

SYLLABUS

M. Sc. Biochemistry

(Semester III & IV)

Choice Based Credit System (CBCS)

Effective from June 2017



Accredited **Grade A** by NAAC

(CGPA 3.05)

Department of Biochemistry

Saurashtra University

Rajkot

M.Sc. Biochemistry Syllabus
Choice Based Credit System (CBCS)

(Total 96 credits)

Effective from June 2016

Name of Program	Semester	Course Group	Credits	Hours / Week	Internal marks	External Marks	Practical /Viva Marks	Total Marks	16 digit Number
M.Sc. Biochemistry	3	Core							
		CBC 7: Immunology	04	04	30	70		100	1603120102030700
		CBC 8: Clinical and Nutritional Biochemistry	04	04	30	70		100	1603120102030800
		Elective (Any one)							
		EBC 1: Microbial Biochemistry	04	04	30	70		100	1603120602030100
		EBC 2: Pharmaceutical Biochemistry and Regulatory Affairs	04	04	30	70		100	1603120602030200
		EBC 3: Plant Biochemistry	04	04	30	70		100	1603120602030300
		Practical							
		PBC 3: Practical	08	18		-	200	200	1603120302030300
		Seminar							
		Research article presentation	04	02		100		100	1603120502030200
	4	Elective (Any one)							
		EBC 4: Research Methodology	04	04	30	70		100	1603120602040400
		EBC 5: Animal Cell Tissue Culture	04	04	30	70		100	1603120602040500
		Project Work							
		Dissertation work	20	30	-	500		500	1603120702040100

SEMESTER III

CBC 7: IMMUNOLOGY

UNIT 1: The Immune System and Effect or Mechanism

Properties and Overview of Immune Response, Innate Immunity, Cells and Tissues of The Adaptive Immune System, Cytokines, Effect or Mechanism of Cell Mediated Immunity, Effect or Mechanism of Humeral Immunity

UNIT 2: Recognition of Antigens and Maturation, Activation, Regulation of Lymphocytes

Antibodies and Antigens, The Major Histocompatibility Complex, Antigen Processing and Presentation to T Lymphocyte, Antigen Receptors and Accessory Molecules of T and B Lymphocytes, Lymphocyte Development and the Rearrangement and Expression of Antigen Receptor Genes, Activation of T Lymphocyte, B Lymphocyte and Antibody Production, Immunological Tolerance

UNIT 3: Diagnostic Immunology, Hybridoma Technology and Vaccination

Antigen and Antibody Reactions: Precipitation and Agglutination Reactions, Immunofluorescence Assay ,ELISA Assay, Immunoelectrophoresis Techniques, Production of Monoclonal and Polyclonal Antibodies, Applications of Monoclonal Antibodies, Vaccines

UNIT 4: The Immune System in Defense and Immunological Disorders

Immunity to Microbes, Transplantation Immunology, Immunity to Tumors, Hypersensitive Reactions, Autoimmune Disorders, Immunodeficiency

CBC 7: IMMUNOLOGY

Objectives:

- In-depth knowledge and understanding of major cellular and molecular mechanisms underlying immunological processes in health and diseases
- To acquire a knowledge of immunochemical techniques in qualitative and quantitative analysis of antibodies and antigens.
- An understanding of the factors that determine the effectiveness of immune responses to microorganisms (bacteria, viruses, parasites) and tumours and how protective immunity can be elicited by vaccination

Outcome:

The expected learning outcomes of this course is to attain a working knowledge of current immunological principles as they relate to the cells and molecules of the immune system. Understanding of mechanism of interaction in defending the body against invading microorganisms. Students will get knowledge of development and acquisition of ability to recognize antigens and finally how they malfunction in autoimmune diseases. Furthermore, students will extend and solidify their understanding of the presented principles through critical readings from the primary research literature. Reading of research papers will help introduce students to research techniques and also help them appreciate the value of scientific research.

CBC 8: CLINICAL AND NUTRITIONAL BIOCHEMISTRY

UNIT 1: Blood

Functions and Components of Blood, Different Types of Blood Cells and its Physiology, Formation of Blood Cells, Blood Clotting - Extrinsic and Intrinsic Pathways of Blood Clotting, Control Mechanism for Blood Clotting, Blood groups, Blood transfusion, Laboratory Test to Measure Coagulation and Thrombolysis, Anemia, Polycythemia, Hemoglobinopathy, Tissue and Organ Transplantation.

UNIT 2: Diseases

Biochemical, Clinical, Pathological and Diagnostic Aspects of Diseases- Gastritis, Ulcer, Inflammatory Diseases. Liver: Jaundice and Cirrhosis. Kidney: Glomerulonephritis, Nephrotic Syndrome. Diabetes, Hypertension, Atherosclerosis and Myocardial Infarction, Respiratory System: Tuberculosis and Asthma. Malaria, AIDS, Cancer.

UNIT – 3: Nutritional Aspects of Carbohydrates, Lipids and Proteins:

Introduction, Different Dietary Types, Requirements, Utilization and Functions, Special Role of the Unavailable Carbohydrates, Essential Fatty Acids, Essential Amino Acids, Nutritive Value of Proteins and the Methods for its Determination, Amino Acid Imbalance, Protein Requirements, Utilization and Functions

UNIT – 4: Balanced Diet and Vitamins

Recommended Dietary Allowances for Different Categories of the Human Beings, Disorders Related to the Nutrition- Protein Energy Malnutrition, Starvation, Obesity, Classification of Vitamins, Dietary Sources, Rda, Functions and Biochemical Role of Vitamin A, Vitamin B Complex, B₁thiamine, B₂riboflavin, Niacin, Folic Acid, Vitamin B₁₂, Vitamin C, Vitamin D, Conversion of Vitamins from Precursor: β -Carotenes to Vitamin-A, Argosterol to D₃, Disease of Vitamins Deficiency: Clinical Symptoms, Prevention and Treatment

CBC 8: CLINICAL AND NUTRITIONAL BIOCHEMISTRY

Objectives:

- To study the classification and functional properties of blood components.
- To understand the coagulation, anti-coagulation mechanism of blood and its disorders.
- To study the biochemical, clinical, pathological and diagnostic aspects of diseases.
- To study dietary types, requirements, utilization and functions of different class of diet.
- To study the nutrition deficiency disorders and balance diet.

Outcome:

This paper will provide students with advance understanding and knowledge of theoretical and practical aspects of blood biochemistry and its components, how blood connects entire organ system of body in single circulatory channel, consequences of environmental and genetic factors of blood disorders, rationale and theoretical basis for methods and tools used in the diagnosis of common biochemical disorders, distinguish between vitamins and minerals; between fat-soluble vitamins and water-soluble vitamins. Biochemical functions and synthesis for these vitamins.

EBC 1: MICROBIAL BIOCHEMISTRY

UNIT 1: Regulation of Genes in Bacteria

Nucleic Acids as Carriers of Genetics Information, Arrangement and Organization of Gene in Prokaryotes: Operon Concept, Catabolite Repression, Instability of Bacterial RNA, Inducers and Corepressors, *E. coli* Lac Operon: Negative Regulation and Positive Regulation, *E. Coli* Arabinose Operon: Regulation by Attenuation, His and Trp Operons: Anti-termination, Genetic Transfer: Conjugation, Transformation and Transduction.

UNIT 2: Virology

Introduction to Virus, Classification, Assay Methods, Properties and Characteristic of Bacterial, Plant and Animal Viruses, Virus Host Interaction, Acute Virus Infections, Persistent of Virus Infection, Influenza, Herpes, Hepatitis A and B.

UNIT 3: Biological Nitrogen Fixation

Nitrogen Metabolism: Mechanism and Regulation of Utilization of Ammonia, Nitrate and other Nitrogen Source, Nitrogen Fixation: Mechanism and Regulation of Nitrogen Fixation, Symbiotic and Asymbiotic Nitrogen Fixation and Biochemistry of Nitrogenase.

UNIT 4: Antimicrobial Agents

The Development of Antimicrobial Agents, Past, Present and Future, Selection of Antimicrobial Agents, Synthetic Organic Antimicrobials, β -Lactam Antibiotics, Aminoglycoside Antibiotics, Antifungal Drugs, Antiviral Drugs, Resistance to Antimicrobial Drugs

EBC 1: MICROBIAL BIOCHEMISTRY

Objectives

- To enable the student to learn the regulation of genes in bacteria.
- Morphology, classification and types of viruses.
- To introduce to the process of biological nitrogen fixation.
- Detailed information on antibiotics.

Outcomes

Students will be able to appreciate the entire spectrum of microscopic life forms - from relatively simple, small but unique viruses to bacteria. Enable the students to understand the fine mechanism of regulation of gene expression. Awareness will be created on different types of viruses and diseases caused by them. Appreciate the crucial role played by bacteria in nitrogen metabolism. Students will get deep insight to antimicrobials.

EBC 2: PHARMACEUTICAL BIOCHEMISTRY AND REGULATORY AFFAIRS

UNIT 1: Pharmacokinetics

Introduction to Drug Absorption, Deposition, Drug Metabolism And Elimination, Important Pharmacokinetics Parameters In Defining Drug Disposition and In Therapeutics, Uses of Pharmacokinetics In Drug Development Process, Concept of Prodrug and Soft Drug

UNIT 2: Pharmacodynamics

Introduction, Concept of Receptor Agonists and Antagonists, Drug Receptors Interactions, Theories of Drug Activity Relationship, Treatment of Diseases by Enzyme Stimulation and Enzyme Inhibition, Elementary Treatment of Drug Receptor Interaction, Ld50, Ed50, Mic and Mec etc. (Mathematical Derivations of Equation Excluded), Membrane Active Drugs (Sulphonamides). Mechanisms of Drug effects, Drug Delivery Systems e.g. Liposomes

UNIT 3: Regulatory Affairs

Pharmaceutical Products-their Manufacturing, Analytical Aspect, Product Registration and their Requirement looking to WHO-GMP, European DMF, US-FDA Regulations, ICH Guidelines, Pharmacopaeal and Extra Pharmacopaeal Entry

UNIT 4: Intellectual Property Rights

Documentation Required for Filing Patent, Chemical, Physical and Biological (Clinical) Data Documentation, Patent Writing Art and Introduction of Concept of Non-infringing Patent Ability, Looking to GATT-WTO Scenario, Computer Based Data Mining in Drug Research, Pharmaceutical Product Management Aspect

EBC 2: PHARMACEUTICAL BIOCHEMISTRY AND REGULATORY AFFAIRS

Objectives:

- To study the drug development process, absorption and metabolism
- To develop a concept of drug action, receptor interaction, roll of enzyme in stimulation or inhibition of drug activity.
- To understand the lethal and effective dose of drug; Mechanism of drug delivery systems.
- To study the different guidelines for manufacturing of drugs.
- In-depth study of intellectual property rights

Outcome:

From this paper students will gain detail understanding of how drug act inside the body after absorption from intestine in to blood, factors that affect drug absorption, interaction with target receptors and inhibition of enzymes, process of product registration and different guidelines which control the manufacturer to follow correct strategy for manufacturing of drug, how one can write and file the patent; how to document clinical data of the concern drug research.

EBC 3: PLANT BIOCHEMISTRY

UNIT 1: Structure and Biochemical Aspects of Specialized Plant Cell Organelles

Structure and Biochemical Aspects of Cell Plate, Primary and Secondary Cell Walls, Plasmodesmata, Importance of Vacuoles, Characteristics of Meristematic Cells.

UNIT 2: Concepts of Photosynthesis and Phytohormons

Photochemistry, Energy Considerations, Light Reaction with Z – Scheme, CO₂ fixation, Calvin Cycle, C₃, C₄ and CAM, Photorespiration, Chemistry and Action of Phytohormones and Plant Growth Regulators.

UNIT 3: Secondary Metabolites

Special Features of Secondary Plant Metabolism Formation and Functions of Alkaloids, Phenolic Compounds, Tannins, Lignins, Flavonoid Pigments, Surface waxes, Cutin and Suberin – the Plant Protective Waxes, Terpenes. Different Types of Bioreactors for Mass Production

UNIT-4: Water Relations of Plants

Role of Water, Absorption, Conduction and Transpiration, Guttation, Water balance and Stress Physiology. Osmoprotectant

EBC 3: PLANT BIOCHEMISTRY

Objectives

- To provide students with an understanding of core topics with general principles.
- To introduce the students to the structural organization of plant cells and along with the cell wall structure formation and growth.
- To give an overview of photosynthesis and its significance to plant and human environment.
- To explain the biosynthetic pathway of plant hormones. Explain secondary metabolites and their potential therapeutic and nutritional uses.
- The overall relation of water with respect to plants is made thorough.

Outcomes

It will enable the students to appreciate the constituents of the plant cell, identify the components of the plant cell and appreciate the role of each of the components. Students will be able to understand the biological significance of photosynthesis in plants and human environment. Students will be able to appreciate the modes and pathways involved in the biosynthesis of plant hormones and highlight their roles in the cell. As secondary metabolites relate to therapeutic and nutritional uses, their multidimensional aspect will be highlighted.

SEMESTER IV

EBC 4: RESEARCH METHODOLOGY

UNIT 1: Types of Research & Literature Survey

Types, Research process and steps in it, Hypothesis, Research proposals and aspects. Literature survey and review, Research design process, Errors in research. Report Writing: Pre writing considerations, Thesis writing, Formats of report writing, Formats of publications in Research journals.

UNIT 2: Design of Experiments

Research Modeling: Types of Models, Model building and stages, Data consideration and testing, Heuristic and Simulation modeling. Research Design: Need, Problem Definition, variables, research design concepts, Objectives, strategies, Factorial experimental design, Designing engineering, experiments, basic principles: replication, randomization, blocking, Guidelines for design of experiments.

UNIT 3: Statistical Methods

Single Factor Experiment: Hypothesis testing, Analysis of Variance components (ANOVA) for fixed effect model; Total, treatment and error of squares, Degrees of freedom, Confidence interval; ANOVA for random effects model, Estimation of variance components, Model adequacy checking.

UNIT 4: Computer Applications

Spreadsheet Tool: Introduction to spreadsheet application, features and functions, Using formulas and functions, Data storing, Features for Statistical data analysis, Generating charts/graph and other features. Tools used may be Microsoft Excel, Open office or similar tool. Presentation Tool: Introduction to presentation tool, features and functions, Creating presentation, Customizing presentation, Showing presentation. Tools used may be Microsoft Power Point, Open Office or similar tool. Web Search: Introduction to Internet, Use of Internet and WWW, Using search engine like Google, Yahoo etc, Using advanced search techniques.

EBC 4: RESEARCH METHODOLOGY

Objectives:

- The main objective of this paper is to provide students with a broad introduction to the methodological foundations and tools used in research.
- To learn how to identify problems, develop hypotheses and research questions.
- To check for the validity and reliability of studies and design research projects.
- To expose the students to the broad range of designs used in research from laboratory, field experiments, surveys and content analysis.
- To study the statistical tools and computer applications used in research.

Outcome:

By studying this paper students will be able to define research, explain and apply research terms, describe the research process and the principle activities, skills and ethics associated with the research process; students can explain the relationship between theory and research, describe and compare the major quantitative and qualitative research methods; construct an effective research proposal that will serve as the launching point for the research project, understand the importance of research ethics and integrate research ethics into the research process. Students will easily use the statistical tool and computer software for organization and analysis of data.

EBC 5: ANIMAL CELL TISSUE CULTURE

UNIT 1: Introduction

History, Biology of cell culture, Laboratory design and layout, equipments, aseptic condition, safety, bioethics and validation

UNIT 2: Media

Culture vessels, substrates, defined media supplements, serum free media, media preparation and sterilization

UNIT 3: Various Cell Culture

Primary culture, subculture and cell lines, cloning and selection, cell separation, characterization, differentiation, transformation and immortalization

UNIT 4: Techniques and Media

Contamination, cryopreservation, quantification, cytotoxicity, special cell type culture, culture of tumor cells, organotypic culture, scale up and specialized techniques

EBC 5: ANIMAL CELL TISSUE CULTURE

Objectives:

- Understating the basics of animal tissue culture i.e. laboratory design and requirements
- To acquire a knowledge of various types of media and methodologies
- An understanding of the various types of cell cultures and separation techniques
- In-depth knowledge and understanding of cell preservation, scale up and special cell cultures

Outcome:

The expected learning outcomes of this course is to attain a working knowledge of discrimination between the different types of cell culture technologies. Detailed criteria for consideration for scale up of cell culture and media composition. Students will gain knowledge in identifying the appropriate cell model for a large scale process and explaining recent developments in cell and tissue engineering.

DISSERTATION PROJECT WORK

Dissertation research work is offered to students of Semester IV to carry out research according to the provision of objectives and teacher guide. Students are eligible to apply in other national and international level research institutes, Universities and industries of high repute to pursue six month dissertation research project for the partial fulfillment of M.Sc. Biochemistry degree.

REFERENCE BOOKS

1. Analytical Biochemistry by Holme, D. J. & Peck, H.
2. Biochemical calculation by Segel
3. Laboratory Manual in Biochemistry by Jayraman
4. Biochemistry and Molecular Biology of Antimicrobial Drug Action by Franklin, T. J. & Snow, J. A.
5. Biochemistry by Champe
6. Biochemistry by Todd, W. B., Mason, M., Bruggen, R. V. & Macmillan.
7. Biochemistry by Voet & Voet
8. Lehninger Principles of Biochemistry by Nelson, D. L. & Cox, M. M.
9. Biochemistry by Mathews
10. Biochemistry by Satyanarayana, U.
11. Biochemistry: The Chemical Reactions of Living Cells by Metzler, D. E.
12. Biochemistry with Clinical Correlation by Devlin, T. M.
13. Biochemistry by Zubay, J.
14. Biochemistry by Stryer
15. Cell Biology Protocols by Harris, R., Graham, J. & Rickwood, D.
16. Color Atlas of Biochemistry by Koolman, J. & Roehm, K. H.
17. Current Protocols in Protein Science (All Vol) John Wiley & Sons
18. Dynamics of Proteins and Nucleic Acids by Mccammon, J. A. & Harvey, S. C.
19. Enzymes : Biochemistry Biotechnology And Clinical Chemistry by Palmer, T.
20. Fundamentals of Enzymology by Price & Stevens
21. Enzyme kinetics - A modern approach by Marangoni, A. G.
22. Enzyme Kinetics Principles and Methods by Bisswanger, H.
23. Practical and Clinical Immunology by Talwar, G. P.
24. Immunology by Kuby
25. Immunology by Roitt
26. Fundamentals of Biostatistics by Bernard Rosner
27. Fundamentals of Protein Structure and Function by Buxbaum, E.
28. Human Nutrition and Dietetics by Davidson & Passmore
29. Human Physiology by Devis
30. Instant Notes in Biochemistry by Hames, B. D. & Hooper, N. M.
31. Introduction to Molecular Biology by Paolella, P.

32. Introduction to Protein Architecture: The structural biology of proteins by Lesk, A. M.
33. Introductory Biostatistics by Chap T. Le
34. Modern Experimental Biochemistry by Boyer, R.
35. Molecular Biology of The Cell - Bruce Alberts
36. Molecular Cell Biology by Lodish, H.
37. Molecular biology of the gene by Watson.
38. Genes IX by Lewin, B.
39. Essential Molecular Biology by T. A. Brown
40. Principles Of Gene Manipulation And Genomics by Primarose
41. Molecular Cloning by Russell Sambrook
42. Analytical chemistry by Skoog
43. Nutritional Biochemistry by Tom Brody
44. Plant Biochemistry by Heldt, H-W.
45. Plant Physiology By Taiz and Zeiger
46. Principles of Biochemistry by Zubay, J.
47. Protein Biochemistry and Proteomics: Experimental series by Rehm, H
48. Principles of Anatomy & Physiology by Tortora, G.J.
49. Textbook of Medical Physiology by Guyton and Hall
50. Essentials of Medical Physiology by Sembulingam K.
51. Proteins: structure and function by Whitford, D.
52. Culture of Animal Cells by Freshney R. I.
53. Animal Cell Culture by Masters
54. Microbiology by Pelczar, M. J.
55. Microbiology Ecology Fundamental and Application by Ronald M. Atlas
56. Pharmacology by Rang and Dele
57. Vitamins, Their Role in the Human Body by Ball
58. The Vitamins by Gerald F. Combs
59. Bioinformatics Methods and Applications by Rastogi, S.C.
60. Bioinformatics for Dummies by Jean-Michel Claverie
61. Textbook of bioinformatics by Subramaniam, C.
62. Human Nutrition by Geissler Powers
63. Human Nutrition and Dietetics by Ashok Kumar Sharma
64. Home page, help / tutorial page of respective databases and Tools

65. Review & Research papers from Bioinformatics & related Journals
66. Arthur M. Lesk, Introduction to Bioinformatics, Oxford University Press, 2008.
67. David W. Mount, Bioinformatics – Sequence and Genome analysis, 2004.
68. G. Gibson & S.V.Muse, A Primer of Genome Science, 2009.
69. A. Baxevanis and B.F. Ouellette. Bioinformatics: A practical Guide to the Analysis of Genes and Proteins, Wiley- Interscience, Hoboken, NJ, 2005.
70. A. M.Campbell & L. J. Heyer, Discovering Genomics, Proteomics & Bioinformatics, CSHL Press, 2006.
71. S.R. Pennington & M.J. Dunn, Proteomics – from protein sequence to function, BIOS Scientific Publishers, 2002.
72. Fundamentals of Biostatistics by Bernard Rosner 5th Ed.