GUJARAT UNIVERSITY

Structure of **M.Sc. Biochemistry PG Course (BCH)** for Credit Based Semester System to be implemented from June 2010

<table>
<thead>
<tr>
<th>Department</th>
<th>Semester</th>
<th>Course</th>
<th>No of Hours per week</th>
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SEMESTER I

BCH 401: INSTRUMENTATION AND TECHNIQUES

UNIT 1 Radiotopic Techniques
Type of radio isotopes used in Biochemistry, units of radioactivity measurements, techniques used to measure radioactivity (gas ionization and liquid scintillation counting), nuclear emulsions used in biological studies (pre-mounted, liquid and stripping), isotopes commonly used in biochemical studies - $^{32P}$, $^{35S}$, $^{14C}$, and $^{1}$H, Autoradiography. Biological hazards of radiation and safety measures in handling radioisotopes. Biological applications. Radioimmunoassay.

UNIT 2 Chromatography /Centrifugation
General principles and applications of Adsorption chromatography; Partition; ion-exchange chromatography; Thin-layer chromatography & HPTLC; Molecular-sieve chromatography; Gas- liquid chromatography; FPLC & UPLC; Affinity chromatography. Preparative and Analytical Ultracentrifugation

UNIT 3 Electrophoresis
Basic principles and types of Gel Electrophoresis, PAGE and SDS-PAGE, Two-dimensional electrophoresis and its importance. Isoelectrofocussing. Immunoelectrophoresis.

UNIT 4 Spectroscopic techniques
Beer-Lambert law, Types of emission spectra, light absorption and its transmittance and application of extinction coefficient, application of visible and UV spectroscopic techniques (structure elucidation and numericals excluded). Principle and application of NMR, ESR, Mass spectroscopy. Fluorescence and emission spectroscopy.

BCH 402: MOLECULAR CELL BIOLOGY

UNIT 1 Microscopy, Principles and Instrumentation of Light, Phase, Fluorescence Electron and Con focal Microscopes, Cell variability (size, shape, complexity, functions), Structural organization of prokaryotic and eukaryotic cells.

UNIT 2 The ultrastructure and functions of plasma membrane, nucleus, mitochondria and energy transaction, endoplasmic reticulum (rough and smooth), ribosome, Golgi apparatus, Network of intra cellular protein trafficking and degradation, lysosomes and peroxisomes.


BCH 403: BIOENERGETICS AND INTERMEDIARY METABOLISM


UNIT 2 The mitochondrial respiratory chain, the Q cycle and the stoichiometry of proton extrusion and uptake. Reversed electron transfer, respiratory controls and
UNIT 3
Glycolysis, TCA cycle — Regulation and function in energy generation, pentose phosphate pathway and its regulation, (HMP Shunt), Gluconeogenesis, Biosynthesis of glycogen, starch. Regulation of blood glucose homeostasis.

UNIT 4
Fatty acid biosynthesis: Acetyl CoA carboxylase, Fatty acid synthesis, desaturase and elongase. Fatty acid oxidation: $a, \beta, \omega$, oxidation and lipoxidation. Lipid biosynthesis: Biosynthesis of triacylglycerols, phosphoglycerides and sphingolipids, biosynthetic pathway of steroids and prostaglandins. Chylomicrons, LDL, HDL, and VLDL.

**BCH 404 : MICROBIAL BIOCHEMISTRY**

UNIT 1
**Introduction to Microbiology and Microorganisms**
Scopes and Avenues of Microbiology
Historical developments in Microbiology
Genera) Characteristics of major group of Microorganisms

UNIT 2
**Microbial Taxonomy**
Importance and systems of Classification
Status of microorganisms into kingdoms
Basic principles of nomenclature and classification
Criteria used for classification and identification of microorganisms
Genetic approaches used for Microbial taxonomy

UNIT 3
**Morphology, Reproduction and Significance**
Bacteria : Staphylococcus (Gram positive) and Eschericheria (gram negative )as model examples.
Moulds: Rhizopus, Penicillium, Puccinia as model examples
Yeast: Saccharomyces as model examples
Bacterial viruses: Coliphage T4 and lambda phage as examples
Animal viruses: Adenovirus, Influenza virus as model examples
Plant viruses: TMV as mode) examples.

UNIT 4
**Microbial Physiology and Genetics**
Modes of uptake of nutrients in microorganisms, Nutritional requirements and Nutritional classification of microorganisms.
An overview of microbial metabolism
Microbial Growth:
Growth in prokaryotes and modes of cell division
Mathematical nature and expression of growth,
Normal growth curve of microbial population and Diauxic growth
Continuous cultivation of microorganisms,
Methods of measurement of microbial growth
Effect of environment of on microorganisms
General principles of Microbial Genetics:
DNA and its replication
Bacterial plasmids and transposable elements
Recombination methods: Transfection, Transduction, Conjugation, Parasexually.

**BCH 405 PR : Practical and viva voce based on BCH 401 & BCH 402**

**BCH 406 PR : Practical and viva voce based on BCH 404 & BCH 404**
SEMESTER II

BCH 407: PLANT BIOCHEMISTRY

UNIT 1 Cytology and Evolution: Membrane Systems
Plant Vacuole: Tonoplast Membrane; functions
Nucleus Structure; Nuclear Pores; Nucleosome Organization;

UNIT 2 Plant Physiology: Growth and Development
Growth, development, concept, qualitative — quantitative changes
Growth regulators, biosynthesis, bioassay, mechanism of action, physiological effects, applications (auxin, cytokinin, gibberellins, ABA, ethylene)
Physiological effects and role of jasmonic acid, polyamines, brassinosteroids, salicylic acid

UNIT 3 Plant Ecology
Ecological Factors: Soil, light, water etc, Principles of limiting factors; biotic factors. Productivity: Population ecology — concept, types, fluctuation, factors regulating size, mortality — natality
Population ecology, concept, type, fluctuations, factors regulating size, autecology, mortality, natality.

UNIT 4 Plant Breeding
Plant breeding — objectives, origin, domestication, hybrid vigour
Principles and methods of Plant Breeding, Self pollinated crops, Cross pollinated crops, Clonal crops
Plant Introductions — NBPGR

BCH 408: NUTRITIONAL BIOCHEMISTRY

UNIT 1 Basic Concepts: Composition of human body- Energy content of foods. Measurement of energy expenditure: Direct & indirect calorimetry - Definition of BMR and SDA and factors affecting these. Thermogenic effects of foods. Energy requirements of men and woman and factors affecting energy requirements.

UNIT 2 Minerals: nutritional significance of dietary calcium, phosphorus, magnesium, iron, iodine, zinc and copper.


**UNIT 1**
Review of unisubstrate enzyme kinetics and factors affecting the rates of enzyme catalyzed reactions. Classification of multisubstrate reaction with examples of each class. Kinetics of multisubstrate reactions.

**UNIT 2**

**UNIT 3**

**UNIT 4**
**Multienzyme system:** Occurrence, isolation and their properties. Polygenic nature of multienzyme systems. **Co-enzymes and cofactors:** Water soluble vitamins and their coenzymes. Metalloenzymes **Enzyme regulation:** general mechanisms of enzyme regulation: Feed Back Inhibition and Feed forward stimulation; Enzyme repression, induction and degradation, control of enzymatic activity by product and substrates; Reversible covalent modification of enzymes; Mono-cyclic and cascade systems with specific examples.

**BCH 410 : HUMAN PHYSIOLOGY**

**UNIT 1**

**UNIT 2**
Transfer of blood gases- oxygen and carbon dioxide. Role of 2,3 DPG, Bohr effect and chloride shift. **Hydrogen ion homeostasis:** Factors regulating blood pH — buffers, respiration and renal regulation. Acid-base balance- metabolic and respiratory acidosis and alkalosis.

**UNIT 3**
Digestive system: Composition, functions and regulation of saliva, Gastric, Pancreatic, intestinal and bile secretions- digestion and absorption of carbohydrates, lipids, proteins, filtration, tubular re-absorption of vitamins.

**UNIT 4**
Excretory system: Structure of nephron, formation of urine, glomerular filtration, tubular re-absorption of glucose, water and electrolytes — tubular secretion. Regulation of water and electrolyte balance, role of kidneys and hormones in their maintenance, Role of Hormones, Signal transduction

**BCH 411 PR : Practical and viva voce based on BCH 407 & BCH 408**

**BCH 412 PR : Practical and viva voce based on BCH 409 & BCH 410**
SEMESTER III

BCH 501: ADVANCED MOLECULAR BIOLOGY

UNIT 1  Nucleic acids: Physical and chemical properties of nucleic acids, Polymorphism in DNA, Isolation, purification and analysis of Nucleic acids. PCR, Rapid DNA sequencing techniques and strategies, Blotting techniques

UNIT 2  Gene Structure & Organization
Eukaryote genome and chromosome organization, Eukaryotic gene structure, transcription, post transcriptional modifications, translation, post-translational modifications and regulation of gene expression.

UNIT 3  Replication
Replication of DNA in eukaryotes, Enzymes and events in DNA replication; DNA Repair Mechanisms; Site directed mutagenesis, PCR mediated mutations, Applications of RAPDs and DNA finger printing.

UNIT 4  Protein engineering
Basics of Proteomics, Isolation, Purification of Proteins. Protein Folding and basics of protein engineering

BCH 502: BIOTECHNOLOGY

UNIT 1  Recombinant DNA Technology:
Methodology of creating a recombinant DNA molecule, splicing, properties of restriction endonucleases and their mode of action, selection/screening, construction of DNA library, chemical synthesis of gene, cloning vectors (λ-phage, plasmid, M-I3 phage, cosmid), shuffle vectors, yeast and viral vectors, expression vectors, uses of cloned gene, sub cloning, protein production in bacteria, antisense-RNA technology.

UNIT 2  Hybridoma Technology
Monoclonal antibodies, mycelium cell fusion, selection of hybrids, hybridomas, protoplast fusion and HAT-medium, screening assays, purification and application and of monoclonal antibodies.

UNIT 3  Plant and Animal Cell Culture
Primary, Secondary Cultures, Requirements for animal cell culture. Micropropagation, somatic cell culture, somatic cell hybridization, protoplast isolation, fusion and culture, genetic transformation. Various methods of gene transfer (all vector and vectorless methods), production of transgenic plants and animals, differentiated cells in culture, applications.

UNIT 4  Fermentation Technologies
Primary and secondary metabolites in biotechnology, continuous and batch type culture techniques, principle types of fermenters, general design of fermenter, fermentation processes brewing, manufacture of penicillin and single cell proteins, production strategies for other antibiotic and other organic compounds.

BCH 503: CLINICAL BIOCHEMISTRY

UNIT 1  Automation In Clinical Biochemistry
Instrument concepts
Chemical reaction phase
Measurement approaches
Selection of instrument
Control of analytical variables
External and internal quality control measurements
UNIT 2 Diabetes mellitus and related tests
- Glycohemoglobins
- Hypoglycemias
- Ketone bodies
- Glucose estimation methods and various types of glucose tolerance tests.
- Glycogen storage diseases

UNIT 3 Clinical significance of lipids/lipoproteins, lipidosis
- Clinical inter-relation of lipids (sphingolipidosis, multiple sclerosis), lipoproteins and apolipoproteins.
- Diagnosis tests for apolipoproteins, HOL-cholesterol, LDL-cholesterol and triglycerides disorders.
- Enzymes and other tests of cardiac function

UNIT 4 Enzymes and metabolites as Liver function indices; clinical tests for renal function.
- Disorders of amino acid metabolism: Phenylalaninemia, homocystineuria, tyrosinemia and related disorders, aminoacidurias.
- Disorders of Purine and Pyrimidine metabolism, Anaemia.

BCH 504: IMMUNOLOGY

UNIT 1 Basic Immunology
- History and Significance
- Immunity and its types
- Immune System, Cell and Organs involved
- Complement System
- Cytokines and their significance
- Cancer and Immune response (Tumour Immunology)

UNIT 2 Basic Immunology II
- Antigens: General properties, criteria for antigens, types of Antigens
- Antigenicity MHC, HLA complex
- Immunoglobulins: Basic structure and types
- Immunogenetics: Genetic basis of clonal selection and generation of antibody diversity
- In-vivo antigen-antibody interactions.

UNIT 3 Immunotechnology
- In vitro antigen-antibody reactions and diagnostic significance: Agglutination tests, Precipitation and Immunodiffusion tests, Radioimmunoassay, IRMA, ELISA / ELISPOT, RAST
- Hybridoma technology applications of monoclonal antibodies, Vaccines and Immunotherapy

UNIT 4 Dysfunction Immunity
- Hypersensitivity Reactions, Tolerance and Autoimmunity
- Autoimmune diseases
- Immunodeficiency and their consequences
- Transplantation immunology, Hazards of vaccine

BCH 505 PR: Practical and viva voce based on BCH 501 & BCH 502

BCH 506 PR: Practical and viva voce based on BCH 503 & BCH 504
BCH 507PT: Dissertation/ Project work

Students are supposed to carry out field / laboratory training cum experimental work and prepare a comprehensive report along with a research proposal. The area should include basics to latest developments and discoveries, which will impart a broad training in various disciplines of Biochemistry and Biotechnology. These students will be able to pursue careers in pharmaceutical industries, research laboratories, clinical research organizations, school, colleges and Universities as researchers or academicians.

BCH 508S: Seminars and Field/Industrial Visit

Students should deliver seminars and attend the same at regular basis tropics from syllabus, or recent advances in the subject and from prepared review of research articles from research Journals. Students are also required to visit laboratories, research institutes and industries for real exposure in subject and qualitative interactions to understand applications of the subject. If possible a study tour during the span of two years may be organized pertaining to different Biochemistry/Microbiological/ Biotechnological/ Pharmaceutical industries/ research institutes/ within or outside Gujarat State. The study tour is highly essential for study various concepts, processes and technology pertaining to Biochemistry and its advances.

BCH 509M: Assignment and Group Discussion

Department will allocate the assignment from the subject and related areas to each student and arrange group discussion between students and also between faculties and students.

SEMESTER I

PRACTICAL BCH 405 PR:

Practicals based on the theory topics of Semester

Paper 401- Instrumentation & Techniques

Paper 402— Molecular Cell Biology

PRACTICAL BCH 406 PR:

Practicals based on the theory topic of Semester I

Paper 403- Bioenergetics and Intermediary Metabolism

Paper 404— Microbial Biochemistry

SEMESTER II

PRACTICAL BCH 411 PR:

Practicals based on the theory topic of

Semester II Paper 407- Plant Biochemistry

Paper 408— Nutritional Biochemistry

PRACTICAL BCH 412 PR:

Practicals based on the theory topic of

Semester II Paper 409- Advanced Enzymology

Paper 410- Human Physiology
Reference Books

28. Microbial Genetics S.S. Rajan Anmol Publications New Delhi