCM -102
CELL BIOLOGY**

Unit I

Cytoskeletal Network Intramembrane System Cytoskeletal network, alpha and beta tubulins, actin-myosin system and Dynein activator complex. Structure and Function of Endoplasmic Reticulum, Golgi body and Lysosome.

Unit II

Nucleus, Cell cycle and Molecular Structure of Gene The nuclear envelop and traffic between nucleus and cytoplasm, internal organization of the nucleus, the nucleolus, nucleus during mitosis. The eukaryotic cell cycle, regulation of cell cycle progression, The events of M Phase, Meiosis and fertilization. Chromosomal organization of genes and non-coding DNA, functional rearrangement in chromosomal DNA, Morphology and functional elements of eukaryotic chromosome, organelles DNA.

Unit III

Cell to Cell Signaling Overview of extracellular signaling, identification and purification of cell surface receptors, G-protein coupled receptors and their effectors, Receptor tyrosine kinase and RAS, MAP kinase pathways. Program cell death.

Unit IV

Molecular basis of Cancer Tumor cells and onset of cancer, Protooncogene and tumor suppressor gene, oncogenic mutations affecting cell proliferation, mutation causing loss of cell cycle control, mutation affecting genome stability.

Recommended Books

1. The Cell, A Molecular Approach – 6th Edition – Geoffrey M. Cooper/Robert E. Hausman- Sinauer Associates, Inc.
2. Molecular Biology of the Cell - 5th Edition - Bruce Alberts et al - Garland Science
3. Molecular Cell Biology - 7th Edition - Harvey Lodish, Arnold Berk & Chris A. Kaiser - W.H. Freeman
4. Lewin's Cells – 2nd Edition – Cassimeris/Lingappa/Plopper – Johns & Bartlett Publishers
5. Cell Biology, A Short Course – 3rd Edition – Stephen R. Bolsover et al – John Wiley& Sons
6. Microbial Physiology: Moat, Foster and Spector
7. Cell and molecular biology: Gerald Karp.
8. Cell and molecular biology: DeRobertis and DeRobertis

BCM -103 GENETICS

Unit I

Chromatin structure, Nucleosome, Chromosome structure-centromere and telomere. Tandomly repeated non-coding DNA Interspersed repeated non-coding DNA Expression and processing of heterogeneous nuclear RNA, r RNA, t RNA. Alternate transcription and processing on individual genes. Mitochondrial genome and diseases.

Unit II

General homologous recombination. Non-homologous end joining. Site specific recombination, Transposable elements, Mechanism of Transposition. The Lac -operon positive, negative and repression. Arabinose operon. Tryptophan operon. The lambda phase: a complex of operon.

Unit III

Molecular basis of gene mutation. Gain of function mutation. Loss of function mutation and their consequences. Chemical mutagenesis in higher organism. Repair of DNA damage. Photoreactivatration. SOS repair mechanism. Base excision repair. Nucleotide excision repair. Stability of the genome.

Unit IV

Population and gene pool. Calculating allele frequencies. The Hardy-Weinberg law. Extension of Hardy -Weinberg law, Natural selection, Mutation, Migration, Genetic drift, Non-random mating. Adaptive radiation and modification, Isolating mechanism, Speciation- Allopatric and Sympatric, Convergent evolution, Sexual selection, Co-evolution.

Recommended Books

1. Introduction to Genetic Analysis. 9th Edition by Griffiths et al. 2008.
2. Concept of Genetics. 9th Edition, by Klug et al. 2009.
3. Principles of Genetics by Snustad et al. 2004.
4. Genes IX Lewin 2008.
5. Molecular Biology of the Gene Watson et al. 6th Edition 2009.
6. Molecular Cell Biology by Lodish et al. 2008
7. Molecular Biology of the Cell Alberts et al. 5th Edition. 2007.

BCM -104
MICROBIOLOGY (CBCS)

Unit I

Introduction to microbial systems. Importance of microbiology in agriculture, human health, industry and environment. Types of microorganisms, general characteristics of main groups of microorganisms. Criteria used in the classification of microorganisms- cytology, genetics, host specialization, serology.

Unit II

Microbial growth: different phases of growth. Measurement of microbial growth. Effects of various environmental factors on microbial growth; Uptake of nutrients by microbial cells and their nutritional requirements. Control of microbial growth: physical control, chemical control and antibiotics. Mechanisms of drug resistance.

Unit III

Isolation, culture, identification and preservation of bacteria. Gram positive and gram-negative organisms. Structure and functions of peptidoglycan in gram positive and gram- negative organisms. Functions of polymeric components in outer membrane and acidic polymers in gram-negative organisms. Special features of bacterial metabolism. Role of microorganisms in domestic and industrial sewage.

Unit IV

Classification of viruses. Virus structure, virus proteins. Viroids and prions. Virus-host interaction. Replication of RNA viruses – negative strand (VSV), positive strand (polio), retroviruses (to include all events in the infectious cycle). Replication of DNA viruses (Adenovirus or SV40). Microbial diseases: Respiratory diseases caused by viruses and bacteria-tuberculosis and small pox. Sexually transmitted diseases. Food spoilage and food-borne diseases.

Recommended Books

1. Pelczar MJ, Chan ECS and Krieg NR. (1993). Microbiology. 5th edition. McGraw Hill Book Company.
2. Stanier RY, Ingraham JL, Wheelis ML, and Painter PR. (2005). General Microbiology. 5th edition. McMillan.
3. Tortora GJ, Funke BR, and Case CL. (2008). Microbiology: An Introduction. 9th edition. Pearson Education.
4. Willey JM, Sherwood LM, and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology. 7th edition. McGraw Hill Higher Education.
5. Gottschalk G. (1986). Bacterial Metabolism. 2nd edition. Springer Verlag

BCM -201 IMMUNOLOGY

Unit I

Introduction and Overview of the Immune System. Origin of Immunology and its evolution. Infection and immunity. Types of immunity- Innate and acquired, active and passive, humoral and cell mediated. Clonal selection theory. Organs and cells of the immune system: structure and function. Hematopoiesis. Lymphocyte traffic. Antigens and immunogens. Adjuvants. Requirements for immunogenicity.

Unit II

Structure and function of immunoglobulins. Antibody variants- isotypes, allotypes and idiotypes. Monoclonal antibodies. Hybridoma technology. Organization of immunoglobulin genes. Theories and genetic basis of antibody diversity. Antibody – antigen binding: affinity, avidity, cross reactivity. Antigen-antibody interactions; agglutination, hemagglutination. Precipitation reactions in solution and in gels. Immunoassays: Radioimmunoassay, ELISA, ELISPOT, immunofluorescent assays. Fluorescence activated cell sorting. Western blotting.

Unit III

Major histocompatibility complex. MHC genes and Histocompatibility antigens. Role of MHC in T cell selection. Cytokines and their role in immune regulation. Complement system. Mechanism of its fixation; complement activation and its biological activities. Classical, alternative and lectin pathways; Regulation of complement.

Unit IV

Immunological tolerance to self and to antigens; its induction and features. Immunosuppression- specific and non-specific. Allergy and hypersensitivity. Effector mechanisms and examples of each type of hypersensitivity. Transplantation immunology. Tumor immunology. Immunodeficiencies; primary and secondary. Autoimmunity: factors contributing to autoimmunity; examples and diagnosis. Immunization and Vaccines.

Recommended Books

1. Basic Immunology by Abul Abbas Andrew H. Lichtman and Shiv Pillai, Elsevier
2. Basic immunology by Jacqueline Sharon, Williams & Wilkins
3. Kuby Immunology. W. H. Freeman & Co.
4. Immunology by Ivan Roitt, Jonathan Brostoff, and David Male, Elsevier
5. How the Immune System Works, by Lauren M. Sompayrac, Wiley
6. The Elements of Immunology by Fahim Halim Khan Pearson Education India, 2009
7. Kuby Immunology, Sixth Edition 6th Edition by Thomas J. Kindt (Author), Barbara A. Osborne (Author), Richard A. Goldsby (Author)

BCM -202
INTERMEDIARY METABOLISM

Unit I- Carbohydrates

Intermediary Metabolism: Approaches for studying metabolism. Glycolysis, citric acid cycle; its function in energy generation and biosynthesis of energy rich bonds, pentose phosphate pathway and its regulation. Alternate pathways of carbohydrate metabolism Gluconeogenesis, interconversions of sugars; Biosynthesis of glycogen, starch and oligosaccharides. Regulation of blood glucose homeostasis. Hormonal regulation of Carbohydrate metabolism.

Unit II- Lipids

Fatty acid biosynthesis: acetyl CoA carboxylase, Fatty acid synthase, desaturase and elongase, Fatty acid oxidation: α , β , and ω - oxidation and lipooxidation. Lipid biosynthesis: Biosynthesis of Triacylglycerol sphingolipids and phosphoglycerides, Biosynthesis of terpenes, steroids and prostaglandins. Ketone bodies: Formation and utilization, metabolism of Circulating lipids: chylomicrons, LDL, HDL and VLDL. Free fatty acids. Lipid levels in pathological conditions.

Unit III- Amino Acids

Biosynthesis and degradation of amino acids and their regulation. Specific aspects of amino acid metabolism. Urea cycle and its regulation. In-born errors of amino acid metabolism.

Unit IV- Nucleic Acids

Biosynthesis of purines and pyrimidines; Degradation of purine & pyrimidine. Regulation of purine & pyrimidine biosynthesis. Structure and regulation of ribonucleotide reductase. Biosynthesis of ribonucleotides, deoxyribonucleotides and polynucleotides; Inhibitors of nucleic acid and biosynthesis.

Recommended Books

1. Nelson, David L., Albert L. Lehninger, and Michael M. Cox. Lehninger principles of biochemistry. Macmillan, 2008. Berg, Jeremy M., John L. Tymoczko, and Lubert Stryer. "Biochemistry 5th ed." (2002).
2. Voet, Donald, Judith G. Voet, and Charlotte W. Pratt. Fundamentals of Biochemistry 2002 Update. John Wiley & Sons, 2002.

BCM -203 ENZYMOLGY

Unit I

Review of unisubstrate enzyme kinetics and factors affecting the rates of enzyme catalyzed reactions. Michaelis Menten equation & temperature pH functions and their significance. Classification of multisubstrate reactions with examples of each class. Kinetics of multisubstrate reactions. Derivation of rate of expression for Ping Pong and ordered Bi Bi reaction mechanism. Methods for measuring kinetics and rate constants of enzyme reactions. Enzyme turnover and methods employed to measure Turnover of enzyme. Significance of enzyme Turnover.

Unit II

Protein-Ligand binding. Co-operativity phenomenon, Hill and Scatchard plots. Allosteric enzymes, Sigmoidal kinetics and their physiological significance. Symmetric and sequential modes of action of allosteric enzymes. Multienzyme Systems: Occurrence, isolation and their properties. Polygenic nature of multienzyme systems. Mechanism of action and regulation of pyruvate dehydrogenase and fatty acid synthetase complexes. Immobilized Enzyme Systems and their applications.

Unit III

Co-enzyme, Cofactors & Diagnostic Enzymes: Water soluble vitamins and their coenzymes. Metallo enzymes. Detailed mechanisms of catalysis of serine proteases. Chymotrypsin and Triose phosphate isomerase. Clinical significance of Aspartate aminotransferase, Alanine aminotransferase, Creatine kinase, Aldolase, Lactate dehydrogenase.

Unit IV

Enzyme regulations: General mechanisms of enzyme regulation: Feedback inhibition and feed forward stimulation; enzyme repression, induction and degradation, control of enzyme activity by products and substrates; Reversible and irreversible covalent modification of enzymes. Proteolytic activation. Concepts of Convergent and Divergent evolution of enzymes.

Recommended Books

1. Enzymology and Enzyme Technology 3 March 2014 by Bhatt S.M.
2. Enzymology, 2010 by T. Devasena
3. ENZYMES: Biochemistry, Biotechnology, Clinical Chemistry, 2/E –2008 by Trevor Palmer (Author), Philip Bonner (Author)
4. Enzyme Technology: Pacemaker of Biotechnology – 2011 by Prasad N.K (Author)
5. Voet, Donald, Judith G. Voet, and Charlotte W. Pratt. Fundamentals of Biochemistry 2002 Update. John Wiley & Sons, 2002.

BCM -204
HUMAN PHYSIOLOGY (CBCS)

Unit I- Cardiovascular System and Respiratory System

Comparative anatomy of heart structure, myogenic heart, specialized tissue, ECG-its principle and significance, cardiac cycle, blood pressure, regulation of blood pressure. Disorders of erythrocyte metabolism, hemoglobinopathies, thalassemias, and anaemias. Comparison of respiration in different species, transport of gases (oxygen transport, oxygen – haemoglobin dissociation curve, carbon dioxide transport), exchange of gases, waste elimination, regulation of respiration.

Unit II- Digestive System

Physiological anatomy of Gastro-Intestinal Tract (GIT), Digestion and absorption of carbohydrates, proteins and fats. Disorders of Carbohydrate & Lipids Metabolism: Diabetes mellitus, Hypoglycemias, Ketone bodies, Glycogen storage diseases, Galactosemia, Lipidosis, Sphingolipiodsis, Multiple sclerosis Diagnostic tests for Apolipoproteins, HDL- cholesterol, LDL-cholesterol and triglycerides disorders. Energy balance, BMR.

Unit III- Excretory System

Comparative physiology of excretion, kidney, urine formation, urine concentration, waste elimination, micturition, regulation of water balance, acid-base balance and its disorder homeostasis, Renin-Angiotensin System. Disorder of Amino acid. Disorders of Mineral Metabolism: Hypercalcemia, hypocalcemia, normocalcemia, hypophosphatemia, hyperphosphatemia.

Unit IV- Endocrine system and Reproductive System

Endocrine glands(Hypothalamus, pituitary gland, pineal gland, thyroid gland, parathyroid gland, thymus, adrenal gland, pancreas, testis, ovary), basic mechanism of hormone action, hormones and diseases. Adrenocortical steroids, Reproductive endocrinology, Thyroid function. Male reproductive system, female reproductive system, reproductive processes (spermatogenesis, oogenesis), Neuroendocrine regulation.

Recommended Books

1. Barret Kim E., Boitano Scott, Barman Susan M., Brooks Heddwen L. *Ganong's Review of Medical Physiology*. 25th ed. New York: McGraw Hill Medical, 2015.
2. Hall John E. *Guyton and Hall Textbook of Medical Physiology*. 13th ed. Philadelphia, PA: Saunders Elsevier, 2015.
3. Human Physiology in Nutshell 2017 by A.K. Jain (Author)
4. Medical Physiology , 1 Apr 1995 by William F. Ganong (Author)
5. Human Physiology Volume 2 – 2005 by Chatterjee Cc (Author)

BCM -205
BIOCHEMICAL TECHNIQUES (SEC)

Unit I

Water: Physical properties and structure of water, hydrogen bonding, ionization of water, pH scale, acids – bases. Henderson – Hasselbach equation, buffers, ionization behavior of amino acids and proteins, titration curve, buffer solutions and their actions.

Unit II

Radioisotopic techniques: nature of radioactivity, properties of α -, β -, and γ -rays; measurement of radioactivity, use of radioisotopes in research. In vivo and in vitro labeling techniques, double labeling, quenching, internal standard, channel ratio, external standard ratio, emulsion counting, radioactive decay, autoradiography.

Unit III

Viscosity: its measurement, viscosity of macromolecules, molecular weights of biomolecules. Sedimentation of macromolecules, centrifugation, density gradient and ultracentrifugation techniques. Sub cellular fractionation. Electrophoretic Techniques: Moving boundary and zonal electrophoresis, paper and gel electrophoresis, isoelectric focusing. Chromatography: Paper, TLC, adsorption, partition, ion- exchange, reverse phase, gel filtration, gas chromatography, HPLC.

Unit IV

Spectroscopy: Basic concepts and applications of X-ray diffraction, NMR, ESR, UV, IR, fluorescence, Raman mass spectroscopy in structure determination of organic and biomolecules, CD and ORD. Microscopy: Light, electron (scanning and transmission), phase contrast, fluorescence microscopy, freeze-fracture technique, specific staining of organelles or marker enzymes.

Recommended Books

1. Biochemical Techniques Wilson, Keith, and John Walker, eds.
2. Principles and techniques of biochemistry and molecular biology. Cambridge university press, 2010.
3. Biophotonics, Part B: 361 (Methods in Enzymology) Hardcover – Import, 11 Mar 2003 by Gerard Marriott (Editor), Ian Parker (Editor)

BCM -301 MOLECULAR BIOLOGY

Unit I

Enzymes used in Molecular Cloning: Restriction enzymes, DNA polymerases, ligase, kinase, phosphatase, nuclease; molecular cloning of DNA or RNA; Cloning Vectors: Lambda phage, plasmid, M13 phage, cosmid, shuttle vectors, yeast and viral vectors, construction of genomic and DNA library. DNA Sequencing and Amplification of DNA: DNA Sequencing and Amplification of DNA by polymerase chain reaction, types of PCR: RT-PCR, inverse PCR, asymmetric PCR.

Unit II

RNA Synthesis: Types of RNA polymerases, mechanism of transcription, RNA processing, capping, polyadenylation, splicing; micro RNA. Protein Synthesis: Ribosome, formation of initiation complex, initiation, elongation and termination of protein synthesis.

Unit III

Replication of DNA: DNA polymerase and other enzymes involved, replication origin, replication fork, semi conservative replication of double stranded DNA, mechanism of replication.

Unit IV

Gene Expression and Regulation: Prokaryotic and eukaryotic gene expression; gene silencing: transcriptional, post transcriptional, antisense RNA, oligonucleotide technology. Methods of Gene Transfer: Analysis of gene expression, micro arrays, restriction fragment length polymorphism, DNA finger printing, production of transgenic plants, transgenic animals.

Recommended Books

1. Principles of Gene Manipulations & Genomics, S.B. Primrose, M. Twyman, John & Willey Publishers
2. Molecular Biotechnology: Principles and Applications of Recombinant DNA, Bernard R.Glick and Jack J.Pasternack, Panima Publishing Corporation.
3. Gene Cloning – An Introduction. Blackwell Publishing, Brown, T. A. , 2016, (7th edition).
4. Krebs E, J., Goldstein S, E. and Kilpatrick, T. S. (2013). Lewins Gene XI. Jones and Bartlett publishers, Inc.
5. Molecular Cell Biology, Lodish, H., Berk, A., Zipursky, S., Matsudaira, P., Baltimore, D. and Darnell, J. (2016), W. H. Freeman and Company, 8th Ed.
6. Molecular Biology, David P. Clark & Nanette J. Pazdernik, Elsevier Academic Press, UK, (2013), 2nd Ed.

BCM -302
NUTRITIONAL BIOCHEMISTRY

Unit I

Basic Concepts: Composition of human body. Energy contents of foods. Measurement of energy expenditure: Direct and Indirect calorimetry. Definition of BMR and SDA and factors affecting these. Thermogenic effects of foods. Energy requirements of men and women and factors affecting energy requirements.

Carbohydrates: Dietary requirements and sources of available and unavailable carbohydrates. Physicochemical properties and physiological actions of unavailable carbohydrates (dietary fiber). Simple and complex carbohydrates. Artificial sweeteners.

Unit II- Proteins & Lipids

Proteins: Protein reserves of human body. Nitrogen balance studies and factors influencing nitrogen balance. Essential amino acids for man and concept of protein quality. Cereal proteins and their limiting amino acids. Protein requirement at different stages of development. Protein Energy Malnutrition (PEM): Etiology, clinical features, metabolic disorders and management of Marasmus and Kwashiorkor diseases. Starvation: Protein metabolism in prolonged fasting. Protein sparing treatments during fasting. Basic concepts of high protein, low caloric weight reduction diets. Lipids: Major classes of dietary lipids. Properties and composition of plasma lipoproteins. Dietary needs of lipids. Essential fatty acids and their physiological functions. Obesity: Definition and classification. Genetic and environmental factors leading to obesity. Role of leptin in regulation of body mass.

Unit III- Vitamins

Dietary sources, biochemical functions and specific deficiency diseases associated with fat – and water- soluble vitamins. Hypervitaminosis symptoms of fat-soluble vitamins. Nutritional requirements during pregnancy, lactation and growth of infants and children. Minerals: Nutritional significance of dietary calcium, phosphorus, magnesium, iron, iodine, zinc and copper.

Unit IV- Clinical nutrition

Role of diet and nutrition in the prevention and treatment of disease: Dental caries, fluorosis, renal failure, hyperlipidemia, atherosclerosis, and rheumatic disorders, inherited metabolic disorders: Phenyl ketonuria, Maple syrup disease, homocystinuria, galactosemia, gout, diabetes insipidus and diabetes mellitus. Anti-nutrients: Naturally occurring food-borne toxicants: Protease inhibitors, Hemagglutinins, Hepatotoxins, Allergens, Oxalates, Toxins from mushrooms, animal food stuffs and sea food.

Recommended Books

1. Biochemistry of Human Nutrition - 2nd edition by George Gropper
2. Nutritional Biochemistry by D.C.Sharma / Devanshi Sharma
3. Nutrition Chemistry and Biology by Julian F. Spallholz and Mallory Boylan
4. Biochemical, Physiological, and Molecular Aspects of Human Nutrition - 4th edition by Martha H. Stipanuk
5. Nutritional Biochemistry Hardcover – Import, 21 Dec 1998 by Tom Brody (Author)

BCM -303
NEUROBIOCHEMISTRY

Unit I - Neuromorphology and Neurocellular Anatomy

Central Nervous system – General features of Neurons. Cellular organization of neurons, astrocytes, oligodendrocytes, ependymal cells, schwan cells. Afferent and efferent pathway; sense organs. Chemical Composition of Brain. Formation, structure and biochemistry of myelin, chemistry of major brain lipids, lipid composition.

Unit II- Energy Metabolism

Role of astrocytes in energy metabolism, Blood Brain CSF Barriers morphology, diffusion, mediated transport, enzymatic barriers in capillary endothelium. Oxygen consumption by the brain, energy demanding functions, role of cerebral circulation, local cerebral blood flow and metabolism, cerebral energy metabolism. Characteristics of blood CSF barrier, composition of CSF, formation of CSF, active transport from CSF to brain.

Unit III

Synaptic Transmission and Second Messenger Pathways Structure of the synapse, correlation of structure and function at the synapse, transmission across the synapse, pre and post synaptic events, membrane potential in the steady state action, action potential and propagation of nerve impulse. Neurotransmitter and Neuropeptides. Chemistry, synthesis, storage and release of nervous neurotransmitters, transmitter action, synaptic modulation and mechanism of neuronal integration. Classes of neuropeptides, mode of action, role of neuropeptides in obesity and pain. Neuropeptide receptors.

Unit IV- Developmental Biology

Organogenesis and neuronal multiplication, axonal and dendritic growth, glial multiplication and myelination, growth in size, regeneration and plasticity. Learning and Memory. Correlation of behavioral and biochemical events, measurement of learning and memory, enhancing agents, biochemical correlates of excitation, learning and behavior.

Recommended Books

1. General and Applied Toxicology. (1995). Marrs and Turner. Macmillian Press Ltd.
2. Basic Environmental Toxicology (1994). Lorris G Corkerhem and Barbara S Shane CRP Press Inc.
3. Tietz Fundamentals of Clinical Chemistry. 5th edition CA Burtis, ER Ashwood. Saunders WB Co.
4. Principles of Internal Medicine. TR Harrison. McGraw Hill, NY.
5. Basic Neurochemistry by Siegel.

BCM - 304
BIOCHEMICAL & ENVIRONMENTAL TOXICOLOGY (CBCS)

Unit I- Definition and scope of toxicology

Eco-toxicology and its significance. General classification and nature. Dose – Response relationship: Synergism and Antagonism, Determination of ED50 and LD50. Acute and Chronic exposures. Factors influencing Toxicity. Pharmacodynamics. Principles and procedures of testing for acute toxicity. Biochemical basis of toxicity Mechanisms of Toxicity: Disturbance of Excitable membrane function. Altered calcium Homeostasis. Covalent binding to cellular macromolecules and Genotoxicity. Tissue specificity of Toxicity.

Unit II- Xenobiotic metabolism

Absorption and distribution. Phase I reactions. Oxidation, Reduction, Hydrolysis and Hydration. Phase II reactions/Conjugation: Methylation, Glutathione and amino acid conjugations. Detoxification mechanism in the body. Toxicity testing Test protocol, Genetic toxicity testing and Mutagenesis assay: In vitro Tests systems – Bacterial Mutation Tests: Reversion Test, Ames Test, Fluctuation Tests and Eukaryotic Mutation Tests. In vivo Mammalian Mutation tests – Host mediated assay and Dominant Lethal Test. Use of Drosophila in toxicity testing. DNA repair assays. Chromosome damage test. Toxicological evaluation of Recombinant DNA – derived proteins.

Unit III- Pesticides toxicity

Insecticides: Organochlorines, Anti-cholinesterases – Organophosphates and Carbamates. Fungicides. Herbicides. Environmental consequences of pesticide toxicity. Biopesticide. Food toxicity Role of diet in cardio-vascular diseases and cancer. Toxicology of food additives. Diagnosis of toxic changes in liver and kidneys Metabolism of Haloalkanes, Haloalkenes and Paracetamol with their toxic effect on tissue. Detoxification Mechanism in the Body: Enzymes of detoxification – polymorphism in drug metabolizing enzymes. Detection of toxic substances by specific procedures. Occupational toxicology and assessment of occupational hazards Industrial effluent toxicology and Environmental health.

Unit IV- Air Pollution

Common air pollutants and their sources. Air pollution and ozone. Air pollution due to Chlorofluorocarbons (CFCs) and asbestos. Metal toxicity Toxicology of Arsenic, mercury, lead and cadmium. Environmental factors affecting metal toxicity – effect of light, temperature of pH. An overview of regulatory agencies Responsibilities of regulatory agencies. Management of Toxicological risk. Regulatory approaches. Regulatory systems and organizations.

Recommended Books

1. Casarett & Doull's Toxicology: The Basic Science of Poisons by Louis J. Casarett, Mary O. Amdur, Curtis D. Klaassen and John Doull (Eds.), Mc Graw Hill
2. Principles and Methods of Toxicology by Andrew Wallace Hayes (Ed.), CRC Press

3. Introduction to Biochemical Toxicology by Ernest Hodgson, Academic Press, John Wiley, New York
4. Patty's Industrial Hygiene and Toxicology by Frank Arthur Patty, Interscience Publishers
5. Toxicology and Risk Assessment by Anna M. Fan, Louis W. Chang, Informa Health Care

BCM – 305
PLANT BIOCHEMISTRY

Unit I

Structure and function of plant cell (including cell wall, plasmodesmata, meristematic cells, vacuoles, secretory system and root quiescent zone), isolation of cell organelles, absorption, adsorption and transport of water, nutrients, ions and macromolecules in plants. Evapotranspiration. Respiration, respiratory quotient, photorespiration and its significance. ATP generation, Factors influencing the rate of respiration (light, temperature, oxygen availability).

Unit II

Photosynthesis – structure of organelles involved in photosynthesis in plants and bacteria. Proton gradients and electron transfer in chloroplasts of plants and in purple bacteria – differences from mitochondrial electron transfer. Light receptors – chlorophyll, light harvesting complexes, bacteriorhodopsin, rhodopsin as ion pump. Photosystems I and II, their location, mechanism of quantum capture and energy transfer between photosystems – ferridoxin, plastocyanin, plastoquinone, carotenoids. The Hill reaction; photophosphorylation and reduction of CO₂° C₃, C₄ and CAM metabolism light and dark reactions. Light activation of enzymes, regulation of photosynthesis.

Unit III

Biological nitrogen fixation and ammonia assimilation. Nitrate and sulphate reduction and their incorporation into amino acids. Translocation of inorganic and organic substances. Special features of secondary plant metabolism, formation of phenolic acids, tannins, lignins, lignans, pigments, terpenes, terpenoids, plant phenolics, alkaloids and surface waxes – their biosynthesis and function. Vesicular transport and secretory pathways.

Unit IV

Plant hormones – Growth regulating substances and their mode of action. Molecular effects of auxin in regulation of cell extension and of gibberellic, abscisic acids and cytokinins in the regulation of seed dormancy, germination, growth and development, and embryogenesis. Biochemistry of seed development and fruit ripening.

Recommended Books

1. Introduction To Plant Biochemistry Paperback – 2005 by Goodwin / Mercer (Author)
2. Plant Biochemistry Hardcover – 12 Nov 2010 by Hans-Walter Heldt Professor Em (Author), Birgit Piechulla (Author)
3. Fundamentals Of Plant Biochemistry and Biotechnology (As per new ICAR Syllabus) Paperback – 2018 by Rajan Katoch (Author)

BCM -401
TECHNICAL WRITING & SEMINAR (AECC)

In Presence of the Supervisor

BCM - 402
BIOINFORMATICS & BIostatISTICS (CBCS)

Unit I

What is Bioinformatics, Biosciences, Emerging areas in Bioinformatics, Future prospects of Bioinformatics, Introduction to Genomics, Introduction to Proteomics, Human Genome Project, Public Database, Gene Bank, Using Public Database? Computer Basics: Computer and its components, Characteristics of computer, Classification of Computers, Hardware: Processor/CPU, Input/Output devices, motherboard slots/cards, bus parallel and serial ports, various storage devices/media, Client-Server concepts, Memory. Software basics: Data vs. information, Software: types of software's, Firmware, Operating system, Programming Languages, Compilers, Interpreters, Ideas of portability and platform dependence, MS-DOS, Windows, UNIX, Linux.

Unit II

DNA and Protein sequence analysis, tools, BLAST, FASTA, Protein Visualization tools, Ras Mol. VMDL, Chime, ORF finder, Gene finder, Gene Scan. Biological databases: Medline EMBL Gene bank, Pub Med, PDB, Entry and retrieval of Data from public databases. Database: Database basics, RDBMS, MS Access, My SWL, ER- Diagram, Relationship. Internet: Computer networking: LAN & WAN, Internet and its application, Major features, WWW and its attributes, web browsers & web server, websites/ address/ pages, Client Server Principles, Protocols and search engines/tools, Bioinformatics resources on internet.

Unit III

Measures of central tendency- average, mean, median, mode, measures of location-percentile, graphic method, Arithmetical method, application and uses of percentiles, Types, biological, real, experimental, measures of variability, range, semi-inter quartile range (Q), mean deviation, standard deviation (SD), and coefficient of variation (CV), Probability: Addition law of probability, multiplication law, binomial probability distribution, Poisson distribution, probability chance from shape of normal distribution or normal curve. Basic introduction to Multivariate statistics.

Unit IV

Idea of parametric and non parametric statistics, Hypothesis testing (Large and small samples test), types of errors and level of significance, confidence interval, test of significance (F-test & T-test), chi-square test, Significance of difference in proportions of large samples, Correlation and regression, Design and methodology of an experiment or a study: Step and methodology, format for presentation of any research work.

Recommended Books

1. Fundamental Concepts of Bioinformatics Dan E. Krane, Wright State University
Michael L. Raymer, Wright State University
2. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins By Andreas Baxevanis and Francis Ouellette'
3. Bioinformatics: A Biologist's Guide to Biocomputing and the Internet By Stuart Brown
4. All of Statistics: A Concise Course in Statistical Inference by Larry Wasserman
5. Biostatistics: The Bare Essentials Geoffrey R. Norman PhD, David L. Streiner PhD
6. Principles and Practice of Biostatistics B Antonisamy, Prasanna S. Premkumar

**BCM -403
PROJECT & DISSERTATION**

In Presence of the Supervisor