

**SYLLABUS FOR**  
**M.Sc. COURSE IN BIOCHEMISTRY**  
(With effect from the academic year 2021-22 Under CBCS system)



**DEPARTMENT OF BIOCHEMISTRY**  
**KAKATIYA UNIVERSITY**  
**WARANGAL - 506 009**  
**TELANGANA STATE**

**KAKATIYA UNIVERSITY, DEPARTMENT OF BIOCHEMISTRY**  
(With effect from the academic year 2021-22 Under CBCS system)

S.No	Paper Code	Title of the Paper	Instruction Hrs/Week	No. of Credits	Marks		Total Marks
					External	Internal	
<b>SEMESTER-I</b>							
1	101	Cell Biology	4	4	80	20	100
2	102	Structure and Function of Biomolecules	4	4	80	20	100
3	103	Bioanalytical Techniques	4	4	80	20	100
4	104	Enzymology	4	4	80	20	100
5	105	Practical-I	4	4	100	--	100
6	106	Practical-II	4	4	100	--	100
7	107	Seminar	--	1	--	25	25
		Total		25	520	105	625
<b>SEMESTER-II</b>							
1	201	Metabolism	4	4	80	20	100
2	202	Molecular Biology	4	4	80	20	100
3	203	Immunology	4	4	80	20	100
4	204	Microbial Biochemistry	4	4	80	20	100
5	205	Practical-I	4	4	100	--	100
6	206	Practical-II	4	4	100	--	100
7	207	Seminar	--	1	--	25	25
		Total		25	520	105	625

  
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S.No	Paper Code	Title of the Paper	Instruction Hrs/Week	No. of Credits	Marks		Total Marks
					External	Internal	
<b>SEMESTER-III</b>							
1	301	Clinical Biochemistry	4	4	80	20	100
2	302	Genetic Engineering	4	4	80	20	100
3	303	Endocrinology	4	4	80	20	100
4	304	Animal Biotechnology	4	4	80	20	100
5	305	Practical – I	4	4	100	--	100
6	306	Practical – II	4	4	100	--	100
7	307	Seminar	--	1	--	25	25
		Total		25	520	105	625
<b>SEMESTER-IV</b>							
1	401	Bioinformatics and Biostatistics	4	4	80	20	100
2	402	Nutritional Biochemistry	4	4	80	20	100
3	403	Physiology and Genetics	4	4	80	20	100
4	404	Developmental Biology and Plant Biochemistry	4	4	80	20	100
5	305	Practical – I	4	4	100	--	100
6	406	Practical – II	4	4	100	--	100
7	407	Seminar	--	1	--	25	25
		Total		25	520	105	625
<b>GRAND TOTAL (Sem I+II+III+IV)</b>				<b>100</b>	<b>2080</b>	<b>420</b>	<b>2500</b>

  
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# **FIRST YEAR – BIOCHEMISTRY**

## **SEMESTER – I AND SEMESTER - II**

**Kakatiya University - Faculty of Science**  
**M.Sc, Biochemistry, SEMESTER – I**  
**Paper Code: 101**  
**CELL BIOLOGY**

**Unit-I: Introduction to cell biology and Biomembranes.**

- 1.1. Membrane structure and function: Structure of model membrane, lipid bilayer and membrane protein diffusion, osmosis, ion channels, active transport, ion pumps
- 1.2 Mechanism of sorting and regulation of intracellular transport, electrical properties of membranes.
- 1.3 Structural organization and function of intracellular organelles: Cell wall, nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes.
- 1.4 Plastids, vacuoles, chloroplast, structure & function of cytoskeleton and its role in motility.

**Unit-II: Intracellular Compartments and protein sorting**

- 2.1. Organization of genes and chromosomes: Operon, interrupted genes, gene families, structure of chromatin and chromosomes.
- 2.2 Unique and repetitive DNA, heterochromatin, euchromatin, transposons.
- 2.3 Cell division and cell cycle: Mitosis and meiosis, their regulation, steps in cell cycle, and control of cell cycle.
- 2.4. Microbial Physiology: Growth, yield and characteristics, strategies of cell division, stress response.

**Unit III: Cell Communication and Cell Signaling.**

- 3.1. Cell signaling: Hormones and their receptors, cell surface receptor, signaling through G-protein coupled receptors, signal transduction pathways, second messengers, regulation of signaling pathways.
- 3.2 Bacterial and plant two-component signaling systems, bacterial chemotaxis and quorum sensing.
- 3.3 Cellular communication: Regulation of hematopoiesis, general principles of cell Communication.
- 3.4 Cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrins, neurotransmission and its regulation.

**Unit IV: Cell cycle, apoptosis and cancer**

- 4.1. Genetic rearrangements in progenitor cells, oncogenes, tumor suppressor genes.
- 4.2. Cancer and Cell cycle, virus-induced cancer, metastasis, interaction of cancer cells with normal cells.
- 4.3 Apoptosis, therapeutic interventions of uncontrolled cell growth.
- 4.4. Cell senescence, telomerase.

  
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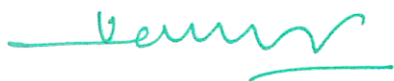
  
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## **PRACTICALS:**

1. Observation of a Eukaryotic cell under higher microscope.
2. Preparation of mitotic chromosomes from roots tips.
3. Preparation of mitotic Chromosomes from testis of grasshopper/onion roots tips.
4. Isolation of Mitochondria from the cell through differential and density gradient centrifugation.
5. Glucose uptake activity of the cells.
6. Isolation of Endoplasmic Reticulum from mammalian cells
7. Extraction of nuclear Chromate
8. Cell counting using hemocytometer.

## **REFERENCE BOOKS:**

1. Molecular all biology : Lodish, etal.
2. Molecular all biology : Bruce Alberts, etsl.
3. Cell Biology : DeRoberts.
4. Cell and molecular biology, :Gerad karp
5. Molecular cell biology : David Baltimoe.
6. Cell Biology :Sc Rostogi.



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**Kakatiya University - Faculty of Science**  
**M.Sc, Biochemistry, SEMESTER – I**  
**Paper Code: 102**  
**STRUCTURE AND FUNCTION OF BIOMOLECULES**

**Unit – I: Molecular Logic of Life**

- 1.1. **Atoms:** Structure of Atoms, molecules and chemical bonds. Stabilizing Interactions (Van der Waals, electrostatic, hydrogen bonding, hydrophobic interactions).
- 1.2. **Carbohydrates:** Classification, structure, chemical properties. Reactions of monosaccharides, formation of glycosidic bond.
- 1.3. Chemistry and Biological role of homo and heteropolysaccharides; Structural polysaccharides (Cellulose and Chitin)
- 1.4. Storage polysaccharides (Starch, Glycogen and inulin); Mucopolysaccharides, Blood group substances, peptidoglycons.

**Unit –II: Amino Acids and Proteins**

- 2.1 Classification, structure and physico chemical properties of amino acids, Essential and non-essential amino acids.
- 2.2 Acid base properties and general reactions of amino acids, Non-protein or unusual amino acids, Peptide bond formation and stability.
- 2.3 Classification of proteins, Purification and isolation of proteins, criteria of purity.
- 2.4 Structural organization of proteins-Primary, Secondary, Tertiary and Quaternary structure, confirmation of proteins-Ramachandran plot, Denaturation of proteins.

**Unit-III: Lipids and Porphyrins**

- 3.1 Classification and Structure, properties and classification of lipids.
- 3.2 Fatty acids, waxes, phospholipids, cerebrosides and gangliosides.
- 3.3 Lipoproteins, prostaglandins, leukotrienes, thromboxanes, steroids and bile acids.
- 3.4 Structure of Porphyrins, Structure and function of Heme, Cytochromes and Chlorophyll

**Unit – IV: Nucleic Acids**

- 4.1 Purine and Pyrimidine Bases, Nucleosides, Nucleotides.
- 4.2 Formation of phosphodiester bond and its stability; Stabilizing interactions (Van der Waals, electrostatic, hydrogen bonding, hydrophobic interaction, etc.).
- 4.3 Structure of DNA-Watson and Crick model, different forms of DNA; forces stabilizing secondary structure; Conformation of nucleic acids (A-, B-, Z-,DNA), t-RNA, micro-RNA).
- 4.4 Types and Structure of RNA (mRNA, tRNA and rRNA), Denaturation and Renaturation of DNA, melting curves.

  
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## PRACTICALS:

### I. Qualitative analysis of Biomolecules:

1. Carbohydrates (Specific reactions of sugars like Glucose, Fructose, Sucrose, Maltose, Lactose, Xylose, Galactose).
2. Amino acids (Tyrosine, Histidine, Methionine, Tryptophan, Cysteine and Arginine).

### II. Biochemical Preparations:

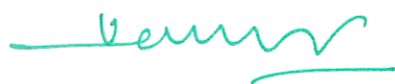
1. Preparation of Starch from Potatoes
2. Preparation of Casein from Milk.
3. Isolation of Cholesterol and Lecithin.
4. Preparation of Lactose from Milk.

### III. Colorimetric Estimations:

1. Estimation of Glucose by Nelson-Somogyi method.
2. Estimation of maltose by Di NitroSalicylic acid method.
3. Estimation of inorganic Phosphorus by Fiske-Subbarow method.
4. Estimation of protein by Biuret method.
5. Estimation of protein by Lowry method.

### REFERENCE BOOKS:

1. Glycoproteins by Hughes R.C., Chapman & Holl.
2. Biochemistry – Mechanisms of metabolism Cunningham, E.B., Mc Grew – Hill.
3. Nucleic acid – Chargaff & Davidson Vol. II
4. The Biochemistry of Nucleic acids; Adams et al., Chapman and Hall.
5. Proteins: A guide to study by Physical & Chemical
6. Proteins: Structure, function and evolution. Dickerson Geis, 2nd Edn, Benjamin/ Cummings, Menlo Park, California.
7. The proteins: Neurath and Hill, 3rd Ed. Academic New York.
8. Biochemistry – Zubay C, Addison – Wesley.
9. Biochemistry of Lipids and Membranes – Vance D, Addison – Wesley.
10. Biochemistry, Lehninger A.H.
11. Textbook of Biochemistry West, E.S., Todd, Manson & Vanbruggen, Macmillan & co.
12. Principles of Biochemistry white- A. Handler and Smith E.L. Mc Graw Hill.
13. The carbohydrates: Pigman & Hartman Vol. II – A & II- B.
14. Comprehensive Biochemistry – Florkin & stotz, Academic Press.



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**M.Sc, Biochemistry, SEMESTER – I**  
**Paper Code: 103**  
**BIOANALYTICAL TECHNIQUES**

**Unit – I: Microscopy, Histological and Immunotechniques in Biology**

- 1.1 **Microscopic techniques:** Visualization of cells and subcellular components by light microscopy, resolving powers of different microscopes, microscopy of living cells, image processing methods in microscopy.
- 1.2 Scanning and transmission electron microscopes, different fixation and staining techniques for EM (Electron Microscopy), freeze-etch and freeze-fracture methods for EM.
- 1.3 **Histochemical and immunotechniques:** Antibody generation, detection of molecules using ELISA, RIA, western blot, immunoprecipitation, flow cytometry and immunofluorescence microscopy.
- 1.4 Detection of molecules in living cells, *in situ* localization by techniques such as FISH and GISH. Sedimentation methods. Basic Principle of Centrifugation.. preparative, differential, density gradient, analytical, ultra Centrifugation. Applications.

**Unit –II: Electrophysiological & Radiolabeling Techniques**

- 2.1 **Electrophysiological methods:** Single neuron recording, patch-clamp recording, ECG, Brain activity recording, lesion and stimulation of brain pharmacological testing.
- 2.2 **Brain Scanning Techniques:** MRI (Magnetic resonance imaging), fMRI, CT (Computerised tomography), PET (Positron emission tomography)
- 2.3 **Radiolabeling techniques:** Properties of different types of radioisotopes normally used in biology, their detection and measurement.
- 2.4 Incorporation of radioisotopes in biological tissues and cells, molecular imaging of radioactive material.


**Unit-III: Computational & Biophysical Methods**

- 3.1 **Computational methods:** Nucleic acid and protein sequence databases; data mining methods for sequence analysis,
- 3.2 Web-based tools for sequence searches, motif analysis and presentation.
- 3.3 **Biophysical methods:** Analysis of biomolecules using UV/visible, fluorescence, circular dichroism, NMR and ESR spectroscopy,
- 3.4 Structure determination using X-ray diffraction and NMR; analysis using light scattering, different types of mass spectrometry.

**Unit – IV: Molecular and Recombinant DNA techniques in Biology**

- 4.1 Isolation and purification of RNA, DNA (genomic and plasmid) and proteins. Different separation methods; analysis of RNA, DNA and proteins by one and two dimensional gel electrophoresis. SDS PAGE, AND Isoelectric focusing capillary, pulse field gel electrophoresis.
- 4.2 Molecular cloning of DNA or RNA fragments in bacterial and eukaryotic systems; expression of recombinant proteins using bacterial, animal and plant vectors;
- 4.3 Isolation of specific nucleic acid sequences; generation of genomic and cDNA libraries in plasmid, phage, cosmid, BAC and YAC vectors;

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4.4 Theroretical Priniciples methodology and Biochemical Applications of Separating methods. Counter Current Distribution, paper, Thin Layer, Reverse phase, Absorption Ion Exchange, Affinity Chromatography, Gel filtration, HPLC, GC, MS; Blotting Techniques- Northern blot, Southern blot, Western blot Analyses and development of blots.

### **PRACTICALS :**

1. Separation of cell organelles by Differential centrifugation.
2. Separation of protein by electrophoresis (Native & SDS page).
3. Separation of amino acids by paper and thin layer Chromatography Demonstration of column Chromatography.
4. Validation of Beer-lamberts law of a coloured compound (CuSO<sub>4</sub>).
5. Measurement of pH meter Preparation of buffer.
6. Light microscope and its parts Observation of unstained and stained cells.
7. Demonstration of a fixation, dehydration, sectioned and stained of any animal tissue.
8. Demonstration of Carbohydrates, Proteins Lipids and nuclear acids in tissue sections.
9. Preparation of chick fibroblast culture and viability testing.
10. Desalting of proteins by dialysis

### **REFERENCE BOOKS :**

1. Principles and Techniques in biochemistry and molecular biology - Wilson & Walkes
2. Culture of animal cells - Freshuay
3. Sharma V.K. (1991), Techniques in microscopy and cell Viology, Tata-Mc Craw Hil.
4. Robert Braun Introduction to instrumental analysis - Mc.Crew.Hil
5. Bisen & Mathw. Tools and Techniques in Life Sciences,- CBS Publishers & distributors.
6. Principles of Animal Cell Culture - Basant Kumar & Rinesh Kumar, Int.Bork 2008,XXII edn.

  
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**Kakatiya University - Faculty of Science**  
**M.Sc, Biochemistry, SEMESTER – I**  
**Paper Code: 104**  
**ENZYMOLOGY**

**Unit I: Enzymes**

- 1.1 Classification of enzymes; Remarkable properties of enzymes – catalytic power, specificity, active sites.
- 1.2 Enzyme localization and assay of enzymes, Units of enzyme activity, Active site – Fisher and Koshland models, formation of enzyme – substrate complex and experimental evidences.
- 1.3 Factors affecting velocity of enzyme catalyzed reactions.
- 1.4 Modern concepts of evolution of catalysis, ribozymes, abzyme and synzymes.

**Unit II: Enzyme Kinetics**

- 2.1 Kinetics of single substrate enzyme catalyzed reactions, Michaelis – Menten equation.
- 2.2 Lineweaver - Burk, Eadie – Hofstee and Hanes plots. Significance of  $V_{max}$ ,  $K_m$ ,  $K_{cat}$ , specificity constant ( $K_{cat}/K_m$ ).
- 2.3 Kinetics of multisubstrate reaction – Classification with examples. Rate expression for non-sequential and sequential (ordered and random) mechanisms.
- 2.4 Use of initial velocity, Inhibition and exchange studies to differentiate between multi substrate reaction mechanisms.

**Unit-III: Enzyme Inhibition**

- 3.1 Enzyme Inhibition, irreversible inhibition, mechanism and kinetics of competitive noncompetitive and un-competitive inhibition.
- 3.2 Model of enzyme inhibitions, kinetics of bi-substrate reaction, ping-pong reaction, multi-substrate reaction, theorell chance displacement.
- 3.3 Allosteric enzymes, symmetrical and sequential model, Hill's coefficients, cooperativity, positive and negative, hemoglobin as a model for cooperativity.
- 3.4 Enzyme regulation and feedback control, phosphorylation, enzyme regulation of aspartic transcarbamylase and metalloenzymes, carboxypeptidase A, isozymes and their significances.

**Unit IV: Enzyme Reactions**

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

  
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## PRACTICALS:

1. Assay of catalase from liver
2. Assay of acid phosphatase
3. Assay of alkaline phosphatase
4. Assay of urease
5. Assay of arginase from liver
6. Assay of Succinate Dehydrogenase
7. Any enzyme inhibition experiment.
8. Preparation of buffer/solution of given pH, molarity, normality and molality
9. Effect of pH on enzyme activity
10. Effect of temperature on enzyme activity
11. Effect of [S], determine  $K_m$  and  $V_{max}$
12. Immobilization of enzymes

## REFERENCE BOOKS:

1. Understanding enzymes: Palmer T., Ellis Harwood ltd., 2001.
2. Enzyme structure and mechanism. Alan Fersht, Freeman & Co. 1997
3. Principles of enzymology for food sciences: Whitaker Marc Dekker 1972.
4. Methods in enzymology Ed. Colowick and Kaplan, Academic Pr (Continuing series)
5. Text book of Biochemistry with clinical correlations (4th edition)-Thomas M.Devlin.
6. Biological chemistry; H.R. Mehler & E.H Cordes Harper & Rev.
7. Enzyme kinetics Siegel interscience – Wiley 1976.
8. Biochemistry chemical reactions of living cells (2001) David E.Matzler.Vol.I.



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**Kakatiya University - Faculty of Science**  
**M.Sc, Biochemistry, SEMESTER – II**  
**Paper Code: 201**  
**METABOLISM**

**Unit-I: Metabolism of Carbohydrates**

- 1.1. Glycolysis, various forms of fermentations in micro-organisms, citric acid cycle, its function in energy generation and biosynthesis of energy rich bond.
- 1.2 Pentose phosphate pathway and its regulation. Gluconeogenesis, glycogenesis and Glycogenolysis.
- 1.3 Glyoxylate and Gamma amino butyrate shunt pathways, Cori cycle, anaplerotic reactions, Entner-Doudoroff pathway, glucuronate pathway.
- 1.4 Metabolism of disaccharides. Hormonal regulation of carbohydrate metabolism. Energetics of metabolic cycle.

**Unit – II: Metabolism of Proteins**

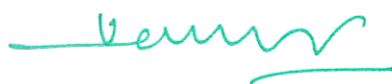
- 2.1. General reactions of amino acid metabolism - Transamination, decarboxylation, oxidative & non-oxidative deamination of amino acids.
- 2.2 Special metabolism of methionine, histidine, phenylalanine, tyrosine, tryptophan, lysine, valine, leucine, isoleucine and polyamines.
- 2.3 Urea cycle and its regulation.
- 2.4 Intermediary Metabolism – Approaches for studying metabolism.

**Unit – II: Metabolism of Lipids, Nucleotides and Vitamins.**

- 3.1 Introduction, hydrolysis of tri-acylglycerols,  $\alpha$ -,  $\beta$ - oxidation of fatty acids.
- 3.2 Fatty acid biosynthesis; Lipid biosynthesis; Metabolism of cholesterol and its regulation. Energetics of fatty acid cycle.
- 3.3 Biosynthesis and degradation of purine and pyrimidine nucleotides and its regulation. Purine salvage pathway.
- 3.4 Biosynthesis of Vitamins – Ascorbic acid, thiamine, pantothenic acid and Folic acid

**Unit-IV: Bioenergetics:**

- 4.1 Thermodynamic principles - Chemical equilibria, free energy, enthalpy, entropy. Free energy change and high energy compounds, phosphoryl transfer potential, role of ATP.
- 4.2. Biological redox systems. Organization of electron carriers in the mitochondria.
- 4.3. Substrate level and oxidative phosphorylation, un-couplers and inhibitors of oxidative phosphorylation. Mechanisms of oxidative phosphorylation.
- 4.4. Mitochondrial transport system. Microsomal electron transport. Bioluminescence



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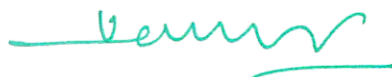
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## PRACTICALS:

1. Estimation of glucose by Nelson Somogyi method.
2. Estimation of total sugar by anthrone method.
3. Estimation of maltose by dinitrosalicylic acid method.
4. Estimation of inorganic phosphorous by Fiske Subbarow method.
5. Estimation of protein by Lowry method.
6. Estimation of protein by Biuret method.
7. Estimation of ammonia by Nessler's method.
8. Estimation of ammonia by Berthelot method.
9. Estimation of Urea by Dam method.
10. Estimation of Pyruvate

## REFERENCE BOOKS :

- 1) Principle of Biochemistry – A.L Lehninger (CBS Publisher)
- 2) Biochemistry – Lubert STRYER (5THEdt)
- 3) Principle of Biochemistry – General aspects – Smith et al(8thEdt)
- 4) Harper s Biochemistry –Murray et al (Lange)
- 5) Text Book of Biochemistry – West et al 1966 (McMillian)
- 6) Biochemistry (2ndEdt) C,K Mathews and K,E Van Holde (1995).
- 7). Text of biochemistry and clinical correlation- Thomos M. Devlin (John Wiley)2nd edition
- 8). Biochemistry 2nd edition David Voet and J.G Voet (1984) (john Wiley)
- 9). Outlines of Biochemistry by E.E Conn & Stump (Wiley Eastern Lt)
- 10) Biochemistry by Zubay



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**M.Sc, Biochemistry, SEMESTER – II**  
**Paper Code: 202**  
**MOLECULAR BIOLOGY**

**UNIT- I: DNA replication, repair and recombination**

- 1.1 Concept of gene, non-coding DNA, transposons; DNA damage and repair mechanisms.
- 1.2 Unit of replication, enzymes involved, replication origin and replication fork, fidelity of Replication; Extra-chromosomal replicons
- 1.1. Regulation of phages, viruses; Prokaryotic and eukaryotic gene expression.
- 1.2. Role of chromatin in regulating gene expression and gene silencing; Regulation of gene expression by intra cellular receptors.

**UNIT- II: RNA synthesis and processing**

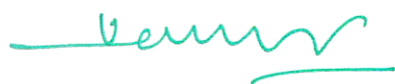
- 2.1. Structure and function of different types of RNA.
- 2.2. Transcription factors and machinery, formation of initiation complex, transcription activators and repressors. RNA polymerases.
- 2.3. Capping, elongation and termination, RNA processing.
- 2.4. RNA editing, splicing, polyadenylation, RNA transport.

**UNIT- III: Protein synthesis and processing**

- 3.1. Ribosome structure, Genetic code (codon anticodon recognition).
- 3.2. Formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination.
- 3.3. Aminoacylation of tRNA, tRNA-identity, aminoacyl tRNA synthetase.
- 3.4. Translational proof-reading, translational inhibitors, post- translational modification of proteins.

**UNIT- IV: Molecular biology and recombinant DNA techniques**

- 4.1 DNA sequencing methods, strategies for genome sequencing; methods for analysis of gene expression at RNA and protein level.
- 4.2 Micro array based techniques; isolation, separation and analysis of carbohydrate and lipid molecules; RFLP, RAPD and AFLP techniques.
- 4.3 Generation of genomic and cDNA libraries in plasmid, phage, cosmid, BAC and YAC vectors.
- 4.4 Expression of recombinant proteins using bacterial and animal vectors. Gene knock out in bacterial and eukaryotic organisms.



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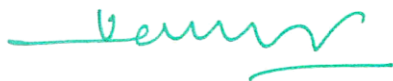
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## **PRACTICALS :**

1. Isolation of DNA from goat spleen
2. Estimation of DNA (diphenyl method)
3. Estimation of RNA (Orcinol method)
4. UV absorption spectra of native and denatured DNA
5. Agarose gel Electrophoresis of DNA
6. DNA amplification by PCR
7. Gel Documentation

## **REFERENCE BOOKS:**

1. Molecular Cell Biology by Lodish et al
2. Molecular Cell Biology by Alberts et al
3. Principles of Biochemistry by Lehninger
4. The Cell by Geoffrey Cooper
5. Genetics , A molecular approach by Peter J Russell
6. Biochemistry by Voet and Voet
7. Principles of Genetics by Tamarin
8. GENES VIII by Lewin
9. Biochemistry by U.Satyanarayana and U Chakrapani
10. Benjamin Lewin. GENES IX 2008. Ninth edition



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**Kakatiya University - Faculty of Science**  
**M.Sc, Biochemistry, SEMESTER – II**  
**Paper Code: 203**  
**IMMUNOLOGY**

**UNIT-I: INTRODUCTION TO IMMUNE SYSTEM**

- 1.1 Cells and tissues of the immune system.
- 1.2 Innate and acquired immunity.
- 1.3 Antibody – Structure, types and functions; Primary and Secondary Ab responses.
- 1.4 Antigen, antigenicity and immunogenicity, B and T cell epitopes.

**UNIT-II: MATURATION ACTIVATION AND REGULATION OF LYMPHOCYTES**

- 2.1 T-cell maturation and differentiation.
- 2.2 T-cell receptors, molecular components and structure.
- 2.3 TH -cell activation mechanism. Cell death and T-cell regulation of immune response.
- 2.4 B-cell receptors B-cell generation, activation, differentiation and proliferation.

**UNIT-III: EFFECTOR MECHANISM AND REGULATION OF IMMUNE RESPONSE**

- 3.1 Structure of MHC molecules – Class -I and Class-II MHC in mouse and HLA system in human.
- 3.2 Structure and functions of cytokines.
- 3.3 Cytokine receptors and signaling, Toll-like receptors
- 3.4 Components of Innate Immune system. NK cells mechanism and action.

**UNIT-IV: IMMUNITY IN DEFENCE AND DISEASE**

- 4.1 Immunity responses during Bacteria (TB), parasitic (Malaria) and viral (HIV) infections.
- 4.2 Bone marrow Transplantation Immunology. Mechanism of Allograft rejection Graft -Versus-Host Disease.
- 4.3 Recognition and entry processes of different pathogens like bacteria, viruses into animal.
- 4.4 Hyper sensitivity, AutoImmunity, Congential and Aquired Immuno Deficiency disease

  
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## PRACTICALS:

1. Agglutination Reaction:
  - a) Tube Agglutination Reaction
  - b) Slide Agglutination Reaction
  - c) Indirect Agglutination Inhibition Reaction
2. Precipitation Reaction
  - a) Double Diffusion Reaction
  - b) Single Diffusion Reaction
3. Erythrocyte Rosette-forming Cell Test.
4. Separation of Lymphocytes
5. Enzyme-Linked Immunosorbent Assay
6. Measurement of Phagocytosis by Phagocytes
7. Demonstration of Immunelectrophoresis
8. Neutralization and complement fixation
9. Collection of macrophages and their characterization
10. Identification of histological slides of lymphoid tissue - Spleen, thymus, lymphnode and bone marrow

## REFERENCE BOOKS:

1. Abul K. Abbas – Cell And Molecular Immunology
2. Kubly. Immunology, W.H Freeman, USA
3. W.Pual, Fundamentals of immunology.
4. I.M. Roitt , Essential immunology, ELBS Edition.

  
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**Kakatiya University - Faculty of Science**  
**M.Sc, Biochemistry, SEMESTER – II**  
**Paper Code: 204**  
**MICROBIAL BIOCHEMISTRY**

**UNIT – I: General Principles**

- 1.1. History of microbiology, major contribution in microbiology related to biochemistry; Pasteur's contributions,
- 1.2. Classification of microbial world (Haeckel, Whittaker, Carl Woese).
- 1.3. Comparative account of Archea, eubacteria and eukaryotes.
- 1.4. Nutrition of microorganisms; major and minor bioelements, their sources and physiological functions. Growth factors and their functions in metabolism.

**Unit – II : Microbial Growth**

- 2.1. Isolation, cultivation and identification of bacteria.
- 2.2. Growth curve, mathematics of growth, measurement of microbial growth.
- 2.3. Effect of limiting factor, continuous cultures: chemostat, turbidostat, balanced and unbalanced growth.
- 2.4. Influence of environmental factors on growth solutes, water activity, pH, temperature, oxygen pressure, radiation, growth inhibition.

**UNIT – III: Viruses And Bacteriophages**

- 3.1. Nature of viroids, prions and viruses; composition.
- 3.2. Structure of viruses; isolation and assay of viruses- General methods of virus isolation with examples of TMV and t phages; Assay of TMV and bacteriophages.
- 3.3. Assay of animal viruses with special reference to oncogenic viruses, pock assays.
- 3.4. Bacteriophages structure and life cycles of T7 phages,  $\lambda$ -phage,  $\phi$  x 174, Q $\beta$  and M13, one step growth, burst size and eclipse.

**UNIT – IV: Animal Viruses and Cancer**

- 4.1. Animal viruses – General features, genome organization and replication strategies of adenoviruses,
- 4.2. Polioviruses, influenza virus, SV 40, retroviruses (RSV and HIV), SARS-CoV-2.
- 4.3. Oncogenic viruses and carcinogenesis, oncogenes.
- 4.4. Mechanism of cell transformation, interaction in permissive and non-permissive hosts.

  
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## **PRACTICALS:**

- 1 Sterilization techniques (Autoclaving, hot air oven sterilization, filtration, membrane filtration)
2. Preparation of routine laboratory media – nutrient broth, LB Broth, agar media
3. Isolation of bacteria, actinomycetes and fungi from soil/water
4. Development of a single colony from a bacterial culture
5. Staining techniques – simple, differential, acid-fast and spore staining
6. Measurement of microbial growth
7. Motility (hanging drop) of microbial cells
9. Study of growth of bacteria, cyanobacteria and fungi
10. Effect of pH, temperature and osmotic concentrations on bacterial growth

## **REFERENCE BOOKS:**

- 1) Tex Book of Microbiology – william Burrows
- 2) The Microbial World – R,Y.Stainer et al
- 3) Microbiology –Pelczar ,Reid and Chain
- 4) Biology of Microorganisms –sandee T,Y lyles
- 5) Fundamentals of Microbiology – M Frebisher
- 6) Microbiology –Pyalkin
- 7) Principles of Microorganisms—Brocks
- 8) Cell biology (1993) –David E Sada(jones and Baret)

  
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# **SECOND YEAR – BIOCHEMISTRY**

## **SEMESTER – III AND SEMESTER - IV**

**Kakatiya University - Faculty of Science**  
**M.Sc, Biochemistry, SEMESTER – III**  
**Paper Code: 301**  
**CLINICAL BIOCHEMISTRY**

**UNIT – I – Disorders of Carbohydrate Metabolism**

- 1.1. Importance of extracellular glucose, blood glucose homeostasis-role of tissues and hormones; diseases due to low and high carbohydrate levels.
- 1.2. Diabetes mellitus –classification, etiology, clinical and laboratory features. Diagnosis of diabetes mellitus-glucose tolerance test, random, fasting and post prandial glucose levels,
- 1.3. Hypoglycemia, fasting & provoked-stimulation tests (IV, glucagon & leucine test ), extended GTT.
- 1.4. Hypoglycemia in children, neonatal and early infancy. Insulinomas. Galactosaemia, hereditary fructose intolerance. Glycogen storage diseases.

**UNIT – II – Disorders of Lipids and Proteins**

- 2.1. Disorders of Lipids – Plasma lipoproteins, cholesterol, triglycerides & phospholipids in health and disease
- 2.2. In born Errors of aminoacids, purines, pyrimidines and porphyrin metabolisms.
- 2.3. Inborn Errors of Metabolism – Phenylketonuria, alkaptonuria, albinism, tyrosinosis, sickle cell anemia
- 2.4. Muscular Dystrophy and cystic fibrosis, Blood Disorders Immunodeficiency disorders. Autoimmunity.

**UNIT – III - Biochemical Evaluation of Diseases**

- 3.1. Biochemical aspects of liver disease: Liver function tests. Serum enzymes in liver disease. Cirrhosis, gallstones, hepatitis: types and clinical manifestation.
- 3.2. Gastric function tests: Gastric function, stimulation of gastric secretion. Compassion of gastric secretion.
- 3.3 Tests for evaluation of Pancreatic diseases, Steatorrhea and malabsorption syndrome.
- 3.4. Renal function tests: Glomerular and tubular functions. Tests for evaluation- concentration, dilution, excretion, clearance test. Nephritis and nephritic syndrome

**UNIT-IV – Clinical Diagnostics**

- 4.1. Basic techniques used in molecular diagnostics, future of molecular diagnostics,
- 4.2. Fluorescent in-situ hybridization for identification of chromosomal abnormalities.
- 4.3. Pre Clinical Studies: Pre clinical Models - Drug discovery and development, including animal studies, tissue culture studies, safety, efficacy,
- 4.4. Assessment of pharmacokinetics in early phase drug evaluation, Metabolism studies – in vitro and in vivo tests, Pharmacogenomics,

  
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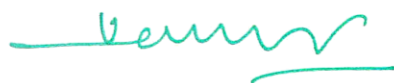
  
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## PRACTICALS

1. Qualitative analysis of abnormal constituents in urine
2. Determine urinary titrable activity
3. Determine PCV, ESR, differential count
4. Determine osmotic fragility of RBC
5. Determine urinary glucose, creatinine
6. Determine blood hemoglobin (Drabkins) and glycosylated hemoglobin
7. Determine blood urea
8. Determine blood glucose (POD-DOD method, enzymatic method)
9. Determine A:G ratio
10. Analyze plasma Ca, K, Na, and Mg by flame photometry
11. Assay serum alkaline phosphatase
12. Assay serum ALT (SGPT)
13. Assay serum AST (SGOT)
14. Assay serum LDH
15. Serum lipid profile
16. Determine total protein content (Kjeldahl) in a food item
17. Determine total carbohydrate and lipid content in a food item

## RECOMMENDED BOOKS

- 1) Text Book of Biochemistry with Clinical correlations . Thomas M.Devlim (John wily)
- 2) Harper Review of Biochemistry Murray et al (Longman)
- 3) Clinical chemistry in diagnosis and treatment – joan f zilva and P R Pannall (1988)
- 4) Clinical diagnosis and management by Laboratory methods(John Bernard Henry 1984)
- 5) Medical Biochemistry – S-Rmakrishnan and Rajiswami.
- 6) Clinical Biochemistry A cantorow and L, Trumper (Saunders)
- 7) Clinical chemistry in diagnosis and treatment – joan f zilva and P R Pannall (1988)
- 8) Clinical diagnosis and management by Laboratory methods(John Bernard Henry 1984)
- 9) Medical Biochemistry – S-Rmakrishnan and Rajiswami.
- 10) Clinical Biochemistry A cantorow and L, Trumper (Saunders)
- 11) Biochemical disorders in Human diseases R.H S Thompson and E,J King (churchil)
- 12) Harper s Review of Biochemistry ,Murray et al (Longman.)
- 13) Principles of gene manipulation – R.W Old and S.B. Primrose.
- 14) Elements of Biotechnology – R.K. Gupta.



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**Kakatiya University - Faculty of Science**  
**M.Sc, Biochemistry, SEMESTER – III**  
**Paper Code: 302**  
**GENETIC ENGINEERING**

**Unit I: rDNA technology**

- 1.1 Restriction enzymes types, restriction modification system, DNA ligase, RNA and DNA polymerases.
- 1.2 Molecular vectors- plasmids, phage vectors, shuttle vectors and cosmids.
- 1.3 High capacity cloning vectors – YACs, BACs and PACs. Shuttle vectors.
- 1.4 Mechanism of rDNA technology.

**Unit II: Genomic & rDNA therapy**

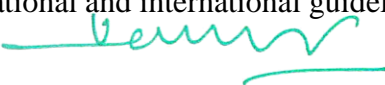
- 2.1 Methods for construction of genomic and cDNA libraries – vectors used, generation of cDNAs, preparation of genomic DNA for library construction.
- 2.2 Methods used in the identification and analyses of recombinant DNA clones. Protein-protein interaction and yeast two hybrid system.
- 2.3 Introduction to siRNA, siRNA technology, microRNA, construction of siRNA vectors, principle and application of gene silencing. Production of insulin, drug, vaccines, diagnostic probe of genetic diseases. Gene therapy.
- 2.4 Polymerase chain reaction (PCR) in recombinant DNA technology, Chromosome walking

**Unit III: Transgenic Technology**

- 3.1 Gene knockout and knock-in, Generation of transgenic animals and its application, Cre-loxP recombination technology.
- 3.2 Homologous and Non-homologous recombination, Gene isolation, gene transfer systems.
- 3.3 Ti plasmid, plant virus vectors, electroporation, microinjection, microprojectile technology, particle bombardment.
- 3.4 Generation of transgenic plants and animals and its application, somatic embryogenesis, embryo rescue, application of recombinant DNA technology in photosynthetic efficacy, nitrogen fixation efficiency and resistance to environmental stresses.

**Unit IV: Techniques in Genetic Engineering**

- 4.1 Molecular genetics maps: Restriction mapping, restriction fragment length polymorphisms (RFLP) linkage and recombination between molecular and phenotypic markers, Random amplified polymorphic DNA (RAPDs).
- 4.2 Using PCR. Sequencing of nucleic acids- Maxim and Gilber chemical degradation and Sanger's dideoxy chain termination methods.
- 4.3 Cloning of specific genes and their expression in bacteria and eukaryotic system. Human genome project, Microarray.
- 4.4 Genetic Engineering- Applications in Medicine, Agriculture and Industry, Social and moral implications, national and international guidelines/regulations.

  
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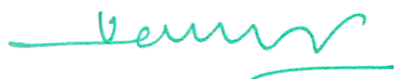


## PRACTICALS

1. Preparation of electro and chemically competent E.coli
2. Isolation of plant genomic DNA
3. Restriction digestion of lambda DNA
4. Construction of restriction map of lambda DNA
5. Cloning of foreign DNA in pUC 18 and screen for positive clones using blue white selection
6. Amplification of selected DNA fragment of PCR
7. Reporter gene assay (Gus/CAT/ $\beta$ -GAL)

## RECOMMENDED BOOKS

1. Genes and probes, A Practical Approach series (1995) by BD. Hames and SJ Higgins, Oxford Univ. Press.
  2. Gel Electrophoresis of Nucleic acids, A Practical Approach (1990) by D Rickwood and BD Hames. Oxford Univ. Press.
- Refer the books already mentioned for other Molecular Biology course.
3. Recombinant DNA – James D Watson et al.
  4. Gene Cloning – T. A. Brown.
  5. From Genes to Genomes – J.W. Dala and Schantz
  6. Gene Biotechnology – S.N. Jogdand
  7. Medical Biotechnology - S.N. Jogdand
  8. Principles of gene manipulations – R. W. Old and S.B. Primerose
  9. Genes – Lewin B.
  10. PCR-Technology: Principles and application of DNA amplification – H.A. Erlich.



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**M.Sc, Biochemistry, SEMESTER – III**  
**Paper Code: 303**  
**ENDOCRINE BIOCHEMISTRY**

**UNIT-I : Endocrine Glands**

- 1.1 Endocrine system – organization of the endocrine system.
- 1.2 General features and classification of hormones, mechanism of action of hormones, chemistry, biosynthesis, Secretion, physiological functions.
- 1.3 Regulation and disorders of anterior and posterior pituitary hormones, hypothalamic hormones.
- 1.4 Hormones of the pineal gland – Serotonin and melatonin

**UNIT-II : Thyroid hormones**

- 2.1 Thyroid hormones – chemistry, biosynthesis, secretion, physiological function.
- 2.2 Regulation and disorders, hypo and hyperthyroidism, tests for thyroid function.
- 2.3 Parathyroid hormones – Parathormone and calcitonin, their role in calcium and phosphate metabolism.
- 2.4 Disorders of parathyroid hormone.

**UNIT – III : Pancreatic and gastrointestinal hormones**

- 3.1 Pancreatic and gastrointestinal hormones – Biosynthesis, secretion, physiological functions and regulation of insulin and glucagon.
- 3.2 Role of insulin and glucagon in carbohydrate, lipid and protein metabolism. Disorders of pancreas. Gastrin, secretin, Cholecystokinin.
- 3.3 Adrenal hormones – Chemistry, biosynthesis and functions of adrenal medullary and adrenal cortical hormones.
- 3.4 Disorders of adrenal hormones, tests for the evaluation of adrenal function.

**UNIT –IV : Hormones of reproduction**

- 4.1 Spermatogenesis and Oogenesis.
- 4.2 Gonadal hormones, chemistry.
- 4.3 Biosynthesis and physiological functions of androgens, estrogens and progesterone.
- 4.4 Hormonal regulation of menstrual cycle, contraception, reproductive disorders.

  
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## PRACTICALS:

1. Histological slides pertaining to endocrine glands.
2. Alloxan diabetes induction and insulinization study by blood glucose and liver glycogen estimation.
3. Effect of adrenalectomy on glycogen content in liver in terms of glucose.
4. Monitoring the plasma progesterone levels during estrous cycle in bovine.
5. Role and application of *PGF2a* in bovines
6. To study the ferning pattern of vaginal mucus during estrus stage of the cycle.
7. Isolation and study of the histological structure of the rat mammary gland
8. To enumerate somatic cells in milk and study its relationship with various hormones.
9. To assess the responsiveness of mammary epithelial cells to hormones

## REFERENCE BOOKS :

1. Text book of Biochemistry and Human Biology by Talwar G.P., Prentice Hall India.
2. Human Physiology and Mechanism of distance. Guyton 3rd Ed. Iggushoen/Seunders.
3. Clinical Biochemistry, Vol. 1 and 2, Williams *et al.*, Heinemann Medical, 1978.
4. Lynchs Medical Laboratory Technology by Raphael, S. S., 4th Ed. Iggushoen/Seunders.
5. Text Book of Endocrinology, William.
6. General Endocrinology – Turner.
7. Biochemical Endocrinology of the Vertebrates – E. Fruden and H. Lines.
8. Foundation of Modern Biochemical Series, Prentice Hall Inc., 1971.
9. Metabolic and Endocrine Physiology – Jay Teppermann.
10. Metabolic Pathways – Green Berg.
11. Intermediary Metabolism and its regulation – Larner
12. Principles of Biochemistry – White A., Handler P and Smith.
13. Receptors and Hormone action. Receptors and Recognition series. Text book of medical physiology by A.C. Guytom.

  
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**Kakatiya University - Faculty of Science**  
**M.Sc, Biochemistry, SEMESTER – III**  
**Paper Code: 304**  
**ANIMAL BIOTECHNOLOGY**

**UNIT-I: Basics of Animal Biotechnology**

- 1.1 History and Scope of Animal Biotechnology; Current status and Future Applications of Animal Biotechnology.
- 1.2 History and Scope of Animal Cell Culture; Types of Cell Culture.
- 1.3 Laboratory facilities for Animal Cell Culture; Culture Media and Culture Procedures.
- 1.4 Stem Cells: Definition and Meaning of Stem Cells; Functions and origins of Stem Cells; Types of Stem Cells; Stem Cell Therapy.

**UNIT-II: Applied Animal Biotechnology**

- 2.1 Concepts of r-DNA Technology; Genetic Engineering through Plasmids, Cosmids and Lambda phages.
- 2.2 Animal Cloning Methods and Utility; Transfection Methods and Transgenic Animals.
- 2.3 Biosensors: History of the Development of Biosensors; Working Principle and Protein Engineering for Biosensors; Applications of Biosensors.
- 2.4 Nucleic acid Hybridization; Establishment and importance of Gene Banks; Construction of Genomic libraries and DNA libraries.

**UNIT-III: Pharmaceutical Animal Biotechnology**

- 3.1 Introduction to Pharmaceutical Biotechnology; Basics on Products of Pharmaceutical Biotechnology (Lymphokines, Interferon's, Human Growth Hormone and Insulin).
- 3.2 Genetic Engineering for the production of Insulin.
- 3.3 Production and Applications of Monoclonal Antibodies (MAbs).
- 3.4 Vaccines: Preparation and role of Genetic Engineering in the production of Vaccines.

**UNIT-IV: Medical Animal Biotechnology**

- 4.1 Animal and Human Health Care: Diagnosis and Treatment of Diseases; Genetic Counseling; Forensic Medicine (DNA Finger Printing).
- 4.2 Gene Therapy: Human Diseases Targeted for Gene Therapy; Vectors and other Delivery systems for Gene Therapy.
- 4.3 Gene Therapy for Genetical and Acquired Diseases; Gene therapy using Nanotechnology.
- 4.4 Intellectual Property Rights: Introduction to Intellectual Property; Types of IP; Patents, Trademarks, Copyright & Related Rights, Protection of GMOs; IPs of relevance to Biotechnology; Types of patent application.

  
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## PRACTICALS:

1. Laboratory demonstration on safe handling of microorganisms.
2. Isolation of plasmid DNA from E-Coli .
3. Isolation of yeast DNA and Transformation of E-Coli.
4. Qualitative assay of B.Galactosidase in yeast Colonies/cell extracts.
5. Propagation & maintenance of tissue culture.
6. Isolation of Bone marrow and culture of mesenc hymel stem cells from isoleted murine/sleep/rat bone marrow.
7. Try pan blue exclusion method for cell viability estimation.
8. Mycoplasma detection method using PCR.
9. Production of penicillin and testing of antimicrobial activity.
10. Production of monoclonal of tissue culture.

## REFERENCE BOOKS:

1. Culture of Animal cells – manual of basic Technique by R. Iam Freshney published by
2. Molecular Biotechnology by john Wiley & Sons Primrose Published by parima publishing corporation.
3. Principles and practice of Animal tissue culture by Sudha Gangal Published by University Pren
4. Laboratory procedures in Biotechnology--- Alam Doyle ,J.Bryan Griffiths.wiley publisher
5. Animal Biotechnology- A Laboratory course, --- Jeddrey M.Beeker. Elsevien IInd edition,2007.
6. Tools & Techniques in Biotechnology – Mousami Debnath, pointer publishers,2002
7. Principles & techniques of Biotechnology & Muecular Biology-- 6th edition, keith Wilson& John Walker
8. Gene cloning & manipulation, Christopher howe, Combridge Publications.
9. A manual of Laboratory Practices. Good



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**M.Sc, Biochemistry, SEMESTER – IV**  
**Paper Code: 401**  
**BIOINFORMATICS, COMPUTERS AND BIOSTATISTICS**

**Unit – I: Biostatistics**

- 1.1 Measures of central tendency and dispersal.
- 1.2 Probability distributions (Binomial, Poisson and normal); sampling distribution; difference between parametric and non-parametric statistics;
- 1.3 Confidence interval; errors; levels of significance; regression and correlation;
- 1.4 T-test; analysis of variance (ANOVA);  $X^2$  test; basic introduction to Multivariate statistics, etc.

**Unit – II: Basics of Computers**

- 2.1. Basic components of computers – Hardware (CPU, input, output storage devices), Software (operating systems).
- 2.2. Introduction to MS EXCEL – use of worksheet to enter data, edit data, copy data, move data and Graphical tools in EXCEL for presentation of data.
- 2.3. MS – WORD – editing, copying, moving, formatting, table insertion, drawing flow charts etc.,
- 2.4. Introduction to Power Point, image, data handling and Graphical tools in PPT for Presentation.

**Unit – III: Bioinformatics Databases**

- 3.1 Branches of Bioinformatics, scope of bioinformatics, useful sites on the internet.
- 3.2 Data bases and search tools: NCBI (<http://www.ncbi.nlm.nih.gov/>). EMBL serve: (<http://www2.ebi.ac.uk/services.html>).
- 3.3 Sequence alignment: gene bee multiple sequence alignment (<http://www.genebee.msu.su.>), Tree view (<http://taxonomy.zoology.gla.ac.uk/rod/treeview.html>), Sequence analysis.
- 3.4 Introduction to Proteomics and genomics.

**Unit – IV: Bioinformatics in Drug Design**

- 4.1 Protein modelling (homology modelling, threading and *ab initio* prediction).
- 4.2 Identification of drug targets, Molecular docking (Rigid docking, flexible docking), docking based screening.
- 4.3 Preparation of ligand and receptor for docking, lead discovery, lead optimization, combinatorial library, force fields, molecular energy minimization.
- 4.4 Molecular dynamics simulation, Quantitative Structure Activity Relationship (QSAR), ADMET studies, 3D pharmacophore, Pharmacokinetics, pharmacogenomics, cheminformatics and chemogenomics,

  
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## PRACTICALS:

### (a) Statistics

1. Problems on Mean and Median.
2. Problems on Standard Deviation.
3. Problems related to X<sup>2</sup> test, Student T Test . And Probability
4. Problems on Correlation.

### (b) Computers

2. Literature collection using INTERNET, search engines, websites, browsing and downloading for scientific investigation.
3. Creating an e-mail account, sending and receiving mails.
4. Application of excel sheet for data processing.
5. Preparation of power point presentation with software.
6. Representation of statistical data by Histograms and Pie diagrams.

### (c) Bioinformatics

1. Study of Internet resources in Bioinformatics. E.g. NCBI and EMBL.
2. Multiple Sequence Alignment.
3. Sequence Retrieval from Databases.
4. Building of Molecules.
5. BLAST, FASTA programs for sequence database search.
6. Molecular Docking.

## REFERENCE BOOKS:

1. Statistical methods, Snedecor, G.W. and W.G. Cochran, Iowa State Univ. Press Biometry by W. H. Freeman and Francisco
2. Fundamentals of Biometry by L.N. Balaram (1980)
3. Biostatistics by N. Gurumani
4. Biostatistics, A foundation for analysis in the Health (7th Ed. 1999) by WWW Daniel and Sons Inc., New York.
5. Bioinformatics, Sequence, Structure and Databanks by Des Higgins Willie Taylor (2000).
6. Introduction to Bioinformatics by T.K. Altwood and D.J Parry- Smith (Oearson Education Asia 1999)
7. Mount W. 2004. Bioinformatics and sequence genome analysis 2nd Editon CBS Pub. New Delhi.
8. Bergman, N. H. Comparative Genomics. Humana Press Inc. Part of Springer Science+BusinessMedia, 2007.
9. Baxevanis, A. D. Ouellate, B. F. F. 2009. Bioinformatics: A Practical Guide to the analysis of genes and proteins. John-Wiley and Sons Publications, New York.
10. Campbell A. M. and Heyer, L. J. 2007. Discovering Genomics, Proteomics and Bioinformatics, 2nd Edition. Benjamin Cummings

  
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**Kakatiya University - Faculty of Science**  
**M.Sc, Biochemistry, SEMESTER – IV**  
**Paper Code: 402**  
**NUTRITIONAL BIOCHEMISTRY**

**UNIT - I – Basic Concepts**

- 1.1 Function of nutrients. Measurement of the fuel values of foods. Direct and indirect calorimetry.
- 1.2 Basal metabolic rate - factors affecting BMR, measurement and calculation of BMR.
- 1.3 Recommended dietary allowance of macro and micro nutrients.
- 1.4 Biological value of proteins. Concept of protein quality. Specific dynamic action of proteins. Biological value of proteins and essential amino acids. Kwashiorkor and marasmus.

**UNIT – II - Nutritional Supplements**

- 2.1. Elements of nutrition – Dietary requirement of carbohydrates and lipids. Protein sparing action of carbohydrates and fats.
- 2.2. Essential fatty acids and their physiological functions.
- 2.3. Minerals – Nutritional significance of dietary calcium, phosphorus, magnesium, iron, iodine, zinc and copper
- 2.4. Vitamins – Dietary sources, biochemical functions, requirements and deficiency diseases associated with vitamin B complex, C and A, D, E & K vitamins.

**UNIT – III - Nutritional Disorders**

- 3.1 Malnutrition – Prevention of malnutrition, improvement of diets. Requirement of proteins and calories under different physiological states- infancy, childhood, adolescence, pregnancy, lactation and ageing.
- 3.2. Requirement of calories and nutrients for conditions like malnutrition, diabetes anemias, pregnancy, lactating women and obesity.
- 3.3. Starvation – Techniques for the study of starvation. Protein metabolism in prolonged fasting.
- 3.4. Obesity – Definition, Genetic and environmental factors leading to obesity.

**UNIT – IV - Homeostatic Mechanisms and Xenobiotics:**

- 4.1. Structure and function of nephrons. Urine formation, composition.
- 4.2. Water and electrolyte balance. Abnormal constituents of urine. Homeostatic control of body fluids.
- 4.3. Metabolism of xenobiotics: biomedical importance, metabolism of xenobiotics, hydroxylation, conjugation (glucoronidation, sulfation, conjugation with glutathione, acetylation, methylaltionetc).
- 4.4 Toxic effects of xenobiotics.

  
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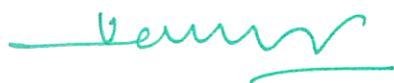


## PRACTICALS

1. Estimation of moisture and ash content of foodstuffs
2. Estimation of acid value of fats and oils
3. Estimation of vitamin-C by titrimetric method
4. Qualitative testing of food adulterants – metanil yellow in turmeric, arhar dal and yellow sweets; vanaspati in pure ghee; chalk powder and sand in wheat flour; lead chromate in turmeric powder; starch in milk.
5. Paper chromatography

## RECOMMENDED BOOKS

- 1) Essentials of food and nutrition , Vol 1&2 . M.SSwaminathan.
- 2) Physiological basis of medical practice (12thedt)- Best and Taylor
- 3) Human physiology .C Chatterji(vol 1&2)
- 4) Review of physiological chemistry by H .A.Harper(lange)
- 5) Biochemistry- White ,Handler and smith
- 6) Text book of Genaral Physiology by H.Davson (chruchill)
- 7) Text book of biochemistry by West Todd Mason and Brugger (Macmillan)
- 8) The chemical analysis of food by David pearson (churchill)
- 9) Human Nutrition and Dietectics by Davidson &passmore(williams)
- 10) Human physiology – stuart Ira Fox (5thEdt) (WCB)



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**PHYSIOLOGY AND GENETICS**

**Unit – I: Digestion, Respiration and Circulation**

- 1.1. Digestion and absorption, Energy Balance, BMR, Respiratory system-Anatomical considerations
- 1.2. Transport of gases, exchange of gases, waste elimination, Respiratory quotient. Neural and chemical regulation of respiration.
- 1.3. Blood composition, Haemopoiesis.
- 1.4. Heart Structure and Function, Neural and Chemical regulation of Cardiovascular system.

**Unit –II: Excretion and Neuro Physiology**

- 2.1. Physiology of excretion, kidney, urine formation, urine concentration, waste elimination, Micturition, Regulation of water balance, blood volume, blood pressure, Homeostasis.
- 2.2. Gross neuro-anatomy of the brain and spinal cord, central and peripheral nervous system. Structure of neuron, Fundamentals of nerve impulse- resting potential, Action potential.
- 2.3. Types of synapses- electrical and chemical, Mechanism of synaptic transmission.
- 2.4. Types of muscles, Ultra structure of striated muscle and Muscle contraction, neural control of muscle tone and posture.

**Unit –III: Principles of Genetics**

- 3.1 Mendelian principles: Dominance, segregation, independent assortment, deviation from Mendelian inheritance.
- 3.2 Concept of gene: Allele, multiple alleles, pseudoallele, complementation tests.
- 3.3 Extensions of Mendelian principles: Codominance, incomplete dominance, gene interactions, Pleiotropy.
- 3.4 Genomic imprinting, penetrance and expressivity, phenocopy.

**Unit II: Population Genetics**

- 4.1 Gene mapping methods: Linkage maps, tetrad analysis. Mmapping with molecular markers, mapping by using somatic cell hybrids.
- 4.2 Recombination: Homologous and non-homologous recombination, including transposition, site-specific recombination.
- 4.3 Extra chromosomal inheritance: Inheritance of mitochondrial and chloroplast genes, maternal inheritance.
- 4.4 Human genetics: Pedigree analysis, lod score for linkage testing, karyotypes, genetic disorders.

  
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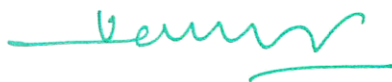
  
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## PRACTICALS

1. Action of pepsin in digestion of proteins.
2. Estimation of salivary amylase activity.
3. Estimation of lipase activity.
4. Oxygen consumption and estimation in an aquatic or terrestrial animal.
5. Demonstration of fermentation.
6. Action of insulin on blood sugar level.
7. Experiments on urine analysis in human urine sample:
8. Test for urea, blood cells, bile salts, albumin, ketone bodies and sugar in human urine sample.

## RECOMMENDED BOOKS

1. Animal Physiology ----- Samson & Writy
2. Animal Physiology ----- Nelsion & Nelsion
3. Animal Physiology ----- Medical Physiology-Guiton
4. Text book of Animal Physiology ----- Nagbushenen
5. Text book of Animal Physiology ----- Guize
6. Text book of Animal Physiology ----- A.K. Berry.



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**DEVELOPMENTAL BIOLOGY & PLANT BIOCHEMISTRY**

**UNIT-I: Basic concepts of development**

- 1.1 Potency, commitment, specification, induction, competence, determination and differentiation; Morphogenetic gradients; cell fate and cell lineages.
- 1.2 Stem cells, cytoplasmic determinants, genomic equivalence and genomic imprinting.
- 1.3 Mutants and transgenics in analysis of development; Plant genome organization, plant nuclear genome organization, biogenesis of organelles.
- 1.4 Development of chloroplast, interaction between nuclear and organellar genome.

**UNIT-II: Gametogenesis, fertilization and early development**

- 2.1 Production of gametes, Activation of Sperm and Sperm-Oocyte Interaction.
- 2.2 Fertilization and Early Embryogenesis. Zygote formation, cleavage, blastula formation, embryonic fields, Gastrulation and formation of germ layers in Animals; embryogenesis.
- 2.3 Organization of shoot and root apical meristem; shoot and root development; leaf development and phyllotaxy.
- 2.4 Transition to flowering, floral meristems and floral development in *Arabidopsis* and *Antirrhinum*

**UNIT-III: Plant System Physiology-I**

- 3.1 Structure and functions of plant cell - including cell wall, plasmodesmata, meristematic cells, vacuoles, secretory systems and root quiescent zone; Isolation of cell organelles, absorption and transport of water and ions in plant, evapotranspiration.
- 3.2 Photosynthesis - Light harvesting complexes; mechanisms of electron transport; photoprotective mechanisms; CO<sub>2</sub> fixation-C<sub>3</sub>, C<sub>4</sub> and CAM pathways.
- 3.3 Respiration and photorespiration – Citric acid cycle; plant mitochondrial electron transport and ATP synthesis; alternate oxidase; photorespiratory pathway.
- 3.4 Nitrogen metabolism - Nitrate and ammonium assimilation; amino acid biosynthesis; Plant hormones – Biosynthesis, storage, breakdown and transport; physiological effects and mechanisms of action.

**UNIT-IV: Plant System Physiology-II**

- 4.1 Sensory photobiology - Structure, function and mechanisms of action of phytochromes, cryptochromes and phototropins; stomatal movement; photoperiodism and biological clocks.
- 4.2 Solute transport and photoassimilate translocation – uptake, transport and translocation of water, ions, solutes and macromolecules from soil, through cells, across membranes, through xylem and phloem; Transpiration; mechanisms of loading and unloading of photoassimilates.
- 4.3 Secondary metabolites - Biosynthesis of terpenes, phenols and nitrogenous compounds and their roles.
- 4.4 Stress physiology – Responses of plants to biotic (pathogen and insects) and abiotic (water, temperature and salt) stresses.

  
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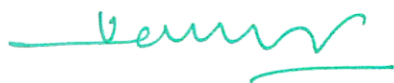
  
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## PRACTICALS

1. Observation of living Chick embryo.
2. Dissection and Morphology observation of the 4-14 somite chick embryo (24-34 hours).
3. Dissection and Morphology observation of the 24-38 somite chick embryo (48-85 hours).
4. Culture of Early chick embryo *in vitro*.
5. Mounting of 72 and 96 hours chick embryo.
6. Micropropagation of plants
7. Callus culture
8. Anther / pollen culture
9. Embryo culture
10. Somatic embryogenesis

### REFERENCE BOOKS:

1. Gilbert, S.F. Developmental Biology. 10<sup>th</sup> Edition, Sinauer Associated Inc., Massachusetts
2. Balinsky, B.I. Introduction to Embryology. Saunders, Philadelphia
3. Berril, N.J. and Karp, G. Development Biology. McGraw Hill, New York
4. Hamburger V and Hamilton HL. Handbook of chick developmental stages. Saunders Publications. 1965.
5. Berril, N.J. and Karp, G. Development Biology. McGraw Hill, New York



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