

**ADIKAVI NANNAYA UNIVERSITY**

**RAJAMAHENDRAVARAM**



**School of Life and Health Sciences**

**M.Sc. Biotechnology**

**Course Structure and Syllabus**

**2019-20 Onwards**

**I and II Semester syllabus is common for  
M.Sc. Biochemistry and M.Sc. Biotechnology**

### M.Sc. Biotechnology Program Structure

Code	Title of the paper	Total Marks	Credits	Hours per week
<b>I SEMESTER</b>				
BCBT101	Cell Biology	100	4	4
BCBT102	Biomolecules	100	4	4
BCBT103	Microbiology	100	4	4
BCBT104	Analytical Techniques	100	4	4
	<b>Lab Course</b>			
BCBT105	Cell Biology lab	50	2	3
BCBT106	Biomolecules lab	50	2	3
BCBT107	Microbiology lab	50	2	3
BCBT108	Analytical Techniques lab	50	2	3
<b>II SEMESTER</b>				
BCBT201	Molecular Biology	100	4	4
BCBT202	Enzymology	100	4	4
BCBT203	Immunology	100	4	4
BCBT204	Bioinformatics and Biostatistics	100	4	4
	<b>Lab Course</b>			
BCBT205	Molecular Biology lab	50	2	3
BCBT206	Enzymology lab	50	2	3
BCBT207	Immunology lab	50	2	3
BCBT208	Bioinformatics and Biostatistics lab	50	2	3
<b>III SEMESTER</b>				
BT301	Cell culture Technology and Tissue Engineering	100	4	4
BT302	Plant Biotechnology	100	4	4
BT303	Animal and Aquaculture Biotechnology	100	4	4
BT304	Medical and Environmental Biotechnology	100	4	4
	<b>Lab Course</b>			
BT305	Cell culture technology and Tissue Engineering lab	50	2	3
BT306	Plant Biotechnology lab	50	2	3
BT307	Animal and Aquaculture Biotechnology lab	50	2	3
BT308	Medical and Environmental Biotechnology lab	50	2	3
<b>IV SEMESTER</b>				
BT401	Industrial Biotechnology	100	4	4
BT402	Genetic Engineering and Gene Transfer Techniques	100	4	4
BT403	Proteomics and Genomics	100	4	4
BT404	Bioethics, IPR and Research Methodology	100	4	4
	<b>Lab Course</b>			
BT405	Industrial Biotechnology lab	50	2	3
BT406	Genetic Engineering and Gene Transfer Techniques lab	50	2	3
BT407	Proteomics and Genomics lab	50	2	3
BT408	Bioethics, IPR and Research Methodology lab	50	2	3
BT 409	Comprehensive Viva-voce	100	4	
	<b>Total</b>	<b>2500</b>	<b>100</b>	<b>112</b>

**ADIKAVI NANNAYA UNIVERSITY: RAJAHMUNDRY**

**BOARD OF BIOTECHNOLOGY**

**Date: 04-04-2019**

**AGENDA:**

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

**Members:**

Dr. A. Matta Reddy

Prof. Lakshmi Devi

Dr. K. Ramaneswari

Dr. P. Vijaya Nirmala

Dr. D. Kalyani

Dr. K. Sarala

Dr. I. J. N. Padmavathi

Dr. K. Satish Kumar

Dr. M. Padmaja

Sri P. Sunila Rani

Minutes of the meeting of the Board of Studies for M.Sc. Biochemistry, M.Sc. Biotechnology, M.Sc. Clinical Nutrition and M.Sc. Microbiology courses held on 04-04-2019 at 11:30 AM at the Department of Zoology, Adikavi Nannaya University, Rajamahendravaram

### Members present

1. Dr. A. Matta Reddy, Associate Professor, Department of Zoology Adikavinannaya University, R.T.Y. Convener Amma 4/4/19
2. Prof. Lakshmi Devi, Dept. of Biochemistry, Sri Krishna Devaraya University, Anantapur. Member
3. Dr. K. Ramaneewari, Associate Professor, Dept. of Zoology, Adikavi Nannaya University, R.T.Y. Member K.R. 4/4/19
4. Dr. P. Vijaya Nirmala, Assistant Professor, HOD, Dept. of Zoology, Adikavi Nannaya University, R.T.Y. Member P.V.N. 4/4/19
5. Dr. D. Kalyani, Assistant Professor, Dept. of Zoology, Adikavi Nannaya University, R.T.Y. D.K. 4/4/19
6. Dr. K. Sarala, Principal scientist, Central Tobacco Research Institute, R.T.Y. Member Sarala
7. Dr. I J Naga Padmevathi, Assistant Professor (Ad-hoc), Dept. of Biochemistry, Adikavi Nannaya University, R.T.Y. I.J.N.P. 4/4/19
8. Dr. K. Satish Kumar, Assistant Professor (Ad-hoc), Dept. of Biotechnology, Adikavi Nannaya University, R.T.Y. S.K. 4/4/19
9. Dr. M. Padmaja, Dept. of Clinical Nutrition, Ch. S.D.S. St. Theresa's College for women, Eluru. M.P.
10. Sr. P. Sunila Rani, Dept. of Clinical Nutrition, Ch. S.D.S. St. Theresa's College for women, Eluru. S.P.S.R.

## 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 the following.

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 2019-20 academic year.
2. The syllabus for practical for the above course was 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 and II semesters are common for M.Sc. Biochemistry and M.Sc. Biotechnology whereas III and IV semesters have separate syllabus for M.Sc. Biochemistry and M.Sc. Biotechnology respectively.
6. Marks and credits are allotted to theory and practical papers in each semester. There will be 100 marks for each theory, and 200 marks for 4 practicals each 50 marks and total marks of (600 x 4) 2400 for the four semesters. There will be 100 marks for comprehensive viva-voce. 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(SEE) while the remaining 25 marks for Continuous Internal Assessment(CIA)

Continuous Internal Assessment		
S.No	Scheme of Evaluation	Marks
1	Mid-Semester Examination	10M
2	Assignment/Seminar Presentation	5M
3	Attendance	5M
4	Swachhata Activity	5M
	Total	25M

Details of Attendance Marks		
S.No	Attendance	Marks Allotted
1	95% above	5
2	85-94%	4
3	75-84%	3
4	65-74%	2
5	55-64%	1
6	< 54%	0

- b) The Semester End Examination question paper comprises of two sections –Section A & 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) For practical, 75% of marks for Semester End Examination (38 Marks) and 25% of marks for Continuous Internal Assessment (12 Marks, 9 + Record-3).

- 8) A comprehensive viva-voce for 100 marks is to be conducted by external examiner at IV semester end examination. 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 and remuneration will be borne by the respective College / Department strictly as per the approved norms to be notified from time to time.

**ADIKAVI NANNAYA UNIVERSITY**  
**M.Sc. BIOTECHNOLOGY**

**Examination pattern:**

- Theory:** 75% for End Semester Examination  
25% for Internal Continuous Assessment
- Practical:** 75% for End Semester Examination  
25% for Internal Continuous Assessment

**ADIKAVI NANNAYA UNIVERSITY**  
**M.Sc. BIOTECHNOLOGY**  
**SEMESTER END EXAMINATION**

**Model question paper**

Time: 3 hrs

Max. Marks: 75

Answer all the questions. Each question carries 15 marks.

**Section-A**

**4x15=60**

**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 questions with at least two from each unit, carrying 3 marks.

5 questions out of 8 are to be answered.

**I SEMESTER**  
**BCBT101 Cell Biology**

**Unit I:**

Structure of a typical cell, Differences between prokaryotic and eukaryotic cells; Structural organization and functions of nucleus, endoplasmic reticulum, golgi complex. lysosomes, vacuole, microbodies, ribosomes.

**Unit II:**

Structural organization and chemical composition of cell membrane, symmetry of the membrane; membrane fluidity; membrane structure models, membrane transport - active transport; active transport of  $\text{Na}^+$   $\text{K}^+$  (Sodium potassium ATPase)  $\text{Ca}^{2+}$  ( $\text{Ca}^{2+}$ -ATPase); active transport of sugars coupled to phosphorylation; Passive transport - anion exchange proteins; Donnan membrane equilibrium, group translocation ( $\gamma$ -Glutamyl cycle).

**Unit III:**

Mitochondria - Structural organization, composition and functions; mitochondrial respiratory chain; mechanism of oxidative of phosphorylation; Chloroplast - Structural organization, composition, components and functions of chloroplast.

**Unit IV:**

Cell cycle – phases and events of cell cycle; Cell division - Mechanism of mitosis and meiosis; Regulation of cell cycle - Molecular events including cell cycle check points and CDK – cyclin complexes, tyrosine kinases; Programmed cell death - apoptosis.

**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.



## BCBT102 Biomolecules

### Unit I:

Chemical foundations and chemical bonding of biology; Amino acids – classification, structure and physicochemical properties, Peptide bond – structure; Proteins – classification, structural organization, physicochemical properties; Isolation, purification, sequence determination and characterization of proteins; biological functions of proteins; Denaturation & renaturation of proteins.

### Unit II:

Carbohydrates – classification, structure and physicochemical properties, biological importance; Monosaccharides, Oligosaccharides and Polysaccharides; carbohydrate derivatives and glycoconjugates.

### Unit III:

Lipids – classification, biological importance; fatty acids – classification, structure and physicochemical properties; Structure and biological roles of triglycerides, phospholipids, sphingolipids, cholesterol, lipid derivatives and lipid conjugates.

### Unit IV:

Nucleic acids – classification, structure - nucleotides, purine and pyrimidine bases; physicochemical properties of nucleic acids, biological role; DNA and RNA – structure and types; nucleosome and chromatin formation; DNA – histone interactions; DNA denaturation and renaturation kinetics –  $T_m$ , Cot curve and C-value paradox.

### 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, Macmillan & Co.
5. Biochemistry, Lubert Stryer.

## **BCBT103 Microbiology**

### **Unit I:**

History and Scope of Microbiology; Classification and taxonomy – morphological, physiological and metabolic, ecological, genetic analysis and molecular characterizations; Characteristics and importance of Archaeobacteria, Actinomycetes, Eubacteria, Pseudomonads, cyanobacteria, mycoplasma; Bacterial cell - Structural components and their functions; Gram positive and Gram negative bacteria.

### **Unit II:**

Modes of nutrition – phototrophy, chemotrophy, methylotrophy, organotrophy, mixotrophy, saprophytic, symbiotic and parasitic modes of nutrition; Sterilization techniques – Physical, chemical and radiation; Culture media – types, batch and continuous cultures, chemostat; Microbial Growth curve and kinetics, Direct and Indirect methods of measuring microbial growth; Effect of pH and temperature on microbial growth; Preservation of cultures (glycerol stocks, freeze drying).

### **Unit III:**

Virus - morphology, characteristics and life cycle (ØX174, t4, HIV, Rota virus); Methods of culturing of viruses; Biology of subviral agents – Viroids, Prions, Satellite viruses; Antiviral agents- chemical and biological agents; Inactivation of viruses – photodynamic inactivation; Yeasts – morphology, characteristics and reproduction; Molds – morphology, characteristics and reproduction.

### **Unit IV:**

Microbial diseases – Source, Symptoms, Diagnosis and Prevention – bacterial infections (Cholera, Typhoid, Hepatitis B, tuberculosis), viral infections (Polio, Rabies, small pox, HIV), fungal infections (systemic mycoses, candidiasis), protozoan diseases- Malaria, Trypanosomiasis).

### **Recommended Books:**

1. Prescott, Harley and Klein, Microbiology Publisher: McGrawHill Science
2. Gerard J. Tortora, Berdell, R. Funke, Christine L. Case, Microbiology: An Introduction Benjamin Cummings Publisher.
3. Microbiology by Pelczar, Chan and Krieg McGraw-Hill.
4. A Textbook of Microbiology, R.C. Dubey and D.K. Maheswari, S. Chand Co.
5. Fundamentals of Microbiology – M. Frebisher.
6. Microbiology An Introduction by John L. Ingraham (Author), Davis Catherine A. Ingraham
7. Brock Biology of Microorganisms (15<sup>th</sup> Edition) by Madigan Michael T, Martinko John M, Bender, Kelly S, Buckley Daniel H, Stahl David A.

## **BCBT104 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, 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 sedimentation. Types of centrifuges. Applications of preparative and analytical ultra-centrifuges.

Principle and applications of lyophilization.

### **Unit III:**

Electrophoresis - General Principle of electrophoretic techniques, Poly Acryl amide Gel Electrophoresis, Isoelectric focusing, Isotachopheresis, 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. Principles and applications of Ion-selective and gas sensing electrodes, Operation of pH electrodes and Oxygen electrodes.

### **Recommended Books:**

1. Principles and Techniques of Biochemistry and Molecular Biology by Keith Wilson and John Walker. Cambridge University press.
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**

### **BCBT105 Cell Biology Lab**

1. Microscopic observation of cell tissues
2. Observation of stages of mitosis and meiosis
3. Mitosis in onion root tip cells by Squash method
4. Arrest and observation of chromosomes after colchicine treatment in onion roots
5. Blood smear preparation and identification of cells
6. Total RBC count
7. Separation of cell organelles

### **BCBT106 Biomolecules Lab**

1. Qualitative analysis of proteins
2. Quantitative analysis of proteins
3. Qualitative analysis of carbohydrates
4. Quantitative analysis of carbohydrates
5. Qualitative analysis of lipids.
6. Quantitative analysis of nucleic acids.

### **BCBT107 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-streakplate, spread plate and pour plate.
7. Bacterial growth curve.

### **BCBT108 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.

## II SEMESTER BCBT201 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:  $\phi$  mode replication,  $\sigma$  mode or rolling circle replication and D-loop replication; Inhibitors of replication.

### **UnitII:**

DNA Repair mechanisms, Photo reactivation, 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.

### **UnitIII:**

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 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.

### **UnitIV:**

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,

### **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

## **BCBT202 Enzymology**

### **Unit I:**

Enzymes - Classification, nomenclature, properties, assay, Units of enzyme activity; Factors affecting enzyme activity; Enzyme – substrate complex formation by Fisher and Koshland models, Active site mapping, Modern concepts of evolution of enzyme catalysis.

### **Unit II:**

Enzyme kinetics - 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, Enzyme inhibitions – competitive, non-competitive, uncompetitive inhibition, irreversible inhibition, Determination of  $K_I$  values.

### **Unit III:**

Enzyme catalysis – General acid – base, electrostatic, covalent, metal – ion catalysis, Proximity and orientation, Mechanism of reaction catalyzed by chymotrypsin, carboxypeptidase, lysozyme, ribonuclease; Mechanism of catalysis with coenzymes – pyridoxal phosphate, flavin nucleotides, thiamine pyrophosphate, biotin.

### **Unit IV:**

Enzyme regulation – Allosteric enzymes (ATCase), Symmetric and sequential models of allosteric enzymes and their significance; Feedback inhibition and feed forward stimulation, Isoenzymes – Lactate Dehydrogenase, Multienzyme complex systems – Pyruvate dehydrogenase complex; Methods for isolation and purification of enzymes.

### **Recommended Books:**

1. Enzymes: Palmer T., Bonner P.
2. Enzyme structure and mechanism. Alan Fersht, Freeman & Co.
3. Principles of enzymology technology: Khan M.Y., Khan Farha, Eastern Economy Edition.
4. Methods in enzymology Ed. Colowick and Kaplan, Academic Press
5. Enzyme kinetics: Siegel interscience – Wiley.

## **BCBT203 Immunology**

### **Unit I:**

Types of immunity – Innate and adaptive; Antigens – properties, Haptens, Adjuvants; Immunoglobulins – structure, types and biological activities; Theories of antibody diversity; Organs of the immune system -Thymus, bone-marrow, spleen, lymph node.

### **Unit II:**

Cells of Immune system - T and B lymphocytes – Origin, activation, differentiation, characteristics and functions; Humoral and cell-mediated immune responses - Immunological memory and immune tolerance; Antigen presenting cells - Processing and presentation of antigens, Major Histocompatibility Complex and its role in immune response.

### **Unit III:**

Antigen-antibody interactions - Precipitation reactions – single immunodiffusion, double immunodiffusion, immunoelectrophoresis; Agglutination reactions - Heme agglutination; complement fixation - components and activation; Immunofluorescence, RIA, ELISA, Immunoblotting, Hybridoma technology - production of monoclonal antibodies and their applications; Vaccines- production of conventional and recombinant vaccines.

### **Unit IV:**

Hypersensitivity: immediate (type I, type II, type III and type V) and delayed hypersensitivity (type IV); Immunodeficiency diseases – SCID and AIDS; Autoimmunity - organ specific (Hashimoto's thyroiditis) and systemic (Rheumatoid arthritis) diseases; Tissue transplantation – types, graft rejection and graft acceptance, immunosuppressive agents.

### **Recommended Books:**

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

## BCBT204 Bioinformatics and Biostatistics

### UNIT-I

Scope of computers in current biological research. Basic operations, architecture of computer. Introduction of digital computers. Organization, low level and high level languages, binary number system. The soft side of the computer – Different operating systems – Windows, Linux. Introduction of programming in C. Introduction to Internet and its applications.

### UNIT-II

Introduction to Bioinformatics, Genomics and Proteomics. Bioinformatics – Online tools and offline tools. Biological databases; An overview of types of biological data bases – NCBI, EMBL, Gen bank, Swiss prot, and PDB. Database searching using BLAST and FASTA. Human Genome Project.

### UNIT-III

Sequence alignment-Introduction and significance of sequence alignments. Pair wise and Multiple sequence alignment. Gene and Genome annotation – Tools used. Physical map of genomes. Protein secondary structure prediction. Protein 3D structure prediction. Protein docking. Introduction to homology modeling, Computer Aided Drug Design (CADD) in Drug discovery. Molecular phylogeny - Concept methods of tree construction.

### UNIT-IV

Brief description and tabulation of data and its graphical representation. Measures of central tendency - mean, median, mode. Measures of dispersion- range, variance, standard deviation. Simple linear regression and correlation. Types of errors and level of significance. Tests of significance – t- test, Chi-square test, ANOVA.

#### **Recommended 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..
7. Bioinformatics – D.Mount
8. Programming in C by Balaguru Swamy.
9. Introduction to Bioinformatics by Arthur M.Lesk, Oxford.
10. Biostatistics – Daniel. (Wiley).
11. Methods in biostatistics by Mahajan and Srimathi
12. PSS Sundar Rao & J Richard. An introduction to biostatistics and Research methods



## II SEMESTER PRACTICALS

### BCBT205 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, blotting gel
5. Determination of sugar and phosphate ratios in DNA and RNA samples.
6. Determination of melting temperature ( $T_m$ ) of DNA.

### BCBT206 Enzymology Lab

1. Assay of Amylase from saliva
2. Assay of Acid phosphatase from potato
3. Effect of substrate concentration on enzyme activity
4. Time course effect on enzyme activity
5. Effect of pH on enzyme activity
6. Effect of temperature on enzyme activity
7. Isoenzymes of LDH – electrophoretic separation and specific staining technique-demonstration

### BCBT207 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. Bleeding time and clotting time
5. Total WBC count
6. Radial Immunodiffusion
7. Rocket immunoelectrophoresis- demonstration
8. Enzyme Linked Immuno Sorbent Assay (ELISA)- demonstration

### BCBT208 Bioinformatics and Biostatistics 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. Measures of dispersion- Standard deviation
8. Correlation coefficient calculation
9. Tests of significance - one way ANOVA.

### III SEMESTER

#### 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. Isolation of protoplasts, protoplast fusion and culture.

##### UNIT-II

Animal cell and tissue culture. Primary culture, balanced salt solutions and simple growth medium. Cell lines, primary and established cell line cultures. Basic techniques of mammalian cell culture *in vitro*. 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- isolation and propagation, fetal tissue stem cells, adult stem cells; stem cell differentiation. 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; bone marrow transplantation - advantages and disadvantages. Clinical applications of stem cell therapy; neurodegenerative diseases – Parkinson's disease, Alzheimer's disease.

#### Recommended Books:

1. Plant tissue culture – theory and practice by Bhojwani S.S.
2. Plant cell culture – A practical approach by Dixon R.A.
3. Culture of Animal cells by R.I.Freshney. Wiley – Liss.
4. Animal Cell Culture – A Practical approach Ed. by John R.W.Masters (IRL Press).
5. Animal cell culture techniques, Ed. Martin Clynes, Springer.
6. Plant Cell, Tissue and Organ Culture, By Reinert, J. and YPS Bajaj (Springer – Verlag).
7. Plant tissue and cell culture, by Street, HE (Blackwell).
8. Stem cells in regenerative medicine by Audet (Springer).
9. Cell and tissue reaction engineering by Eibl (Springer).

## **BT302 Plant Biotechnology**

### **UNIT-I**

Plant Genetic engineering: Gene cloning, Gene transfer techniques in 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, SSR, SNP and QTL in plants. RAPD for molecular mapping and crop improvement. Genome Editing - CRISPR

### **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 abiotic stress tolerance - Drought and Salinity

### **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.

### **Recommended Books:**

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

## BT 303 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.

### UNIT-II

Production of transgenic animals - mice 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.

### UNIT-III

The role of biotechnology in aquaculture. Economically important aquatic resources from fresh water, brackish water and marine habitats – the finfish, shellfish, algae, corals and holothurians. Aquaculture - Fresh water fish culture practices and types. Brackish water shrimp culture practices. Bioactive compounds from corals. Pearl culture technology – principles and applications.

### UNIT-IV

Hypophysation and induced breeding techniques in finfish. Eyestalk ablation. Techniques involved in transgenic fish production. Genome manipulation in fish - Gynogenesis, Androgenesis and Polyploidy. Hormonal manipulation of sex in fishes. Diagnosis of shrimp & fish diseases caused by bacterial, fungal and viral pathogens using molecular methods. Vaccines - DNA vaccines application in aquaculture.

### Recommended Books:

1. Elements of Biotechnology by PK Gupta (Rastogi & Co).
2. Biotechnology by Kashav. T (Wiley Eastern Ltd).
3. Concepts in Biotechnology by Balasubrahmanian et. al.,(University press).
4. Principles and practices of aquaculture by TVR Pillay. Blackwell Scientific publications
5. Coastal aquaculture by Santhanam. R. and Ramanathar, N. C.B.S.
6. Fisheries of India by CBL Srivatsava.
7. Molecular Biotechnology by Glick.
8. Reddy. P V G K. Ayyapan et al., . Text Book of Fish Genetics and Biotechnology. 218p,ICAR Publications. ISBN:81-7164-029-X
9. 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;
11. U.K. Srivastava B.H. Dholakia, S. Srinivasa Rao. S.Vathsala. Freshwater Aquaculture in India, Oxford & IBH Publishing Co., New Delhi.
12. Dunham R.A., Aquaculture and fisheries biotechnology, 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.

### **Recommended Books:**

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

### III SEMESTER PRACTICALS

#### **BT305 Cell Culture Technology and Tissue Engineering Lab**

1. Preparation of media for plant tissue culture (MS and B5).
2. Establishment of callus cultures from carrot cambial tissue.
3. Establishment of cell cultures and plating.
4. Embryo culture of maize/ *Crotalaria*.
5. Organogenesis and regeneration of plants from tobacco explants.
6. Anther culture and production of haploids.
7. 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. Western analyses of expressed plant protein.
6. *Agrobacterium* mediated plant transformation/Preparation of competent cells
7. *Agrobacterium* Co-cultivation method
8. Strip test/dipstick test for GMO detection

#### **BT307 Animal and Aquaculture Biotechnology Lab**

1. Preparation of animal cell culture media and membrane filtration.
2. Preparation of single cell suspension from spleen and thymus.
3. MTT assay for cell viability and growth.
4. Demonstration of sections of human ovary, testis and aborted human embryos.
5. Identification of some commercially important aquatic species.
6. Estimation of water quality parameters: Dissolved Oxygen, Alkalinity, Hardness
7. Identification and partial characterization of fish and shrimp pathogens.
8. Fish Pituitary hypophysation- Demonstration
9. PCR diagnosis of WSSV-Demonstration

#### **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.

## **IV SEMESTER**

### **BT401 Industrial Biotechnology**

#### **UNIT-I**

Heterologous Expression: Expression vectors and hosts Generally Regarded As Safe (GRAS) organisms. Large Scale Production of active recombinant proteins of prokaryotes, Eukaryotic and mammalian. Principles of microbial growth, Principle and Types of Fermentation, Design and Types of Bioreactors

#### **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, Crystallization of proteins

#### **UNIT-III**

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

#### **UNIT-IV**

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

#### **Recommended Books:**

1. Biotechnology – Volumes 1 to 5 by Rehem.
2. Industrial Microbiology by LE Casida Jr.
3. Industrial Microbiology by Prescott and Dunn.
4. Immobilized enzymes by Messing.
5. Biochemical engineering fundamentals by Bailey and Ollis.
6. Biotechnology by BD Singh (Kalyani).
7. Cruegers Biotechnology: A Textbook of Industrial Microbiology by Wulf Crueger Medtech publisher
8. Prescott & Dunn's Industrial Microbiology by G. Reed, CBS Publishers & Distributors; 4th edition

## **BT402 Genetic Engineering and Gene Transfer Techniques**

### **UNIT-I**

Isolation of DNA and RNA. Restriction mapping, DNA sequencing by chemical and enzymatic methods. Nucleic acid blotting – southern and northern blotting. DNA cloning. Enzymes used in genetic engineering: Restriction endonucleases - types, nomenclature and properties. DNA polymerase-I, polynucleotide kinase, DNA ligase, terminal nucleotide transferase, Reverse transcriptase, alkaline phosphatase, S<sub>1</sub> nuclease.

### **UNIT-II**

Salient features of cloning vectors, types of cloning vectors - plasmids, cosmids, phages (lambda and M13 phages), animal (SV40, Baculo) and plant (CMV) viruses, Artificial chromosomes - YACs and MACs. Ligation of foreign DNA to vectors - cohesive and blunt end methods - homopolymer tailing and adaptors. Preparation of gene libraries and c-DNA libraries .

### **UNIT – III**

Techniques of gene transfer - transformation , transfection, micro injection, electroporation, lipofection and biolistics. Selection of r-DNA clones and their expression. Nucleic acid probes, colony and fluorescent in-situ hybridization.

### **UNIT – IV**

Polymerase Chain Reaction and its applications. DNA micro array technology. Applications of genetic engineering in agriculture, animal husbandry, medicine and in industry. Genomics – genome sequencing by shot gun and hierarchical method. Genome annotation – identification of genes, promoters and exon – intron boundaries

### **Recommended Books:**

1. Recombinant DNA technology by Watson et. al., (Scientific American Books).
2. Genes-VIII by Benjamin Lewin.(Oxford).
3. Principles of Gene Manipulation by Old and Primrose.(Blackwell).
4. DNA Science by Carolina Publishing Company.
5. From genes to clones by Winneker.
6. From genes to genomes concepts and applications of DNA technology by Jeremy W dale and Malcolm von Scrantz, Weil publications
7. Molecular Biotechnology by Glick.
8. Genetic Engineering by Sandhya Mitra.
9. Genomes by T.A. Brown



## BT403 Proteomics and Genomics

### UNIT-I

**Introduction to proteomics-** Protein structure, function and expression. Proteome analysis: high-throughput proteome analysis with 2D- IEF. Current concepts of peptide sequencing with MS-MS methods, MALDI-TOF; Phage display, Protein chips Rational drug design, lethal mutants, Significance and applications of proteomics in biology.

### UNIT-II

**Protein sequence Data base-** Swiss-prot, Tr-EMBL, PIR, Uniprot. Structural Data bases-CATH, SCOP. Molecular Modeling-Homology modelling and docking studies (Using Molegro Virtual Docker) – RASMOL. 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

The human genome project. 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).

### UNIT-IV

**Functional Genomics** - ESTs, SAGE, Shotgun libraries. Conventional sequencing (Sanger and Maxam & Gilbert methods), automated sequencing. Analysis of Single nucleotide polymorphism (SNP) using DNA chips.

### Recommended Books:

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

### **Recommended Books:**

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 Industrial Biotechnology Lab**

1. Production of protease/amylase by batch fermentation.
2. Immobilization of whole cells for enzyme/antibiotic production by gel entrapment.
3. Screening of soil samples for isolation of bacteria, fungi and actinomycetes.
4. Microbial growth curve.
5. Production of alcohol by *S.cerevisiae* and its estimation.
6. Production of citric acid by *A. niger*.
7. Production of red wine from grapes.

### **BT406 Genetic Engineering and Gene Transfer Techniques**

1. Isolation of DNA from blood
2. Isolation of RNA from yeast
3. Blotting Techniques
4. Gene transfer techniques
5. PCR applications

### **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: e filing of 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.

**AdikaviNannaya University, Rajamahendravaram**

**M.Sc Biotechnology I Semester**

**Model Question Paper: Paper-I**

**BCBT101-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) Explain cell cycle regulation mechanism.

**Section-B**

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

**AdikaviNannaya University, Rajahmundry**

**M.Sc Biotechnology I Semester  
Model Question Paper: Paper-II  
BCBT102-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 polysaccharides and their occurrence in nature.
3. a) Discuss about the classification, structures, properties and biological functions of fatty acids.  
(OR)  
b) Explain phospholipids with their biological role.
4. a) Discuss 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) Cot curve

**ADIKAVI NANNAYA UNIVERSITY, RAJAHMUNDRY**

**M.Sc Biotechnology I Semester  
Model Question Paper: Paper-III  
BCBT103-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 about Bacterial cell - Structural components and their functions
2. a) Discuss about modes of nutrition of microorganisms, add a note on culture media  
(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) Describe about morphology, characteristics and reproduction of Yeasts and Molds
4. a) Explain about source, symptoms, diagnosis and prevention of bacterial diseases  
(OR)  
b) Give detailed information about viral diseases infecting humans.

**Section-B**

5. Answer any **FIVE** of the following:
  - a) Chemoautotrophs
  - b) Actinomycetes
  - c) Symbiosis
  - d) Chemostat culture
  - e) Prions
  - f) Antiviral agents
  - g) Malaria
  - h) Rabies

**ADIKAVI NANNAYA UNIVERSITY, RAJAHMUNDRY**

**M.Sc Biotechnology I Semester  
Model Question Paper: Paper-IV  
BCBT104-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 Electron Microscopy.  
**(OR)**  
b) Write the principle, instrumentation, and uses of UV-visible spectroscopy.
2. a) Describe the principle, and application of HPLC.  
**(OR)**  
b) What is centrifugation? Describe the application of analytical ultra centrifugation.
3. a) Write the principle, instrumentation, and applications of PAGE  
**(OR)**  
b) Describe the different blotting techniques procedure and their applications.
4. a) What is radioactive isotope? Explain different measures of radioactivity  
**(OR)**  
b) Discuss the working methods of pH electrodes and their applications.

**Section-B**

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

**ADIKAVI NANNAYA UNIVERSITY, RAJAHMUNDRY**

**M.Sc Biotechnology II Semester**

**Model Question Paper: Paper-I**

**BCBT201-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**

**BCBT202-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 lysozyme catalysis.  
(OR)  
b) Describe the covalent catalysis mechanism of enzyme substrate interaction.
4. a) Explain about allosteric enzymes and cooperativity phenomenon.  
(OR)  
b) Write about methods for isolation and purification of enzymes.

**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) Pyridoxal phosphate
  - g) isoenzymes
  - h) Feedback inhibition

**ADIKAVI NANNAYA UNIVERSITY, RAJAHMUNDRY**

**M.Sc Biotechnology II Semester  
Model Question Paper: Paper-III  
BCBT203-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) Explain various classes of immunoglobulins and their biological role.
  
2. a) What is major histocompatibility complex? Describe the antigen presentation and processing mechanism by MHC molecules.  
(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 defence 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**

**BCBT204-Bioinformatics and Biostatistics**

**Time: 3hours**

**Max. Marks: 75**

**Answer ALL questions.**

**All questions carry equal marks**

**Section-A**

1. a) Describe the basic architecture of a computer  
(OR)  
b) Define operating system. Describe different operating systems.
2. a) Give a note on online and offline tools in bioinformatics  
(OR)  
b) Describe database searching using BLAST
3. a) What is Multiple sequence alignment in bioinformatics explain in detail.  
(OR)  
b) Define molecular phylogeny and describe methods of tree construction.
4. a) What is measure of dispersion and explain standard deviation.  
(OR)  
b) Write an essay on tests of significance.

**Section-B**

5. Answer any **FIVE** of the following:
  - a) Internet
  - b) Binary system
  - c) Genomics
  - d) NCBI
  - e) Dot matrix
  - f) CADD
  - g) Histogram
  - h) Correlation coefficient

**ADIKAVI NANNAYA UNIVERSITY, RAJAHMUNDRY**

**M.Sc Biotechnology III Semester**

**Model Question Paper: Paper-I**

**BT301- Cell Culture Technology and Tissue Engineering**

**Time: 3hours**

**Max. Marks: 75**

**Answer ALL questions.**

**All questions carry equal marks**

**Section-A**

1. 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.
2. 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.
3. 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.
4. 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**

5. 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) Knock out mice

**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 abiotic 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) TI and RI 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) Describe the embryo culture and transfer techniques in farm animals
2. a) Give a detailed note on transgenic mice  
(OR)  
b) Write an essay on animal cloning in detail.
3. a) Write an essay on role of biotechnology in aquaculture.  
(OR)  
b) Write an account on pearl culture technology and its applications.
4. a) What are the induced breeding techniques in finfish  
(OR)  
b) Give an account hormonal manipulation of sex in fishes.

**Section-B**

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

- a) Cryopreservation
- b) Immuno contraception
- c) Transgenic animal
- d) Molecular pharming
- e) Gynogenesis
- f) Pearl sac theory
- g) P.monodon
- h) Eye stalk ablation

**ADIKAVI NANNAYA UNIVERSITY, RAJAHMUNDRY**

**M.Sc Biotechnology III Semester**

**Model Question Paper: Paper-IV**

**BC304-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-Industrial Biotechnology**

**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 Production 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-Genetic Engineering and Gene Transfer Techniques**

**Time: 3hours**

**Max. Marks: 75**

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

**Section-A**

1. a) Define Nucleic acid blotting. Discuss in detail about southern blotting  
(OR)  
b) Write in detail about Enzymes used in genetic engineering
  
- 2 a) Write in detail about types of cloning vectors  
(OR)  
b) Write in detail about Artificial chromosomes and its features
  
- 3a) Write in detail about Techniques of gene transfer  
(OR)  
b) Write in detail about Nucleic acid probes
  
- 4a) ) Write in detail about Applications of genetic engineering in agriculture, animal husbandry, medicine and in industry  
(OR)  
b) Write in detail about Polymerase Chain Reaction and its applications

**Section-B**

2. Answer any **FIVE** of the following:
  - a) DNA polymerases
  - b) DNA ligase
  - c) Reverse transcriptase
  - d) Gene libraries
  - e) DNA vectors
  - f) FISH
  - g) Genomics
  - h) Genome annotation

**ADIKAVI NANNAYA UNIVERSITY, RAJAHMUNDRY**

**M.Sc Biotechnology IV Semester**

**Model Question Paper: Paper-III**

**BT403-Proteomics and Genomics**

**Time: 3 hours**

**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) Tr-EMBL
- g) ESTS
- 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 (GLP) 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