

BIO-TECHNOLOGY

CENTRE FOR BIOTECHNOLOGY ACHARYA NAGARJUNA UNIVERSITY NAGARJUNANAGAR – 522 510

Course structure of M.Sc. Biotechnology – Semester pattern (To be implemented from 2006-2007)

Paper	Course title	Marks
M.Sc. (Previous)		
Semester – I		
Paper-I ---	Chemistry of Biomolecules	100
Paper-II ---	Cell Biology	100
Paper-III ---	Bioanalytical Methods & Biostatistics	100
Paper-IV ---	Genetics	100
Practical-I ---	Cell Biology & Biomolecules	50
Practical-II---	Genetics & Biostatistics	50
Semester - II		
Paper-I ---	Biochemistry	100
Paper-II ---	Microbiology	100
Paper-III ---	Molecular Biophysics & Enzymology	100
Paper-IV ---	Immunology	100
Practical-I ---	Microbiology & Immunology	50
Practical-II---	Biochemistry & Enzymology	50
M.Sc. (Final) - Semester - III		
Paper-I ---	Molecular Biology	100
Paper-II ---	Protein Engineering	100
Paper-III ---	Genetic Engineering	100
Paper-IV ---	Bioinformatics	100
Practical-I ---	Molecular Biology & Protein Engineering	50
Practical-II---	Genetic Engineering & Bioinformatics	50
Semester - IV		
Paper I ---	Plant Biotechnology	100
Paper-II ---	Animal Biotechnology	100
Paper-III ---	Biochemical Engineering	100
Paper-IV ---	Fermentation Technology	100
Practical-I ---	Plant & Animal Tissue Culture & Fermentation Technology	50
Practical-II ---	Project work of 3 months duration – Project Report, Seminar & Viva-voce	50
Total -		2000

P.S. The marks are included with 20% internal marks in each theory and practical paper

Semester - II

Paper I- Biochemistry

Unit I: Basic concepts of metabolism. Diversity of metabolic processes in microorganisms, plants and animals; Autotrophs and heterotrophs; Glycolysis, Gluconeogenesis and Glycogen metabolism, cori cycle, Citric acid cycle, Electron transport system and oxidative phosphorylation, Pentose phosphate pathway ,

Unit II: Biochemistry of photosynthesis, C₃, C₄ and CAM pathways, photosynthetic electron transport and Photophosphorylation, Photorespiration; Secondary metabolic processes and their regulation (Ex. Antibiotic synthesis).

Unit III: Fatty acid metabolism Triglycerols as energy storages, degradation of fatty acids, synthesis of fatty acids, formation of ketone bodies, cholesterol metabolism, regulation of fatty acid metabolism. Synthesis of Eicosinoids, Glyoxalate cycle in plants.

Unit IV: Protein and amino acid metabolism, Conversion of nitrogen to NH_4 by microorganisms, utilization of ammonia in higher organisms. Regulation of amino acid biosynthesis. Amino acids as precursors of variety of biomolecules. Degradation of amino acids, urea cycle, linkage between urea cycle and citric acid cycle. Biosynthesis of heme, Chlorophyll and Porphyrins.

Unit V: Nucleotide metabolism-Biosynthesis of purines, Pyrimidines; Biosynthesis of deoxyribonucleotides, Catabolism of purines and pyrimidines; Integration of carbohydrate, lipid and protein metabolism. Major metabolic pathways and control sites, key Junctions, metabolic process of major organs, Hormonal regulation of fuel metabolism, metabolic adaptation.

Recommended Books

Nelson, David L. , Cox, Michael M. [Lehninger Principles of Biochemistry](#) 4/e, 2005, W.H. Freeman ,Madison avenue, New York.

Berg Jeremy M. , Tymoczko, John L. , Stryer, Lubert [Biochemistry](#) 5/e, 2002, W.H. Freeman, Madison avenue, New york

Switzer, Robert L. , Garrity, Liam F. [Experimental Biochemistry](#) 3/e, 1999, W.H. Freeman ,Madison avenue, New york.

Biochemistry Campbell K.M and Farrel O.S 5ed 2005,Thomson brooks and Cole.

Biochemistry, Berg M.J, Tymoczko J.L, Stryer L., 5ed 2002, W.H. Freeman ,Madison avenue, New york.

Harper'sBiochemistry ,Murray R.K, Granner D.K , Mayes P.A and Rodwell V.W 26ed 2003 Mc graw-Hill professional publishers, New Delhi.

Voiet D. and Voiet J.G., Biochemistry, 2nd ed ,1995, John Wiley publications, New york

Paper II- Microbiology

Unit I: Introduction to microbiology - Scope and history. Broad classification of bacteria - Ultrastructure of capsule, envelope, flagella, pili. Mesosomes. Virus-Classification, morphology and composition in general, Bacteriophage ϕ x174, Cynophage and retroviruses. Prions, viroids, virusoids.

Unit II: Nutritional requirements of bacteria; Essentials of microbial nutrition. Phototrophs, chemotrophs, and heterotrophs; Pure and enrichment culture methods; Microbial growth kin amitosis and binary fission etics, Batch and continuous cultures; Chemostats and turbidostats; Chemical control amitosis and binary fission of microbial growth; Methods of sterilization of media. Isolation, cultivation and identification of bacteria; Selective culture methods.

Unit III : General characteristics of Chemolithotrophs, photosynthetic bacteria, archebacteria, methanogens, fermentative and sulfur reducing bacteria, Mycoplasma and Rickettsiae. General features of Fungi and algae. Role of microbes in carbon, sulphur and nitrogen cycle in nature. General features and importance of mycorrhiza.

Unit IV: Modes of gene transfer in bacteria – Transformation, Transduction, Conjugation, recombination in bacteria; Lytic cycle – Phage multiplication; Lysogeny - Life cycle of Lamda; Nitrogen cycle, Nitrogenase enzyme catalysis; Genetics of nitrogen fixation, Nif gene structure and regulation; Methods of controlling microbes and pathogens, HIV transmission and control, Tuberculosis, Baculovirus and Influenza virus.

Unit V: Industrial microbiology – Brief outline and type of reactions, in fermentation, fermentative production of alcohol, lactic acid and butyric acid; Production of acetic acid (vinegar), citric acid, and gluconic acid; Fermentative production of amino acids (Glutamic acid, Aspartic acid, Lysine, Phenylalanine, Histidine). Production of vitamins (Rboflavin, vitamin B₁₂ and Carotenoids). Polysaccharides (Xanthans, Dextrans, Pullulans and Alginates) and enzymes (Proteases, Pectinases, Lipases, Cellulases). Tissue culture and its applications in agriculture, horticulture and industry.

Recommended Books

Prescott L.M. Harley J.P Klein D.A Microbiology, 6th ed, 2004, Mcgra-hill publishers, New Delhi

Brooks G.F, Butel J.S., Morse S.A., Medical microbiology, 23rd ed , 2004,McGra-Hill Professionals, USA

Johnson A.G., Ziegler. R.J Microbiology and Immunology, 4th ed , 2002, Lippincott Williams & Wilkins publishers, Baltimore.

Microbiology, 5th edition, Pelczar, Michael J, Krieg, Noel R.; Jr.; Chan, E. C, McGraw-Hill publishers.

Principles of Microbiology, Atlas, RM, 2nd edition, W.M.C. Brown Publishers, Dubuque

Paper III- Molecular Biophysics and Enzymology

Unit I: Interactions in biological systems - Intra and intercellular forces, electrostatic interactions, hydrogen bonding, Vander wall interactions, hydrophobic interactions and disulphide bridges; Role of water and weak interactions.

Unit II: Prediction of primary, secondary and tertiary structure of proteins by X-ray crystallography, CD, ORD, ESR and NMR. Multiple equilibrium -Titration of proteins, scatchard plot, protein folding unfolding equilibrium, denaturation of proteins and nucleic acids, effect of solvent conditions and temperature on the thermodynamics of protein folding - Kinetics of folding and unfolding; Phenomenon of self assembly and its biophysical basis.

Unit III: Basic concepts of Enzymology – Classification of enzymes, nomenclature and general properties of enzymes; Formation, of enzyme-substrate complex and experimental evidences Diffusion and the rate of encounter of enzyme with substrate; Methods of isolation and purification of enzymes; Isozymes; Enzyme activation - zymogens, Multienzyme complexes and multi functional enzymes.

Unit IV: Enzyme Kinetics - Kinetics of enzyme-catalyzed reactions, Michaelis-Menten equation, Significance of K_m , V_{max} and K_{cat} , effect of pH, temperature, Substrate and enzyme concentrations on the rate of enzyme catalyzed reactions, Turnover numbers, Enzyme inhibition

Unit V: Identification of binding and catalytic sites of enzymes, Allosteric and multiple site enzymes, cooperativity, Hill equation, Sigmoidal kinetics, MWC and KNF models, study of ATCase as a typical allosteric enzyme. The cage effect and rotation of molecules.

Recommended Books

Introduction to Biophysics, Tyszynski J.A, Kurzynki.M, First edition , 2003, CRC Press, Florida.

Essentials of Biophysics, 1st edition, Narayanan. K , 2005, New age publishers, New Delhi.

Biophysics, 4th Edition, Glaser .R, 2001, Springer, New york.

Jackson . M.B , Molecular & Cellular Biophysics, First edition, 2006 , Cambridge University Press.

Understanding of Enzymes, Fourth edition, Trevor Palmer, 2003, Cambridge University Press, New york

Creighton, T.E., Proteins Structure and molecular properties, 2nd edition, 1993, W H freeman publishers, Madison avenue, New york

Paper IV - Immunology

Unit I: The lymphoid system - Common characteristics of the lymphoid system. Primary and secondary lymphoid Organs, characteristics of cells involved in the immune response; Adaptive and innate immunity, Humoral and cell mediated immunity. Structure and physiology of the immune cells, B-lymphocytes, T-lymphocytes; Humoral and Cell mediated immunity.

Unit II: Antibodies - Classes and sub-classes of Ig, structure, properties and activity of various antibodies; Immunoglobulin genes and Antibody diversity, Mechanism of generation of antibody diversity, avidity and affinity of antibodies. Antigens – Immunogenicity, antigenicity, properties of immunogenicity, determinant groups of epitopes. Synthetic peptides and immune response to peptides

Unit III: Immunodiagnostics, Antigen - antibody interactions, precipitation and agglutination reactions, Immunoelectrophoresis; Direct and indirect immunofluorescence. FACS, ELISA and immunoblotting. Hybridoma technology. Immunodiagnostics and immunotherapy using monoclonal antibodies.

Unit IV: The immune response system - Cell cooperation in the immune response, activation of T cells and B cells and other cells involved in immune response to virus bacteria and parasites; Interferons, chemotactic and colony stimulating factors. Major histocompatibility complex -

Structure and function of MHC. Molecules other than antibodies which recognize antigens, MHC restriction by helper and cytotoxic T-cells, the T cell receptor, binding of peptides with MHC, antigen presentation.

Unit V: Cytokines; Basic biology of Interleukins, complement components and pathways of activation; Tumor immunology - Tumor associated antigens, immune response to tumor antigens. Basis and types of autoimmunity and hypersensitivity. Vaccines, routes of administration, immunoprophylaxis, designing and production of vaccines, viral and recombinant vaccines

Recommended Books

Kindt Thomas J. ,Osborne, Barbara A., Goldsby, Richard A. [Kuby Immunology](#) 6/e, 2006, W.H. Freeman, Madison avenue, New york

Immunobiology, 6th edition, Charles A. Janeway, Garland Science Publishers.

Cellular and Molecular Immunology, 5th edition, Abul K. Abbas and Andrew H. Lichtman. Elsevier publications

Immunology, Immunopathology and Immunity, Stewart Sell, Edward E M, 6 ed,2001 ASM press, Washington

Roitt's Essential Immunology Roitt I.M and Delves P.J, 10th edition, 2001, Blackwell publishers.

Practical – I – Microbiology and Immunology

Microbiology

- Staining techniques - Preparation of staining reagent, Simple staining, Negative staining, Grams staining, Spore staining
- Isolation of microorganisms - Serial dilution technique (Isolation of bacteria from soil), Fungal isolation from air, Isolation of *Rhizobium* from root nodules, T.S. of root nodule, Observation of bacterioids
- Pure culture techniques - Spread plate method, Streak plate method, Pour plate method
- Identification of microbes
- Biochemical characterization of Microbes – IMVIC test, Qualitative tests for the enzyme production and extra cellular compounds
- Determination of different phases of growth curve in a batch culture
- Effect of physical factors on microbial growth – Temperature, pH, Salt concentration, UV radiation, Antibiotic sensitivity test, Minimum inhibitory concentration, Bacteriological examination of milk, Phage titration
- Cell spore counting by Haemocytometer
- Preparation of Replica Plates of bacteria
- Preparation of competent cells of bacteria

Immunology

ABO and Rh blood typing
Electrophoretic study of Serum proteins
Preparation of immunoglobulin of serum
Rapid serological diagnostics of syphilis
Widal test
Ouchterlony double Immuno diffusion technique
Differential Leucocyte count
Agglutination Inhibition test (Pregnancy test)
Determination of cross reactivity
Mancini technique
Immuno electrophoresis
Radial immunodiffusion
Rocket immuno electrophoresis
Counter current Immuno electrophoresis
ELISA – Quantitative and Quantitative

Practical – II – Biochemistry and Enzymology

Biochemistry

Estimation of maltose by 3,5 dinitro salysilic acid

Estimation of reducing sugars by Nelson and Somogyi method
Estimation of total sugars by Anthrone method
Determination of molar extinction coefficient of p- Nitrophenol
Quantitative measurement of amino acids and proteins by Spectrophotometric methods
Isolation and estimation of Cholesterol
Estimation of Ascorbic acid by Colorimetry
Estimation of inorganic phosphorus by Fiske and Subbarao method
Estimation of Urea by Diphenyl amine method
Estimation of Creatinine by Jaffee's method
Estimation of Calcium by Clark and Collip method
Purification of proteins – Ammonium sulfate fractionation, Dialysis, Column Chromatography and Freeze drying

Enzymology

Assay of amylase activity from seedlings of rice or mungbean
Determination of optimum pH of an enzyme
Effect of time of incubation on enzyme activity
Effect of substrate concentration on enzyme activity
Effect of temperature on enzyme activity
Production of amylase from bacteria/potato/sweet potato
Assay of protease activity
Effect of inhibitors on enzyme activity
Determination of K_m and V_{max} of an Enzyme (Amylase)
Determination of enzyme activity of Urease and malate dehydrogenase or catalase or peroxidase using UV-VIS Spectrophotometer