

GUJARAT UNIVERSITY

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

Department	Semester	Course		No of Hours per week				Course credit
				Lecture	Others	Practical	Total	
BCH	1	BCH 401	Instrumentation & Techniques	3	1		4	4
		BCH 402	Molecular Cell Biology	3	1		4	4
		BCH 403	Bioenergetics and Inter-Metabolism	3	1		4	4
		BCH 404	Microbial Biochemistry	3	1		4	4
		BCH 405 PR	Practical I + Viva voce			6	6	4
		BCH 406 PR	Practical II + Viva voce			6	6	4
			TOTAL	12	4	12	28	24
BCH	2	BCH 407	Plant Biochemistry	3	1		4	4
		BCH 408	Nutritional Biochemistry	3	1		4	4
		BCH 409	Advanced Enzymology	3	1		4	4
		BCH 410	Human Physiology	3	1		4	4
		BCH 411 PR	Practical III + Viva voce			6	6	4
		BCH 412 PR	Practical IV + Viva voce			6	6	4
			TOTAL	12	4	12	28	24
BCH	3	BCH 501	Advanced Molecular Biology	3	1		4	4
		BCH 502	Biotechnology	3	1		4	4
		BCH 503	Clinical Biochemistry	3	1		4	4
		BCH 504	Immunology	3	1		4	4
		BCH 505 PR	Practical V + Viva voce			6	6	4
		BCH 506 PR	Practical VI + Viva voce			6	6	4
			TOTAL	12	4	12	28	24
BCH	4	BCH 507 P	Dissertation/Project Work				20	16
		BCH 508 S	Field/Industrial Visit/Seminar				4	4
		BCH 509 M	Group Discussion/Assignment				4	4
			TOTAL				28	24

SEMESTER I

BCH 401 : INSTRUMENTATION AND TECHNIQUES

- UNIT1 Radiol isotopic 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 ³H), 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,
- UNIT4 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.
- UNIT 3** The cytoskeleton- microtubules and microfilaments. Cell Motility,The extra cellular matrix-collagen, elastin, fibrillin, fibronectin, Cell division — cell division by mitosis and meiosis. Molecular events in Cell cycle and its regulation.
- UNIT 4** Cell differentiation. Cell ageing and Apoptosis. Biochemistry of cancer, Characteristics of a cancer cell, Agents promoting carcinogenesis.

BCH 403 : BIOENERGETICS AND INTERMEDIARY METABOLISM

- UNIT 1** Energy transformation, Laws of thermodynamics, Energy transducing membranes. Gibbs energy, free energy change and redox potentials, phosphate potential, ionelectro-chemical potentials, chemiosmotic theory, ion transport across energy transducing membranes. Influx and mechanisms. Proton circuit and electrochemical gradient.
- UNIT 2** The mitochondrial respiratory chain, the Q cycle and the stoichiometry of proton extrusion and uptake. Reversed electron transfer, respiratory controls and

oxidative phosphorylation, uncouplers and inhibitors of energy transfer. ATPsynthetase complex. Microsomal electron transports, Biological oxidations, oxygenases, hydroxylases, partial reduction of oxygen, superoxides.

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: α, β, ω , 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
a. Bacteria b. Rickettesia c. Chlamydia d. Mycoplasma e. Fungi
f. Viruses g. Sub viral entities like Prions, Viroids, Virusoids and Satellite RNAs.

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
Yeasts: 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***
Plasma Membrane: Structure, Models and Functions, Plasmodesmata:
Structure and Functions.
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.
Ecosystem Organization: Structure and Function, Types, Energy Flow in
Ecosystem, Biogeochemical cycles (C, N, P and S).
- 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.
Vitamins: dietary sources, biochemical functions and specific deficiency
disease associated with fat and water-soluble vitamins. Hypervitaminosis
symptoms of fat soluble vitamins. Nutritional requirements during pregnancy,
lactation and infants and children.
- UNIT 3 *Protein Energy malnutrition (PEM) :***Aetiology, clinical features, metabolic
disorders and management of Marasmus and Kwashiorkar disease.
Starvation: Techniques for the study of starvation. Protein metabolism in
prolonged fasting. Protein sparing treatment during fasting. Basic concept of
high protein, low caloric weight production diets. Obesity.
- UNIT 4 *Clinical nutrition:*** Role of diet and nutrition in the prevention and treatment of
disease, dental caries, fluorosis, renal failure, hyperlipidemia, Atherosclerosis
and Rheumatic disorders, inherited metabolic disorders: Phenyl ketonuria,
maple syrup disease. Homocystinuria, galactosemia, gout. Diabetes insipidus
and diabetes mellitus.

BCH 409 : ADVANCED ENZYMOLOGY

- 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** Method of examining enzyme-substrate complexes. Methodology for measuring kinetic and rate constants of enzymic reaction and their magnitudes. Enzyme turnover and methods employed to measure turnover of enzymes. Significance of enzymes turnover.
- UNIT 3** Protein-Ligand binding, including measurement, analysis of binding isotherms. Co-operativity phenomenon. Hill and Scatchard plots. Allosteric enzymes, Sigmoidal kinetics and their physiological significance. Immobilized enzymes and their industrial applications.
- 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 enzymic activity by product and substrates; Reversible covalent modification of enzymes; Mono-cyclic and cascade systems with specific examples.

BCH 410 : HUMAN PHYSIOLOGY

- UNIT 1** **Blood:** Composition and function of plasma, erythrocytes including Hb, leukocytes and thrombocytes, plasma proteins in health and disease.
Blood coagulation — mechanism and regulation. Fibrinolysis.
- 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-13 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
 G lycohemoglobins
 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

SEMESTER IV

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 topics 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

1. Instrumental Analysis in the Biological Sciences. M.H. Gordon and R. Macrae Latest Edition. Blackies, Scientific Publishers.
2. Lehninger's Principles of Biochemistry, Nelson and Cox, 5th Edition. 2009.
3. Biochemistry. Grisham and Garret 4th Edition 2009.
4. An Introduction to Practical Biochemistry. David T Plummer. Third Edition
5. Fundamentals of Analytical Chemistry. D.A. Skoog, D.M. West, F.J, Holler and S.R. Crouch, Thomson Pub. 2004.
6. Principles of Instrumental Analysis. D.A. Skoog, F.J. Holler and T.A. Nieman Harcourt Asia Pvt. Ltd. 2001.
7. Cell and Molecular Biology. Gerald Karp, John Wiley & Sons, 1996.
8. Molecular Cell Biology. H. Lodish, D.Baltimore, A. Berk and J. Darnell. W.H. Freeman, New York. Fourth Edition, 1995
9. Molecular Biology of the Cell. Bruce Alberts, D. Bray J. Lewis M.Raff K. Roberts and J.D. Watson. 5th Edition Garland Publishing Inc., NY. 2002/
10. Laboratory procedures in Biotechnology, Cell and Tissue Culture. Doyle. Wiley International. 1999.
11. Molecular Biology of the Gene. J.D. Watson. Pearson Publications Inc. 2004.
12. The Enzymes. Bayer, Lardy and Myrback Academic Press 2000
13. Enzymes. Trevor, S.P. Harwood Inc. 2001.
14. Enzymology for Recombinant DNA technology. Academic press. 1996
15. Textbook of Medical Physiology. Guyton, Elsevier 2000
16. Human Physiology : The basis of Medicine. G. Pocock and C. Richards 1999
17. Blood: Physiology and Pathophysiology C. Pallister Butterworths, 2000
18. Clinical Biochemistry: Metabolic and Clinical Aspects. W.J. Marshall and S.K.Bangert. Churchill Livingstone 1995.
19. Clinical Biochemistry —Lecture notes . A.F. Smith G.J. Beckett S.W. Walker, P.W.H. Rae. 1998.
20. Immunology - Roitt, Brostoff and Male – 3rd edition 1998. Mosby Intl.
21. Kuby's Immunology 4th Edition R.A. Goldsby T.J. Kindt and B.A. Osborne. Freeman Press
22. Molecular Biology and Gene Cloning Volumes I and II T.A. Brown , Academic Press 2000.
23. Genomes T.A. Brown Academic press. Latest Edition.
24. Culture of Animal Cells. Ian Freshney. 2003
25. Molecular Biotechnology. S.B. Primrose. Blackwell Scientific Publishers Oxford University Press. 2004
26. Genes VII. Benjamin Lewin Oxford University Press.
27. Microbiology 5th Edition M.J. Pelczar, E.C.S.Chan and N.R. Krieg. Tat McGraw Hill 1996.
28. Microbial Genetics S.S. Rajan Anmol Publications New Delhi
29. Harper's Illustrated Biochemistry. Robert Murray, Daryl Granner, Peter Mayes and Victor Rodwell. McGraw Hill International Publications 26th Edition, 2006.
30. Immunobiology 4th Edition C.A. Janeway P.Travers Churchill Livingstone Pub. 1999.
31. Fundamentals of Enzymology Nicholas C. Price & Lewis Steven Oxford Univ. Press 2003