

**ADIKAVI NANNAYA UNIVERSITY
RAJAMAHENDRAVARAM**



**M.Sc. Biotechnology
Course Structure and Syllabus**

2016-17 Onwards

I & II semester syllabus is common for both M.Sc. Biotechnology & M.Sc. Biochemistry

ADIKAVI NANNAYA UNIVERSITY



M.Sc. DEGREE EXAMINATION IN BIOTECHNOLOGY - SYLLABUS (Effective from 2016-2017 Batch)

Synoptic note

- 1) BoS meeting for all PG Courses with effect from 2016-17 admitted batches
- 2) Syllabi last revised in 2012-13
- 3) There are about 25 different courses
- 4) The syllabus is proposed to be revised in accordance to the emerging concepts, industry and market needs

Proposed Guidelines:

- 5) All Arts and Commerce PG courses have 5 subjects in each of the four semesters, with 100 marks for each paper and a total of 2000 marks.
- 6) All Science PG courses have 4 subjects in each of the four semesters with theory and practical in each of 100 and 50 marks respectively for each of the four semesters, all of which makes a total of 2400 marks. An additional 100 marks are allotted for project dissertation and presentation in all PG courses [except MBA/MCA/MA (SW) and M.Tech]. Thus the grand total for the science PG courses is 2500 marks.
- 7) Out of 100 marks for each subject, 75 marks (75%) in each paper are assigned for Semester End Examinations and 25 marks (25%) for internal / continuous assessment for all PG courses.
- 8) Each subject will have four units of syllabi in all PG courses (except MBA, which will have five units of syllabus for each subject).
- 9) Each subject will have 4 - 5 periods of class per week with 5 credits.
- 10) Semester end examination question paper has two sections, viz. section A with four essay questions, with internal choice a) or b) - one question from each unit of syllabus; section B has eight short answer questions, two from each unit of syllabus, with choice to answer any five.

For MBA the question paper consist of 3 sections; viz. section 'A' has 8 short answer questions, with a choice to answer any five for 20 marks. Section 'B' consist of 5 long answer question with internal choice; one question from each unit of syllabus for 40 marks and section 'C' is case study with no choice for 15 marks.

11) For all PG courses including MBA, the brake up for 25 marks (25 %) of internal examination / continuous assessment is as follows;

- a) 15 marks for written examination; two written examinations are to be conducted and an average of both examinations is considered for awarding final score
 - b) 5 marks for attendance
 - c) 5 marks for assignment preparation and presentation
- (The proportionate may be followed for 50 marks paper / practical)

12) There will be project work for all PG courses except MBA, MCA, M.Tech and MA (Social work) for 100 marks (50 marks for dissertation and 50 marks for presentation and viva-voice. The project work is to be done during summer vacation i.e. after II semester and before III semester. The dissertation of the project work is to be submitted by the student to the respective department during 2nd year study. The presentation and viva-voce examination of the project work is to be conducted at IV semester end examination. The project presentation and vive-voce examination is to be conducted by external examiner. For affiliating colleges, University teachers will be the external examiner and for University Department, external examiner is to be invited from other university. MCA / MBA /M.Tech/ MA (SW) will continue the extant system. The external examiner TA / DA and remuneration will be borne by the respective College / Department strictly as per the approved norms to be notified from time to time.

13) There may be comprehensive Viva-Voce at the end of every semester being conducted by all subject teachers, together assigning suitable credit from internal marks to be taken. This is intending to prepare and boost the student interview facing skills and comprehension of subject. This is proposed for PG courses.

M.Sc. BIOTECHNOLOGY
Scheme of Examination

Code	Title of the paper	Total Marks	Credits
I SEMESTER			
BT101	Cell Biology	100	4
BT102	Biomolecules	100	4
BT103	Microbiology	100	4
BT104	Analytical Techniques	100	4
	Lab Course		
BT105	Cell Biology lab	50	2
BT106	Biomolecules lab	50	2
BT107	Microbiology lab	50	2
BT108	Analytical Techniques lab	50	2
II SEMESTER			
BT201	Molecular Biology	100	4
BT202	Enzymology	100	4
BT203	Immunology	100	4
BT204	Biostatistics	100	4
	Lab Course		
BT205	Molecular Biology lab	50	2
BT206	Enzymology lab	50	2
BT207	Immunology lab	50	2
BT208	Biostatistics lab	50	2
III SEMESTER			
BT301	Cell Culture Technology and Tissue Engineering	100	4
BT302	Plant Biotechnology	100	4
BT303	Animal and Aquaculture Biotechnology	100	4
BT304	Medical and Environmental Biotechnology	100	4
	Lab Course		
BT305	Cell Culture Technology and Tissue Engineering lab	50	2
BT306	Plant Biotechnology lab	50	2
BT307	Animal and Aquaculture Biotechnology lab	50	2
BT308	Medical and Environmental Biotechnology lab	50	2
IV SEMESTER			
BT401	Heterologous Expression and Down Stream Processing	100	4
BT402	Bioinformatics	100	4
BT403	Proteomics and Genomics	100	4
BT404	Bioethics, IPR and Research Methodology	100	4
	Lab Course		
BT405	Heterologous Expression and Down Stream Processing lab	50	2
BT406	Bioinformatics Lab	50	2
BT407	Proteomics and Genomics lab	50	2
BT408	Bioethics, IPR and Research Methodology lab	50	2
BT409	Project work *	100	4
	Total	2500	100

* 2 month project work at the end of II semester during summer & evaluation at the end of IV semester

minutes of the meeting of the Board of Studies in Biotechnology, Biochemistry, microbiology and Clinical Nutrition held on 8-7-2016 at Department of Zoology, Atikavi Nannaya University Rajahmundry

Members present :-

1. Dr. A. Malta Reddy

Amrany

2. Dr. K. Sarala

Sarala.K

3. Dr. M. Padmaja

M. Pad

4. Dr. Sunila Rani

Sunila Rani

5. Dr. K. Ramameshwari

RD

6. Dr. P. Vijaya Nirmala

P. Vijaya Nirmala
8/7/16

7. Dr. D. Kalyani

D. Kalyani
8/7/16

8. Dr. K. Sahish Kumar

K. Sahish Kumar

9. Dr. I. J. N. Padmavathi

I. J. N. Padmavathi

ADIKAVI NANNAYA UNIVERSITY: RAJAMAHENDRAVARAM

BOARD OF BIOTECHNOLOGY

Date: 08-07-2016

AGENDA:

1. Syllabus for theory papers
2. Syllabus for practicals
3. Number of teaching hours / Periods theory / Practical
4. Credits / Evaluation
5. Eligibility and Entrance Examinations
6. Scheme of Valuation
7. List of Examiners for papers setting and Model Question Papers
8. List of Practical Examiners

Members present:

Dr. A. Matta Reddy

Dr. K. Sarala

Dr. M. Padmaja

Dr. Sunila Rani

Dr. P.Vijaya Nirmala

Dr. D. Kalyani

Dr. K. Satish Kumar

Dr. I.J.N.Padmavathi

RESOLUTION:

The common Board consisting of the above members have met in the Department of Zoology, Adikavi Nannaya University, Rajamahendravaram and considered the enclosed agenda. After thorough deliberations and discussions, the Board members have resolved as follows.

1. The members formulated the syllabus for M.Sc Biotechnology, 2 years course on par with other Universities in the Country to be implemented from 2016-17 academic year.
2. The syllabus for practical for the above courses formulated on par with UGC model curriculum.
3. There shall be 4 to 5 periods per week for each theory paper & 3 periods for each practical.
4. A B.Sc Graduate with any subject in biology is eligible to apply for admission into M.Sc Biotechnology.
5. I & II Semesters are common for M.Sc Biochemistry & M.Sc. Biotechnology. III & IV Semesters have separate syllabi for M.Sc Biochemistry & M.Sc. Biotechnology courses.
6. Marks and credits are allotted to theory & practical papers in each semester. There will be 100 marks for each theory and 50 marks for each practical and a total of 600 marks for each semester. So 2400 marks for the four semesters (600 x 4). 100 marks for Project work. A grand total of 2500 marks for the 2 year M.Sc. Biotechnology course.
7. **Examination pattern will be as follows.**
 - a) 75% of marks for Semester end Examination while the remaining 25% of marks for continuous Internal assessment which includes 5 marks for attendance (5 marks 95 % above, 4 marks 85-94%, 3 marks 75 – 84%, 2 marks 65-74%, 1 mark 55-64%), 5 marks for Assignment and Presentation and 15 marks for Mid-Examination, with one essay (10 marks) & one short question (5 marks) with internal choice.
 - b) The Semester End Examination question paper comprises of two sections –Section A & Section B. Section A consists of 4 questions, one question from each unit of syllabus with internal choice ‘a’ or ‘b’. Section-B consists of 8 short questions two from each unit of the syllabus, with a choice to attempt only 5 out of 8 questions.
 - c) In practical, 75% of marks for semester end examination (38 Marks) and Internal Semester Examination 25% (12 Marks) for continuous assessment for Practical paper (9 + Record-3).
8. There will be Project work for Biotechnology for 100 marks (50 marks for Dissertation & 50 marks for Presentation & Viva-voce). The Project work is to be done during summer vacation i.e after II Semester & before III Semester. Dissertation should be submitted by the students, during 2nd year of study, Presentation and Viva-voce is to be conducted by External Examiner. For affiliating colleges, University teachers will be the external examiner and for University Department, external examiner is to be invited from other university. The External Examiner TA/DA & Remuneration will be borne by the respective College/Department as per the approved norms.
9. A comprehensive Viva-voce to be conducted for students at the end of every semester in the presence of all subject teachers with 20 marks in order to prepare & boost the students to face the interview in future. The marks are adjusted from the internal presentation marks (5 marks in each subject i.e 4x5=20 marks).

ADIKAVI NANNAYA UNIVERSITY

M.Sc. BIOTECHNOLOGY

Examination pattern:

Theory: 75% is End Semester Examination

25% is Internal Assessment

Practical: 75% is End Semester Examination

25% is Internal Assessment – Continuous Assessment

ADIKAVI NANNAYA UNIVERSITY
M.Sc. BIOTECHNOLOGY
SEMESTER END EXAMINATION

Model question paper

Time: 3 hrs

Max. Marks: 75

Section-A

4x15=60

Answer all the questions. Each question carries 15 marks

Q1. Unit-1

a or b

Q2. Unit-2

a or b

Q3. Unit-3

a or b

Q4. Unit-4

a or b

Section-B

5x3=15

- Q5.** It contains 8 short note questions with at least two from each unit, carrying 3 marks.
5 questions are to be answered at least one from each unit.

I SEMESTER

BT101 Cell Biology

Unit I:

Structure of a typical cell, Differences between prokaryotic and eukaryotic cells, animal and plant cells, Nucleus - structure and function of nuclear membrane, nucleolus, chromosome and its high resolution organization, DNA-histone interactions - formation of chromatin fibers - Hetero/ Euchromatin, endoplasmic reticulum, golgi, lysosomes, vacuole, microbodies, ribosomes, cytoskeleton, extracellular matrix.

Unit II:

Biomembranes - Chemical composition of membranes of animal and plant cells, Distribution of membrane lipids, assembly of membrane components, molecular structure of membranes, micelles and liposomes, symmetry of the membrane; membrane fluidity; fluid mosaic model of biological membranes; membrane Transport - Donnan membrane equilibrium, Diffusion across cellular membranes mediated transport; Energetics of transport systems; Passive transport - anion exchange proteins; active transport; active transport of Na^+ K^+ (Sodium potassium ATPase) Ca^{2+} (Ca^{2+} -ATPase); active transport of sugars coupled to phosphorylation; group translocation (γ -Glutamyl cycle); proton motive force in bacterial transport processes; ionophores, gap junctions; endocytosis, exocytosis; nature of receptors.

Unit III:

Mitochondria - structure, biogenesis and enzymatic compartmentation; organization of mitochondrial respiratory chain; mechanism of oxidative phosphorylation; ultrastructure of the chloroplast; Photosynthesis – photophosphorylation; Carbon dioxide fixation in C3, C4 and CAM plants; Photorespiration.

Unit IV:

Cell division and chromosomal variations: Mechanism of cell division - mitotic apparatus, cytokinesis, chromosome movement; Meiotic process - stages, chromosome pairing, chiasma formation molecular mechanisms of recombination, synaptonemal complex; Nondisjunction, regulation of eukaryotic cell cycle - Molecular events including cell cycle check points and CDK – cyclin complexes; Chromosomal abnormalities - euploidy, haploidy - their fundamental and practical significance, polyploidy - induction - aneuploidy - type and genetic significance.

Recommended Books:

1. Cell and Molecular Biology by EDP de Robertis and EMF de Robertis.
2. Cell and Molecular Biology by Baltimore.L
3. The Cell - Hooper
4. Molecular Biology of the Cell by B.Alberts, Garland publications incorporation.
5. Molecular Cell Biology by J. Darnell, Scientific American Books.
6. Cell and Molecular Biology by P.K.Gupta, Rastogi Publ.

BT102 Biomolecules

Unit I:

Chemical foundations of biology – pH, pK, acids, bases, ionization of water, buffers - buffering in biological systems, chemical bonding – various forces and interactions in biological systems; Amino acids – classification, structure and physicochemical properties, non-protein amino acids, Peptide bond – Structure and conformation, Naturally occurring peptides; Proteins – classification, purification, isolation and criteria of homogeneity; sequence determination and characterization of proteins, physicochemical properties, structural organization of proteins, Elucidation of primary structure, secondary structure, tertiary structure, quaternary structure, Denaturation & renaturation of proteins.

Unit II:

Carbohydrates: Definition and classification of carbohydrates, nomenclature, Reaction of Mono-saccharides, Acid derivatives of Monosaccharides amino-sugars, Oligo saccharides, structure, and properties, Chemistry and biological roles of homo and heteropolysaccharides, peptidoglycan, glycosaminoglycans, glycoproteins and other glycoconjugates.

Unit III:

Classification of Lipids, Fatty acids and their physicochemical properties, physicochemical properties and characterization of fats and oil; Structure, properties and biological roles of triacylglycerol, phospholipids, sphingolipids, Gangliosides, Prostaglandins, Thromboxanes, Leukotrienes and steroids.

Unit IV:

Nucleic acids – bases, nucleosides, nucleotides, purine and pyrimidine bases physicochemical properties of nucleic acids, cleavage of nucleic acids by enzymatic methods, non enzymatic transformation of nucleotides and nucleic acids, chemical synthesis of DNA; Nucleic acid sequencing – Higher orders of DNA & RNA Structure, chromatin structure; Three dimensional structure of DNA; Types of RNA, Structure of RNAs – Secondary and Tertiary structure; DNA denaturation and renaturation kinetics.

Recommended Books:

1. Nelson.D.L, Cox. M. M. Lehninger's Principle of Biochemistry. Freeman.
2. Murray. R.K, Granner.D.K, Mayes. P. A, Rodwell. V. W. Harper's Biochemistry, McGraw Hill.
3. Fundamentals of Biochemistry by Donald Voet.
4. Textbook of Biochemistry West, E.S., Todd, Mason & Vanbruggen, Macmillian&Co.
5. Biochemistry, Lubert Stryer.

BT103 Microbiology

Unit I:

History and Scope of Microbiology; Classification of Microorganisms-Bacteria, Fungi, Virus, Alga, Protozoa, phenotype, numerical and phylogenetic tree - rRNA, DNA and Proteins, Microbial diversity, Major characteristics used in taxonomy – morphological, physiological and metabolic, ecological, genetic analysis and molecular characterizations- (protein, nucleic acid composition); sterilization techniques, disinfectant and antiseptic agents; Major groups of bacteria- Archaeobacteria, Actinomycetes, Chemoautotrophs, Eubacteria, Pseudomonads, cyanobacteria; Bacterial cell- structure and functions of cellular components-cell wall composition of Gram positive and Gram negative bacteria, sub-cellular organizations, flagella, capsule and spores.

Unit II:

Modes of nutrition – phototrophy, chemotrophy, methylotrophy, organotrophy, mixotrophy, saprophytic, symbiotic and parasitic modes of nutrition; Isolation of microorganisms – Direct and indirect; Methods of maintenance of culture, composition of culture media - solid and liquid media, chemically defined media, complex and differential media; Growth and kinetics of bacterial cells; batch and continuous cultures, chemostat; Effect of pH, temperature and radiation on microbial growth; Preservation of cultures (glycerol stocks, freeze drying); staining techniques, differences between Gram-positive and Gram-negative bacteria.

Unit III:

Introduction to Virology: Classification, Morphology, size, ultra structure and life cycle of some representative viruses (ØX174, t4, SV40, Phage λ, m13 and HIV); Methods of culturing of viruses, Biology of subviral agents – Viroids, Prions, Satellite viruses, Antiviral agents-chemical and biological agents; Molds – characteristics, classification and reproduction; Yeasts – morphology, characteristics and reproduction; General characteristics of Actinomycetes, Rickettsia, Spirochaetes and mycoplasma; Economical and industrial uses of algae.

Unit IV:

Role of microorganisms in domestic and industrial sewage; Microbes and Diseases - Diseases of the respiratory tract-diphtheria, tuberculosis, pneumonia, influenza, mumps; Diseases of the skin- systemic mycoses, candidiasis; herpes viral infections, chicken pox, and small pox; Genitourinary infections- Gonorrhoea, syphilis; Diseases of GIT- Cholera, Typhoid; Hepatitis; Major human protozoan diseases- Malaria, Trypanosomiasis, meningoencephalitis, Viral diseases – Dengue, Hepatitis, HIV, Polio, Rabies, SARS; Inactivation of viruses – photodynamic inactivation.

Recommended Books:

1. Prescott, Harley and Klein, Microbiology Publisher: McGraw Hill Science
2. Gerard J. Tortora, Berdell, R. Funke, Christine L. Case, Microbiology: An Introduction Benjamin Cummings Publisher.
3. Microbiology by Pelczar, Chan and Krieg Mc Graw- Hill.
4. A Textbook of Microbiology, R.C.Dubey and D.K.Maheswari, S.Chand Co.
5. Fundamentals of Microbiology – M. Frebisher.

BT104 Analytical Techniques

Unit I:

Microscopy- Principles and applications of light, phase contrast, fluorescence, scanning and transmission electron microscopy; Properties of electromagnetic radiations; Principles, instrumentation and applications of UV, visible, infrared, ORD, CD, NMR spectroscopy; Spectrofluorimetry and mass spectrometry, X-ray diffraction; Flow cytometer.

Unit II:

Chromatography - Principles and applications of gel-filtration, ion-exchange and affinity chromatography; TLC, GLC and HPLC; Centrifugation - Basic principles of centrifugation, types of centrifuges, Applications of preparative and analytical ultra-centrifuges, Principles and applications of sedimentation and lyophilization.

Unit III:

Electrophoresis - Principle of electrophoretic techniques, Poly Acryl amide Gel Electrophoresis, Isoelectric focusing, Isotachophoresis, 2-D Electrophoresis, Capillary electrophoresis, Agarose gel electrophoresis of DNA and RNA, Blotting techniques.

Unit IV:

Stable and radioactive isotopes, Detection and measurement of radioactivity, Applications of radioisotopes in biological sciences, Autoradiography, Non-isotopic tracer techniques; Principles and range of electrochemical techniques, Operation of pH electrodes, Principles and applications of Ion-selective and gas sensing electrodes, Oxygen electrodes.

Recommended Books:

1. Principles and Techniques of Biochemistry and Molecular Biology by Keith Wilson and John Walker.
2. Biophysical chemistry principles and techniques by Upadyay, Upadyay and Nath (Himalaya publishing).
3. A Biologists guide to Principles and techniques of practical Biochemistry. By B.D.williams (Edward Arnold).
4. Modern experimental Biochemistry by Rodney Boyer (Pearson Education).

I SEMESTER PRACTICALS

BT105 Cell Biology Lab

1. Light Microscopic examination of tissues
2. Preparation of different cell types–hepatic parenchymal cells, adipocytes, macrophages, neuronal cells, epithelial cells.
3. Stages of mitosis and meiosis
4. Mitosis in onion root tip cells: All phases (Squash method).
5. Meiosis in onion flower buds: All phases including zygotene, diplotene and diakinesis of prophase I (Smear method).
6. Arrest and observation of chromosomes after colchicine treatment in onion roots.
7. Blood smear preparation and identification of cells.
8. Isolation of cellular organelles by differential centrifugation.

BT106 Biomolecules Lab

1. Estimation of glycine by formal titration.
2. Estimation of proteins by Lowry and Bradford methods.
3. Analysis and identification of monosaccharides.
4. Estimation of Maltose by DNS method.
5. Determination of Iodine value of oils.
6. Estimation of cholesterol.
7. Estimation of DNA by DPA method.
8. Estimation of RNA by orcinol method.

BT107 Microbiology Lab

1. Introduction to sterilization techniques.
2. Preparation of liquid and solid media for growth of microorganisms.
3. Isolation of Bacteria from soil –serial dilution technique.
4. Simple Staining, acid fast staining, spore staining, Grams staining.
5. Biochemical tests for bacteria.
6. Pure culture techniques-streak plate, spread plate and pour plate.
7. Bacterial growth curve.
8. Isolation of viruses.

BT108 Analytical Techniques Lab

1. Microscopic examination.
2. Spectroscopic determination of nucleic acids and proteins.
3. Separation of biomolecules by paper chromatography and Thin Layer Chromatography
4. Subcellular fractionation by differential centrifugation.
5. Polyacrylamide gel electrophoresis of proteins.
6. Qualitative determination of nucleic acids by agarose gel electrophoresis.
7. Preparation of buffers and pH determination by pH meter.
8. Measurement of radioactivity by Geiger Muller Counter.

II SEMESTER BT201 Molecular Biology

Unit I:

Models of DNA Replication, Origin and direction of replication, Semi discontinuous replication, DNA polymerases of prokaryotes and their mechanism of action, Primase, Ligase, Single strand DNA binding protein, Helicase, Topoisomerases, Replication strategies for replicating circular DNA: ϕ mode replication, σ mode or rolling circle replication and D-loop replication; Eukaryotic DNA polymerases, Reverse transcriptase, Strategies for replicating linear DNA, Fidelity and processivity of replication, Inhibitors of replication.

Unit II:

DNA Repair mechanisms, Photoreactivation, Excision repair mechanism, Post replication repair mechanisms - recombination repair, mismatch repair system, SOS response, transcription-repair coupling. Recombination - models of general recombination; Holliday model, asymmetric strand transfer model, double strand break repair model, site-specific recombination; Transposition of DNA; Transposable elements, Prokaryotic transposons, Eukaryotic transposons, Retrotransposons.

Unit III:

Prokaryotic RNA polymerase, Conserved sequences of prokaryotic promoters, Initiation of transcription, Chain elongation, Chain termination, Eukaryotic RNA polymerases, Conserved sequences of eukaryotic promoters, Transcriptional factors and basal eukaryotic transcription complex, Enhancers, Transcriptional termination in eukaryotes, Post transcriptional processing of pre-mRNA - addition of Cap to the 5' end, Polyadenylation to the 3' end, mechanism of intron removal and exon splicing, Processing of r-RNA, Self-splicing of introns, Processing of tRNA, Inhibitors of RNA synthesis.

Unit IV:

General features of genetic code, Structural components of prokaryotic and eukaryotic ribosomes, Mechanism of protein synthesis in prokaryotes and eukaryotes - aminoacylation of tRNA, protein synthesis - initiation, elongation and chain termination, Protein synthesis inhibitors, Post translational modifications of proteins, role in targeting (isoprenylation); Signal peptide (ERLS), role of SRP in translation of secreted proteins; molecular chaperones, HSPs in protein folding; Lysosomal pathways (endocytosis, macroautophagy, microautophagy, direct translocation from cytosol), Ubiquitin-proteasome pathway.

Recommended Books:

1. Lehninger Principles of Biochemistry, David L. Nelson, Michael M. Cox Publisher: W. H. Freeman.
2. Molecular Biology of the Cell, Bruce Alberts, Dennis Bray, Julian Lewis, Martin Raff, Keith Roberts, and James D Watson. Publisher New York: Garland Science
3. Biochemistry, Donald Voet, Judith G. Voet, Publisher John Wiley & Sons
4. Molecular Biology of the gene by Watson
5. Molecular Cell Biology by Harvey Lodish, David Baltimore, W. H. Freeman Publisher.
6. Molecular Biology by D Friefelder

BT202 Enzymology

Unit I:

Classification of enzymes, Remarkable properties of enzymes – catalytic power, specificity, Transformation of different forms of energy, Enzyme localization and assay, Units of enzyme activity, Active site – Fisher and Koshland models, formation of enzyme – substrate complex and experimental evidences, Nature of active site, mapping of enzyme active site through chemical procedures and site directed mutagenesis, Factors affecting enzyme activity, Modern concepts of evolution of catalysis, ribozymes, abzyme and synzymes.

Unit II:

Kinetics of single substrate enzyme catalyzed reactions, Michaelis – Menten equation, Lineweaver - Burk, Eadie – Hofstee and Hanes plots, Significance of V_{max} , K_m , K_{cat} specificity constant (K_{cat}/K_m), Kinetics of multisubstrate reaction, Rate expression for non-sequential (ping-pong) and sequential (ordered and random) mechanisms, Use of initial velocity, Inhibition and exchange studies, Flexibility and conformational mobility of enzymes, Enzyme inhibitions – reversible inhibition – competitive, non-competitive, uncompetitive inhibition, irreversible inhibition, Determination of K_I values.

Unit III:

Types of reaction catalysis – General acid – base, electrostatic, covalent, intermolecular, metal – ion catalysis, Proximity and orientation, Mechanism of reaction catalyzed by serine proteases – trypsin and chymotrypsin, carboxypeptidase, lysozyme, triose phosphate isomerase, ribonuclease, Rotational catalysis in ATPase, Mechanism of catalysis with coenzymes – pyridoxal phosphate, flavin nucleotides, thiamine pyrophosphate, biotin, tetrahydrofolate, lipoic acid.

Unit IV:

Enzyme regulation – general mechanisms of enzyme regulation, Allosteric enzymes (ATCase), Cooperativity phenomenon, Hill and Scatchard plots, Sigmoidal kinetics and their physiological significance, Symmetric and sequential models of action of allosteric enzymes and their significance, Feedback inhibition and feed forward stimulation, Control of enzymatic activity by products and substrates, Reversible and irreversible activation, Isoenzymes, Multifunctional enzymes, Multienzyme systems – properties, mechanism of action and regulation of Pyruvate dehydrogenase and Fatty acid synthase complex; Enzyme purification - Methods of isolation, purification, Recovery and yield of enzymes, Criteria for testing purity of enzyme preparations; Immobilized enzymes - Methods of immobilization, Applications of immobilized enzymes.

Recommended Books:

1. Understanding enzymes: Palmer T., Ellis Harwood Ltd.
2. Enzyme structure and mechanism. Alan Fersht, Freeman & Co.
3. Principles of enzymology for food sciences: Whitaker Marc Dekker.
4. Methods in enzymology Ed. Colowick and Kaplan, Academic Press
5. Text book of Biochemistry with clinical correlations-Thomas M.Devlin.
6. Biological chemistry; H.R. Mehler & E.H Cordes Harper & Rev.
7. Enzyme kinetics Siegel interscience – Wiley.
8. Biochemistry chemical reactions of living cells David E.Matzler.

BT203 Immunology

Unit I:

Types of immunity – Innate and adaptive; Antigens, Super antigens, Adjuvants; Cells and organs of the immune system -Thymus, bone-marrow, spleen, lymph node; T and B lymphocytes – Origin, activation, differentiation, characteristics and functions, Nature of T and B cell surface receptors; Major Histocompatibility Complex- H-2, HLA, Polymorphism of MHC molecules, MHC restriction and its role in immune response, Antigen presenting cells, Processing and presentation of antigens.

Unit II:

Structure of immunoglobulins, Immunoglobulin classes and biological activities, Isotypes, Allotypes, Idiotype; Antibody diversity: Mini gene theory, Mutation theory, Germ line theory, Somatic recombination, V (D) J recombination, Combinatorial diversity, Junctional diversity, Class switching; Immunological memory; Humoral and cell-mediated immune responses, Cytokines, Interleukins, Interferons; Complement components and biological consequences of complement activation.

Unit III:

Antigen-antibody interactions: Antibody affinity and avidity, Precipitation reactions – Immunodiffusion, Radial immunodiffusion, double immunodiffusion, immunoelectrophoresis, Rocket immunoelectrophoresis, Agglutination reactions-Heme agglutination and complement fixation, Immunofluorescence, FACS, RIA, ELISA, Immunoblotting, Hybridoma technology - production of monoclonal antibodies and their applications; Development of Vaccines- conventional vaccines- attenuated, killed organisms and subunit vaccines; modern vaccines- recombinant vaccines and DNA vaccines.

Unit IV:

Immune effector mechanisms – Hypersensitivity: immediate (type I, type II, type III) and delayed hypersensitivity reactions; Immunodeficiencies - SCID and AIDS; Autoimmunity - organ specific (Hashimoto's thyroiditis) and systemic (Rheumatoid arthritis) diseases; Tissue transplantation - auto, allo, iso and xenograft, tissue matching, transplantation rejection, mechanism and control, immunosuppressive agents; Cancer immunology – Tumor associated antigens, Immunological surveillance of cancer.

Recommended Books:

1. Essential immunology- Ivan M. Roitt.
2. Introduction to Immunology – John W.Kinball.
3. Immunology – D.M. Weir.
4. Immunology – Janis Kuby.

BT204 Biostatistics

Unit I:

Introduction- definition of statistics-population and universe, the sample and population, statistical inference parameter and statistics, Handling of bulky data, construction of a histogram, interpretation of histogram, the normal distribution, the mean, mode and standard deviation representing the normal curve as straight line, uncertainties in estimating a mean.

Unit II:

Measures of variation, Range, quartile deviation, mean deviation and standard deviation, Coefficient of variation; Probability - Addition and multiplication theories, conditional probability and probability distributors; Proportion data- Examples of Proportion data – testing of medicines, animal toxicity, infection and immunization studies e.g., LD₅₀, ED₅₀, PD₅₀ statistical treatment to proportion data; normal distribution; Count data- Examples of count data (bacterial cell count, radioactivity count, colony and plaque count, etc.), Statistical treatment to count data - Poisson distribution, standard error, confidence limits of counts.

Unit III:

Simple linear regression and correlation, Correlation regression and line fitting through graph points, standard curves, correlation - linear regression (fitting the best straight line through series of points)- standards curves and interpolations of unknown y-values, Regression coefficients and properties.

Unit IV:

Types of errors and levels of significance, Parametric tests of significance– F & t tests, chi-square tests, Analysis of variance (ANOVA); Non parametric tests- sign test, Wilcoxon signed rank test, Mann-Whitney test, Kruskal-Wallis test and Friedman tests; computer aided statistics- STATVIEW, SPSS, STATISTICA, STATSOFT.

Recommended Books:

1. Statistics, Basic Concepts and Methodology for the Health Sciences Daniel WW, Pub Wiley India
2. An Introduction to statistical methods and data analysis by Lyman Ott PWS-Kent publication Co-Boston
3. Methods in Biostatistics Mahajan B K and Srimathi
4. Pollard, J H. A handbook of Numerical and statistical techniques with examples mainly from the life sciences. Cambridge University, Cambridge.
5. J medhi statistical methods. An introductory text. New international (P) Ltd. Publishers.
6. P S S Sudar Rao & J Richard. An introduction to biostatistics and Research Methods, Phi Learning Publisher.

II SEMESTER PRACTICALS

BT205 Molecular Biology Lab

1. Isolation of DNA from bacterial, plant and animal cells.
2. Isolation of RNA from yeast cells.
3. Estimation of DNA and RNA by UV absorption method and determination of purity of nucleic acids.
4. Agarose gel for RNA, DNA, blot the gel
5. Determination of sugar and phosphate ratios in DNA and RNA samples.
6. Determination of melting temperature (T_m) of DNA.

BT206 Enzymology Lab

1. Assay of Amylase from saliva
2. Assay of Acid phosphatase from potato
3. Assay of Trypsin
4. Alkaline phosphatase from Serum.
5. Assay of urease from Horse gram
6. Assay of Succinate dehydrogenase from the liver
7. Isoenzymes of LDH – electrophoretic separation and specific staining technique
8. Time course of enzyme activity
9. Effect of pH and temperature on enzyme activity
10. Immobilization of enzymes (demonstration).

BT207 Immunology Lab

1. Determination of A, B, O and Rh blood groups in human beings
2. Diagnostic test for typhoid fever
3. VDRL Test
4. Pregnancy Test
5. Ouchterlony immunodiffusion for detection of Antigens
6. Radial Immunodiffusion
7. Immunoprecipitation and precipitin curve
8. Rocket immunoelectrophoresis
9. Enzyme Linked Immuno Sorbent Assay (ELISA)

BT208 Biostatistics Lab

1. Classification of data, computation of mean and standard deviation.
2. Simple statistical analysis with Excel.
3. Correlation and regression coefficients.
4. Binomial distribution
5. Poisson distribution
6. Normal distribution
7. Analysis of data using Student's "t" test using any statistical tool
8. One way ANOVA with equal number of observations and with unequal number of observations and ANOVA with two way classified data using any statistical tool.

BT301. Cell Culture Technology and Tissue Engineering

UNIT-I

Plant tissue culture technology: culture media – composition and preparation. Factors governing *in-vitro* behaviour, Somatic embryogenesis, organogenesis and plant regeneration. Culture types. Micro propagation, Haploids, somaclonal variations, metabolite production in cultures. Isolation of protoplasts, protoplast fusion and culture. Somatic hybridization.

UNIT-II

Animal cell and tissue culture. Primary culture, balanced salt solutions and simple growth medium. Serum and protein free defined media. Cell lines, primary and established cell line cultures. Basic techniques of mammalian cell culture *in vitro*. Tissue and organ culture. Production and use of artificial tissues and organs – Skin, liver and pancreas. Apoptosis - mechanism and significance.

UNIT-III

The biology of stem cells – types of stem cells – embryonic stem cells, fetal tissue stem cells, adult stem cells; stem cell differentiation, stem cell plasticity – Differentiation versus stem cell renewal. Isolation and propagation of embryonic stem cells; chimeras; generation of knock-out mice and knock-in technology.

UNIT-IV

Hematopoietic stem cells and bone marrow transplantation: Cells for hematopoietic reconstitution – Cord blood stem cells; cells for adoptive cellular immunotherapy; bone marrow transplantation - advantages and disadvantages. Allogenic, autologous, syngenic and congenic transplantation. Clinical applications of stem cell therapy; neurodegenerative diseases – Parkinson's disease, Alzheimer's, spinal cord injury and other brain syndromes.

Suggested Reading Material:

01. Plant tissue culture – theory and practice by Bhojwani S.S.
02. Plant cell culture – A practical approach by Dixon R.A.
03. Culture of Animal cells by R.I.Freshney. Wiley – Liss.
04. Animal Cell Culture – A Practical approach Ed. by John R.W.Masters (IRL Press).
05. Animal cell culture techniques, Ed. Martin Clynes, Springer.
06. Plant Cell, Tissue and Organ Culture, By Reinert, J. and YPS Bajaj (Springer – Verlag).
07. Plant tissue and cell culture, by Street, HE (Blackwell).
08. Stem cells in regenerative medicine by Audet (Springer).
09. Cell and tissue reaction engineering by Eibl (Springer).

BT302. Plant Biotechnology

UNIT-I

Plant Genetic engineering: Gene cloning techniques, Techniques for gene transfer into plants. Mechanism of gene transfer by TI and RI plasmids as vectors. Reporter genes, transient gene assays and identification of transgenic plants. Molecular markers and their significance. RFLP, AFLP and QTL in plants. RAPD for molecular mapping and crop improvement.

UNIT-II

Agricultural Biotechnology: Engineering of herbicide tolerance in plants, production of disease resistant plants by gene transfer; Development of insect resistant plants. Biotechnological strategies for engineering stress tolerance.

UNIT-III

Altering protein and oil quality traits in seeds. Chloroplast transformation – advantages in tobacco and potato plants for expression of bacterial, viral and eukaryotic genes. Edible vaccines and plant antibodies. The genetic manipulation of crop yield by enhancement of photosynthesis.

UNIT-IV

Algal Biotechnology: Laboratory culture of micro algae. Large scale biomass production. Marine micro algae/sea weeds and their products. Edible sea weeds and their cultivation. Biofertilizers – Blue green algal fertilizers – Azolla, Anabaena, symbiotic association. Sea weed fertilizers. Mycorrhizal biofertilizers, bacterial fertilizers. Biopesticides in agricultural production.

Suggested Reading Material:

01. Plant Biotechnology by A. Slater, N.W. Scott and M.R. Fowler (Oxford University press).
02. Biotechnology in Agriculture by Swaminathan, M.S (Mc. Millan India Ltd).
03. Biotechnology and its applications to Agriculture, by Copping LG and P.Rodgers (British Crop Projection).
04. Plant Biotechnology, by Kung, S.and C.J.Arntzen (Butterworths).

BT303. Animal And Aquaculture Biotechnology

UNIT-I

Types and causes of male and female infertility, sperm collection, Cryopreservation, artificial insemination, Oocyte recovery, superovulation, oocyte maturation *in-vitro*, *In-vitro* fertilization in humans and cattle. Embryo culture, embryo transfer in farm animals. Immunocontraception - hormonal methods. Biotechnological approaches for the management of pests, mosquitoes and nematodes. Live stock improvement

UNIT-II

Production of transgenic animals - mice, sheep and fish. Molecular pharming and animal cloning. Somatic cell nuclear transfer in humans – Legal and ethical aspects. Potential applications of transgenic animals – Animal models for diseases and disorders. Transgenic poultry and transgenic insects as bioreactor.

UNIT-III

The concept of aquatic biotechnology and blue revolution. Economically important aquatic resources from fresh water, brackish water and marine habitats – the finfish, shellfish, algae, corals, and holothurians. Bioactive compounds from corals. Fish byproducts. Pearl culture technology – principles and applications.

UNIT-IV

Aquaculture - Fresh water fish culture practices and types. Freshwater prawn culture. Brackish water fish, shrimp and crab culture practices. Fresh water fish hatchery and seed production. Hypophysation and induced breeding techniques. Eyestalk ablation. Techniques involved in transgenic fish production. Post harvest technology. Diagnosis of shrimp & fish diseases caused by bacterial, fungal and viral pathogens using molecular methods. Vaccines - DNA vaccines application in aquaculture.

Suggested Reading Material:

01. Elements of Biotechnology by PK Gupta (Rastogi & Co).
02. Biotechnology by Kashav. T (Wiley Eastern Ltd).
03. Concepts in Biotechnology by Balasubrahmanian et. al., (University press).
04. Principles and practices of aquaculture by TVR Pillay. Blackwell Scientific publications
05. Coastal aquaculture by Santhanam. R. and Ramanathar, N. C.B.S.
06. Fisheries of India by CBL Srivatsava.
07. Molecular Biotechnology by Glick.
08. Reddy. P V G K. Ayyapan et al., . Text Book of Fish Genetics and Biotechnology. 218p ICAR Publications. ISBN:81-7164-029-X
09. Lakra. W S et al., “Fisheries Biotechnology” Narendra Publishing house, 240p,
10. Jhingran, V.G. 1991 Fish and Fisheries of India. Hindustan Publishing Co., Delhi;
13. U.K. Srivastava B.H. Dholakia, S. Srinivasa Rao. S.Vathsala. Freshwater Aquaculture in India, Oxford & IBH Publishing Co., New Delhi.
13. Dunham R.A., Aquaculture and fisheries biotechnology, 1s, CABI Publishers, Cambridge, USA

BT304. Medical And Environmental Biotechnology

UNIT-I

Health care products. Products from recombinant DNA Technology - insulin, growth hormone, factor VIII, tissue plasminogen activator, interferons, lymphokines and Hepatitis-B vaccines.

UNIT-II

Disease diagnosis: DNA probes, Enzyme probes - glucose oxidase, lactate oxidase, monoamine oxidase. PCR amplification and diagnosis - Applications in forensic medicine. Genetic diseases and gene therapy. Current strategies for development of vaccines against HIV, Malaria, Tuberculosis.

UNIT-III

Environmental pollution – types, sources and control. Reduction of environmental impact of industrial effluents, chemical herbicides and fertilizers. Removal of oil spills. Environmental monitoring and biomonitoring. Bioremediation - solid and liquid waste treatment. Biomass and energy production from waste. Bioleaching – Microbial recovery of metals and acid mine drainage. Water pollution and its control. Microbiological approach of waste water treatment.

UNIT-IV

Environment and energy: Renewable sources of energy – Biogas, waste materials, energy crops, cellulose. Production of energy and fuel using microorganism – Biofuels and Biodiesel. Global environmental problems: Ozone depletion, UV-B, Green house effect. Biodiversity - benefits to mankind - Conservation; Ecology and sustainable development.

Suggested Reading Material:

01. Biotechnology by B.D.Singh (Kalyani).
02. Ecology and Environment by PD Sharma.
03. Fundamentals of Ecology, by Odum, EP (Mc Graw Hill)
04. Environmental Biotechnology by Forster, C.F. and Wase D.A.J. (Ellis Horwood).
05. Biotechnological innovations in environmental management by Leach, CK and Van Dam- Mieras, MCE (Butterworth-Heinemann, Oxford (Biotol Series).
06. Molecular Biology and Biotechnology by Meyers, RA, A comprehensive Desk reference (VCH Publishers).
07. Biotechnology by U. Satyanarayana (Books & Allied (P) Ltd).

III SEMESTER PRACTICALS

BT305 Cell Culture Technology and Tissue Engineering Lab:

01. Preparation of media for plant tissue culture (MS and B5).
02. Establishment of callus cultures from carrot cambial tissue.
03. Establishment of cell cultures and plating.
04. Embryo culture of maize/ *Crotalaria*.
05. Organogenesis and regeneration of plants from tobacco explants.
06. Anther culture and production of haploids.
07. Micropropagation using suitable system: Potato / *Solanum*

BT 306 Plant Biotechnology Lab:

1. Isolation of genomic DNA from dicot and monocot plants.
2. Qualitative and quantitative analysis of plant genomic DNA
3. Amplification and cloning of a plant gene
4. Mapping of a plant gene. Analysis of a plant gene sequence using Clone Map Software
5. Overexpression of plant protein in *Escherichia coli*
6. Western analyses of expressed plant protein.
7. Cloning of pathogenesis related proteins in *Agrobacterium*
8. *Agrobacterium*-mediated plant transformation.
9. Analysis of transgene integration and expression in plants.

BT307-Animal and Aquaculture Biotechnology Lab:

01. Reporter gene assay (GUS).
02. Preparation of animal cell culture media and membrane filtration.
03. Preparation of single cell suspension from spleen and thymus.
04. MTT assay for cell viability and growth.
05. Demonstration of sections of human ovary, testis and aborted human embryos.
06. Identification of some commercially important aquatic species.
07. Fish Pituitary hypophysation.
08. Estimation of water quality parameters : dissolved oxygen, salinity, ammonia.
09. Antagonistic test with probiotics and fish pathogens
10. Identification and partial characterization of fish and shrimp pathogens .
11. Ploidy detection using karyotyping.
12. PCR diagnosis of white spot syndrome virus, monodon baculovirus, hamotopoetic necrosis virus - Demonstration
14. Induction of breeding in fish using ovaprim-invitro fertilization and rearing of fry.

BT308-Medical and Environmental Biotechnology Lab:

1. Estimation of dissolved oxygen
2. Estimation of salinity in water samples.
3. Estimation of Chemical Oxygen Demand (COD).
4. Estimation of Biochemical Oxygen Demand (BOD).
5. Determination of suspended solids in industrial effluents.
6. Removal of colour of the industrial effluents by biological methods.
7. Reduction of pollution load in effluents by biological methods (laboratory models).
8. PCR - demonstration.

BT401. Heterologous Expression And Down Stream Processing

UNIT-I

Heterologous Expression: Expression vectors and hosts Generally Regarded As Safe (GRAS) organisms. Production of active recombinant proteins of mammalian/Eukaryotic origin in prokaryotes. Large scale production of proteins from recombinant microorganisms. Principles of microbial growth – Batch fermentation, feed-batch fermentation – continuous fermentation, high density cell cultures – Bioreactors – Large scale fermentation system – tandem Airlift reactors – Single stirred tank reactors.

UNIT-II

Downstream processing: Harvesting microbial cells – Membrane filtration system, high speed semi continuous centrifugation – disrupting microbial cells. Gram scale purification of recombinant proteins – Chromatography systems and analytical methods for large scale purification. Stabilization of the proteins.

UNIT-III

Processing technology: Microbial metabolites - Organic solvents (Alcohol, Acetone, Butanol), Organic acids (Citric acid, lactic acid), Wines and beers, Antibiotics (penicillin, streptomycin, tetracycline, semi synthetic penicillins), Vitamins (Vitamin B12 and Riboflavin), Amino acids (lysine, glutamic acid). Production of single cell proteins.

UNIT-IV

Enzyme technology: Sources, production, isolation and purification of enzymes for the industrial use. Application of enzymes in pharmaceutical, food processing and other industries. Different techniques of immobilization of enzymes, applications and kinetics of immobilized enzymes. Design and operation of immobilized enzyme systems and bioreactors. Whole cell immobilization. Biosensors - principle and types.

Suggested Reading Material:

01. Biotechnology – Volumes 1 to 5 by Rehem.
02. Industrial Microbiology by LE Casida Jr.
03. Industrial Microbiology by Presscot and Dunn.
04. Immobilized enzymes by Messing.
05. Biochemical engineering fundamentals by Bailey and Ollis.
06. Biotechnology by BD Singh (Kalyani).

BT 402-Bioinformatics

UNIT – I

Introduction, History, Internet, and Bioinformatics knowledge, Discovery, data mining, problems found in Bioinformatics area, opportunities in Bioinformatics and human genome project.

UNIT – II

Data bases and their management: Data base concept, introduction, history of data bases, data base management system, types of databases, codd rules, data normalization.

UNIT – III

Biological databases: Introduction, need, organization and search for data bases. An over view of types of biological data bases - NCBI, EMBL, DDBJ, SWISS – PROT, PDB, KEGG.

Microbial and cellular data bases, primary sequence databases, carbohydrate data bases, RNA data bases, Genome data bases, Organism data bases, Biodiversity. Database searching using BLAST and FASTA.

UNIT – IV

Data base querying with NCBI using words, sequences (Proteins and genes), finding similarities, identifying genes and proteins from different organisms.

Sequence alignment – Introduction, significance of sequence alignments and use of dot matrices. Pairwise and multiple sequence alignment.

Text Books:

1. T.K. Attwood & D.J. Parry-Smith 1999. Introduction to Bioinformatics. Pearson Education Asia.
2. Stephen Misener & S.A. Krawez 2000. Bioinformatics: Methods and Protocol.
3. R. Durbin, S. Eddy, A. Krogh & G. Mitchson. 1998. Biological sequence analysis. Cambridge University Press.
4. C.P. Freidman & J.C. Wyatt, 1997. Computers and machine: Evaluation methods in Medical information. Springer Verlag, New York.
5. M.J. Bishop & C.J. Wyatt, 1997. DNA and Protein structure analysis: A Practical approach. Oxford University Press.
6. S.B. Primrose. 1998. Principle of genome analysis, 2nd edition. Blackwell Science.

BT403. Proteomics and Genomics

UNIT-I

Introduction to proteomics- Significance and applications of proteomics in biology
Protein function and expression, essential proteins, protein function from structure, rational drug design, lethal mutants. Proteome analysis: high-throughput proteome analysis with 2D-IEF, current concepts of coimmunoprecipitation for protein interaction analysis, amino acid sequencing, Current concepts of peptide sequencing with MS-MS methods, MALDI-TOF mass spectrometry and nanospray MS, Phage Display, Protein chips; Micro Arrays- Affimetrics and spotted array concepts.

UNIT-II

Protein sequence Data base- Swiss-prot, Tr-EMBL, PIR, Uniprot and Pfam, Structural Data bases-CATH, SCOP, MMDB. Molecular Modeling-Homology modelling and docking studies (Using Molegro Virtual Docker) – RASMOL. Molecule Import and preparation from PDB, Docking, Analysis, Constrains, Data analyser, sidechain flexibility and template docking Drug discovery – target identification, target validation, lead identification, lead optimization, Phase I, II and III clinical trials, pharmacodynamics.

UNIT-III

Origin of genomes, the human genome. Technology, Data bases- INSD-International Nucleotide Sequence Database, Gen Bank, EMBL, DDBJ, special focus on NCBI, Sequence comparison techniques (BLAST etc). Comparative Genomics - Phylogeny, Synteny (comparison of grass genomes), COGS (Cluster of orthologous genes, NCBI website).

UNIT-IV

Functional Genomics - ESTs, Digital northern, SAGE, Relational Data Base Basics, Gene finding tools. Whole genome analysis: preparation of ordered cosmid libraries, bacterial artificial chromosome libraries, shotgun libraries and sequencing. Conventional sequencing (Sanger and Maxam & Gilbert methods), automated sequencing. Analysis of single nucleotide polymorphism (SNP) using DNA chips.

Suggested Reading Material:

1. Proteomics by T. Palzkill, Kluwer Academic Publishers
2. Proteomics: From protein sequence to function by S. Pennington and M.J. Dunn, Springer Verlag.
3. Structural bioinformatics by P.E. Bourne and H. Weissig, Wiley-Liss publishers
4. Posttranslational modifications of proteins: Tools for functional proteomics (Methods in Molecular Biology Vol 194) by C. Kannicht, Humana Press
5. Bioinformatics: Sequence and Genome analysis by DW Mount, Cold Spring Harbor press
6. Bioinformatics: A practical guide to the analysis of genes and proteins by AD Baxevanis and BFF Ouellette, John Wiley and Sons Inc.
7. A Primer of Genome Science, 3rd Edition" by Greg Gibson and Spencer Muse
8. The internet and new biology: Tools for Genomic and Molecular Research by Peruski, Jr. and Peruski (ASM)
9. Functional Genomics: A practical approach, Stephen P. Hunt and Risk Livesey, eds., Oxford University Press.
10. DNA microarrays: a practical Approach, Mark Schlena, ed. Oxford University Press.
11. Introduction to Genomics by: Arthur Lesk, publisher: Oxford University Press,
12. Discovering Genomics, Proteomics and Bioinformatics by: A. Malcolm Campbell publisher: Benjamin Cummings,
13. Bioinformatics and Functional Genomics, by: Jonathan Pevsner. Wiley-Blackwell

BT404. BIOETHICS, IPR AND RESEARCH METHODOLOGY

UNIT-I

Introduction – causes of unethical acts, ignorance of laws, policies and procedures, recognition, friendship, personal gains. Professional ethics – professional conduct
Ethical decision making, ethical dilemmas Teaching ethical values to scientists, good laboratory practices, good manufacturing practices, laboratory accreditation.

UNIT-II

Socio-economic and legal impacts of biotechnology, national and international guidelines, experimental protocols approval, levels of containment
Use of genetically modified organisms, their release in the environment, moral and ethical issues in biotechnology, cloning, safety issues with GMO.

UNIT-III

Fundamentals of IPR, Basic Principles, Copyright, Trademark, Design, Geographical indication, Acquisition of rights and remedies for infringement of these IPRs- Patent Law History, development of patent law, basic principles, criteria, novelty. Utility and non obviousness, subject matter in US, UK, drafting patent specifications – International Institutions and International instruments (WTO, WIPO, TRIPS, CBT, Paris Convention, Budapest treaty)

UNIT-IV

Introduction – Basic research, applied research, need based research, Identification of the problem, defining the problem, Research project planning, Literature search – Information sources, library resources – online literature search. Design of the experimental programme – variables in the experiments, materials and methods, evolution of methods, application of methods, Progress of research – evaluation of results, statistical approach, comparison with existing methodologies, validation of findings, research communications, impact factor of journals

Suggested Reading Material:

1. Elements of Biotechnology by P.K. Gupta, 1st Ed., Rastogi Publ., Meerut, India.
2. Environmental Biology by P.K. Gupta, 1st Ed., Rastogi Publ., Meerut, India.
3. Bioethics and Biosafety in Biotechnology by V. Sree Krishna, New Age International Publishers.

IV SEMESTER PRACTICALS

BT405- HETEROLOGOUS EXPRESSION AND DOWN STREAM PROCESSING

Lab:

01. Production of protease/amylase by batch fermentation.
02. Immobilization of whole cells for enzyme/antibiotic production by gel entrapment.
03. Screening of soil samples for isolation of bacteria, fungi and actinomycetes.
04. Selective isolation of actinomycetes from soil samples.
05. Microbiological assay of an antibiotic including the construction of standard curve.
06. UV survival curve.
07. Production of alcohol by *S.cerevisiae* and its estimation.
08. Production of streptomycin by fermentation.
09. Production of citric acid by *A.niger*.
10. Production of red wine from grapes.
11. Production of Glutamic acid by *M. glutamicus*

BT406 Bioinformatics Lab:

1. Searching Data from NCBI Database.
2. Working on EMBL.
3. Searching structural data from PDB.
4. Genome Map viewer from NCBI.
5. Database search using BLAST.
6. Sequence alignments.
7. Sequence and structure visualization.

BT407 Proteomics & Genomics Lab:

1. Demonstrate familiarity with databases of information pertaining to genes, markers, maps
2. Diseases such as Online Mendelian Inheritance in Man (OMIM) and Medline;
3. Understanding the principles of designing oligonucleotide primers for PCR and utilization of relevant software;
4. PCR applications in assigning genotypes to RFLP / VNTR sequences;
5. Screening samples for identified mutations.
6. Immobilisation of an enzyme (amylase or invertase) and its assay.
7. Expression of an enzyme activity using a western Blotting technique.
8. Equation for substrate consumption in an immobilized cell reactor.
9. Affinity purification of Histidine Tagged proteins.
10. Expression of Eukaryotic protein in a prokaryotic system.

BT408 Bioethics, IPR And Research Methodology Lab:

1. Intellectual property and India: comprehensive e filing patents , Trademarks.
2. On line patent search.
3. Online patent register and application status.
4. Online public search for Patents, trademarks and design.
5. e filing services for designs, GI, status of patents, designs,trademarks,
6. IP Case studies.
7. WIPO online database search.

Adikavi Nannaya University, Rajamahendravaram
M.Sc Biotechnology I Semester
Model Question Paper: Paper-I
BT101-Cell Biology

Time: 3hours

Max. Marks: 75

Answer ALL questions.
All questions carry equal marks

Section-A

1. a) Explain in detail about nucleus, its organization and its biological role.
(OR)
b) Describe the structure, and application of ER, Golgibody, lysosomes and ribosomes.
2. a) Give the complete information about plasma membrane composition and various theories.
(OR)
b) Explain various transport mechanisms performed by plasma membrane.
3. a) Write about mitochondrial structural organization and its applications.
(OR)
b) Explain the structure, composition, and functions of chloroplast.
4. a) Discuss the mechanism of meiotic cell division and its regulation.
(OR)
b) List out the chromosomal aberrations and explain with example.

Section-B

5. Answer any **FIVE** of the following:
 - a) Nucleosome
 - b) Vacuole
 - c) Ionophores
 - d) Liposomes
 - e) Photorespiration
 - f) Oxidative phosphorylation
 - g) Aneuploidy
 - h) CDK – cyclin

Adikavi Nannaya University, Rajahmundry
M.Sc Biotechnology I Semester
Model Question Paper: Paper-II
BT102-Biomolecules

Time: 3hours

Max. Marks: 75

Answer ALL questions.
All questions carry equal marks

Section-A

1. a) Describe the structure, classification and properties of amino acids.
(OR)
b) Explain the characterization and determination of proteins.
2. a) Write about the classification, structure, properties and functions of monosaccharides.
(OR)
b) Explain about polysaccharides and their occurrence in nature.
3. a) Discuss about the classification, structures, properties and biological functions of fatty acids.
(OR)
b) Explain about phospholipids, sphingolipids, prostaglandins, and steroids with their biological role
4. a) Explain about the structure, types and physicochemical properties of Nucleic acids.
(OR)
b) Write in detail about RNA and its functions

Section-B

5. Answer any **FIVE** of the following:
 - a) Vander waal's interaction
 - b) Stereo isomerism
 - c) Isoelectric pH
 - d) Chitin
 - e) Wax
 - f) Leukotrienes
 - g) mRNA
 - h) Denaturation

ADIKAVI NANNAYA UNIVERSITY, RAJAHMUNDRY

**M.Sc Biotechnology I Semester
Model Question Paper: Paper-III
BT103-Microbiology**

Time: 3hours

Max. Marks: 75

**Answer ALL questions.
All questions carry equal marks**

Section-A

1. a) Write about the history and classification criteria of microorganisms.
(OR)
b) Explain the sterilization techniques and anti-microbial agents.
2. a) Discuss different methods of isolation of microorganisms and their maintenance.
(OR)
b) Explain the growth kinetics of bacterial cells.
3. a) Write about the classification, morphology, ultra structure and life cycle of viruses.
(OR)
b) Give the general characteristics of algae with their economical and industrial uses.
4. a) Explain about the causative organism, mode of infection and symptoms of respiratory tract.
(OR)
b) Give detailed information about viral diseases infecting humans.

Section-B

5. Answer any **FIVE** of the following:
 - a) Chemoautotrophs
 - b) Spores
 - c) Symbiosis
 - d) Chemostat culture
 - e) Prions
 - f) Influenza
 - g) Mycoplasma
 - h) Rabies

ADIKAVI NANNAYA UNIVERSITY, RAJAHMUNDRY

**M.Sc Biotechnology I Semester
Model Question Paper: Paper-IV
BT104-Analytical Techniques**

Time: 3hours

Max. Marks: 75

**Answer ALL questions.
All questions carry equal marks**

Section-A

1. a) Explain the principle, instrumentation, and applications of Microscopy.
(OR)
b) Write the principle, instrumentation, and uses of UV, visible, infrared spectroscopy
2. a) Describe the principle, and application of ion exchange and affinity chromatography.
(OR)
b) What is centrifugation? Describe the application of preparative and analytical ultra-centrifugation.
3. a) Write the principle, instrumentation, and applications of horizontal electrophoresis.
(OR)
b) Describe the different blotting techniques procedure and their applications.
4. a) What is radioactive? Explain about liquid scintillation counter.
(OR)
b) Discuss the working methods of pH electrodes and their applications.

Section-B

5. Answer any **FIVE** of the following:
 - a) Fluorescence
 - b) X-ray diffraction
 - c) TLC
 - d) Lyophilization
 - e) Agarose
 - f) Isoelectric focusing
 - g) Isotope
 - h) Buffer

ADIKAVI NANNAYA UNIVERSITY, RAJAHMUNDRY
M.Sc Biotechnology II Semester
Model Question Paper: Paper-I
BT201-Molecular Biology

Time: 3hours

Max. Marks: 75

Answer ALL questions.
All questions carry equal marks

Section-A

1. a) Describe the various modes of replication in Prokaryotes.
(OR)
b) List out the proteins involved in replication and explain the mechanism of their action in replication process.
2. a) Write about DNA repair mechanisms.
(OR)
b) What is DNA recombination? Explain the different recombination mechanisms of DNA.
3. a) Explain the process of RNA synthesis and list out the differences of RNA synthesis between prokaryotes and eukaryotes.
(OR)
b) Write about splicing process of synthesized RNA.
4. a) Discuss protein synthesis with a note on post translational modifications.
(OR)
b) Explain ubiquitin proteasome pathway and its occurrence.

Section-B

5. Answer any **FIVE** of the following:
 - a) Helicase
 - b) Semi conservative replication
 - c) SOS
 - d) Transposons
 - e) Promoters
 - f) Exons and Introns
 - g) Genetic code
 - h) Signal peptide

ADIKAVI NANNAYA UNIVERSITY, RAJAHMUNDRY

M.Sc Biotechnology II Semester

Model Question Paper: Paper-I

BT202-Enzymology

Time: 3hours

Max. Marks: 75

Answer ALL questions.

All questions carry equal marks

Section-A

1. a) Explain enzyme classification, nomenclature and the characterization of active site.
(OR)
b) What is enzyme activity? Explain the factors effecting enzyme activity and its measurement.
2. a) Discuss enzyme kinetics and the significance of K_m and V_{max} .
(OR)
b) Explain enzyme inhibitions with their mechanism of action.
3. a) Write about the mechanism of serine protease catalysis.
(OR)
b) Describe the covalent catalysis mechanism of enzyme substrate interaction.
4. a) Explain about allosteric enzymes and cooperativity phenomenon.
(OR)
b) What are immobilized enzymes? Explain the methods of Immobilization and their applications.

Section-B

5. Answer any **FIVE** of the following:
 - a) Specific activity
 - b) Abzymes
 - c) K_{cat}
 - d) Irreversible inhibition
 - e) Metal ion catalysis
 - f) Biotin
 - g) isoenzymes
 - h) Feedback inhibition

ADIKAVI NANNAYA UNIVERSITY, RAJAHMUNDRY

**M.Sc Biotechnology II Semester
Model Question Paper: Paper-III
BT203-Immunology**

Time: 3hours

Max. Marks: 75

**Answer ALL questions.
All questions carry equal marks**

Section-A

1. a) Write about various immune cells and organs of the body.
(OR)
b) What is major histocompatibility complex? Describe the antigen presentation and processing mechanism by MHC molecules.
2. a) Explain various classes of immunoglobulins and their biological role.
(OR)
b) Discuss the theories and recombination process of antibody diversity.
3. a) Mention the antigen – antibody interactions and various techniques and reactions involved.
(OR)
b) Explain vaccine preparation and types of vaccines developed for defense mechanism.
4. a) What are the different types of hypersensitivity? Describe them with examples.
(OR)
b) Explain the mechanism involved in autoimmune disorders.

Section-B

5. Answer any **FIVE** of the following:
 - a) Adjuvant
 - b) Lymph node
 - c) Idiotype
 - d) Interleukins
 - e) Agglutination
 - f) ELISA
 - g) Immunological tolerance
 - h) Xenograft

ADIKAVI NANNAYA UNIVERSITY, RAJAHMUNDRY

**M.Sc Biotechnology II Semester
Model Question Paper: Paper-IV
BT204-Biostatistics**

Time: 3hours

Max. Marks: 75

**Answer ALL questions.
All questions carry equal marks**

Section-A

1. a) Define Biostatistics. Explain about histogram and its interpretation.
(OR)
b) Write about normal distribution and normal curve in estimating the mean.
2. a) What is probability? Explain the theories of probability.
(OR)
b) How is the data measured in terms of variation?
3. a) Write about linear regression and its applications in analyzing the data.
(OR)
b) What is correlation? Mention its mode of analysis.
4. a) Explain students t test with various levels of significance used in analysis of the data.
(OR)
b) Discuss various parametric tests used for testing more than two groups of the experiment.

Section-B

5. Answer any **FIVE** of the following:
 - a) Sample size
 - b) Bell shaped curve
 - c) Standard deviation
 - d) Poisson distribution
 - e) Chi square test
 - f) Regression
 - g) SPSS
 - h) Mann Whitney U test

ADIKAVI NANNAYA UNIVERSITY, RAJAHMUNDRY
M.Sc. Biotechnology-III Semester
Model Question Paper: Paper I
BT 301-Cell Culture Technology and Tissue Engineering

Time: 3hours

Max. Marks: 75

Answer ALL questions.
All questions carry equal marks
Section-A

2. a) What is plant tissue culture? Explain the different types of tissue culture.
(OR)
b) What is a protoplast? Describe in detail about protoplast isolation and its culture.
3. a) What are cell lines? Explain the establishment of different types of cell lines and their culture.
(OR)
b) Describe the techniques involved in *in-vitro* mammalian cell culture.
4. a) Define stem cells. Write in detail about stem cell differentiation and plasticity.
(OR)
b) Discuss in detail about isolation and propagation of embryonic stem cells.
5. a) Explain bone marrow transplantation. Discuss its advantages and disadvantages.
(OR)
b) Write an account on stem cell therapy and its clinical applications.

Section-B

6. Answer any **FIVE** of the following:
- a) Culture media
 - b) Serum free media
 - c) Stem cell renewal
 - d) Chimeras
 - e) Somatic hybridization
 - f) Apoptosis
 - g) Parkinson's disease
 - h) Autologous transplantation

ADIKAVI NANNAYA UNIVERSITY, RAJAHMUNDRY
M.Sc. Biotechnology-III Semester
Model Question Paper: Paper II
BT302-Plant Biotechnology

Time: 3hours

Max. Marks: 75

Answer ALL questions.
All questions carry equal marks

Section-A

1. a) Define cloning? Discuss on cloning strategies.
(OR)
b) What is gene transfer? Describe the techniques involved in gene transfer?
2. a) Elaborate on the use of transgenic technology in producing disease resistant plants.
(OR)
b) What are the biotechnological approaches in engineering stress tolerance in plants?
3. a) How does chloroplast transformation help in the expression of bacterial and viral genes in plants?
(OR)
b) Genetic manipulation of enhancement of rate of photosynthesis increases crop yield. Discuss.
4. a) How biomass can be produced in large scale? Justify its importance
(OR)
b) Write an account on edible sea weed cultivation. Discuss its significance.

Section-B

5. Answer any **FIVE** of the following:
 - a) T_I and R_I plasmids
 - b) Herbicide tolerance in plants
 - c) Oil quality traits in seeds
 - d) Biofertilizers
 - e) Molecular mapping
 - f) Insect resistant plants
 - g) Edible vaccines
 - h) Biopesticides

ADIKAVI NANNAYA UNIVERSITY, RAJAHMUNDRY
M.Sc. Biotechnology-III Semester
Model Question Paper: Paper III
BT303-Animal and Aquaculture Biotechnology

Time: 3hours

Max. Marks: 75

Answer ALL questions.
All questions carry equal marks

Section-A

1. a) What is infertility? Enumerate the types and causes of infertility in humans.
(OR)
b) Elaborate on the biotechnological approaches used in pest management.
2. a) Give a detailed account on molecular pharming.
(OR)
b) Describe somatic cell nuclear transfer technique. Add a note on its legal and ethical aspects.
3. a) What is blue revolution? Discuss its impact on aquatic biotechnology.
(OR)
b) Write an account on pearl culture technology and its applications.
4. a) Write in detail about fresh water pisciculture practices and types.
(OR)
b) Give an account on fish and shrimp diseases and their diagnosis.

Section-B

5. Answer any **FIVE** of the following:
 - a) Cryopreservation
 - b) Transgenic animals
 - c) Marine habitat
 - d) Hypophysation
 - e) Livestock improvement
 - f) Cloning
 - g) Fish byproducts
 - h) Eye stalk ablation

ADIKAVI NANNAYA UNIVERSITY, RAJAHMUNDRY
M.Sc. Biotechnology-III Semester
Model Question Paper: Paper IV
BT304-Medical and Environmental Biotechnology

Time: 3hours

Max. Marks: 75

Answer ALL questions.
All questions carry equal marks

Section-A

1. a) Explain the role of biotechnology in health.
(OR)
b) Discuss the development of vaccines for Hepatitis –B.
2. a) Write in detail about different diagnostic measures for various diseases.
(OR)
b) Explain various strategies used in development of vaccines.
3. a) Describe the sources, types and control of environmental pollution
(OR)
b) What is bioremediation? Add a note on the methods used in solid and liquid waste treatment.
4. a) Give an account on various renewable resources of energy.
(OR)
b) Explain the beneficial aspects of biodiversity to mankind and the need for its conservation.

Section-B

5. Answer any **FIVE** of the following:
 - a) Interferons
 - b) Forensic medicine
 - c) Oil spills
 - d) Biofuels
 - e) Lymphokines
 - f) Tuberculosis
 - g) Bioleaching
 - h) Ozone depletion

ADIKAVI NANNAYA UNIVERSITY, RAJAHMUNDRY
M.Sc. Biotechnology-IV Semester
Model Question Paper: Paper I
BT401- Heterologous Expression and Down Stream Processing

Time: 3hours

Max. Marks: 75

Answer ALL questions.
All questions carry equal marks

Section-A

1. a) Describe the method of production of active recombinant proteins of mammalian origin in prokaryotes.

(OR)

- b) What is a bioreactor? Describe various types of bioreactors

2. a) Describe various methods of microbial cell harvesting.

(OR)

- b) Give a detailed account on purification of recombinant proteins.

3. a).What are the microbial metabolites? Write a note on organic solvents and organic acids produced by microbes.

(OR)

- b) Write an essay on role of microbes in production of wines, beers and antibiotics.

4. a) What are the industrially useful enzymes? Give an account on their isolation and purification methods.

(OR)

- b) Describe different techniques of immobilization of enzymes and add a note on applications of immobilized enzymes.

Section-B

5. Answer any **FIVE** of the following:

- a) Batch fermentation
- b) High density cell cultures
- c) Stabilization of proteins
- d) Disruption of microbial cells
- e) Vitamin B12 production
- f) Single cell protein
- g) Biosensors
- h) Use of enzymes in food processing industry

ADIKAVI NANNAYA UNIVERSITY, RAJAHMUNDRY
M.Sc. Biotechnology-IV Semester
Model Question Paper: Paper II
BT402- Bioinformatics

Time: 3hours

Max.

Marks: 75 Answer ALL questions.

All questions carry equal marks

Section-A

1. a) What is internet? Write an essay on its applications in biology.
(OR)
b) Give an account on basic operations and architecture of computer.
2. a) Write an essay on offline and online tools used in Bioinformatics.
(OR)
b) What are different type's databases available for DNA and protein sequences?
Explain
3. a) What are different types of biological databases describe in detail?
(OR)
b) Explain database searching using BLAST and FASTA
4. a) Give a detailed account on Gene and Genome annotation.
(OR)
b) How to predict secondary and 3-D structures of proteins?

Section-B

4. Answer any **FIVE** of the following:
 - a) Linux
 - b) Binary number system
 - c) BLAST
 - d) Swissprot
 - e) Computer aided drug design (CADD)
 - f) Phylogenic tree
 - g) NCBI
 - h) RNA data base

ADIKAVI NANNAYA UNIVERSITY, RAJAHMUNDRY
M.Sc. Biotechnology-IV Semester
Model Question Paper: Paper III
BT403-Proteomics and Genomics

Time: 3hours

Max. Marks: 75

Answer ALL questions.
All questions carry equal marks

Section-A

1. a) Describe the process of high-throughput proteome analysis using 2D-IEF.
(OR)
b) What is mass spectrometry? Explain MALDI-TOF mass spectrometry.
2. a) Give an account on various databases available for protein sequence analysis.
(OR)
b) What are different steps involved in drug discovery? Explain.
3. a) Write an essay on various databases available for DNA sequence analysis.
(OR)
b) What is molecular phylogeny? Add a note on phylogenetic trees.
4. a) Define functional genomics. Describe various tools and techniques used to find out the function of a gene.
(OR)
b) Give an account on DNA sequencing methods with a special focus on Sanger's method and add a brief note on automated sequencing.

Section-B

5. Answer any **FIVE** of the following:
 - a) Rational drug design
 - b) Protein chips
 - c) Uniprot
 - d) RASMOL
 - e) Human genome project
 - f) COGS
 - g) Bacterial artificial chromosome (BAC)
 - h) Single nucleotide polymorphism (SNP)

ADIKAVI NANNAYA UNIVERSITY, RAJAHMUNDRY
M.Sc. Biotechnology-IV Semester
Model Question Paper: Paper IV
BT404-Bioethics, IPR and Research Methodology

Time: 3hours

Max. Marks: 75

Answer ALL questions.
All questions carry equal marks

Section-A

1. a) Write an essay on professional ethics and professional conduct.
(OR)
b) Give an account on good laboratory practices and good manufacturing practices.
2. a) Explain the socio-economic and legal impacts of biotechnology.
(OR)
b) What are the genetically modified organisms? Discuss the moral, ethical and safety issues related to them.
3. a) Write short notes on basic principles of IPR, Copyright, Trade mark, Design and Geographical indication
(OR)
b) Discuss the history and development of patent law and write about its basic principles and criteria.
4. a) Write an essay on Research project planning.
(OR)
b) How to evaluate the progress of Research? Describe various steps involved in evaluation.

Section-B

5. Answer any **FIVE** of the following:
 - a) Laboratory accreditation
 - b) Causes of unethical acts
 - c) Approval of experimental protocols
 - d) National guidelines on biotechnology
 - e) Drafting patent specifications
 - f) WTO
 - g) Impact factor
 - h) Need based research