M.Sc. BIOCHEMISTRY PROGRAMME – CSS

(FOR 2015 ADMISSION)

DEPARTMENT OF BIOCHEMISTRY

UNIVERSITY OF KERALA

REVISED SYLLABUS

2015

M.Sc BIOCHEMISTRY PROGRAMME

CORE COURSES

Course No.	Title	L	T	P	C
BCH 511	Biomolecules	4	1	0	4
BCH 512	Advanced Techniques in Biochemistry & Biostatistical Analysis	3	1	0	3
BCH 513	Microbial Biochemistry	3	1	0	3
BCH 514	Physiology and Specialized Tissues	4	1	0	4
BCH 515	Lab Course I (Biochemical and Microbial Techniques)	0	0	9	3
BCH 521	Enzymes	4	1	0	4
BCH 522	Metabolism - I	3	1	0	3
BCH 523	Metabolism - II	3	1	0	3
BCH 524	Plant Biochemistry	3	1	0	3
BCH 525	Immunology	3	1	0	3
BCH 526	Lab Course II (Enzymology)	0	0	6	2
BCH 531	Cell Biology	4	1	0	4
BCH 532	Molecular Biology	4	1	0	4
BCH 533	Nutritional and Clinical Biochemistry	4	1	0	4
BCH 534	Genetics and Genomics	2	1	0	2
BCH 535	Lab Course - III (Clinical Biochemistry)	0	0	6	2
BCH 541	Molecular Endocrinology	3	1	0	3
BCH 542	Lab Course – IV (Techniques in Molecular Biology and Immunology)	0	0	6	2
BCH 543	Dissertation	0	0	12	4

ELECTIVE COURSES

BCH 501	Biotechnology	4	1	0	4
BCH 502	Environmental Biochemistry	2	1	0	2
BCH 503	Bioinformatics	3	0	3	4
BCH 504	Pharmacology & Toxicology	2	1	0	2

EXTRA DEPARTMENTAL ELECTIVES

BCH 51A	Radiation biology and health	2	1	0	2
BCH 52A	Enzymology	2	1	0	2
BCH 53A	Lifestyle diseases	2	1	0	2

*L- Lecture, T- Tutorial, P- Practical, C- Credit

OUTLINE OF COURSES

CORE COURSES

SEMESTER I

BCH 511 Biomolecules (4, 1,0, 4)

Overview of physical aspects in Biochemistry, Carbohydrates: classification of carbohydrates, structure and function.

Lipids- Classification, Simple and complex lipids, derived lipids, steroids and sterols. Amino Acids and Peptides,

Proteins: Functional diversity of proteins, Methods for the isolation, purification and characterization of protein, Chaperones, Protein denaturation. Structural aspects of nucleic acids, nucleic acid sequencing, Physical properties of DNA, RNA-types of RNA, Ribosome assembly, nucleic acid denaturation.

BCH 512 Advanced Techniques in Biochemistry & Biostatical analysis (3,1,0,3)

Microscopic techniques- light, fluorescence, confocal and electron microscopy. Radioactivity- applications and measurements. Electrophoresis techniques and blotting. PCR-types and applications. Spectroscopy, NMR, ESR. MALDI-TOF and X-ray crystallography. Chromatography- TLC, GLC, HPLC and LC-MS/MS. Measures of central value and dispersion. Coefficient of variation and regression. Probability, test of significance and analysis of variance.

BCH 513 Microbial Biochemistry (3,1,0,3)

Clasification of microorganism. Growth, ultra structure and physiology of microbes. Staining. Preparation of media. Isolation and identification of bacteria, Bacterial growth kinetics. Bacterial genetics. Virus structure and replication. Antimicrobial therapy. Medical and applied microbiology.

BCH 514 Physiology & Specialized Tissues (4,1,0,4)

Digestion and Absorption- carbohydrate, proteins and fats, Epithelial Tissue, Connective Tissue and Lymph, Composition of Blood, Coagulation, Hemoglobin metabolism and Chemistry of Respiration, Renal Function, Water and acid Base balance, Biochemistry of Muscle, muscle proteins and muscle contraction, Neurochemistry, Specialised functions of brain and Nervous system, Biochemistry of vision, Liver and detoxification.

BCH 515 Lab Course I (Biochemical and Microbial Techniques) (0,0,9,3)

Measurement of pH and getting familiar with techniques of Dialysis, Ultracentrifugation, Paper chromatography, TLC, GC, Gel filtration, Ion exchange chromatography, Affinity chromatography, HPLC, Electrophoresis, Freeze drying, Iso electric focusing and Western blotting, sterilization techniques, media preparation, culture techniques, pure culture isolation.

SEMESTER II

BCH 521 Enzymes (4,1,0,4)

Enzyme isolation and characterization, Classification and Nomenclature, Kinetics, Enzyme inhibition, Coenzyme and Cofactors, Active site mapping, Mechanism of enzyme action, Regulation of enzyme activity, Allosteric enzymes, Isoenzymes,Multienzyme system, Industrial and clinical applications of enzymes, Immobilised enzymes, Enzyme engineering, Abzymes, Ribozymes.

BCH 522 Metabolism - I **(3,1,0,3)**

Metabolism of carbohydrates- metabolic regulation and control of glycolysis, glycogen metabolism, citric acid cycle, Pentose phosphate pathway, Gluconeogenesis, glyoxylate cycle, biosynthesis of oligosaccharides and glycoproteins. Bioenergetics- Ultrastructure of Mitochondria, electron transport chain, oxidative Phosphorylation, Electron transport in other membrane system- microsomal electron transport chain. Metabolism of lipids- Fatty acid synthesis and degradation, Regulation, Ketone bodies, Associated metabolic disorders.

BCH 523 Metabolism - II **(3,1,0,3)**

Cholesterol metabolism- Eicosanoids, phospholipid and glycolipid metabolism, metabolism of lipoproteins and their regulation, metabolism of amino acids and their regulation, metabolism of purines and pyramidine nucleotides and their regulation. Aminoacid metabolism- catabolism of aminoacids, Biosynthesis of nonessential aminoacids.
Nucleotide metabolism- de novo and salvage pathway of nucleotide synthesis, Regulation of metabolic pathways. Metabolic status and co-ordinated regulation in different physiological conditions. Associated metabolic disorders

BCH 524 Plant Biochemistry **(3,1,0,3)**

Photosynthesis, chloroplasts, light and dark reactions. Special features of plant metabolism - formation of acids, tannins, pigments, terpenes and alkaloids, photomorphogenesis, cell wall components, plant hormones, nitrogen metabolism, senescence, toxic principles in plants, biochemistry of pest resistance and disease resistance. Stress metabolism in plants. Production of secondary metabolites of commercial/ medical importance, Morphogenesis and organogenesis in plants, Biochemical basis of plant diseases.

BCH 525 Immunology **(3,1,0,3)**

Overview of the Immune system, Anatomy and functions of lymphoid tissues, Cellular components of the immune system, Nature of Antigen and Antibody, Innate Immunity, Anatomical and physiological barriers, Soluble factors, Inflammation, Phagocytosis. Adaptive Immunity, Lymphocyte Structural Organization of T and B cell-receptors, T and B cell maturation, Activation, Differentiation, Proliferation, Effector functions, Clinical Immunology, Antigen – antibody interactions, Diagnostic techniques, Application, Immunodeficiencies, Immuno therapy.

BCH 526 Lab Course II (Enzymology) **(0,0,6,2)**

Enzyme purification - sub cellular fractionation of organelles from liver cells and identification by marker enzymes, purification of β- glucuronidase from rat liver lysosomes, enzyme assay, enzyme kinetics, isoenzyme separation- LDH activity, staining- SOD enzyme, immobilization techniques**.**

SEMESTER III

BCH 531 Cell Biology **(4,1,0,4)**

Overview of the following: cell, organelles, subcellular fractionation. Plasma membrane: structure and membrane transport. Cytoskeleton: Microtubules, Microfilaments and intermediary filaments. Extracellular matrix and cellular interactions: Extracellular Matrix components, Cell adhesion molecules, Cell – Cell communications, Cell – Cell Interaction. Cell signaling: receptors and their functions, signaling molecules, signal hypothesis, intracellular signaling pathways. Protein sorting and targeting, Cell cycle and regulation, Check points in cell cycle regulation, Apoptosis, Caspases, Cancer.

BCH 532 Molecular Biology (4,1,0,4)

Genetic information carriers- Transposons and mechanism of transposition, DNA replication (prokaryotes and eukaryotes) and Repair, cellular control of DNA synthesis, Transcription (prokaryotes and eukaryotes), post transcriptional processing, types of RNA, genetic code, Translation (prokaryotes and eukaryotes), post translational modification, regulation of transcription and Translation, operons, gene regulation in the development of Drosophila, maternal genes, gapgenes, gene silencing, microRNA, epigenetics

BCH 533 Nutritional and Clinical Biochemistry (4,1,0,4)

Energy value of foods, Recommended Daily Allowance, Nutritional aspects of Carbohydrates, lipids, proteins, vitamins, minerals and fiber. Free radical, Nutrients as antioxidant, Balanced diet formulation, Diseases caused by Malnutrition (protein, minerals and vitamins), Nutritional aspects of life style diseases, Neurodegenerative diseases, Inborn errors of metabolism, diseases related to digestion and absorption of food, Abnormal Hemoglobin and their deficiencies, Tropical diseases, Liver diseases

BCH 534 Genetics & Genomics (2,1,0,2)

Concept of gene and genome, Mendelian genetics, Human genetics- pedigree analysis, linkage analysis, chromosome mapping, human disorders. Human cytogenetics- Chromosome culture technique, chromosome aberrations, Genomics- human genome project, structural genomics, functional genomics, proteomics, transcriptomics, metabolomics.

BCH 535 Lab Course - III (Clinical Biochemistry) (0,0,6,2)

Liver function test, kidney function test, thyroid function test, cardiovascular markers-lipid profile, biochemical markers of diabetes mellitus, hematological analysis

SEMESTER IV

BCH 541 Molecular Endocrinology (3,1,0,3)

Introduction to endocrinology, Synthesis, secretion, transport, Biological actions and metabolic fate. Hypothalamus and Pituitary hormones, Hypo and hyperactivity of Pituitary hormones, Thyroid Hormones, Thyroid diseases, Pancreatic hormones: Insulin, Glucagon, somatostatin. Diabetes Mellitus, Adrenal hormones: Glucocorticoids, Mineralocorticoids, Gonadal hormones.

BCH 542 Lab Course – IV (Techniques in Molecular Biology and Immunology) (0,0,6,2)

Isolation of DNA and RNA, qualitative and quantitative analysis. Restriction insertion of DNA in plasmid. Transformation of E.coli, broth culture and plasmid isolation. Restriction mapping of Plasmid. PCR amplification and agarose electrophoresis. Immunodiffusion and immunoelectrophoresis. ELISA.

BCH 543 Dissertation (0,0,12,4)

ELECTIVES

BCH 501 Biotechnology (4,1,0,4)

Introduction to Biotechnology, Nanobiotechnology, Marine biotechnology, Recombinant DNA technology-steps involved restrictionendonucleases, Molecular markers and maps, DNA Polymorphism, Human Genome Project and its application, Gene

transfer methods, transgenic plants and transgenic animals, Tissue culture in plants and animals, Vaccine Development, Hybridoma technology, Stem cell transplantation, Phytoremediation, Bioremediation, Biosensors, Biowarfare and Bioterrorism.

BCH 502 Environmental Biochemistry (2,1,0,2)

Introduction to ecosystem and environmental, concept of habitat and ecological niches, Global environmental problems, importance of pollution free and ecofriendly environment, exposure to cold stress, exposure to heat , air pollution, water pollution and soil pollution, waste water treatment, biopesticides, bioremediation

BCH 503 Bioinformatics (3,0,3,4)

Scope of bioinformatics- databases and search tools, Protein structure classification databases, Sequence analysis, pairwise alignment, multiple sequences Alignment, Scoring matrices, phylogenetic tree, Microarrays and 2D gel, Structural bioinformatics- Protein structure prediction methods, computer aided drug design, molecular docking softwares

BCH 504 Pharmacology & Toxicology (2,1,0,2)

Drug dosage- ED50 and LD50. Drug interactions and drug targets. Drug –protein interactions. Absorption and distribution of drugs. Drug metabolism and role of cytochrome p450 enzymes. Methods of drug development- computer aided drug design. Pharmacokinetic analysis. Significance of drug formulation. Drug testing. Overview of pharmacogenomics in drug development. Clinical toxicology, factors affecting toxicity, clinical symptoms and marker parameters.

EXTRA DEPARTMENTAL ELECTIVES

BCH 51A Radiation Biology and Health (2,1,0,2)

Introduction to radiation and its types. Physical properties of radiation and its applications in medicine and research. Toxic effect of radiation- acute and chronic radiation exposure. Safety measures. Methods of radiation detection. Available countermeasures and target patient

BCH 52A Enzymology (2,1,0,2)

Breif description of general aspects of enzymes, enzyme techniques, kinetics, mechanism of enzyme action-enzyme specificity-active sites, mechanism at active sites,covalent catalysis, acid base catalysis, proximity and orientation effects, zymogen, multi enzyme complexes, enzyme technology.

BCH 53A Lifestyle Diseases (2,1,0,2)

Lifestyle diseases - general awareness, Atherosclerosis, Alzheimer’s and Parkinson’s disease, Hypertension, Diabetes mellitus, Cancer.

DEPARTMENT OF BIOCHEMISTRY

UNIVERSITY OF KERALA

CORE COURSES

BCH 511 Biomolecules (L, T, P, C)* (4, 1, 0, 4)

COURSE CODE : BCH 511

COURSE TITLE : Biomolecules

CREDITS : 4

SEMESTER : I

TOTAL TEACHING HOURS : 64

PRE-REQUISITES, IF ANY: None

AIM:

- *This course introduces the classifications, synthesis and reactions of biomolecules such as carbohydrates, proteins, nucleic acids and lipids. It will also emphasize on the three-dimensional structures and fundamental concepts of stereochemistry.*

COURSE DESCRIPTION:

The Cell is basic unit of structure and function in living system. The structural organization and functions of the cells are uniquely maintained by four major biomolecules namely carbohydrates, lipids, proteins and nucleic acids. The course deals in detail with study of definition, classification, structure and cellular functions of biomolecules - carbohydrates, lipids, proteins and nucleic acids. The overall perspective will be the biomolecules their characteristic properties and organization in carrying out all the living functions which constitute the life.

COURSE CONTENT

Unit I: Overview of physical aspects in Biochemistry (8 hrs)

Concept and calculations based on normality, molarity, molality. Donnan-membrane equilibrium-biological applications. Buffers and biological buffer systems- significance of Henderson-Hasselbalch equation. Determination of pH and pKa.

Unit II: Introduction to Biomolecules (12 hrs)

Carbohydrates: classification of carbohydrates- mono, di and polysaccharides. Structure and functional details of mono and disaccharides. Homo and heteropolysaccharides.

Homopolysaccharides: storage polysaccharides (starch, dextrin, glycogen- structure, reaction, properties), structural polysaccharides (cellulose, chitin-structure, properties), Heteropolysaccharides: glycoproteins, proteoglycans, lipopolysaccharides,

Unit III: Lipids (12 hrs)

Simple and Complex lipids: glycerophospholipids, sphingophospholipids, glycolipid, lipoproteins and proteolipids (structure, properties and function), Derived lipids: prostaglandins, thromboxanes, leukotriens, isoprenoids (carotenoids and terpenoids), steroids and sterols (cholesterol, ergosterol, stigmasterol, sitosterol-structure, properties and function).

Unit IV: Amino Acids, Peptides and Proteins (16 hrs)

Overview of aminoacids and peptides. Proteins: Functional diversity of proteins, methods for isolation, purification, and characterization of proteins, protein sequencing. Levels of structural organization: Primary, secondary, tertiary and quaternary. Methods to study biopolymer structure-determination of protein structure- Ramachandran Plot, X-ray crystallography, NMR in revealing 3D structure of proteins, protein folding, CD as a sensitive indicator in chain conformation of proteins. Chaperones, structure - function relationships in protein families. Protein-ligand interaction, protein denaturation. Peptides: Solid phase synthesis. collagen, elastin.

Unit V: Nucleic Acids (16 hrs)

Structural aspects of nucleic acids - Watson - Crick model, A-DNA, B-DNA and Z-DNA, Right - handed and left – handed helix, super coiling, chromatin - nucleosomes, structural polymorphism in nucleic acids, nucleic acids sequencing – Sanger's and Maxam-Gilbert's methods. Oligonucleotide synthesis, classes of DNA sequence. Forces stabilizing DNA structure, Helix parameters, Watson – Crick and Hoogsteen base pairing. Physical prosperities of ds DNA (UV absorption spectra. Denaturation and renaturation, cot curves, DNA hybridization). Structural organization of the DNA in the nuclear material- General properties of histones, nucleosomes and solenoid structure. Packaging of DNA, chaperones and organization of chromosome in bacteria and eukaryotic cells. Types of RNA, structural features of t RNA, ribosome assembly, Nucleic acid denaturation and hybridization

Macromolecular interaction- Supramolecular assembly. protein nucleic acid interaction, proteins that recognize glycans, methods for study of macromolecular interaction.

ASSESSMENT:

Internal Continuous Assessment (40%)

Mid-semester Examination -15%

Assignment - 10%

Seminars - 10%

Attendance - 5%

University End semester Assessment (60%)

This will be through a 3 hour written examination for 60 marks consists of 3 Parts

Part A (20 marks) – Ten essay type questions of 2 marks out of 12 questions.

Part B (20 marks) - Four essay type questions of 5 marks out of 6 questions.

Part C (20 marks) - Two essay type questions of 10 marks out of 3questions

Give equal importance to all units.

References

1. Metzler, David E. *Biochemistry (2 Volume Set): The Chemical Reactions of Living Cells*. Elsevier, 2003.
2. Tymoczko, John L., Jeremy M. Berg, and Lubert Stryer. *Biochemistry: a short course*. Macmillan, 2011.
3. Cox, Michael M. *Lehninger principles of biochemistry*. Freeman, 2013.
4. Garrett, Reginald, and Charles Grisham. *Biochemistry*. Nelson Education, 2012.
5. Voet, Donald, Judith G. Voet, and Charlotte W. Pratt. "Fundamentals of biochemistry." *New York: John Wiley & Sons* 2008.

BCH 512 Advanced Techniques in Biochemistry & Biostatistical Analysis (3, 1, 0, 3)

COURSE CODE : BCH 512

COURSE TITLE : Advanced Techniques in Biochemistry and Biostatistical Analysis

CREDITS : 3

SEMESTER : I

TOTAL TEACHING HOURS : 48

PRE-REQUISITE, IF ANY : Nil

AIM: The purpose of this course is to familiarize students with operation of all biochemical equipments and methods of statistical analysis of biological data.

COURSE DESCRIPTION: The objectives of this course are to:

- Train students on laboratory ethics and the use of some laboratory equipments.
- Expose students to various laboratory techniques in areas of biochemistry.
- Equip students to perform statistical significance and interpretation of data.

Upon successful completion of the course, the student should be able to perform experiments with different laboratory techniques, be familiar with the use of the requisite laboratory equipments, and perform advanced statistical analysis of data obtained from such studies.

COURSE CONTENT:

Unit I: Microscopy and Radiobiology (9 hr)

Basic principles, instrumentation and applications of microscopy. Bright field, phase-contrast, fluorescence and confocal microscopy. Electron microscope – scanning and transmission electron microscopy. Nature of radioactivity, decay and types of radiation. Radiation detection and measurements: GM counter, scintillation counter and pulse height analyzer. Application of radioisotopes in biological science- autoradiography, RIA and receptor affinity binding analysis.

Unit II: Electrophoresis, Blotting and PCR (9 hr)

Factors affecting electrophoresis. Electrophoretic techniques- Slab, Capillary, 2-D, pulsed field, and immuno-electrophoresis. Blotting techniques: Western, Southern and Northern blotting: principle and methodology. PCR- conventional, reverse-transcriptase and real-time PCR. Primer designing and sequence analysis. TaqMan MGB and molecular beacons.

Unit III: Chromatography (9 hr)

Basic Principles, Instrumentation, working and applications of partition chromatography (Paper), adsorption chromatography (TLC, HPTLC, column), affinity chromatography, ion exchange chromatography, gel filtration chromatography, gas-liquid chromatography (GLC), high Pressure liquid chromatography (HPLC).

Unit IV: Spectroscopy (9 hr)

Principle of spectroscopy. Concept of absorptions, transmission, scattering, phosphorescence, fluorescence, luminescence, diffraction spectra. Principle, instrumentation, working and application of – UV, visible and IR spectroscopy, spectro-fluorimetry, flame photometry, atomic absorption spectrometry, luminometry. Principle, instrumentation, working and application of- Nuclear Magnetic Resonance (NMR), Electron Spin Resonance (ESR), Mass spectroscopy - GC-MS, HPLC-MS and LC-MS/MS, Matrix-assisted laser desorption/ionization- Time- of- Flight Mass spectroscopy (MALDI-TOF MS. X-ray crystallography.

Unit V: Biostatistics (12 hr)

Measures of central value - Mean, median and mode. Statistics of Dispersion- SD and SEM; Coefficient of variation; Concepts of moments, skewness and kurtosis; Simple correlation and regression; Concept of sampling and sampling methods. Probability and law of probability; Probability distributions (binomial, poisson and normal); Tests of statistical significance (t –Test, chi-square test); Analysis of variance- one way and two way ANOVA. Software packages for statistical analysis - MS-Excel and Prism Graphpad.

ASSESSMENT:

Internal Continuous Assessment (40%)

Mid-semester Examination -15%

Assignment - 10%

Seminars - 10%

Attendance - 5%

University End semester Assessment (60%)

This will be through a 3 hour written examination for 60 marks consists of 3 Parts

Part A (20 marks) – Ten essay type questions of 2 marks out of 12 questions.

Part B (20 marks) - Four essay type questions of 5 marks out of 6 questions.

Part C (20 marks) - Two essay type questions of 10 marks out of 3questions

Give equal importance to all units.

References:

1. Wilson, Keith, and John Walker, eds. *Principles and techniques of biochemistry and molecular biology*. Cambridge university press, 2010.
2. Bisen, Prakash Singh, and Anjana Sharma. *Introduction to instrumentation in life sciences*. Crc Press, 2012.
3. Rhodes, Gale. *Crystallography made crystal clear: a guide for users of macromolecular models*. Academic press, 2010.
4. Daniel, Wayne W., and Chad Lee Cross. *Biostatistics: basic concepts and methodology for the health sciences*. New York: John Wiley & Sons, 2010.
5. Rosner, Bernard. *Fundamentals of biostatistics*. Cengage Learning, 2010.

BCH 513 Microbial Biochemistry (3, 1, 0, 3)

COURSE CODE : BCH 513

COURSE TITLE : Microbial Biochemistry

CREDITS : 3

SEMESTER : I

TOTAL TEACHING HOURS : 48

PRE-REQUISITES, IF ANY : NIL

AIM: *To get the students in depth knowledge of the different types of microbes, their morphology and functions. The application of microbiology in industry, agriculture and medicine is also discussed in detail.*

COURSE DESCRIPTION: Six modules starting from the classification, going through the developmental stages of bacteria, microbial genetics, viruses and application of microbiology in food industry, disease diagnosis and therapy. The course is designed in such a manner so as to trigger genuine interest of students in the field of microbiology.

COURSE CONTENT:

Unit I - Morphology and classification (8 hrs)

History of Microbiology. Principles of classification of microbes. A brief introduction to major group of microorganisms- Bacteria, Viruses, Fungi, Protozoa, Algae. Ultra structure of bacteria, Chemical composition of cell wall. Types of microscopy. Staining techniques-simple, differential and special staining techniques and negative staining.

Unit II- Microbial growth and culture (8 hrs)

Microbial growth - definition, physical conditions required for growth, Nutritional requirements of bacteria growth curve, measurement of growth and growth yields, synchronous growth, continuous culture, factors affecting growth. Sterilization and disinfection. Bacteriological media-types of media, preparation of media, isolation and identification of bacteria.

Unit III- Microbial genetics (8 hrs)

The inheritance of characteristics and variability. Phenotypic and genotypic changes, mutations, plasmids, bacterial recombination, bacterial conjugation, transduction, bacterial transformation. Genetic engineering of microorganisms for biotechnology- recombinant microbes, recombinant plants, recombinant animals.

Unit IV- Viruses (8 hrs)

Morphology, classification, nomenclature, and replication of viruses, DNA viruses and RNA viruses. Bacteriophage- general characteristics, viral oncogenes and retroviruses. Virus-host interactions. Viral infections- hepatitis, tumor viruses.

Unit V- Applied Microbiology (8 hrs)

Microbiology of food-food spoilage, controlling food spoilage, types of food borne diseases, microbiology of fermented food, Applied environmental microbiology- water purification and sanitary analysis. Waste water treatment. Biodegradation, bioremediation and bioaugumentation.

Unit VI- Medical microbiology and antimicrobial therapy (8 hrs)

Causative agent, Epidemiology, Clinical presentation, treatment and prevention of - Airborne diseases, Food and Waterborne diseases and Soil borne diseases. Antimicrobial Drugs- Interaction between drugs and microbes, antimicrobial action of important antibiotics- Penicillin, Streptomycin, Tetracyclin, Chloramphenicol, Rifampicin. Antibiotic resistance.

ASSESSMENT:

Internal Continuous Assessment (40%)

Mid-semester Examination -15%

Assignment - 10%

Seminars - 10%

Attendance - 5%

University End semester Assessment (60%)

This will be through a 3 hour written examination for 60 marks consists of 3 Parts

Part A (20 marks) – Ten essay type questions of 2 marks out of 12 questions.

Part B (20 marks) - Four essay type questions of 5 marks out of 6 questions.

Part C (20 marks) - Two essay type questions of 10 marks out of 3questions

Give equal importance to all units.

References:

1. Pelczar, M. J., E. C. S. Chan, and N. R. Krieg. *Microbiology. Fifth edition, Tata Mcgraw-hill Publishing Company Ltd., New Delhi* (2004).
2. Willey, J. M. *Prescott, Harley, and Klein's Microbiology-7th international ed.*: McGraw-Hill Higher Education, 2008.
3. Pommerville, Jeffrey. *Alcamo's fundamentals of microbiology: Body systems*. Jones & Bartlett Publishers, 2012.

BCH 514 Physiology & Specialized Tissue (4, 1, 0, 4)

COURSE CODE : BCH 514

COURSE TITLE : Physiology & Specialized Tissue

CREDITS : 4

SEMESTER : I

TOTAL TEACHING HOURS : 64

PRE-REQUISITES, IF ANY : NONE

Aim ***:*** *To study the functions and biochemical role of organ systems, organs and tissues of the human body.*

COURSE DESCRIPTION: To study how foods are digested and absorbed, to help in study structure and functions of circulatory, respiratory, renal, muscular and nervous system of the body. It also deals with characteristics and biochemical functions of specialized tissues like connective tissues and photochemical reactions of eye**.**

COURSE CONTENT:

Unit I : Digestion and Absorption (8 hours)

GIT - Salivary gland, stomach, pancreas, intestine, liver, gall bladder-Structure, secretions, composition and physiological functions. Secretion of digestive enzymes as zymogen- Mechanism of secretion, activation, and regulations by secretogogues-gastrointestinal hormones.

Digestion and Absorption of carbohydrates- Hydrolysis of polysaccharides, disaccharides, action of endosaccharidases and exosaccharidases. Absorption of carbohydrates-facilitated and active transport of monosaccharides, sodium dependent and independent glucose transporters.

Digestion and Absorption of proteins : action of endopeptidases, exopeptidases, gastric, intestinal and pancreatic phases of protein digestion, Absorption of small peptides and free amino acids, specific amino acid transporters.

Digestion and Absorption of lipids: role of bile acids, and bile salts, action of gastric and pancreatic lipases, role of colipase, micellar formation in lipid digestion, absorption of lipids.

Digestion and absorption of DNA, RNA. Absorption of vitamins, water and electrolytes.

Unit II : Epithelial Tissue, Connective Tissue and Lymph (8 hours)

Epithelial tissue : General character and functions. Classification – simple and stratified.

Connective tissue – Areolar tissue, Adipose tissue, white fibrous tissue, Yellow elastic tissue, Recticular tissue, lymphoid tissue, Cartilage, Jelly like tissue– Structure and function

Lymph – origin, circulation, function of lymph, Reticuloendothelial system – structure and function. Membranes: cutaneous, mucous membrane, serous membrane, endothelium, synovial membrane.

Unit III: Biochemistry of Blood and Respiration (12 hours)

Composition of blood, Plasma proteins, Formed elements- overview, RBC - Erythropoiesis, Biochemical information and principal proteins of red cell membrane, Synthesis of hemoglobin, Catabolism of hemoglobin, Formation of bile pigments, Iron metabolism.

Blood coagulation - Hemostasis, Thrombosis, types of thrombi, Formation of Fibrin ,Clotting factors, fibrinolysis, anti-clotting system and anticoagulants, Activation of platelets –Polyphosphoinositide pathway.

Haemoglobin – structure, reactions of hemoglobin with oxygen, carbon dioxide, protons and 2,3-bis phosphorglycerate - overview, Different types of Hb, Transport of Oxygen , Oxygen dissociation curve and Bohr effect, Factors influencing combination of oxygen with Hb, , Transport of Carbon dioxide, Isohydric and chloride shift, Mechanism of Hemoglobin action.

Unit IV: Renal Function (8 hours)

Structure and function of nephron, Renal blood flow and its importance, Formation of Urine- Ultrafiltration, GFR, Tubular reabsorption, threshold substances, Tubular secretion, Composition of urine- normal and abnormal, Osmoregulation, Hormonal regulation of Kidney, Water and Acid base balance- respiratory and renal regulation of pH.

Unit V: Biochemistry of Muscle (10 hours)

Muscle tissue – Voluntary, involuntary and cardiac, Ultra structure-overview,muscle proteins- Myosin and Actin, Tropomyosin, Troponin, Mechanism of muscle contraction –electrical, chemical and mechanical path, Power stroke in contraction ; Regulation of Muscle contraction - Ca^{2+} , Ca^{2+}-Na^{+} exchanger, Ca^{2+} ATPase, Relaxation, Role of NO in muscle relaxation: Sources of energy for muscular work.

Unit VI : Neurobiochemistry (10 hours)

Neuromorphology and Neurocellular anatomy, peripheral nervous system, Spinal Cord, Autonomous nervous system – Sympathetic and Parasympathetic functions. Cells and cellular organization of specific regions. Neurophysiology – ion channels. Nerve and synapse structures: Resting membrane

potential, action potential; Transmission of nerve impulses, Molecular mechanisms in synaptic transmission, Acetylcholine as synaptic transmission, Neuron-neuron interaction , Synthesis, Storage and release of neurotransmitters, Synaptic vesicle proteins, Other Neurotransmitters, Inhibition of acetylcholine esterase and the acetyl choline receptor, Functions of hypothalamus, Intermediary metabolism in brain, Neuropeptides, Developmental neurobiology.

Unit VII : Biochemistry of vision (6 hours)

Structure and functions of rods and cones, photochemistry of vision, Role of vitamin A, light activation of rhodopsin, Biochemical reactions (cycle), Origin of Nerve impulse in vision, Cone vision- cones, mechanism of color vision, Light and dark adaptation.

Unit VIII: Liver and detoxification (2 hours)

Biotransformation reaction, - phase I and Phase II, microsomal and non-microsomal metabolism of drugs – role of cytochrome P450 enzymes and subtypes. Diseases related to these topics not included.

ASSESSMENT:

Internal Continuous Assessment (40%)

Mid-semester Examination -15%

Assignment - 10%

Seminars - 10%

Attendance - 5%

University End semester Assessment (60%)

This will be through a 3 hour written examination for 60 marks consists of 3 Parts

Part A (20 marks) – Ten essay type questions of 2 marks out of 12 questions.

Part B (20 marks) - Four essay type questions of 5 marks out of 6 questions.

Part C (20 marks) - Two essay type questions of 10 marks out of 3questions

Give equal importance to all units.

References

1. Rodwell, Victor W., David Allen Bender, Kathleen M. Botham, Peter J. Kennelly, and P. Anthony Weil. *Harpers illustrated biochemistry*. McGraw-Hill Medical Publishing Division, 2015.

2. Devlin, Thomas M. *Textbook of biochemistry: with clinical correlations*. John Wiley & Sons, 2011.

3. Hall, John E. *Guyton and Hall textbook of medical physiology*. Elsevier Health Sciences, 2010.

4. Ganong, W. H. Review of Medical Physiology. *Appleton and Lange* 1999.

5. White, A., P. Handler, and E. L. Smith. Principles of *Biochemistry. New York, McGraw-Hill* 1117 (1954).

6. Sherwood, Lauralee. *Human physiology: from cells to systems*. Cengage learning, 2015.

BCH 515 Lab Course I (Biochemical and Microbial Techniques) (0, 0, 9, 3)

COURSE CODE : BCH 515

COURSE TITLE : Lab course 1 (Biochemical and Microbial Techniques)

CREDITS : 3

SEMESTER : I

TOTAL PRACTICAL HOURS: 9 hours/week

PRE-REQUISITES, IF ANY: None

AIM:

- *To give hands on training in certain basic as well as advanced instruments used for routine biochemical experiments*
- *To impart basic practical skills of Microbiology*

COURSE DESCRIPTION:

(i) Instrumentation. An introduction to chromatography, freeze drying, centrifugation, electrophoresis

(ii) Basic techniques of microbiology and enzyme activity analysis.

(iii) Construction of bacterial growth curve, water analysis and lac operon studies

COURSE CONTENT

- **BIOCHEMICAL TECHNIQUES:** Methods for sub-cellular fractionation and marker enzymes. Methods for lysis of plant and animal cell. Use of detergents in isolation of membrane proteins.
- **CHROMATOGRAPHY**: TLC, Column chromatography, HPLC and gas chromatography.
- **CENTRIFUGATION**: Ultracentrifugation - Velocity and buoyant density determination. Density gradient centrifugation, molecular weight determination.
- **ELECTROPHORESIS**: Native and SDS-PAGE of proteins, Agarose gel electrophoresis of DNA.
- **MICROBIAL TECHNIQUES:**
    - Sterilization techniques - principles, methods, moist heat, dry heat, filter types.
    - Preparation of media - liquid, solid – agar ; deep, slant and plate.
    - Staining techniques - simple, differential and special staining.
    - Pure culture techniques - streak plate, pour plate.

- Detection of enzyme activity-amylase, caseinase, catalase.
- Phosphatase test for the quality of milk.
- Growth curve of E coli. Total viable count determination - streak plate, pour plate.
- Identification of microbes- IMViC reactions Enumeration of microorganisms from water - standard plate count, MPN test and membrane filtration technique.
- Lac operon by studying β-galactosidase

ASSESSMENT:

Internal Assessment

Attendance- 5 %

Record - 10%

Test/ viva voce- 10%

Mid-semester practical exam- 15%

External Assessment

Semester Examination- 60%

References:

1) Scopes, Robert K. *Protein purification: principles and practice*. Springer Science & Business Media, 2013.
2) Osterman, Lev Abramovich. *Methods of protein and nucleic acid research: Chromatography*. Springer-Verlag, 2012.
3) Birnie, George David, and David Rickwood, eds. *Centrifugal separations in molecular and cell biology*. Butterworth-Heinemann, 2014.
4) Wilson, Keith, and John M. Walker. *Principles and techniques of practical biochemistry*. Cambridge University Press, 2000.
5) Goldman, Emanuel, and Lorrence H. Green, eds. *Practical handbook of microbiology*. CRC Press, 2015.
6) Dubey, R. C., and D. K. Maheshwari. *Practical microbiology*. S. Chand, 2002.

SEMESTER II

BCH 521 Enzymes (4, 1, 0, 4)

COURSE CODE : BCH 521

COURSE TITLE : Enzymes

CREDITS : 4

SEMESTER : II

TOTAL TEACHING HOURS : 64

PRE-REQUISITES, IF ANY : None

Aim: *Primary goals of this course are to provide the students with detailed knowledge in enzyme activity and kinetics, their mechanism of action and regulation and about the way of enzyme application and exploitation.*

Course Description: The course include deepening knowledge in the areas of purification and isolation of enzymes, classification of enzymes and cofactors, kinetics and regulation of enzymes and their applications in industry, therapeutics and diagnosis.

COURSE CONTENT:

Unit-I : Classification, Purification And Active Site (10 hrs)

Nomenclature and classification of enzymes, isolation and purification of enzymes – by different methods, criteria of purity - specific activity. Enzyme units - Katal, IU. Measurement of enzyme activity - two point assay, kinetic assay, using radiolabelled substrates. Active site - determination of active site amino acids - chemical probe, affinity label, and site-directed mutagenesis, intrinsic and extrinsic regulations. Investigation of 3-D structure of active site. A brief account of nonprotein enzymes – ribozymes.

UNIT-II : Enzyme Kinetics And Inhibition (15 hrs)

Kinetics of single substrate enzyme - catalysed reactions - Michaelis - Menten equation, importance of Vmax, Km, MM equation, and turnover number; Lineweaver - Burk plot, Eadie - Hofstee plot, Hanes - Woolf plot and Eisenthal and Cornish - Bowden plot. Kinetics of Allosteric enzymes - MWC and KNF models Hill' equation coefficient. Kinetics of multi - substrate enzyme - catalysed reactions - Ping-pong bi-bi, random order and compulsory order mechanism. Reversible inhibition -

competitive, uncompetitive, noncompetitive, mixed, substrate and allosteric inhibition. Irreversible inhibition. Feedback inhibition.

UNIT-III : Mechanism Of Enzyme Action And Regulation (15 hrs)

Enzyme specificity, Mechanism of enzyme action - general acid-base catalysis, covalent catalysis, proximity and orientation effects, role of metal ion in enzyme catalysis, mechanism of serine proteases - chymotrypsin, lysozyme, and ribonuclease. Regulation of enzyme activity-covalently modified regulated enzymes, allosteric enzymes, multienzyme complex - occurance, isolation and properties. Mechanism of action and regulation of pyruvate dehydrogenase and fatty acid synthase. Isoenzymes-LDH.

UNIT-IV : Coenzymes (12 hrs)

Coenzymes - prosthetic group, classification - vitamin and nonvitamin coenzymes, thiamine pyrophosphate - mechanism of oxidative and nonoxidative decarboxylation, transketolase reaction, FMN and FAD - flavoprotein enzymes, mechanism of oxidation and reduction of: flavin enzymes, NAD and NADP role in enzyme catalysis, PALP and PAMP - role of PALP in transamination and decarboxylation reaction, Coenzyme A involved reactions, biotin - carboxylation reaction, folate coenzymes, coenzyme role of vitamin Bl2 .

UNIT-V : Enzyme Technology (12 hrs)

Industrial uses of enzymes - sources of industrial enzymes, thermophilic enzymes, amylases, glucose isomerases, cellulose degrading enzymes, lipases, proteolytic enzymes in meat and leather industry, detergents and cheese production. Clinical enzymology - Enzymes as thrombolytic agents, anti-inflammatory agents, digestive aids. Therapeutic use of asparginase, streptokinase. Diagnostic enzymes. Immobilization of enzymes and their applications. Abzymes.

ASSESSMENT:

Internal Continuous Assessment (40%)

Mid-semester Examination -15%

Assignment - 10%

Seminars - 10%

Attendance - 5%

University End semester Assessment (60%)

This will be through a 3 hour written examination for 60 marks consists of 3 Parts

Part A (20 marks) – Ten essay type questions of 2 marks out of 12 questions.

Part B (20 marks) - Four essay type questions of 5 marks out of 6 questions.

Part C (20 marks) - Two essay type questions of 10 marks out of 3questions

Give equal importance to all units.

References

1. Dixon, M., and E. C. Webb. "Enzyme inhibition and activation." *Enzymes* 3 (1979): 126-136.

2. Palmer, T. *Understanding Enzymes, 4th ed., Prentice Hall/Ellis Horwood, London* (1995).

3. Price, Nicholas C., and Lewis Stevens. *Fundamentals of Enzymology*. Oxford Science Publications. Second edition. New York, 2001.

4. Buchholz, Klaus, Volker Kasche, and Uwe Theo Bornscheuer. *Biocatalysts and enzyme technology*. John Wiley & Sons, 2012.

5. Copeland, Robert A. *Enzymes: a practical introduction to structure, mechanism, and data analysis*. John Wiley & Sons, 2004.

BCH 522 Metabolism - I (3, 1, 0, 3)

COURSE CODE : BCH 522

COURSE TITLE : Metabolism I

CREDITS : 3

SEMESTER : II

TOTAL TEACHING HOURS : 48

PRE-REQUISITES, IF ANY : None

AIM:

- *This course is aimed at providing an insight into various metabolic pathways operating in living cells with special stress on carbohydrate, lipid metabolism and the electron transport chain.*

COURSE DESCRIPTION:

Metabolism is the set of life-sustaining chemical transformations within the cells of living organisms. These enzyme catalyzed reactions allow organisms to grow and reproduce, maintain their structures, and respond to their environments. Carbohydrate metabolism denotes the various biochemical processes responsible for the formation, breakdown and interconversion of carbohydrates in living organisms. Carbohydrate metabolism is a fundamental biochemical process that ensures a constant supply of energy to living cells. The most important carbohydrate is glucose, which can be broken down via glycolysis, enter into the Kreb's cycle and oxidative phosphorylation to generate ATP.

COURSE CONTENT:

Unit I: Hexose Metabolism (8 hrs)

Overview of glycolysis and gluconeogenesis pathway. Detailed study of key enzymes and mechanism of reciprocal regulation. Anaerobic and aerobic adaptation significance.Cori cycle. Overview of citric acid cycle. Detailed study of regulatory mechanism and energetics. Importance of pyruvate dehydrogenase. Pentose phosphate pathway- significance and regulation machinery.Metabolism of galactose and fructose. Glyoxylate cycle- significance. Metabolic disorders.

Unit II: Glycogen Metabolism (8 hrs)

Storage form of carbohydrate and significance. Overview of glycogenesis and gluconeogenesis-detailed study of hormonal regulation and role of secondary messengers.Mechanism of blood glucose

maintenance.Mechanisms to avoid futile cycles.Overview of Glycogen storage diseases and their biochemistry. Metabolic disorders

Unit III: Oligosaccharide Metabolism (8 hrs)

Biosynthesis of mucopolysaccharides- hyaluronic acid, chondroitin sulfate, dermatan sulfate, heparin and keratin. Biochemistry of mucopolysaccharides.Glycoproteins and proteoglycans. Metabolic disorders

Unit IV: Lipid Metabolism (8 hrs)

Biosynthesis of fatty acids – fatty acid synthase and regulation of fatty acid synthesis. Oxidation of fatty acids – alpha, beta and omega oxidation. Biological regulation and significance of fatty acid metabolism. Metabolism of ketone bodies - Formation, utilization, excretion and clinical significance. Metabolism of triglycerides, phospholipids and sphingolipids. Fatty acid derivatives: eicosanoids, their function and metabolism. Metabolism of lipoproteins. Lipid peroxidation. Prostaglandins, Metabolic disorders.

Unit V: Bioenergetics (8 hrs)

Overview of thermodynamics, Relationship between G and Keq. High energy compounds, standard free energy of hydrolysis of ATP, structural basis of the group transfer potential of ATP. Oxidation reduction potential, different types of oxidation reduction reactions.Ultra structure of mitochondria, anatomy, enzymes. **Electron transport chain**, Thermodynamics of electron transport, oxygen electrode, components and different complexes in detail.Mobile electron carriers.Proton transport during electron flow, inhibitors of electron transport chain.Mitochondrial electron transporters and shuttle systems. Electron transport in other membrane system- microsomal electron transport chain.

Unit VI :Oxidative phosphorylation (8 hrs)

History, mechanism, Chemical Chemiosmotic and conformational coupling, Proton gradient generation, redox loop, Q cycle, Bacteriorhodopsin. Proton pumping. Components of ATP synthase (F_1 F_0 ATPase). Binding charge mechanism of ATP synthase. Control of oxidative phosphorylation, phosphorylation potential.co-ordinated control of ATP production, inhibitors, P/O ratio, Pasteur effect, uncouplors, hormonally controlled uncoupling in Brown adipose tissue-UCP, Ionophores. Bioluminescence- Bioluminescence cycle with fire fly as an example. Physiological implication of aerobic versus anaerobic metabolism, IF1 inhibition of F_1F_0 ATPase during hypoxia. Toxic derivatives of O_2, role of scavenging enzymes, peroxidation.

ASSESSMENT:

Internal Continuous Assessment (40%)

Mid-semester Examination -15%

Assignment - 10%

Seminars - 10%

Attendance - 5%

University End semester Assessment (60%)

This will be through a 3 hour written examination for 60 marks consists of 3 Parts

Part A (20 marks) – Ten essay type questions of 2 marks out of 12 questions.

Part B (20 marks) - Four essay type questions of 5 marks out of 6 questions.

Part C (20 marks) - Two essay type questions of 10 marks out of 3questions

Give equal importance to all units.

References

1. Tymoczko, John L., Jeremy M. Berg, and Lubert Stryer. *Biochemistry: a short course*. Macmillan, 2011.
2. Cox, Michael M. *Lehninger principles of biochemistry*. Freeman, 2013.
3. Garrett, Reginald, and Charles Grisham. *Biochemistry*. Nelson Education, 2012.
4. Voet, Donald, Judith G. Voet, and Charlotte W. Pratt. "Fundamentals of biochemistry." *New York: John Wiley & Sons* 2008.
5. Zubay, Geoffrey L., William W. Parson, and Dennis E. Vance. *Principles of biochemistry: student study art notebook*. Wm. C. Brown, 1995.

BCH 523 Metabolism - II **(3, 1, 0, 3)**

COURSE CODE	**:**	**BCH 523**
COURSE TITLE	**:**	**Metabolism- II**
CREDITS	**:**	**3**
SEMESTER	**:**	**II**
TOTAL TEACHING HOURS	**:**	**48**
PRE-REQUISITE, IF ANY	**:**	**None.**

AIM: The course is designed to give the students insight into the digestion, absorption and metabolic fate of steroids, amino acids and nucleic acids, and their secondary derivatives in the human body.

COURSE DESCRIPTION: The main objectives of this course are as follows-

- To make students familiar with the various control and metabolic regulation (hormonal and non-hormonal) and integrating mechanisms of diverse biochemical events in different metabolic processes, and to understand normal and abnormal human metabolism.
- Explain the genetic controls of these major metabolic pathways and correlate the impact of any abnormality to the medical status.
- To enable the student to identify the concept of signal transduction and signaling molecules giving an illustrated models for better understanding the molecular basics for many diseases.

COURSE CONTENT:

Unit I: Steroid Metabolism (14 hr)

Cholesterol – Biosynthesis, regulation, transport and excretion. HMG CoA reductase regulation. Biosynthesis of cholesterol derivatives; overview- bile acids, vitamin D and steroid hormones. Metabolic disorders

Unit II: Amino Acid Metabolism (14 hr)

Overview of biosynthesis of nonessential amino acids. Catabolism of amino acid nitrogen - transamination, deamination, ammonia formation and the urea cycle. Disorders of the urea cycle. Catabolism of amino acid carbon skeleton. Conversion of amino acids to specialized products. Aminoacid derivatives: Histamine, Serotonin, epinephrine and nor-epinephrine- function and metabolism. Metabolic disorders

Unit III: Nucleic Acid Metabolism (14 hr)

Nucleotide biosynthesis- de novo and salvage pathways for biosynthesis of purine and pyrimidine. Mechanims of feedback regulation. Biosynthesis of dNTPs. Mechanism of purine and pyrimidine catabolism. Uric acid and gout- xanthine oxidase inhibitors. Metabolic disorders

Unit IV: Metabolism interrelationship (6 hr)

Integration of metabolic pathways- overview. Feedback and reciprocal regulation of metabolic pathways. Metabolic variations under altered nutritional/physiological status- starvation, well fed and pregnancy.

ASSESSMENT:

Internal Continuous Assessment (40%)

Mid-semester Examination -15%

Assignment - 10%

Seminars - 10%

Attendance - 5%

University End semester Assessment (60%)

This will be through a 3 hour written examination for 60 marks consists of 3 Parts

Part A (20 marks) – Ten essay type questions of 2 marks out of 12 questions.

Part B (20 marks) - Four essay type questions of 5 marks out of 6 questions.

Part C (20 marks) - Two essay type questions of 10 marks out of 3questions

Give equal importance to all units.

References:

1. Tymoczko, John L., Jeremy M. Berg, and Lubert Stryer. *Biochemistry: a short course*. Macmillan, 2011.
2. Cox, Michael M. *Lehninger principles of biochemistry*. Freeman, 2013.
3. Garrett, Reginald, and Charles Grisham. *Biochemistry*. Nelson Education, 2012.
4. Voet, Donald, Judith G. Voet, and Charlotte W. Pratt. "Fundamentals of biochemistry." *New York: John Wiley & Sons* 2008.
5. Zubay, Geoffrey L., William W. Parson, and Dennis E. Vance. *Principles of biochemistry: student study art notebook*. Wm. C. Brown, 1995.
6. Devlin, Thomas M. *Textbook of biochemistry: with clinical correlations*. John Wiley & Sons, 2011.

BCH 524 Plant Biochemistry (3, 1, 0, 3)

COURSE CODE : BCH 524

COURSE TITLE : PLANT BIOCHEMISTRY

CREDITS : 3

SEMESTER : II

TOTAL TEACHING HOURS : 48

PRE-REQUISITES, IF ANY : NONE

AIM:

"This course aims to give a thorough knowledge on the plant secondary metabolites, the disease resisting mechanisms in plants, along with the basic biochemical processes occurring in plants.

COURSE DESCRIPTION: A brief discussion of photosynthesis followed by detailed study of plant secondary metabolites. Nitrogen cycle, plant hormones, senescence, photomorphogenesis and a section for plant diseases are also included.

COURSE CONTENT:

UNIT I : Photosynthesis (8 hr)

Introduction, light and dark phase, structure of chloroplast, excitation of molecules by absorption of light, structure and properties of chlorophyll. Photochemical reaction system, photosynthetic electron transport chain, cyclic and noncyclic photophosphorylation, Calvin cycle, regulation, Hatch-Slack pathway (C4 pathway), Photorespiration, comparison of mitochondrial and photosynthetic electron transport chain.

UNIT II : Secondary metabolites (8 hr)

Accumulation of secondary compounds, Specialized cell, Tissue and segment specific and storage space differentiation, Tissue specific control of enzymes in secondary metabolism, Integration of secondary metabolism into developmental program, lignifications, role of accumulation of secondary products. "Phenols"- Functions of Phenols, Shikimate Arogenate Pathway, Phenyl Alanine/ Hydroxycinnamate pathway, Phenyl propanoids pathway, Hydroxycinnamate conjugates, Hydroxycoumarins, hydroxy benzoates, Flavonoids, Lignins, Lignans, Neolignans, Tannins and Quinones. "Isoprenoids"- Nomenclature, Classification and Occurrence, General pathway for terpenoid biosynthesis, functions of Terpenoids.

"Alkaloids"- Nicotine, Caffiene and Cocaine. Toxic secondary metabolites, secondary metabolites of medicinal importance.

UNIT III : Plant Hormones (6 hr)

Structure and function of plant hormones such as Ethylene, Cytokinins, Auxins, Absicic acid, Florigin and Gibberlins. Photochemical and hormone control in plants.

UNIT IV : Nitrogen Metabolism (6 hr)

Nitrogen Cycle, Nitrogen Fixation, Assimilation of Nitrate and Ammonium ions. Assimilation of Sulphate ions.

UNIT V : **Photomorphogenesis and Senescence (8 hr)**

Photomorphogenesis:Phytochromes, Structure, properties, function. Mechanism of action of photomorphogenesis. Calcium and Calmodulin mediated Pfr responses. "Senescence"- Various levels of senescence. Factors affecting senescence. Mechanism of different biochemical changes during senescence, Senescence related to stress, Regulation of senescence.

UNIT VI : Morphogenesis and organogenesis in plants (6 hr)

Organisation of shoot and root apical meristem, shoot and root development, leaf development and phyllotaxy, transition to flowering, floral meristems and floral development.

UNIT VII : **Biochemical basis of Plant diseases (6 hr)**

Host pathogen interaction, Mechanism of pathogenesis, Enzymes, Toxins, Mechanism of Plant resistance, Phytoallexins, Elicitors, and Pathogen related proteins

ASSESSMENT:

Internal Continuous Assessment (40%)

Mid-semester Examination -15%

Assignment - 10%

Seminars - 10%

Attendance - 5%

University End semester Assessment (60%)

This will be through a 3 hour written examination for 60 marks consists of 3 Parts

Part A (20 marks) – Ten essay type questions of 2 marks out of 12 questions.

Part B (20 marks) - Four essay type questions of 5 marks out of 6 questions.

Part C (20 marks) - Two essay type questions of 10 marks out of 3questions

Give equal importance to all units.

References:

1. Dey, Prakash M., and Jeffrey B. Harborne, eds. *Plant biochemistry*. Academic Press, 1997.
2. Bonner, James, and Joseph E. Varner, eds. *Plant biochemistry*. Elsevier, 2012.
3. Salisbury, Frank B., and Cleon W. Ross. "Plant physiology. 4th." *Edn. Belmont, CA. Wadsworth* (1992).
4. Lea, Peter J., and Richard C. Leegood. *Plant biochemistry and molecular biology*. John Wiley & Sons, 1993.
5. Heldt, Hans-Walter, and Fiona Heldt. "Plant biochemistry and molecular biology." Oxford University Press, (1997).

BCH 525 Immunology (3, 1, 0, 3)

COURSE CODE : BCH 525

COURSE TITLE : Immunology

CREDITS : 3

SEMESTER : II

TOTAL TEACHING HOURS : 48

PRE-REQUISITES, IF ANY : NONE

AIM: To study the immunity or mechanism that normally protects individuals from infection and how to eliminate foreign substances.

COURSE DESCRIPTION : To know the organs, cells and molecules responsible for immunity. To give clear understanding of cellular and molecular events that occurs after an organism encounters microbes and other foreign macromolecules. To correlate **s**erological reactions used in the diagnostic laboratory to detect interactions between antigens and antibodies.

COURSE CONTENT :

Unit I : Overview of the Immune system (10 hours)

Milestones (major discoveries) in the development of immunology and Contributions of Jenner, Pasteur, Landsteiner, Bordet, Jerne, Milstein and Tonegawa, Early theories of immunity.

Organs of the immune system : Anatomy and functions of lymphoid tissues – Bone marrow, thymus, lymph node and lymphatic system, spleen, cutaneous immune system and mucosal immune system. Cellular components of the immune system -Hematopoiesis, stem cells, granulocytes- Neutrophil, eosinophil, basophil and Mast cell, Mononuclear cells- Lymphocytes, Monocytes, Macrophages, NK cells and Dendritic cells.

Unit II: Nature of Antigen and Antibody (8 hours)

Antigen: Concept of antigenic determinants and immunogens, factors that influence immunogenicity, Classes of antigen, Epitopes, Haptens.

Antibody: Immunoglobulin genes, Molecular Structure - general features , light and heavy chains, Hyper variable and constant regions, Different isotypes and subtypes of immunoglobulins, Allotypes and idiotypes, Synthesis, Assembly and Expression of Ig molecules, Immunoglobulin superfamily.

Unit III : Innate Immunity (10 hours)

Anatomical and physiological barriers, Soluble factors, Inflammation-characteristics, initiation of the inflammatory response, Recruitment of phagocytic cells, recognition by receptors, adhesion molecules, Chemotaxis, Phagocytosis, Acute inflammatory response, Role of innate immunity. Non-cellular components of the immune system -Lipid mediators, Cytokines, Complement system, Acute phase proteins, Kinin system.

Unit IV: Adaptive Immunity (10 hours)

MHC molecules: genes, different classes, structure and function, Antigen processing and presentation:Endogenous and exogenous pathways.

Humoral Immunity–B cell development and selection, BCR, B-Cell maturation, Activation, Differentiation, generation of plasma cells and memory B cells.

Cell-mediated immunity :T cell development, Structural organization of T cell-receptors, T-cell maturation, Activation, Differentiation, Proliferation , B cell – T cell interaction, The germinal centre reactions, Class switch recombination, generation of CD4+and CD8 + cell responses, secondary immune responses, regulation of the adaptive immune response.

Unit V : Clinical Immunology (10 hours)

Antigen – antibody interactions:- precipitation and agglutination reactions, complement fixation, immuno diffusion, Immuno electrophoresis, Immunofluorescence. Diagnostic techniques - RIA, ELISA, Western blotting, Flow cytometry and FACS. Monoclonal and polyclonal antibodies formation and applications. Immunodeficiencies: Hypersensitivity (Type I – IV), autoimmunity-organ specific – Graves disease, Myasthenia Gravis, Systemic autoimmune diseases – Rheumatoid arthritis, Primary and secondary immune deficiencies. Immunotherapy : Vaccination and immunization – active and passive acquired immunity, Abzymes.

ASSESSMENT:

Internal Continuous Assessment (40%)

Mid-semester Examination -15%

Assignment - 10%

Seminars - 10%

Attendance - 5%

University End semester Assessment (60%)

This will be through a 3 hour written examination for 60 marks consists of 3 Parts

Part A (20 marks) – Ten essay type questions of 2 marks out of 12 questions.

Part B (20 marks) - Four essay type questions of 5 marks out of 6 questions.

Part C (20 marks) - Two essay type questions of 10 marks out of 3questions

Give equal importance to all units.

References

1. Owen, Judith A., Jenni Punt, and Sharon A. Stranford. *Kuby immunology*. New York: WH Freeman, 2013.
2. Abbas, Abul K., Andrew HH Lichtman, and Shiv Pillai. *Cellular and Molecular Immunology: with STUDENT CONSULT Online Access*. Elsevier Health Sciences, 2014.
3. Pommerville, Jeffrey. *Alcamo's fundamentals of microbiology: Body systems*. Jones & Bartlett Publishers, 2012.
4. Delves, Peter J., Seamus J. Martin, Dennis R. Burton, and Ivan M. Roitt.*Roitt's essential immunology*. Vol. 20. John Wiley & Sons, 2011.
5. Levinson, Warren, and Ernest Jawetz. *Medical microbiology and immunology: examination and board review.* Appleton & Lange, 1996.

BCH 526 Lab Course II (Enzymology) (0, 0, 6, 2)

COURSE CODE : BCH 526

COURSE TITLE : Enzymology

CREDITS : 2

SEMESTER : II

TOTAL PRACTICAL HOURS : 64

PRE-REQUISITES, IF ANY : None

AIM: The aim of the laboratory practices is to acquire knowledge about determination of enzyme activities. A part of the practices is optimization of conditions for enzymes isolation, inhibition of enzyme reactions, study of factors that influence enzyme activity and study of enzyme kinetics. During the course of the practices, students are directed to master practical enzyme assays and immobilization techniques.

Course Description: Samples of enzyme isolation and purification, activity calculation, enzyme kinetics. Determination of activity of LDH, Trypsin, urease and glucoronidase. Optimum temperature and pH, effect of substrate and enzyme concentrations and inhibitors and activators on reaction rate. Seperation of isoenzymes, activity staining and enzyme immobilization techniques.

Course content:

A. ENZYME PURIFICATION (10 hrs)

1. Sub cellular fractionation of organelles from liver cells and identification by marker enzymes.
2. Purification of β- glucuronidase from rat liver lysosomes

B. ENZYME ASSAY (12 hrs)

1. Absorption spectra of NAD and NADH
2. Assay of LDH from rat liver.
3. Assay of Trypsin
4. Assay of Urease
5. Assay of β-Glucuronidase from rat liver

C. ENZYME KINETICS (21 hrs)

1. Determination of Kinetic constants of Enzymes
2. Effect of substrate concentration on activity Enzyme
3. Determination of optimum temperature.

4. Determination of optimum pH.
5. Effect of activator on Enzyme activity.
6. Effect of inhibitors on Enzyme activity
7. Effect of enzyme concentration on Enzyme activity.

D. ISOENZYME SEPERATION- LDH (5hrs)

E. ACTIVITY STAINING- SOD (6 hrs)

F. ENZYME IMMOBILISATION–techniques **(10 hrs)**

ASSESSMENT:

Internal Assessment

Attendance- 5 %

Record - 10%

Test/ viva voce- 10%

Mid-semester practical exam- 15%

External Assessment

Semester Examination- 60%

References:

1. Bisswanger, Hans. *Practical enzymology*. John Wiley & Sons, 2013.
2. Wilchek, Meir, and Edward A. Bayer. "Methods in enzymology." (1990).
3. Sawhney, S. K., and Randhir Singh. *Introductory practical biochemistry*. Alpha Science Int'l Ltd., 2000.

SEMESTER III

BCH 531 Cell Biology (4, 1, 0, 4)

COURSE CODE : BCH 531

COURSE TITLE : Cell biology

CREDITS : 4

SEMESTER : III

TOTAL TEACHING HOURS : 64

PRE-REQUISITES, IF ANY : None

AIM:

- Explore cells, their characteristics, parts, chemical processes and pays special attention to how molecules control a cell's activities and growth

COURSE DESCRIPTION:

Cell biology focuses on the structure and function of a cell, from the most general properties shared by all cells, to the unique, highly intricate functions particular to specialized cells. It deals with the interactions between the molecular components that carry out the various biological processes in living cells, the structure of cells, the way cells change, the substances needed by the cell to survive, products made by the cell, and other cellular characteristics, cell communication and signaling, the cell cycle, the rotation of phases beginning and ending with cell division and focused on different periods of growth and DNA replication.

COURSE CONTENT:

Unit I : Overview of cell (4 Hours)

Cell theory, cell classification, cell variability (size, shape, complexity and functions), cell movement and chemotaxis, Ultrastructure of organelles, subcellular fractionation, Cytoskeleton organization-Microtubules, Microfilaments and intermediary filaments.

Unit II : Plasma membrane (4 Hours)

Structure and function of plasma membrane, different models, Membrane proteins, Membrane lipids and membrane fluidity, Transport mechanisms-different types, Ion channels, Endocytosis, Exocytosis, Phagocytosis, Pinocytosis, Role of clathrin.

Unit III : Extracellular Matrix and Cellular Interactions (12 Hours)

Overview of Extracellular Matrix components – Glycoproteins, Proteoglycans, Fibronectin, Laminin, Cell adhesion molecules, Proteins involved in Cell – Cell communications. Cell matrix Interaction, Integrins, Focal adhesion, Hemidesmosomes. Cell – Cell Interaction, Cadherin, Ig Super family, Selectins. Adherens junctions and desmosomes. Tight junction, Gap junction, Plasmodesmata.

Unit IV Cell Signaling (12 Hours)

Signaling molecules, receptors and their functions– G protein coupled receptors, Receptor protein tyrosine kinases, Steroid hormone receptors, Non Receptor protein tyrosine kinases, Nitric oxide neurotransmitters, Growth factors, Eicosanoids.

Intracellular signaling Pathways – Cyclic AMP, Cyclic GMP, IP3, Calcium, Ras and Raf, MAP kinase pathway, JAK/STAT Pathway. PPAR, ATP Binding Cassette Transporters, Toll like receptors.

Unit V Protein Sorting and Targeting (10 Hours)

Overall pathway of synthesis of nuclear coded, secretory, lysosomal and membrane proteins. Import across ER – Signal hypothesis, post translational modifications of secretory/membrane proteins in ER, sorting of lysosomal proteins, Mannose - 6 - Phosphate receptors, synthesis, trafficking and localization of mitochondrial proteins. Protein traffic into and out of nucleus.

Unit VI Cell Cycle and Regulation (12 Hours)

Cell division – Mitosis and Meiosis – Role of Cytoskeleton – Microtubules – Microfilaments and Intermediary filaments. Phases of Eukaryotic cell cycle. Regulation of cell cycle, Cyclins, MPF, Cyclin dependent kinases, Growth factors, Nuclear Laminins, inhibition of cell cycle progression, MPF and progression to Metaphase, Proteolysis and MPF, Regulation of MPF activity. Check points in cell cycle regulation.

Unit VII Apoptosis and Cancer (10 Hours)

Programmed cell death, Caspases. Intrinsic and Extrinsic pathways. Pro and anti apoptotic pathways and cell survival. Cancer – Development and causes of cancer, metastasis, tumor viruses, oncogenes, tumor suppressor genes, necrosis.

ASSESSMENT:

Internal Continuous Assessment (40%)

Mid-semester Examination -15%

Assignment - 10%

Seminars - 10%

Attendance - 5%

University End semester Assessment (60%)

This will be through a 3 hour written examination for 60 marks consists of 3 Parts

Part A (20 marks) – Ten essay type questions of 2 marks out of 12 questions.

Part B (20 marks) - Four essay type questions of 5 marks out of 6 questions.

Part C (20 marks) - Two essay type questions of 10 marks out of 3questions

Give equal importance to all units.

References

1. Lodish, Harvey. *Molecular cell biology*. Macmillan, 2008.
2. Berk, Arnold, and S. Lawrence Zipursky. *Molecular cell biology*. Vol. 4. New York: WH Freeman, 2000.
3. Karp, Gerald, and Nancy L. Pruitt. *Cell and molecular biology: concepts and experiments*. J. Wiley, 2002.
4. Cooper, G. M., and R. Hausman. "The Cell-A Molecular Approach, 2000."*Sunderland (MA): Sinauer Associates, Inc*, 2000.
5. Pollard, Thomas D., William C. Earnshaw, and Jennifer Lippincott-Schwartz.*Cell biology*. Elsevier Health Sciences, 2007.

BCH 532 Molecular Biology (4, 1, 0, 4)

COURSE CODE : BCH 532

COURSE TITLE : Molecular Biology

CREDITS : 4

SEMESTER : III

TOTAL TEACHING HOURS : 64

PRE-REQUISITES, IF ANY : None

Aim: The aim of this course is to provide students with an advanced knowledge of molecular biology so as to appreciate and understand molecular mechanisms involved in storage , transmission and expression of genetic information

COURSE DESCRIPTION: The course deals in depth with all aspects of molecular biology starting with basic properties of genes and genomes, replication, transcription, translation and regulation of genes.

COURSE CONTENT:

Unit I: Overview of Chemistry of DNA (10hrs)

Genetic material DNA, RNA, viroid, prions -Concept and definition of the gene, complexity of the eukaryotic gene. Coding and non coding regions C paradox, pseudogenes, and gene clusters, spacers, repetitive sequences, satellites, LINEs and SINES . Single and multiple copy genes in eukaryotes, Site specific recombination-recombinases- transposons -DNA transposons -virus like retro transposons- Poly A retro transposon and mechanisms of transposition

Unit II: DNA synthesis (Replication) (10hrs)

Replicons: linear circular and extrachromsomal repicons –Detailed of mechanism of replication in-Phage T4, bacteria and viruses, eukaryotic nuclear and mitochondrial DNA replication. Reverse transcriptase, topoisomerases

Termination of replication- circular and linear replications (details of proteins and enzymes involved in the replication) - regulation of replication- cellular control- methylation-licensing factor

Mechanisms of replication repair- Overview of mutations - Ames test-Direct reversal-base and nucleotide excision repair-mismatch repair-transcription coupled repair-recombination repair-non homologus, end joining repair- DNA repair in eukaryotes- -SOS

Unit III : Transcription (14hrs)

Transcription (prokaryotes and eukaryotes) –RNA polymerases- transcription factors-consensus sequences. Differences in prokaryotic and eukaryotic transcription factors- heteronuclear RNA post transcriptional modification of mRNA, tRNA, rRNA addition of poly A Tail -Capping RNA-Splicing –chemistry- spliceosome machinery role of ribozymes. Alternative splicing- trans splicing-exon shuffling.

Unit IV : Genetic code and Translation (15hrs)

Overview of genetic code- codon anticodon interactions-non universality of the code- incorporation of novel amino acids.

Translation (prokaryotes and eukaryotes) Structure and role of tRNA amino acyl tRNA synthases- ribosome structure -translation (initiation, elongation and termination in detail in prokaryotes as well as eukaryotes), translational proof-reading,- Posttranslational processing of protein (protein folding, signal cleavage, disulphide bond formation, O and N-glycosylation, folding of nascent protein, role of chaperons, attachment of glycosyl anchor, and other modifications processing by chemical modification, inteins).

Unit V: Regulation of Transcription and Translation (15hrs)

Regulation of Transcription and Translation – Positive and negative control, Repressor & Inducer, concept of operon, lac-, ara-, trp operons, attenuation, catabolite repression, autogenous regulation, lytic cycle of bacteriophage; stringent response of rRNA synthesis. Hormonal control, transcription factors, steroid receptors. DNA binding motifs in pro- and eukaryotes – Helix turn helix, zinc fingers, leucine zippers/ b zip, helix loop helix motifs

Regulation of Gene Expression in Development- Development in Drosophila. Maternal genes –bicoid and nanos and hunchback. Gap genes, pair rule genes segmentation genes, homeotic genes

Gene silencing – of chromatin in regulating gene expression and gene silencing -RNAi_ MicroRNAs-riboswitches-regulation of gene expression in bacteriophage-gene dosage- gene amplification-. Over view of epigenetics

ASSESSMENT:

Internal Continuous Assessment (40%)

Mid-semester Examination -15%

Assignment - 10%

Seminars - 10%

Attendance - 5%

University End semester Assessment (60%)

This will be through a 3 hour written examination for 60 marks consists of 3 Parts

Part A (20 marks) – Ten essay type questions of 2 marks out of 12 questions.

Part B (20 marks) - Four essay type questions of 5 marks out of 6 questions.

Part C (20 marks) - Two essay type questions of 10 marks out of 3questions

Give equal importance to all units.

References:

1. Tymoczko, John L., Jeremy M. Berg, and Lubert Stryer. *Biochemistry: a short course*. Macmillan, 2011.
2. Cox, Michael M. *Lehninger principles of biochemistry*. Freeman, 2013.
3. Garrett, Reginald, and Charles Grisham. *Biochemistry*. Nelson Education, 2012.
4. Voet, Donald, Judith G. Voet, and Charlotte W. Pratt. "Fundamentals of biochemistry." *New York: John Wiley & Sons* 2008.
5. Karp, Gerald, and Nancy L. Pruitt. *Cell and molecular biology: concepts and experiments*. J. Wiley, 2002.
6. Zubay, Geoffrey L., William W. Parson, and Dennis E. Vance. *Principles of biochemistry: student study art notebook*. Wm. C. Brown, 1995.
7. Lewin, Benjamin, and Gabby Dover. *Genes v*. Vol. 299. Oxford: Oxford University Press, 1994.

BCH 533 Nutritional and Clinical Biochemistry (4, 1, 0, 4)

COURSE CODE : BCH 533

COURSE TITLE : Nutrition and Clinical Biochemistry

CREDITS : 4

SEMESTER : III

TOTAL TEACHING HOURS : 64

Aim : *To study the nutritional value of dietary foods and their related disorders.*

COURSE DESCRIPTION:

To get the idea about the balanced diet, their energy metabolism, daily requirement, nutritional aspects dietary foods, defect related to their metabolic pathways, consequences, biochemical, clinical features, diagnosis and treatment.

COURSE CONTENT

Unit I : Energy value of foods (8 hrs)

Determination of Energy value using Bomb calorimeter- Respiratory Quotient (RQ), Basal metabolism, Determination of Basal Metabolic Rate (BMR), Factors affecting BMR, Determination of energy metabolism during work, Energy expenditure for various types of activities, Recommended Daily Allowance (RDA), Specific Dynamic Action (SDA) of foods.

Unit II: Nutritional aspects of nutrients (8 hrs)

Nutritional aspects of Carbohydrates, lipids, proteins and fiber. Nutritional value of vitamins, minerals – physiological and biochemical functions, Daily requirement.Important dietary sources of proteins, Determination of nutritive value of proteins, Biological value of proteins (BV), Protein efficiency ratio (PER), Digestability coefficient, Net protein Utilization, Net Protein Ratio(NPR), Chemical Score, Essential amino acids, Limiting aminoacids, Essential fattyacids- visible and invisible fat.

Unit III : Free Radicals and Antioxidants (6 hrs)

Sources of free radicals, chain reactions, Nutrients as antioxidant, pro-oxidant, Interactions of radicals with DNA, Lipids and Proteins, Cause of Radical damage, Various mechanisms of protection against radical damage.

Unit IV: Diet related Diseases (8 hrs)

Protein energy malnutrition- Kwashiorkor, Marasmus- aetiology, metabolic disorders and management.Deficiency disorders of vitamins and minerals, hypervitaminosis.

Nutritional aspects of life style diseases: Diabetes, Atherosclerosis, Cancer, Inflammatory arthritis, Obesity- Risk factors, biochemical and clinical features, Symptoms, Diagnosis, Treatment.

Unit V : Diseases related to digestion and absorption of foods (10 hrs)

Gastritis, ulcers – peptic ulcer, Zollinger Ellison syndrome, Achlorhydria, Pancreatitis, Lactose intolerance, Disaccharidase deficiency, Disaccharidiuria, monosaccharide malabsorption, Steatorrhea, Chyluria, Cholelithiasis, and Sprue.

Unit VI : Inborn errors of metabolism (12 hrs)

Gycogen storage diseases, Diabetes insipidus, Pentosuria, Fructosuria, Galactosuria, Hereditary fructose intolerance, Fructose-1,6-diphosphatase deficiency, Hypo and Hyperlipoproteinemia, Mucopolysaccharidosis, Spingolipidosis, Phenylketonuria, Tyrosinemia I and II, Albinism, Alkaptonuria, Maple syrup urine disease, methyl malonic acidemia, Homocystinuria, defect in gamma glutamyl cycle, Gout, Lesch-Nyhan syndrome, Hyper and Hypouricemia, orotic aciduria.

Unit VII : Tropical and liver diseases (12 hrs)

Tropical diseases- Malaria, Filariasis, Tetanus, Leprosy – Transmission, Clinical features, diagnosis and treatment. Liver diseases – Porphyria, Jaundice. Abnormal Hemoglobin and their deficiencies - Macrocytic and microcytic anemia, Sicle cell anemia, Thalassemia, Heriditary methemoglobinemia. Disorders of metabolism in brain, Neurodegenerative diseases and their biochemical basis, Ageing.

ASSESSMENT:

Internal Continuous Assessment (40%)

Mid-semester Examination -15%

Assignment - 10%

Seminars - 10%

Attendance - 5%

University End semester Assessment (60%)

This will be through a 3 hour written examination for 60 marks consists of 3 Parts

Part A (20 marks) – Ten essay type questions of 2 marks out of 12 questions.

Part B (20 marks) - Four essay type questions of 5 marks out of 6 questions.

Part C (20 marks) - Two essay type questions of 10 marks out of 3questions

Give equal importance to all units.

References

1. Swaminathan, M. S. *Food science, chemistry and experimental foods*. Bangalore Print. & Publishing Company, 1987.
2. Nelson, David L., Albert L. Lehninger, and Michael M. Cox. *Lehninger principles of biochemistry*. Macmillan, 2008.
3. Bamji, Mahtab S., Kamala Krishnaswamy, and G. N. V. Brahmam. *Textbook of human nutrition*. Oxford & IBH, 2009.
4. Bishop, Michael L., Edward P. Fody, and Larry E. Schoeff, eds. *Clinical Chemistry: Principles, Techniques, and Correlations*. Lippincott Williams & Wilkins, 2013.
5. Bahr, Manson, and D. R. Bell. "Manson's Tropical Diseases." *The English Languages Book Society, Billiere, Tindall and Cassell, Ltd* (1996).

BCH 534 Genetics & Genomics (2, 1, 0, 2)

COURSE CODE : BCH 534

COURSE TITLE : Genetics and Genomics

CREDITS : 2

SEMESTER : III

TOTAL TEACHING HOURS : 32

Aim-Genetics and Genomics

The overall aim of the Genetics and Genomics research theme is to harness advances in genetics, genome biology and genome technologies to improve the understanding and management of common and rare diseases, particularly cardiovascular, metabolic and autoimmune diseases and cancer.

Course Desciption

Genome information and technologies have impacted on almost every area of biomedical research, including molecular and medical genetics, cellular biology and biochemistry, physiology, epidemiology, pharmacology and gene therapy. We are now at a critical point in the development of these technologies for providing insights into the molecular, genetic and cellular basis of rare and common diseases, with growing opportunities for translation into improving individualised patient care.

COURSE CONTENT

Unit I : Concept of gene (6 hrs)

Genome, genome size, higher order genome organization and histone modification – acetylation,methylation, methylation of CpG islands.

Unit II : Mendelian genetics (7 hrs)

Mendel's study of heredity, Phenotype, Genotype, Dominant and Recessive alleles, Principle of dominance, Principle of segregation, Monohybrid crosses, Dihybrid crosses, Trihybrid crosses, Test Cross, Back cross, Alleles, Co-dominant alleles, Multiple alleles, Lethal Genes.

Unit III : Human genetics (7 hrs)

Pedigree analysis, Probability theory, Linkage analysis, Chromosome mapping. Human disorders follow Mendelian patterns of inheritance, Genetics counseling, Genome imprinting, Gene amplification, VNTRs, Paternity test.

Unit IV: Human Cytogenetics (6 hrs)

Human chromosome culture technique, normal human karyotype, chromosome aberrations associated with congenital defects in man. Turner's syndrome, Klinefelter's syndrome, Triple X syndrome, Down's syndrome and Trisomy 18.

Unit V: Genomics (6 hrs)

Human genome project, Overview of the following - Structural genomics, Functional genomics, Transcriptomics, Proteomics and Metabolomics.

ASSESSMENT:

Internal Continuous Assessment (40%)

Mid-semester Examination -15%

Assignment - 10%

Seminars - 10%

Attendance - 5%

University End semester Assessment (60%)

This will be through a 3 hour written examination for 60 marks consists of 3 Parts

Part A (20 marks) – Ten essay type questions of 2 marks out of 12 questions.

Part B (20 marks) - Four essay type questions of 5 marks out of 6 questions.

Part C (20 marks) - Two essay type questions of 10 marks out of 3questions

Give equal importance to all units.

References

1. Carroll, Sean B., Jennifer K. Grenier, and Scott D. Weatherbee. *From DNA to diversity: molecular genetics and the evolution of animal design*. John Wiley & Sons, 2013.
2. Alberts, Bruce, Dennis Bray, Karen Hopkin, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, and Peter Walter. *Essential cell biology*. Garland Science, 2013.
3. Lewin, Benjamin, Jocelyn E. Krebs, Elliott S. Goldstein, and Stephen T. Kilpatrick. *Lewin's Genes XI*. Jones & Bartlett Publishers, 2014.
4. Snustad, D. P., and M. J. Simmons. *Principles of genetics. 6th edition. John Wiley & Sons, Hoboken* (2012).
5. Guttman, Burton. *Genetics: The Code of Life*. The Rosen Publishing Group, 2011.Molecular Genetics: Klug and Cummings

BCH 535 Lab Course - III Clinical Biochemistry (0, 0, 6, 2)

COURSE CODE : BCH 533

COURSE TITLE : Lab Course III (Clinical Biochemistry)

CREDITS : 2

SEMESTER : III

TOTAL PRACTICAL HOURS : 6hrs / week

PRE-REQUISITES, IF ANY : NONE

Aim: To estimate the biochemical analysis of organ function and blood related diseases.

Course Desciption:

Helps to diagnosis various derangements in metabolism or defect in functions of various organs like liver, kidney, thyroid, heart etc and give an idea about their treatment**.**

Course content:

1. **Liver function test**

   Bilirubin, Total protein, A/G Ratio, SGPT, SGOT, Alkaline phosphatase

2. **Kidney function test**

   Urea, Uric acid, Creatinine

3. **Thyroid function test**

   T3, T4 and TSH

4. **Cardiovascular markers-Lipid profile**

   Cholesterol, TG, HDL-C, LDL-C, CRP, CPK

5. **Biochemical markers of Diabetes Mellitus**

   FBS, PPBS, Glycosylated Hb.

6. **Hematological Analysis**

   Total count of RBC and WBC

   Differential count of blood

   Prothrombin time, clotting time and bleeding time determination.

   Estimation of haemoglobin level.

   Estimation of haemoglobin level.

ASSESSMENT:

Internal Assessment

Attendance- 5 %

Record - 10%

Test/ viva voce- 10%

Mid-semester practical exam- 15%

External Assessment

Semester Examination- 60%

Reference:

1. A textbook of practical biochemistry- Joshi A. Reshmi
2. Practical clinical biochemistry- Harold Varley

SEMESTER IV

BCH 541 Molecular Endocrinology (3, 1, 0, 3)

COURSE CODE : BCH 541

COURSE TITLE : Molecular Endocrinology

CREDITS : 3

SEMESTER : IV

TOTAL TEACHING HOURS : 48

PRE-REQUISITES, IF ANY : None

AIM:

- *To impart knowledge on* molecular and cellular mechanisms in endocrinology

COURSE DESCRIPTION:

Endocrinology is the study of the biosynthesis, storage, chemistry, biochemical and physiological function of hormones. The endocrine system consists of several glands, all are located in different parts of the body, secrete different hormones directly into the blood rather than into a duct system. Hormones have many different functions and modes of action; one hormone may have several effects on different target organs, and, conversely, one target organ may be affected by more than one hormone. Hormones act by binding to specific receptors in the target organ. This paper focus on molecular and cellular mechanisms in endocrinology, including gene regulation, cell biology; signalling; mutations; transgenesis, various diseases associated with hormonal dysfunction as well as the integration of developmental events.

COURSE CONTENT:

Unit 1 : Introduction to Hormones (12 hours)

History of Endocrinology, Classification of hormones, overview of circulation, modification and degradation. Target tissue feedback control. Hormone receptors - general features, structure and regulation. Mechanism of hormone action. Signal transduction. - Role of Plasma membrane receptors- G protein coupled receptors, Receptor protein tyrosine kinases, Non Receptor protein tyrosine kinases, Steroid hormone receptors, inositol phosphates and calcium.

Unit II : Hypothalamus and Pituitary hormones (10 hours)

Biochemistry and mechanism of action of Hypothalamus and Pituitary hormones: Hypothalamic releasing factors, Anterior Pituitary hormones, Vasopressin, Oxytocin. Regulation of synthesis. Lactogenic hormones. Glycoprotein hormones of the POMC family, endorphins, MSH, Hypo and hyper activity of Pituitary hormones - gigantism, acromegaly, dwarfism, syndrome of inappropriate ADH secretion.

Unit III : Thyroid Hormones (8 hours)

Synthesis, secretion, transport metabolic fate and Biological actions. Antithyroid agents. Thyroid diseases- thyrotoxicosis, goiter, hypothyroidism, Graves' disease, Hashimoto's thyroiditis. Thyroid function tests. Parathyroid hormone - Biological actions, regulation of calcium and phosphorus metabolism. Calcitriol, Calcitonin. Pathophysiology.

Unit IV : Pancreatic and Gastrointestinal hormones (8 hours)

Pancreatic hormones - Islets of Langerhans. Insulin biosynthesis, regulation of secretion, Biological actions and mechanism of action. Insulin receptor- intracellular mediators. Insulin signalling pathways. Glucagon, somatostatin, pancreatic polypeptide, insulin like growth factors. Diabetes Mellitus. Gastrointestinal hormones- location of .peptide producing cells, synthesis, structure, functions and mechanism of action of secretin, GIP, VIP, gastrin, CCK and other peptides.

Unit V : Adrenal hormones (10 hours)

Adrenal hormones - Glucocorticoids, Mineralocorticoids - synthesis, secretion transport, metabolic fate, biological actions and mechanism of action. Adrenal androgens metabolic effects and functions. Hormones of Adrenal Medulla - Catecholamines - Biosynthesis, storage, metabolism, regulation of synthesis. Abnormal secretion of Adrenal hormones- Addison's disease, Cushing's .syndrorne, Congenital Adrenal Hyperplasia, phaeochromocytoma. Gonadal hormones - Androgens, estrogens. Biological actions. Ovarian cycle. Pregnancy, Biochemical changes in pregnancy.

ASSESSMENT:

Internal Continuous Assessment (40%)

Mid-semester Examination -15%

Assignment - 10%

Seminars - 10%

Attendance - 5%

University End semester Assessment (60%)

This will be through a 3 hour written examination for 60 marks consists of 3 Parts

Part A (20 marks) – Ten essay type questions of 2 marks out of 12 questions.

Part B (20 marks) - Four essay type questions of 5 marks out of 6 questions.

Part C (20 marks) - Two essay type questions of 10 marks out of 3questions

Give equal importance to all units.

References

1. Melmed, Shlomo, Kenneth S. Polonsky, P. Reed Larsen, and Henry M. Kronenberg.Williams textbook of endocrinology. Elsevier Health Sciences, 2011.
2. C. R. Austin, R. V. Short, Mechanisms of Hormone Action, Cambridge University Press, 1979
3. Granner, Robert K. Murray Darryl K., and Peter A. Mayes Victor W. Rodwell.Harper's Illustrated Biochemistry (Harper's Biochemistry).McGraw-Hill Medical, 2006.
4. White, Abraham, Philip Handler, and Emil L. Smith."Principles of Biochemistry." Academic Medicine 39.12 (1964).
5. Mac E. Hadley, Endocrinology, Prentice Hall, 2012

BCH 542 Lab Course – IV Techniques in Molecular Biology and Immunology (0, 0, 6, 2)

COURSE CODE : BCH 542

COURSE TITLE : Lab Course – IV (Techniques in Molecular Biology and Immunology)

CREDITS : 2

SEMESTER : IV

TOTAL PRACTICAL HOURS : 6 hours / week

AIM: *The course is designed to provide students with hands on training in molecular biology and immunological techniques for application from a researcher's point of view.*

COURSE DESCRIPTION: The course provides detailed protocols; experimental design and application oriented training the routine techniques in molecular biology and immunological analysis. Emphasis is given in encouraging self exploration and analytical thinking in approaching biological samples of investigation and data derivation.

COURSE CONTENT:

Expt 1 Isolation of DNA from blood and liver.

Expt 2 Qualitative and quantitative analysis of extracted DNA- Spectrophotometric method.

Expt 3 Plasmid restriction mapping.

Expt 4 Insertion and ligation of foreign DNA in to vector plasmid.

Expt 5 E.coli transformation with recombinant plasmid- heat shock method.

Expt 6 Screening of plasmid uptake – plate culture based identification.

Expt 7 Recombinant plasmid isolation for E.coli broth culture.

Expt 8 Primer designing methods and software application.

Expt 9 PCR based identification of recombinant DNA insert.

Expt 10 Agarose gel electrophoresis of total, plasmid and recombinant plasmid isolates.

Expt 11 Band detection and documentation by UV transillumination.

Expt-12 Isolation of total RNA from blood.

Expt 15 Immunodiffusion.

Expt 16 Immunoelectrophoresis.

Expt 17 Competitive ELISA.

ASSESSMENT:

Internal Assessment

Attendance- 5 %

Record - 10%

Test/ viva voce- 10%

Mid-semester practical exam- 15%

External Assessment

Semester Examination- 60%

References:

1. Frederick M. Ausubel, Roger Brent, Robert E. Kingston, David D. Moore, J. G. Seidman, John A. Smith, Kevin Struhl, Short Protocols in Molecular Biology, Wiley, 2002
2. Brenda D. Spangler, Methods in Molecular Biology and Protein Chemistry: Cloning and Characterization of an Enterotoxin Subunit, Wiley, 2002
3. Frederick M. Ausubel, Current Protocols in Molecular Biology, John Wiley and Sons, 2014

BCH 543 Dissertation (0, 0, 12, 4)

COURSE CODE : BCH 543

COURSE TITLE : Dissertation

CREDITS : 4

SEMESTER : IV

PRE-REQUISITE, IF ANY: Training in routine laboratory techniques and analytical methods.

AIM: *The aim of this course is to expose students to different aspects of research methodology, molecular and biochemical research and data analysis.*

COURSE DESCRIPTION: The primary objective of a dissertation work is to act as an introduction to biological research and its various aspects. Students shall carry out a research project specific to individual laboratory of the supervision teacher they are assigned with.

COURSE CONTENT:

Students are assigned to different faculties and are expected to carry out the research project under close supervision of the research faculty and their research scholars. Each student will work as an integral unit of the research team and thereby, understand and complete the assigned research work. On completion of the project, students are expected to submit a dissertation of the results and its discussion for expert evaluation.

ASSESSMENT:

External viva voce- Based on presentation of results, dissertation, record assessment and viva voce of the research work by an external expert and department research committee members.

References: Open.

OTHER RESOURCES: Open.

ELECTIVE COURSES

BCH 501 Biotechnology (4, 1, 0, 4)

COURSE CODE : BCH 501
COURSE TITLE : Biotechnology
CREDITS : 4
SEMESTER : III
TOTAL TEACHING HOURS : 64 hrs
PRE-REQUISITES, IF ANY : NONE

Aim

Biotechnology is the integrated use of many biological technologies - from molecular genetics to biochemical engineering. This integration is essential for the effective translation of novel research into application.

COURSE DESCRIPTION

Biotechnology is the application of biology for the benefit of humanity and the environment. It harnesses organisms to provide foods and medicines, and for tasks such as cleaning toxic waste or detecting harmful substances. Biotechnology has roots in food and agriculture, using yeast to make beer and bread, and lactic acid bacteria to make cheese. New technologies such as genetic engineering have enabled modern biotechnology to become an important part of the 'smart economy' in areas such as healthcare, agriculture, the food industry and the environment.

A lecture, discussion and project-based course that focus on the molecular and genetic tools used to analyze and modify genetic material and used to modify organisms to produce desired small molecules and proteins. Topics will include the properties and uses of biotechnology-useful enzymes, sequencing techniques, PCR, cloning vectors and hosts, DNA and protein microarrays, directed mutagenesis, and the manipulation of expression (and its levels) of particular gene products. The experimental and model systems that will be studied include bacteria, yeast, plant, and higher mammals.

COURSE CONTENT

Unit I : Review on Biotechnology (8 hrs)

Pioneers in the development of modern biotechnology, Biotechnological applications in agriculture, medicine and industry, Nanobiotechnology, Marine biotechnology.

Unit II : Recombinant DNA technology (8 hrs)

Recombinant DNA technology: Restriction endonucleases, Types of Restriction endonucleases, nomenclature, recognition sequences, cleavage patterns, steps in gene cloning, isolation of desired gene, method of producing cDNA, vectors, properties of good vector, cloning and expression vectors, types of vectors.

Unit III : Molecular markers and maps (8 hrs)

Molecular markers and maps: Agarose gel electrophoresis and generation of Restriction Maps, Genomic library, cDNA library, DNA polymorphism, Restriction Fragment Length Polymorphism (RFLP), use of DNA polymorphism as genetic markers, detection of RFLP's and their uses, RAPD, DNA fingerprinting, Human Genome Project and its application, Gene transfer methods.

Unit IV : Transgenic plants and transgenic animals (8 hrs)

Transgenic plants and transgenic animals: Genetic engineering of plants, golden rice, Ti plasmid, Transgenic plants with herbicide and insect resistance, BT toxin, Creation of transgenic animals, Recombinant protein production, Knockout mice, Inducible endogenous promoters, Transgenic insects, Cloning, Natural transgenesis.

Unit V: **Tissue culture (8 hrs)**

Tissue culture: Tissue culture in plant and animal, micropropagation, storage of germplasm in vitro, plant gene transfer by protoplast fusion, criteria for a successful culture medium for animal cells. Somatic embryogenesis, Somatic hybridization and cryopreservation. Problems associated with mammalian cell culture.

Unit VI: Vaccine Development (8 hrs)

Vaccine Development: Types of vaccines, Vaccine production, Hybridoma technology and Monoclonal antibody production, Therapeutic proteins, Stem cell transplantation and its applications, Organ transplantation and types of transplant, Gene Therapy, Artificial blood, Phytoremediation, Bioremediation, Biosensors, Biowarfare and Bioterrorism.

ASSESSMENT:

Internal Continuous Assessment (40%)

Mid-semester Examination -15%

Assignment - 10%

Seminars - 10%

Attendance - 5%

University End semester Assessment (60%)

This will be through a 3 hour written examination for 60 marks consists of 3 Parts

Part A (20 marks) – Ten essay type questions of 2 marks out of 12 questions.

Part B (20 marks) - Four essay type questions of 5 marks out of 6 questions.

Part C (20 marks) - Two essay type questions of 10 marks out of 3questions

Give equal importance to all units.

References:

1. Rapley, Ralph, and David Whitehouse, eds. Molecular biology and biotechnology.Royal Society of Chemistry, 2014.
2. U Satyanarayana, Biotechnology, BooksAnd Allied (p) Limited, 2013.
3. John E. Smith, Biotechnology, Cambridge University Press, 2009.
4. Sandhya Mitra, Genetic Engineering: Principles and Practice, McGraw-Hill Education, 2015
5. B. D. Singh, "Biotechnology expanding horizons." Kalyani, India (2009).
6. Clark, David P., and Nanette J. Pazdernik. Biotechnology: applying the genetic revolution. Newnes, 2015.
7. Pamela Peters, Biotechnology: a guide to genetic engineering, Wm. C. Brown Publishers, 1993
8. S. B. Primrose, Molecular Biotechnology, Blackwell Scientific Publications,1991
9. James D. Watson, Recombinant DNA, W. H. Freeman,1992
10. Firdos Alam Khan, Biotechnology fundamentals. CRC Press, 2011.

BCH 502 : Environmental Biochemistry (2, 1, 0, 2)

COURSE CODE	**: BCH 502**
COURSE TITLE	**: Environmental Biochemistry**
CREDITS	**: 2**
SEMESTER	**: II**
TOTAL TEACHING HOURS	**: 32**
PRE-REQUISITES, IF ANY	**: NONE**

AIM:

The goal of Environmental biochemistry is to minimize the risks of pollutants and create high value products.

COURSE DESCRIPTION

Biochemistry is used in Environmental Science when understanding the environment's effect on living organisms as they interact with environmental pollutants. The pollutants sometimes referred to as xenobiotics can be ingested, inhaled or absorbed through the skin. Using biochemistry it is possible to study how the different pollutants behave once they are in the body. Where they are transformed, eliminated or stored and how this can affect the different biological process of a normally functioning organism. Xenobiotics studies include pesticides, hazardous wastes, synthetic and natural compounds.

The major environmental issues such as global warming, air and water pollution, and energy crisis, need our immediate attention. Major topics include biomass, bioremediation, microbial metabolism for reduction of carbon dioxide, recovery of precious metals from electronic wastes, algae for biofuel production, chemical and biological fixation of CO_2 into useful products, waste water treatment and CO_2 emissions, monitoring and treatment of water.

COURSE CONTENT

UNIT I : Introduction to ecosystem (6 hrs)

Basic concepts - interactions between environment and biota - concept of habitat and ecological niches - limiting factor.

UNIT II : Global environmental problems (6 hrs)

Ozone depletion - UV-B green house effect and acid rain - their impact and approaches for management.

UNIT III : Environmental pollution (6 hrs)

Types of pollution - methods for the measurement of pollution - methodology of environmental management

UNIT IV : Water pollution and control (8 hrs)

Need for water management – measurement and sources water pollution - kind of aquatic habitats, (fresh and marine) - distribution and impact of environmental factors on the aquatic biota. Waste water treatment - waste water collection - physico – chemical properties of water - physical - chemical and biological treatment processes - activated sludge - oxidation ditches - trickling filter – towers - rotating discs - rotating drums - oxidation ponds. Waste water treatment - anaerobic digestion - anaerobic filters - up flow anaerobic sludge blanket reactors - treatment schemes for waste waters of dairy - distillery tannery - sugar - antibiotic industries.

UNIT V : Biopesticides (6 hrs)

Biopesticides in integrated pest management - bioremediation of contaminated soils and wastelands - solid waste - sources and management (composting, vermiculture and methane production) - environmental mutagenesis and toxicity testing.

ASSESSMENT:

Internal Continuous Assessment (40%)

Mid-semester Examination -15%

Assignment - 10%

Seminars - 10%

Attendance - 5%

University End semester Assessment (60%)

This will be through a 3 hour written examination for 60 marks consists of 3 Parts

Part A (20 marks) – Ten essay type questions of 2 marks out of 12 questions.

Part B (20 marks) - Four essay type questions of 5 marks out of 6 questions.

Part C (20 marks) - Two essay type questions of 10 marks out of 3questions

Give equal importance to all units.

References

1. Stanley E. Manahan, Environmental Chemistry, CRC Press, 2009.
2. Odum, Eugene Pleasants, Howard T. Odum, and Joan Andrews.Fundamentals of ecology. Philadelphia: Saunders, 1971.
3. Hutzinger, Otto, ed. The handbook of environmental chemistry.Springer Science & Business Media, 1980.
4. Harbison, Raymond D., Marie M. Bourgeois, and Giffe T. Johnson.Hamilton and Hardy's industrial toxicology.John Wiley & Sons, 2015.
5. Landis, Wayne G., and Ming-Ho Yu. Introduction to environmental toxicology: impacts of chemicals upon ecological systems. Crc Press, 2003.
6. Lu, Frank C. "Basic toxicology: fundamentals, target organs, and risk assessment. Taylor & Francis, 1996

BCH 503 Bioinformatics (3, 0, 3, 4)

COURSE CODE	**: BCH 503**
COURSE TITLE	**: BIOINFORMATICS**
CREDITS	**: 4**
SEMESTER	**: III**
TOTAL TEACHING HOURS	**: 48 + 3 hours/ week (for practical)**
PRE-REQUISITES, IF ANY	**: None**

AIM:

- *To introduce the nature , scope, techniques and applications of bioinformatics*
- *To impart basic practical skills bioinformatics like 3D visualization, sequence aligning and retrieval of information from databases*

COURSE DESCRIPTION:

A comprehensive outlook on the Definition, history and applications of Bioinformatics. Getting familiar with the biological databases, sequence retrieval techniques, Sequence analysis and multiple sequence alignment. Discussing the Principles of genome annotation, Phylogenetics and Microarrays. Basics in Structural bioinformatics and Computer aided drug design are also covered

COURSE CONTENT:

UNIT I : Scope of Bioinformatics (6 hours)

Definition, history, Applications- evolutionary relationships -Drug discovery, genetic basis of disease- -personalized medicine and gene-based diagnostics

UNIT II : Introduction to biological databases (6 hours)

Types of databases –primary and secondary-Content, structure and annotation, file formats -sequence databases, structural databases, specialized databases, Protein structure classification databases: SCOP and CATH, diseases database – OMIM-sequence retrieval system from net - SRS, ENTREZ.

UNIT III : Sequence analysis (8 hours)

Alignment of pairs of sequence. Dot plot, local and global alignment-dynamic programming-Needleman and Wunsch algorithm, local alignment -Smith Waterman algorithm, Gap penalty-Sequence similarity search tools, FASTA and BLAST, PSI-BLAST- Significance of alignments: E value, Scores-, introduction to scoring matrices - PAM and BLOSSUM, Multiple sequence alignment- Introduction, the goal of multiple sequence alignment, multiple sequence alignment a definition, the consensus, computational complexity, manual methods, simultaneous methods, progressive methods, Clustal W.

UNIT IV : Principles of genome annotation (8 hours)

Finding genes by computer-Detecting ORF-Detecting exons and introns-introduction to gene prediction in prokaryotes and eukaryotes and soft ware used

UNIT V : Phylogenetics (6 hours)

Concepts of trees, Building phylogenetic tree- Distance and parsimony methods; Clustering methods. Rooted and unrooted trees, Bootstrapping, Phylip

UNIT VI : Microarrays (2 hours)

2D – basics- principle technique-applications

UNIT VII : Structural bioinformatics (6 hours)

Protein structure databases and visualization tools- structural alignment. Aligning 3D Structures-Predicting Protein Structure-Specialized Structural Regions- Secondary Structure Prediction-Tertiary Structure Prediction- Protein structure prediction methods- Comparative modeling, Threading. Ab-initio, -RMSD-, introduction to common some structure prediction software packages.

UNIT VIII : Computer aided drug design (6 hours)

Introduction to drug discovery -Drug discovery pipeline, structure based drug design - ligand designing and optimization, docking, Quantitative Structure Activity Relationship (QSAR)- introduction to molecular docking softwares- applications of molecular modeling in drug

PRACTICAL:

Introduction to Bioinformatics

1. Retrieval of DNA sequences from databases
2. Retrieval of protein sequences
3. Retrieval of sequences in different sequence formats
4. Searching for publications in Pubmed by different criteria
5. Aligning 2 DNA sequences
6. Aligning 2 protein sequences
7. Multiple sequence alignment using Clustal X
8. Construction of Phylogenic tree
9. ORF finding and Gene finding
10. Retrieval of structure data from PDB
11. 3-D Protein structure visualization and measurement of bond length, bond angle and torsion angles using RasMol.
12. BLASTp and BLASTn searches and interpretation of results
13. Molecular Docking
14. ADME Studies
15. Protein Structure Prediction

ASSESSMENT:

Internal Continuous Assessment (40%)

Mid-semester Examination -15%

Assignment - 10%

Seminars - 10%

Attendance - 5%

University End semester Assessment (60%)

This will be through a 3 hour written examination for 60 marks consists of 3 Parts

Part A (20 marks) – Ten essay type questions of 2 marks out of 12 questions.

Part B (20 marks) - Four essay type questions of 5 marks out of 6 questions.

Part C (20 marks) - Two essay type questions of 10 marks out of 3questions

Give equal importance to all units.

References:

1. Rastogi, S. C., NamitaMendiratta, and ParagRastogi. Bioinformatics: Methods And Applications:(Genomics, Proteomics and Drug Discovery). PHI Learning Pvt. Ltd., 2013.
2. D.R. Westehead, J.H. Parish, Instant Notes in Bioinformatics, BIOS Scientific Publishers, 2002.
3. Stephen A. Krawetz, David D. Womble, Introduction to Bioinformatics -A Theoretical And Practical Approach, Humana Press, 2003.
4. David W. Mount, Bioinformatics: Sequence and Genome Analysis, CSHL Press, 2004.
5. Swindell, Simon R., R. Russell Miller, and Garry SA Myers.Internet for the molecular biologist.Horizon Scientific Press, 1996.

BCH 504 : Pharmacology and Toxicology (2,1,0,2)

COURSE CODE	**: BCH 504**
COURSE TITLE	**: Pharmacology and Toxicology**
CREDITS	**: 2**
SEMESTER	**: IV**
TOTAL TEACHING HOURS	**: 32**
PRE-REQUISITE, IF ANY	**: Nil**

AIM: *This course is designed to provide detailed understanding of the pharmacological and toxicological aspects of therapeutics and their diverse modes of drug action.*

COURSE DESCRIPTION

This course gives the students an introduction to pharmacology and toxicology and centers on the study of medicines, drugs and poisons. Various aspects covered by the course include-

- Basic understanding of absorption, distribution and elimination of medicines, drugs and poisons.
- Principles of drug action and interaction of medicines, drugs and poisons.
- Toxicological hazards posed by commonly used drugs and drugs of abuse.

COURSE CONTENT:

UNIT I: Pharmaceutical chemistry (4 hrs)

Drugs – definition, source and nature, types of classification and nomenclature, dose response curve - ED50 and LD50. Role of drugs, Drug – protein interactions, routes of drug administration.

UNIT II: Drug targets (6 hrs)

Drug targets– Enzymes, receptors, carrier proteins. Structural proteins, nucleic acids, lipids and carbohydrates. Drug structure and activity relationship. Forces involved in drug – receptor interaction and receptor theories.

UNIT III: Drug Metabolism (8 hrs)

Absorption and distribution of drugs, importance of drug- protein interaction; drug elimination – role of liver and kidney. Pharmacological activities: consequences of non-specific interaction. Drug metabolism; Chemical pathways of drug metabolism– Biotransformation reactions- Phase I and phase II reactions – Microsomal and non-microsomal metabolism of drugs – role of cytochrome p450 enzyme subtypes.

UNIT IV: Drug Design and Formulation (6 hrs)

Drug development. Overview of computer aided drug design. Functional groups and Pharmacophore. Pharmacokinetic oriented drug design – Drug solubility and stability. Significance of formulations. Biological testing and bioassays – testing drugs *in vitro* and *in vivo*. Current advancements-Overview of Pharmacogenomics.

UNIT V: Clinical Toxicology (8 hrs)

Clinical Toxicology: definition, classification of toxicity – occupational, environmental and pharmaceutical. Types of toxins and their mechanism of action. Factors affecting toxicity- Drug tolerance, intolerance and allergy. Methods of detection. Rational prescription of drugs. Clinical symptoms of toxicity and marker parameters.

ASSESSMENT:

Internal Continuous Assessment (40%)

Mid-semester Examination -15%

Assignment - 10%

Seminars - 10%

Attendance - 5%

University End semester Assessment (60%)

This will be through a 3 hour written examination for 60 marks consists of 3 Parts

Part A (20 marks) – Ten essay type questions of 2 marks out of 12 questions.

Part B (20 marks) - Four essay type questions of 5 marks out of 6 questions.

Part C (20 marks) - Two essay type questions of 10 marks out of 3questions

Give equal importance to all units.

References:

1. F S K Barar, Essentials of Pharmacotherapeutics, S. Chand Limited, 2000.
2. Bertram Katzung, Anthony Trevor, Basic and Clinical Pharmacology, McGraw Hill Professional, 2014.
3. Golan, David E., Armen H. Tashjian, and Ehrin J. Armstrong, eds. Principles of pharmacology: the pathophysiologic basis of drug therapy. Lippincott Williams & Wilkins, 2011.
4. Klaassen, Curtis D., ed. Casarett and Doull's toxicology: the basic science of poisons. McGraw-Hill, 2013.

OTHER RESOURCES: Open.

EXTRA DEPARTMENTAL ELECTIVES

BCH 51A Radiation Biology and Health (2, 1, 0, 2)

COURSE CODE : BCH 51A
COURSE TITLE : Radiation Biology and Health
CREDITS : 2
SEMESTER : I
TOTAL TEACHING HOURS : 32
PRE-REQUISITE, IF ANY : Nil

AIM: *The course is designed to act as an introduction to students on the principle and applications of radiation and the effects of radiation on health.*

COURSE DESCRIPTION: Radiation exposure hazard is a serious biomedical hazard but with very little public awareness. The primary objective of this course is to introduce students to the different chemical and physical aspects of radiation, its application and health hazards from accidental exposure. The course shall discuss methods of preventing radiation exposure and current developments in radiation countermeasure research.

COURSE CONTENT

UNIT I: Introduction to Radiation (8 hrs)

Types of radiation- x-ray, gamma-ray, ultraviolet and LASER. Radioactivity and radiation. Physical properties of radiation- penetration potential and energy. Background radiation and sources of radiation exposure.

UNIT II: Applications of Radiation (6 hrs)

Applications of radiation in Medicine- x-ray and gamma knife. Cancer radiology. Radioisotopes in research application.

UNIT III: Acute and Chronic Radiation Exposure (6 hrs)

Acute radiation syndrome- gastrointestinal and hematopoietic toxicity. Symptoms and lethality. Chronic radiation exposure- biology of endothelial tissue damage. Cancer and bystander effect.

UNIT IV: Safety Measures (6 hrs)

Radiation monitoring equipments- GM counter. Personnel radiation protection- protective apparels and accessories. Time, distance and shielding. Personnel monitoring equipments: TLD plates. Maximum permissible dose equivalent. Medical radiology and risk assessment.

UNIT V: Counter measures (6 hrs)

Incidence of mass and limited radiation exposure accidents- Chernobyl, Fukushima and Delhi. Scenario of pre and post exposure management- first responders vs population. Radiation countermeasures: past, present and future potential.

ASSESSMENT:

Internal Continuous Assessment (40%)

Mid-semester Examination -15%

Assignment - 10%

Seminars - 10%

Attendance - 5%

University End semester Assessment (60%)

This will be through a 3 hour written examination for 60 marks consists of 3 Parts

Part A (20 marks) – Ten essay type questions of 2 marks out of 12 questions.

Part B (20 marks) - Four essay type questions of 5 marks out of 6 questions.

Part C (20 marks) - Two essay type questions of 10 marks out of 3questions

Give equal importance to all units.

References:

1. Stabin, Michael G. Radiation protection and dosimetry: an introduction to health physics. Springer Science & Business Media, 2007.
2. Sherer, Mary Alice Statkiewicz, et al. Radiation protection in medical radiography. Elsevier Health Sciences, 2014.
3. Turner, James E. Atoms, radiation, and radiation protection.John Wiley & Sons, 2008.
4. Rubin, David B. The radiation biology of the vascular endothelium.CRC Press, 1997.

OTHER RESOURCES: Open.

BCH 52A Enzymology **(2, 1, 0, 2)**

COURSE CODE	**: BCH 52A**
COURSE TITLE	**: Enzymology**
CREDITS	**: 2**
SEMESTER	**: II**
TOTAL TEACHING HOURS	**: 32**
PRE-REQUISITES, IF ANY	**: NONE**

AIM: *Primary goals of this course are to provide the students with knowledge in enzyme activity and kinetics and their mechanism of action and about the way of enzyme application.*

COURSE DESCRIPTION:

The course includes knowledge in the areas of purification and isolation of enzymes, classification of enzymes and cofactors and kinetics of enzymes and their applications in industry, therapeutics and diagnosis.

COURSE CONTENT:

Unit I : Introduction to enzymes (6 hours)

Brief description of general aspects of enzymes ; apoenzyme – holoenzyme – cofactors and coenzymes – ribozymes – abzymes – nomenclature and classification

Unit II : Enzyme techniques (6 hours)

Reaction system – activity – specific activity – detection of enzyme activity – unit of enzyme activity : katal,IU

Unit III : Enzyme kinetics (8 hours)

Kinetics: Velocity of a reaction – progress curve for enzyme catalyzed reaction – Michaelis Menton equation (no derivation) – Line Weaver Burk Curve – Vmax and Km – factors affecting enzyme catalyzed reaction : substrate concentration, pH, temperature, enzyme concentration – enzyme inhibition – allosteric enzymes.

Unit IV : Mechanism of enzyme action (6 hours)

Enzyme specificity – active site – mechanisms at active site – covalent catalysis – acid base catalysis – proximity and orientation effects – zymogens – multienzyme complexes.

Unit V : Enzyme technology (6 hours)

Industrial uses of enzymes: food pharmaceutical industries, clinical Enzymology- serum enzymes in health and diseases, immobilized enzyme technology.

ASSESSMENT:

Internal Continuous Assessment (40%)

Mid-semester Examination -15%

Assignment - 10%

Seminars - 10%

Attendance - 5%

University End semester Assessment (60%)

This will be through a 3 hour written examination for 60 marks consists of 3 Parts

Part A (20 marks) – Ten essay type questions of 2 marks out of 12 questions.

Part B (20 marks) - Four essay type questions of 5 marks out of 6 questions.

Part C (20 marks) - Two essay type questions of 10 marks out of 3questions

Give equal importance to all units.

References

1. Dixon, M., and E. C. Webb. "Enzyme inhibition and activation." *Enzymes* 3 (1979): 126-136.

2. Palmer, T. *Understanding Enzymes, 4th ed., Prentice Hall/Ellis Horwood, London* (1995).

3. Price, Nicholas C., and Lewis Stevens. *Fundamentals of Enzymology*. Oxford Science Publications. Second edition. New York, 2001.

4. Buchholz, Klaus, Volker Kasche, and Uwe Theo Bornscheuer. *Biocatalysts and enzyme technology*. John Wiley & Sons, 2012.

5. Copeland, Robert A. *Enzymes: a practical introduction to structure, mechanism, and data analysis*. John Wiley & Sons, 2004.

BCH 53A Lifestyle Diseases (2,1,0,2)

COURSE CODE	**: BCH 53A**
COURSE TITLE	**: LIFESTYLE DISEASES**
CREDITS	**: 2**
SEMESTER	**: Optional**
TOTAL TEACHING HOURS	**: 32**
PRE-REQUISITES, IF ANY	**: NONE**

AIM:

- To understand modern lifestyle habits that lead to diseases.
- To provide an insight into the biochemical mechanisms of these diseases.
- To create a general awareness on the prevention and management of these diseases.

COURSE DESCRIPTION

A brief awareness of the diseases that are a part of the changing lifestyle habits of the modern world. The diseases include Parkinson's dementia, Atherosclerosis, Cancer, Diabetes and Hypertension.

COURSE CONTENT

Unit I Lifestyle Diseases : General awareness

Definition, General introduction to lifestyle diseases. Risk factors : Lifestyle, food habits, Physiological stress, Free radicals and Oxidative stress. Preventive factors : Exercise, healthy food habits, antioxidants.

Unit II Atherosclerosis

Signs and symptoms, causes: modifiable and nonmodifiable. Biochemical mechanisms of atherogenesis: including lipid peroxidation, plaque formation, thrombosis and stenosis. Diagnosis, Treatments and Prevention of atherosclerosis including modification of lifestyle habits.

Unit III Alzheimer's and Parkinson's Disease

Dementia, Types of dementia. Alzheimer's disease: Stages of disease, Causes: Genetic, cholinergic hypothesis, amyloid hypothesis, Tau hypothesis, Pathophysiology and disease mechanism,

Management of disease: lifestyle habits. Parkinson's Dementia: Causes, Symptoms, Molecular pathophysiology of disease, Prevention and Disease Management

Unit IV Hypertension- Characteristics, Causes, Risk factors: Obesity. Mechanism of obesity-induced hypertension. Pathophysiology of hypertension in Cardiovascular diseases (CVD). Prevention and Management of hypertension : lifestyle habits

Unit V Diabetes mellitus:

Classification – type 1, type 2, gestational, Complications of diabetes mellitus: Diabetic cataract, retinopathy, cardiomyopathy, nephropathy and neuropathy through advanced glycation end products. Role of glucose transporters in insulin resistance. Management of diabetes mellitus and treatment options.

Unit VI Cancer

Overview, Types, Causes, Genetic basis of cancer: tumor suppressor genes, oncogenes and gene expression. Molecular basis of cancer: disregulation of cell cycle and mutation of p53 and Rb. Strategies for cancer treatment: immunotherapy, inhibition of cancer promoting proteins and inhibition of angiogenesis. Prevention and management

References

1. U Satyanarayana, Biochemistry, Elsevier Health Sciences, 2014
2. John E. Hall, Guyton and Hall Textbook of Medical Physiology, Saunders, 2015
3. Bruce Alberts, Alexander Johnson, Julian Lewis, David Morgan, Martin Raff, Keith Roberts, Peter Walter, Molecular Biology of the Cell, Garland Science, 2014
4. Gerald Karp, Cell and Molecular Biology, Wiley, 2013
5. Lippincott, Disease & Drug Consult: Neurologic Disorders, Williams & Wilkins, 2009.