

BCH – 20 - DCE , Biotechnology

Unit I

Recombinant DNA Technology:

Vectors: Plasmids, bacteriophages, phagemids, cosmids, YACs, and BACs

Methods of creating recombinant DNA molecule

Transformation and screening of recombinant vector

Confirmation of insert

Expression strategies in different hosts, vector and host engineering

Unit II:

Types of restriction endonucleases

Library construction

Types of libraries:

cDNA and genomic libraries

Primary, secondary and tertiary screening methods

Unit III:

Animal Cell Culture:

Primary and established cell lines

Types of various cell lines

Biology and characterization of the cultured cells.

Introduction to balanced salt solutions and simple growth medium.

Role of CO₂, serum and supplements. Serum and serum free media, defined media and their applications, antibiotics

Immortalization and methods used to immortalize cells.

Viability and cytotoxicity assays: Trypan blue, MTT, TUNEL and ELISA based assays.

Unit- IV :

Immunobiotechnology

Development of Monoclonal Antibodies by:

Hybridoma Technology

Applications of MCA and Antibody Fragments.

Vaccination: Conventional and genetically engineered vaccines.

Lymphokines – production and applications

BCH – 28 - DCE, Microbiology

Unit-I

Historical perspectives of microbiology
Importance of microbiology in agriculture, human and animal health industry and environment
Microbial classification
Types of microorganisms
General characteristics of main groups of microorganisms
Criteria used in the classification of microorganisms- cytology, genetics, host specialization, serology
Microbial growth
Different phases of microbial growth
Measurement of microbial growth
Effects of various environmental factors on microbial growth
Control of microbial growth, physical control, chemical control and antibiotics
Mechanism of drug resistance

Unit-II

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

Unit-III

Microbial nutrition
Nutritional types of microorganisms
Uptake of nutrients by the microbial cells
Nutritional requirement of bacteria
Resident flora
The human as a habitat
Pathogenicity and virulence factors
Bacterial toxigenicity (pathogenesis of infectious diseases)
Food spoilage, fermentation, food-borne infection
Biochemistry of nitrogen fixation and sulfur reduction

Unit-IV

Virus classification
Structure of virus
Viral proteins and methods of assay
Virus- host interaction
Microbial diseases
Respiratory diseases caused by viruses and bacteria – tuberculosis, small pox
Sexually transmitted diseases including AIDS

BCH – 29 - DCE, Endocrinology

Unit I

Introduction to endocrinology

Mechanism of action of hormones - hormone receptors, second messenger mechanisms for mediating intracellular hormone functions

Structure, biosynthesis, secretion, transport, mechanism of action and physiological role of Pancreatic and

Thyroid hormones

Unit II

Pituitary hormones and their control by hypothalamus

Structure, biosynthesis, secretion, transport, mechanism of action and physiological role of

Adrenal,

Gastrointestinal,

Sex hormones

BCH – 30 - DCE, Micro Nutrition

Unit I

Vitamins

Introduction to vitamins

Definition, classification

Nutritional sources, DRI recommendations and deficiency and health problems of :

— Vitamin A.

— Vitamin D.

— Vitamin C

— Vitamin E.

— Vitamin K

Role in human nutrition, recommendation, physiology and biochemistry of:

— Thiamine

— Riboflavin

— Niacin

— B6 vitamin

— B12 Vitamin

— Folic acid

Unit II

Minerals:

Nutritional sources, DRI recommendations and role in human nutrition of:

— Calcium

— Iron

— Zinc

— Iodine

— Selenium

— Fluoride

— Magnesium

BCH – 04- DCE, Plant Biochemistry

Unit-I

Photosynthesis
 Photosynthesis in higher plants – general concepts
 Organization of the photosynthetic apparatus
 Mechanism of electron transport in photosynthesis
 Proton transport and ATP synthesis
 Calvin cycle and its regulation
 C4 and CAM pathways
 Repair and regulation of photosynthetic machinery
 Photorespiration and its significance

Unit-II

Assimilation of mineral nutrients
 Nitrate and ammonia assimilation and their incorporation into amino acids
 Biochemistry of nitrogen fixation, nitrogenase complex and its functions
 Nitrogen fixation genes and their regulation
 Sulfate reduction and assimilation
 Sulfite oxidation

Unit-III

Special features of secondary plant metabolism
 Secondary metabolites - phenolics, tannins, lignins, lignans, pigments, terpenes, alkaloids and surface waxes – their biosynthesis and physiological role
 Plant defense against pathogens
 Translocation of inorganic and organic substances
 Pathways of translocation and mechanism of translocation in the phloem

Unit-IV

Plant growth regulators
 Auxins
 Chemical nature, biosynthesis and metabolism
 Physiological and developmental effects,
 Molecular basis of its action
 Gibberellins
 Chemical structure, biosynthesis, metabolism and mechanism of its molecular effects
 Cytokinin
 Properties and biological role
 Cellular and molecular modes of cytokinin action
 Abscissic acid
 Chemical structure, metabolism and transport
 Molecular effects in the regulation of growth and development

BCH - 05 – DCE, Biochemical Techniques

Unit-I

Centrifugation

- Basic principle of centrifugation
- Factors affecting sedimentation
- Types of centrifugation including differential, density gradient and ultracentrifugation
- Analytical and preparative centrifugation
- Applications of centrifugation

Chromatographic techniques

Basic principle and applications of chromatographic techniques:

- Gel filtration chromatography
- Affinity chromatography
- Gas chromatography
- Ion Exchange chromatography
- High-pressure liquid chromatography

Unit-II

Electrophoresis

- Types of electrophoresis
- Factors affecting electrophoretic mobility
- Uses of electrophoresis

Isoelectric focusing

Analysis of biomolecules using UV/visible, fluorescence spectroscopy

Use of radioisotopes in biology

Their detection, measurement and safety guidelines

Unit-III

Different blotting techniques

- Western, Northern, Southern

Microscopy

- Light, electron (scanning and transmission), phase contrast and fluorescence microscopy
- Freeze- fracture techniques

Polymerase chain reaction

Principles of - RFLP, RAPD and AFLP techniques

Single strand conformation polymorphism and heteroduplex analysis

Gel retardation assays

DNA Sequencing

Next generation sequencing

Sequencing while synthesizing

Unit-IV

Detection of molecules using ELISA, RIA, immunoprecipitation, flowcytometry

Detection of molecules in living cells, *in situ* localization by techniques such as FISH and GISH.

Methods for analysis of gene expression at RNA and protein level, large-scale expression analysis, such as micro array based techniques

Coimmunoprecipitation and Chromatin immunoprecipitation

DNA profiling, DNA foot printing

Gene silencing

Micro RNA

RNA interference

BCH - 12 – DCE, Enzymology

Unit-I

Enzyme classification and nomenclature
 Methods of examining enzyme – substrate complexes
 Enzyme kinetics
 An introduction, factors influencing enzyme reaction velocity
 Henri and Michealis Menten equation, Briggs-Haldane modification
 Determination and significance of kinetic constants
 Derivation of rate expression for Ping Pong and ordered Bi Bi reaction mechanism

Unit-II

Enzyme inhibition
 Reversible inhibition, its types
 Determination of inhibitor constants
 Irreversible inhibition
 Enzyme assays
 Mechanism of catalysis of -
 Serine proteases
 Triose phosphate isomerases

Unit-III

Enzyme regulation
 General mechanism of enzyme regulation
 Allosteric enzymes
 Sigmoidal kinetics and their physiological significance
 Symmetric and sequential modes for action of allosteric enzymes and their significance
 Feed back inhibition and feed forward stimulation
 Reversible and irreversible covalent modifications of enzymes

Unit IV

Immobilization of enzymes

- Methods of enzyme immobilization
- Effects of partition on kinetics and performance with particular emphasis on changes in pH and hydrophobicity
- Applications of immobilized enzymes

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BCH – 22 - GE, Metabolic Disorders

Unit I

Introduction to carbohydrates, lipids and their metabolism

Disorders of carbohydrate metabolism

Diabetes

Hereditary fructose intolerance

Lactose intolerance

Glycogen storage diseases

Disorders of Lipid Metabolism

Hypercholesterolemia,

Atherosclerosis,

Carnitine related diseases

Unit II

Introduction to amino acids, proteins and nucleic acids

Inherited disorders of amino acid metabolism- Phenylketonuria, Alkaptonuria, Maple syrup urine disease

Nonketotic hyperglycinemia, Propionic acidemia, Hyperprolinemia

Urea cycle disorders-

Hyperammonemia Argininemia,

Deficiency diseases related to Urea cycle enzymes

Disorders of nucleic acid metabolism

Purine and Pyrimidine metabolism related diseases,

Hypo and Hyperuricemia,

Gout, Lesch Nyhan Syndrome, Severe Combined Immunodeficiency Disease (SCID),

Xeroderma pigmentosum.

BCH – 31 - GE, Biology of Chronic Diseases

Unit I

Diabetes: Types causes and prevention.

Diseases linked to functioning of Heart: Cardiomyopathy, Hypertension

Hepatitis

Unit II

Neurological disorders–

Alzheimer's disease

Parkinson's disease

Epilepsy

BCH – 06 - GE, Nutritional Biochemistry

Unit-I

Energy content of foods

BMR and SDA and factors affecting them

Energy requirements of man and woman and factors affecting energy requirements

Protein nutrition

Essential amino acids for man and concept of protein quality

Cereal protein and their limiting amino acids

Protein energy malnutrition (PEM). Etiology, clinical features, metabolic disorders and management of marasmus and kwashiorkor

Carbohydrate nutrition

Dietary requirement and sources of carbohydrates

Protein sparing action

Physiological actions of dietary fibers

Unit-II

Micronutrition

Dietary sources, biochemical functions and deficiency diseases of:

Water soluble

Fat soluble vitamins

Lipid nutrition

Major classes of dietary lipids

Essential fatty acids and their physiological functions

BCH – 14 - GE, Protein Biochemistry

Unit I

Amino acids, the building blocks of proteins
Protein – a molecule with myriad of functions
Primary structure of the protein and its determination
Secondary structure, types
Tertiary structure, forces stabilizing tertiary structures
Quaternary structures

Unit II

Quantitative estimation of proteins by
Lowry's method
Bradford's method
Spectrophotometric method
Polyacrylamide gel electrophoresis of purified proteins
Molecular weight determination by gel filtration chromatography and SDS-PAGE.

BCH-23-GE, Enzyme Regulation

Unit I

Enzyme regulation
 General mechanism of enzyme regulation
 Allosteric enzymes
 Sigmoidal kinetics and their physiological significance
 Symmetric and sequential modes for action of allosteric enzymes and their significance

Unit II

Feed back inhibition and feed forward stimulation
 Zymogens, Isozymes
 Enzyme repression, induction and degradation
 Control of enzymatic activity by products and substrates
 Reversible and irreversible covalent modifications of enzymes

BCH-24-OE, Diet, Physical Activity and health

Unit-I

Balanced diet
 Components of diet
 Diet requirement: young, old, men, women
 Diseases due to diet deficiency
 Diseases due to over eating
 Diet as medicine

Unit-II

Body systems and energy for physical activity
 Types of physical activity
 Physical activity for health
 Physical fitness
 Nutrition and physical activity
 Participating in physical activity with safety

BCH-32-GE, Signal Transduction

Unit-I

Cell signaling:

Basic concepts of Signal Transduction
Components and general mechanism of Signal Transduction
Signaling motifs: SH2, SH3, PH and PDZ domains
Role of protein kinases in cell signaling: Serine/ Threonine and Tyrosine kinases

Unit-II

Pathways of intra cellular signal transduction:

GPCR pathway
RAS MAPK pathway
PI3 Kinase Pathway
Techniques to study Signal Transduction

BCH - 07-GE, Biochemical Calculations

Unit I

Concentrations based on volume and weight

- Molarity
- Normality
- Osmolarity
- Molality

Acids and bases and their various definition theories

Various definitions

Ionization of strong acids and bases.

Ionization of H_2O , ionic product of water,

Weak acids and bases.

Unit II

Concept of pH and buffer

pH, pK and pI of solutions

Henderson – Hasselbalch equation

Preparation of buffers,

pH changes in buffers, buffer capacity

BCH– 08 – OE, Fundamentals of Biochemistry

Unit I

Water and its role in biological systems

Introduction and roles of biomolecules of life

- Proteins
- Carbohydrates
- Lipids
- Nucleic acids
- Micronutrients

Unit II

Cell as a basic unit of life

Cell components

Functions of the various components

Cell death and its causes

Cell division as the unit of propagation

Concepts of Mitosis and Meiosis

BCH – 15 - GE, Enzyme Immobilization

Unit1

Enzymes as proteins and catalysts

Factors that affect the enzyme activity

Characteristics of free vs. immobilized enzymes

Methods of enzyme immobilization,

Effect of immobilization on enzyme activity, partitioning/ diffusion limitations.

Enzyme conformational changes. Enzyme stability and zulu effect.

Enzyme activity dependence on pH, partitioning of protons and limitation of proton diffusion

Unit II

Immobilized enzymes-

Hydrolysis of proteins, cheese manufacture, conversion of corn-starch to dextrose, conversion of dextrose to fructose, hydrolysis of lactose in whey

Biomedical and Analytical applications.

Concept of Red Blood Cells as carrier of enzymes,

Practical demonstration of immobilization process using RBCs

BCH - 33- OE, Biochemical Laboratory Tests and Interpretation**Unit I**

Concept of reference values

Observed values

Blood biochemistry

Electrolytes estimation and clinical significance

Blood gas analysis

Blood sugar and its clinical importance

Unit II

Cardiac function tests and clinical uses

Liver function tests: diagnostic importance

Kidney function test importance

Tumor markers – PSA, carbohydrate markers

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BCH – 19 - CR, Laboratory Course - III

Isolation of DNA: Different Methods, Different sources
Quantification of DNA by Spectroscopy
Electrophoresis of Isolated DNA
Amplification of a DNA segment by PCR
Purification of PCR product
Restriction digestion of PCR product
Isolation of RNA from leukocytes
cDNA synthesis from mRNA

SEMESTER IV

BCH – 25 - CR, Designing And Drafting Of Research Project

A student will have to pick up a problem in biological sciences and develop a grant application on the theme under mentorship of allotted supervisor. Grant application will have following components.

- Introduction
- National and international scenario
- Review of literature
- Objective
- Possible out come
- Significance of the study
- Material and methods
- Summary

BCH – 26 - CR, Journal Club

The recent and advanced scientific papers in high profile journals will be chosen by the students in consultation with mentor teachers and then presented by the student. The presenter is supposed to have all the relevant knowledge of the article. The audience will include faculty, research scholars and PG students.

BCH – 27 - CR, Laboratory Course - IV

- Bacterial culture methods
- Preparation of plasmid DNA by:
 - Manual
 - Kit
- Plasmid Transformation
- Cloning in plasmid
- Western blotting
- Simple staining
- Gram staining

BCH – 02 - CR, Cell Biology- I

Unit-I

Basic properties of cells

Structural organization of prokaryotic and eukaryotic cells

Introduction of viruses

Cell membrane

Chemical composition

Structure and function of membrane proteins

Membrane lipids and membrane fluidity

Dynamic nature of plasma membrane

Movement of substance across cell membrane

Membrane potentials

Mitochondria

Structure and function

Oxidative metabolism in mitochondria

Role of mitochondria in ATP formation

Translocation of protons and establishment of a proton motive force

Unit-II

Introduction to endomembrane system

Approaches to study endomembrane

Endoplasmic reticulum, structure, functions

Golgi complex

Types of vesicle transport and their types

Lysosomes and plant vacuoles, peroxisomes

Moving membranes and materials into the cell interior

Posttranslational uptake of proteins by peroxisome, mitochondria and chloroplasts

Unit-III

Cell wall

Detailed structure and functions of Cell wall

Microbodies

Chloroplast

Structure, function

Photosynthetic units and reaction centers

Photophosphorylation

Unit IV

Extracellular matrix and cell interaction

Extracellular space

Interaction of cells with extracellular material

Tight Junction- sealing the extracellular space

Cell -cell adhesion

Cell -cell communication

The cytoskeleton

Microtubules

Intermediate filaments

Microfilaments

SEMESTER II

BCH – 09 - CR, Metabolism - I

Unit-I

Bioenergetics

- Energy transformation by biological systems
- Concept and significance of free energy
- Phosphoryl transfer potential
- Coupled reactions
- ATP as energy currency

Metabolon concept

Unit-II

Carbohydrate metabolism

- Glycolysis
- Citric acid cycle, its function in energy generation and biosynthesis of energy rich-bonds
- Pentose phosphate pathway and its regulation
- Alternate pathways of carbohydrate metabolism
- Gluconeogenesis
- Biosynthesis of glycogen and starch

Unit-III

Lipid metabolism

- Fatty acid oxidation- α , β , ω , oxidation and lipo-oxidation.
- Fatty acid biosynthesis- Acetyl CoA carboxylase, Desaturase and elongase
- Biosynthesis of triacylglycerols, Phosphoglycerides and sphingolipids
- Biosynthetic pathways for terpenes, steroids and prostaglandins
- Ketone bodies- Formation and utilization

Unit-IV

- Regulation of carbohydrate and lipid metabolism -hormonal/enzymatic
- Interactions between carbohydrate and lipid metabolism – role of insulin and adiponectin
- Inborn errors of carbohydrate and lipid metabolism