

MASTER OF SCIENCE (BIOCHEMISTRY)

REGULATIONS

ELIGIBILITY

The eligibility conditions for admission to M. Sc Biochemistry is candidates with B.Sc in Biochemistry, Microbiology, Biotechnology, Chemistry, Industrial chemistry, Polymer chemistry, Bioinformatics , Life science, B. Sc Clinical Lab Technology, B.Sc Medical Lab Technology, Nutrition and Dietetics, Botany, Zoology or an Examinations accepted as equivalent there by Academic Council, subject to such conditions as may be prescribed there to are permitted to appear and qualify for the **Master of Science Degree in Biochemistry Examination** of this College after a course of study of two academic years.

OBJECTIVE OF THE COURSE

The PG programme strives continuously to develop in frontline research at the frontiers of modern biology via Molecular genetics, Marine biochemistry, Pharmaceutical biochemistry, and Immunology, Enzymology and Clinical biochemistry.

Students engaged in instrumentation skills and statistical analysis via Excel Macros and SAS, biological software via Bioinformatics, Industrial Biochemistry, and Nanotechnology and Cancer biology.

The Program reflects the consistent changes made in the syllabus to meet the relevant demands of the industry.

SCHEME OF EXAMINATIONS

Subject Code	Subject	Hrs of Instruction	Exam Duration (Hrs)	Max Marks			Credit Points
				CA	CE	Total	
Semester I							
15PBC13A	Biopolymers	5	3	25	75	100	4
15PBC13B	Analytical Biochemistry and Bioinformatics	5	3	25	75	100	4
15PBC13C	Enzymes and Enzyme Technology	4	3	25	75	100	4
15PBC13D	Cellular Biochemistry	5	3	20	55	75	3
15PBC13E	Plant Biochemistry and Biotechnology	4	3	20	55	75	3
15PBC13P	Practical-I :Biochemistry -I	4	3	20	55	75	3
	Elective -I	3	3	20	55	75	3
		30				600	24
Semester II							
15PBC23A	Microbial Biochemistry	5	3	25	75	100	4
15PBC23B	Immunology	5	3	25	75	100	4
15PBC23C	Advanced Clinical Biochemistry	5	3	25	75	100	4
15PBC23D	Molecular Biology	5	3	25	75	100	4
15PBC23P	Practical-II: Biochemistry -II	5	6	25	75	100	4
	Elective -II	5	3	25	75	100	4
		30				600	24
Semester III							
15PBC33A	Biostatistics and Research Methodology	5	3	25	75	100	4
15PBC33B	Metabolism and Metabolic regulation	4	3	25	75	100	4
15PBC33C	Genetic Engineering	5	3	25	75	100	4
15PBC33D	Endocrinology	4	3	20	55	75	

M.Sc. Biochemistry (Students admitted from 2015-2016 onwards)

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15PBC33E	Pharmaceutical Chemistry and Neurochemistry	4	3	20	55	75	3
15PBC33P	Practical-III: Biochemistry-III	4	6	20	55	75	3
	Elective -III	4	3	20	55	75	3
		30				600	24
Semester IV							
15PBC43P	Practical-IV: Biochemistry-IV	5	6	40	60	100	4
15PBC43V	Project	20	6	100	150	250	10
	Elective IV	5	3	40	60	100	4
		30				450	18
	TOTAL	120				2250	90

LIST OF ELECTIVES (GROUP OF ELECTIVES)

(Student shall select any one of the group as Elective)

Paper / Sem	Subject Code	Group A Subject	Subject Code	Group B Subject	Subject Code	Group C Subject
	CELL CULTURE AND MOLECULAR TECHNIQUES		NUTRITIONAL SCIENCE		CANCER BIOLOGY	
Paper I Sem I	15PBC1EA	Plant Tissue Culture	15PBC1EB	Nutrition through life cycle	15PBC1EC	Drug and environmental toxicology
Paper II Sem II	15PBC2EA	Animal Tissue Culture	15PBC2EB	Nutritional biochemistry	15PBC2EC	Molecular basis of clinical disorders
Paper III Sem III	15PBC3EA	Basics of Molecular Biology Techniques	15PBC3EB	Nutrition and clinical nutrition	15PBC3EC	Cancer biology and therapy
Paper IV Sem IV	15PBC4EP	Elective Practical	15PBC4EQ	Elective Practical	15PBC4EV	Elective Project work

FOR COURSE COMPLETION

Students have to Complete the following Subjects:

- Core papers in I, II, III and IV Semesters.
- Elective papers in the I, II, III and IV Semesters.
- Project and Viva -Voce in IV Semester

Total Credit Distribution

Subjects	Credit	Total		Credits	Cumulative
Core	4	10x 100	1000	40	90
Core	3	4 x 75	300	12	
Core Practical	4	2x 100	200	08	
Core Practical	3	2x 75	150	06	
Project Work	10	1 x 250	250	10	
Electives	4	2 x 100	200	8	
Electives	3	2 x 75	150	6	
			2250	90	

15PBC13A	BIOPOLYMERS	SEMESTER -I
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Total Credit: 4
Hours per week: 5

CONTENTS

OBJECTIVES:

1. At the end of this course students will be able to obtain a keen knowledge on the characterization of biological macromolecules.

UNIT-I

Polysaccharides - occurrence, structure and biological functions of cellulose, chitin, starch and glycogen. A brief account on chitin, fructans, arabinans and galactans.

Occurrence, structure, isolation, purification, properties and biological functions of mucopolysaccharides, bacterial cell wall polysaccharides and blood group antigens. Glycosaminoglycans.

UNIT-II

Orders of protein structure. Primary structure - determination of amino acid sequence of proteins. The peptide bond - The Ramachandran plot. Secondary structures - α -helix, β -sheet and β -turns. Pauling and Corey model for fibrous proteins. Reverse turns and super secondary structures. Collagen triple helix. Tertiary structure - α and β domains. Conformational properties of silk fibroin. Quaternary structure of proteins. The structure of haemoglobin. Models for haemoglobin allostery.

UNIT-III

Lipids - Introduction, fate of dietary lipids, simple lipid, compound lipids and derived lipids - structure and functions.

Fatty acids - saturated, unsaturated and hydroxy fatty acids. Phospholipids and glycolipids - structure and functions. Plant and animal sterols - structure and functions of cholesterol. Lipid peroxidation and antioxidants. Lipoproteins - classification and composition.

UNIT-IV

A, B and Z forms of DNA. Triple and quadruple structures. DNA supercoiling and linking number. Properties of DNA - buoyant density, viscosity, denaturation and renaturation - The cot curve - Chemical synthesis of DNA. Salient features of nucleic acid recognition by proteins. DNA binding motifs in proteins - the basic helix loop helix (bHLH) motif, zinc finger, the leucine zipper and helix-loop helix

UNIT-V

Principles of Biophysical chemistry- P^H , buffer, reaction kinetics, thermodynamics, colligative properties. Stabilizing interactions -Van der waals, electrostatic, hydrogen bonding and hydrophobic interactions.

TEXT BOOKS

1. *David L.Nelson and Michael M.Cox*, 2005. **Lehninger Principles of Biochemistry**, 4th edition.W.H.Freeman & company.
2. *Robert K Murray*, 2005. **Harpers Illustrated Biochemistry**, 26th Edition. Lange Medical Publications.
3. *Richard R Sinden*, 1994. **DNA Structure and Function**, Academic Press.

REFERENCE BOOKS

1. *Jeremy M.Berg, John L.Tymoczko and Lubert Stryer*, 2012. **Biochemistry**, 7th Edition. W.H.Freeman and Company.
2. *Geoffrey Zubay*, 1993. **Biochemistry**, 3rd Edition. Wm.C.Brown Publishers.
3. *Donald Voet, Judith G. Voet and Charlotte W.Pratt*, 1999. **Fundamentals of Biochemistry**, John Wiley and Sons, Inc.
4. *Reginald H Garret and Charles M Grisha*, 1995. **Biochemistry**, Saunders College Publishers.

15PBC13B	ANALYTICAL BIOCHEMISTRY AND BIOINFORMATICS	SEMESTER -I
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Total Credit: 4
Hours per week: 5

CONTENTS

OBJECTIVES:

1. At the end of this course students will be able
2. To have a basic understanding of the theoretical principles involved in Bioinstrumentation
3. To have the practical skills and techniques required in biochemical analysis
4. To gain knowledge in using software techniques and internet resources
5. To handle and compare sequence and structure information, search databases and Interpret protein structure.

UNIT-I

Spectroscopic technique: Basic principles, instrumentation and applications of UV, visible and IR spectrophotometers. Electron spin resonance, Nuclear Magnetic Resonance, Mass Spectrometry, Flame Photometry - principles and applications. Centrifugation techniques: Principle and technique of preparative and analytical centrifugation, differential centrifugation, density gradient centrifugation, ultracentrifuge and its application.

UNIT-II

Chromatographic techniques: Principle, technique and applications of paper, TLC, ion-exchange, molecular sieve and adsorption chromatography. Principle, components, limitations and applications of GLC and HPLC.

Electrophoresis techniques: Principle and technique of paper, gels - SDS-PAGE. High voltage and discontinuous electrophoresis. Isoelectric focusing.

UNIT-III

X-rays, X-ray diffraction, crystals and detectors - quantitative analysis and applications. ORD and circular dichroism - principles and applications. Nature and units of radioactivity. Radiochemical methods: basic concepts, counting methods and applications, autoradiography.

UNIT-IV

Introduction: objectives and scope of bioinformatics, internet and world wide web. Useful search engines. Scripting languages - perl and its applications to bioinformatics. Biological databases - sequence and structure. Data retrieval. Database search - FASTA and BLAST. CLUSTAL and PHYLIP.

UNIT-V

Secondary and tertiary structure prediction of proteins. Introduction to proteomics. Fold recognition. Application of proteomics. Mining proteomes, protein expression profiling, identifying protein- and protein complex. Mapping protein modification. protein interactions

TEXT BOOKS

1. *Boyer R*, 2000. **Modern experimental biochemistry**, 3rd edition, Addison Wesley Longman Publishers.
2. *Wilson and Walker*, 2000. **A biologist's guide to principles and techniques of practical biochemistry**, 5th edition, Cambridge University Press.
3. *Rastogi S.C*, 2003. **Bioinformatics - concepts, skills and applications**, 1st edition. CBS publishers.

REFERENCE BOOKS

1. *Sundararajan S, Balaji R*, 2002. **Introduction to bioinformatics**, 1st edition, Himalya publishing house.
2. *Mani K, Vijayrāja N*, 2002. **Bioinformatics for beginners**. 1st edition, Kalaikathir Achagam, Coimbatore.
3. *Lesk A M*, 2002. **Introduction to bioinformatics**, Oxford University Press.
4. *Liebler D.C*, 2002. **Introduction to proteomics**, Humana press.

15PBC13C	ENZYMES AND ENZYME TECHNOLOGY	SEMESTER -I
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Total Credit: 4
Hours per week: 4

CONTENTS

OBJECTIVES:

On successful completion of these units, Students should be able to complete a range of tasks exemplified by the following:

1. Demonstrate an understanding of the kinetics of enzyme-catalysed reactions.
2. Describe how enzymes can be used in the laboratory and industrially.
3. 3.Demonstrate an understanding of the mechanism of enzyme action.
4. Demonstrate a critical appreciation of the preparation and use of immobilized enzymes.

UNIT I

Enzymes- Introduction, Classification of enzymes, Factors affecting enzyme activity. Active site- Definition: investigations of active site structure, Trapping ES complex, use of substrate analogues. Modification by sing chemicals procedures, enzyme modification by treatment with proteases, enzyme modification by site directed mutagenesis. Isoenzymes, Multienzyme complex.

UNIT II

Enzyme catalysis: Acid base catalysis, covalent catalysis, Mechanisms of reaction catalyzed by enzyme lysozyme, chymotrypsin. Metal activated, enzymes & metallo Enzyme Role of metal ions in mechanism - carbonic anhydrase, superoxide dismutase, carboxy peptidase, Coenzymes and cofactors in enzyme catalysed reaction.

UNIT III

Enzyme kinetics: MM Kinetics, LB plot, Eadie - Hofstee plot and Hanes plot. Allosteric enzymes - Cooperativity, Hill plot, K & V series of Enzyme. R & T states. Bisubstrate reaction. Concerted, Sequential Enzyme & enzyme inhibition - Types & kinetic differentiation. Of competitive, uncompetitive, non-competitive inhibitions. Allosteric inhibition and regulation.

UNIT IV

Application of enzymes in industry; Industrial scale enzyme extraction, purification and stabilization.

Industrial application of carbohydrases, proteolytic enzyme, lignocellulose degrading enzyme, pectin and pectic enzyme. Enzyme in animal nutrition.

Non - catalytic industrial proteins. Animal and microbial proteins. Sweet and taste modifying proteins. Application of enzymes in food Industry . Ribozyme, abzyme.

UNIT V

Immobilised enzymes- Techniques of immobilization and applications of immobilized enzyme. Enzymes as diagnostic reagents.

Biosensors: calorimetric biosensors: potentiometric biosensors: Amperometric biosensors: immunosensors.

Applications of Monoclonal antibodies.

TEXT BOOKS:

1. *Palmer*, 2001. **Understanding Enzymes**, 1st edition, Horwood Publishing House.
2. *Gary Walsh*, 2004. **Protein Biochemistry & Biotechnology**, John Wiley Publisher.
3. *Nicholas C Price and Lewis Stevens*, 1999. **Fundamentals of Enzymology**, 3rd edition, Oxford University Press.
4. *Trevor Palmer*, 2004. **Enzymes: Biochemistry, Biotechnology, Clinical chemistry**, 1st edition, Affiliated East West press private limited, New Delhi.

REFERENCE BOOKS:

1. *Irwin H segel*, 2013. **Biochemical Calculations**, 2nd Edition, John Wiley Publisher.
2. *Bhatt S.M.*, 2014. **Enzymology and Enzyme technology**, 15th edition, S. Chand publishers, New Delhi.

15PBC13D	CELLULAR BIOCHEMISTRY	SEMESTER -I
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Total Credit: 3
Hours per week: 5

CONTENTS

OBJECTIVES:

1. At the end of this Course of study students will be able to:
2. Demonstrate an understanding of the membrane models and membrane transport.
3. Demonstrate an understanding of the major types of living organisms and the characteristics of and fundamental differences in their body plans/organisation and functions.
4. Demonstrate an understanding of the various types of microfilaments and microtubules. Demonstrate an understanding of the structures and functions of the major cell and tissue types of higher animals, particularly humans.
5. Demonstrate an understanding of the cell cycle, its control through apoptosis, and explosion of cancer and its mechanism

UNIT-I

Membrane bilayer - Models, Membrane lipids - fluidity, Asymmetry phase transition, Liposomes. Membrane proteins - Types, Orientation, Mobility - Experiments, flippases, proteins or RBC membrane, Bacteriorhodopsin, Porins-aquaporin. RBC ghosts, solubilisation of proteins, lipid anchored proteins carbohydrates - cell surface carbohydrates - Lectins.

UNIT II

Membrane transport - Overview, Passive diffusion, Facilitated diffusion in erythrocytes, Carriers and Ion - Channels. Ion conc. gradients.

Uniporter Catalyzed transport. Active transport systems. Transport process driven by ATP - Ion Pumps :-Calcium, ATPase; Na⁺K⁺ATPase; Mechanism, Gastric H⁺K⁺ATPase; Mechanism, Gastric H⁺K⁺ATPase, ATPases that transport peptides and drugs. ABC superfamily - Bacterial PM permeases, Mammalian MDR proteins: Transport process driven by light and ion gradients. Co-transport by Symporters and antiporters, Group translocation Osmosis and Receptor mediated endocytosis.

UNIT III

Mitochondria - Reduction potentials, electron transport chain Overview, Complexes, Q-cycle, Cyt.C oxidase complex, Translocation of Protons and the establishment of a proton motive force Machinery for ATP formation. Chemi-osmotic mechanism, ATP Synthase Experiments, inhibitions of OP. Uncouplers. Microfilaments- Action - Structures, Assembly, Myosin. Microtubules -Organisation and dynamics, Kinesin and dynein. Cilia and Flagella - Structure and functions, Intermediary filaments. Striated muscle - structure, excitation - contraction.

UNIT IV

Cell - Cell and Cell - matrix adhesion: - An overview.
Cell-Cell, interaction:- ECM; Collagen, hyaluronan & proteoglycans, laminin, integrins and fibronectins.
Cell-Cell adhesion: Specialised junctions -- Desmosomes, Gap junctions, Adhesion molecules - Cadherins - Connexins.
Cell-Cell signaling - Signaling molecules and their receptors: functions of cell surface receptors, pathways, of intracellular signal transduction, second messengers. (G-protein coupled receptors, receptor tyrosine kinases. Ras. MAP kinases.

UNIT V

Cell cycle and cancer: - Cell Cycle: - Overview of cell cycle and its control. General studies; with yeasts. Cell cycle Control in mammalian cells, Checkpoints in cell -cycle regulation. Apoptosis (Programmed cell death) -- Pathways, regulators & effectors in apoptosis.
Cancer: Properties of tumor cells & Genetic basis and onset of cancer. Tumor viruses - DNA and RNA viruses as transforming agents - mechanism.
Tumor suppressor genes and functions of their products. Carcinogenic effect of chemicals and radiation. Molecular diagnosis of cancer.

TEXT BOOKS

1. *Robert K.Murray, Daryl K, Granner and Perter victor W.Rodwell, 1996. Harper's Biochemistry, 26th edition, Prentier Hall International Limited.*
2. *De Robertis E.D.P., De Robertis EMF, 2005. Cell and Molecular Biology, 8th edition, Lippincott Williams and Wilkims, Philadelphia.*
3. *Stephen Baldwin, 2000. Membrane transport, Oxford University Press.*

REFERENCE BOOK

1. *Bruce alberts, Alexandar Johnson, Julian Lewis, Martin Raff, Keeth Roberts, Peter Walltre, 2002. Molecular Biology of the cell, 3rd and 4th Edition, Taylor and Francis company,*
2. *Lodish Berk, Karjer Krieger, Scott Bretishe, Hidden Ploegh, Matsudarirn 2008. Molecular Cell Biology, 6th edition. WH Freeman and company, New york.*

15PBC13E	PLANT BIOCHEMISTRY AND BIOTECHNOLOGY	SEMESTER -I
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Total Credits: 3

Hours per week: 4

CONTENTS

OBJECTIVES

1. To obtain knowledge on production of transgenic plants.
2. To understand the functions and regulations of major biosynthetic pathways of plants.

UNIT-I

Photosynthesis - photosynthetic apparatus; organisation of thylakoid; role of chlorophylls, carotenoids and other photosynthetic pigments; light absorption and energy conservation. Light - properties of both particle and wave; light absorbed by pigment molecules; the reaction centre complex. The photo systems I and II. Electron transport pathways in chloroplast membranes. ATP synthesis in chloroplasts; cyclic and non-cyclic photophosphorylation. Cytochromes.

UNIT-II

Carbon reactions in C₃, C₄ and CAM plants - Calvin cycle; Hatch-Slack pathway. Photorespiration: role of photorespiration in plants; biochemical basis of PR pathway - C₂ cycle; pathways of glucose oxidation in plants; starch biosynthesis and degradation; metabolic transport between organelles

UNIT-III

Nitrogen fixation - symbiotic and non-symbiotic. Symbiotic nitrogen fixation in legumes by Rhizobia - biochemistry and molecular biology of nitrogen fixation - enzymology of nitrogen fixation; regulation of *nif* and *nod* genes of nitrogen fixation. Interaction between nitrate assimilation and carbon metabolism. Sulphur chemistry and functions; reductive sulfate assimilation pathway. Synthesis and function of glutathione and its derivatives.

UNIT-IV

Structure of plant genes. Organisation of plant chromatin. The nuclear, chloroplast and mitochondrial genomes. Interaction between nuclear and organellar genome. Biosynthesis of organelles - development of chloroplast and plastids. Gene transfer to plants; *Agrobacterium* mediated transformation - Ti plasmids. Ri plasmids. Direct DNA transfer to plants - protoplast transformation. Plant viruses as vectors - CaMV, Gemini viruses, RNA viruses (TMV, potato virus X) as vectors. Advantages and uses of transgenic plants

UNIT-V

Tissue culture media - composition and preparation. Micropropagation; somoclonal variation. Callus. Protoplast culture - isolation and purification of protoplasts. Protoplast fusion; Anther, pollen and ovary culture for production of haploid plants and homozygous lines. Uses of plant tissue culture.

Stress physiology: Response of plants to Biotic (pathogen and insects) and abiotic stress (water, temperature and salt)

TEXT BOOKS

1. *Andrian Slater*, 2007. **Plant biotechnology**, First Edition, Oxford University Press, New York.
2. *Primrose S.B.* 2001. **Principles of gene manipulation**, 6th edition, Blackwell Scientific Publishers, Oxford.

REFERENCE BOOKS

1. *Bob B Buchanan*, 2007. **Biochemistry and molecular biology of plants**, First edition, I.K. International Pvt. Ltd., New Delhi.

15PBC13P	PRACTICAL - I: BIOCHEMISTRY-I	SEMESTER -I
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Total Credit: 3
Hours per week: 4

CONTENTS

Clinical biochemistry:

1. Determination of the activity of the following serum enzymes:
 - a) LDH
 - b) Acid phosphatase
 - c) Alkaline phosphatase
 - d) Aspartate amino transferase
 - e) Alanine amino transferase
 - f) Creatine kinase
 - g) Superoxide dismutase
 - h) glutathione Peroxidase
 - i) Alpha amylase
 - j) Glucose-6-phosphate dehydrogenase
 - k) Choline esterase
2. Determination of the following from urine/serum:
 - a) Chloride
 - b) Calcium
 - c) Magnesium
3. Estimation of albumin, globulin and total protein
4. Estimation of glucose in serum
5. Estimation of protein in serum
6. Estimation of thiobarbituric acid reactive substances (TBARS) in serum

15PBC1EA	ELECTIVE -I: PLANT TISSUE CULTURE	SEMESTER -I
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Total Credit: 3
Hours per week: 3

CONTENTS

OBJECTIVES:

1. Know techniques in plant cell and tissue culture, in vitro conservation, protoplast culture, micropropagation and genetic engineering
2. Describe the use of cell cultures in the production of biological products.

UNIT -I

Genome organization in plants. Cell and Tissue culture in plants: Tissue culture media (composition and preparation). Apparatus and chemicals used in plant tissue culture. Primary culture: cell line, cell clone, callus and suspension culture, Somoclonal variation, Micropropagation, Organogenesis.

UNIT- II

Embryo culture and Embryo rescue, somatic embryogenesis, Haploidy, Protoplast fusion and somatic hybridization, Cybrids, Allopheny, Artificial seeds.

UNIT -III

Anther, Pollen and ovary culture for production of haploid plants and homozygous lines. Cryopreservation, slow growth.

UNIT- IV

Application of Plant Transformation for productivity and performance: Herbicide resistance, Insect resistance, virus resistance, Nematode resistance, and Bt genes.

UNIT- V

DNA banking for germ plasm conservation. Production of plant secondary metabolites by plant tissue culture. Ti plasmids, bacterial transformations, insect resistant plants, Edible vaccines.

TEXT BOOKS

1. *Robert H Smith*, 2005. **Plant Tissue Culture, Techniques and Experiments**, Academic press, New Delhi.
2. *Kalyan kumar DE*, 1992. **Plant tissue culture**, New central book agency pvt Ltd., Calcutta.

REFERENCE BOOKS

1. *Kumar.U*, 2001. **Methods in plant tissue culture**, Agrobios (india) – Jodhipur.
2. *Razdan .M.K.*, 1983. **An Introduction to plant tissue culture**, Oxford and IBH, New Delhi.

15PBC1EB	ELECTIVE -I: NUTRITION THROUGH LIFE CYCLE	SEMESTER -I
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Total Credits: 3
Hours per week: 3

CONTENTS

OBJECTIVE:

- To provide information an understanding importance of nutrition during life span.
- To enlighten on the dietary modifications.

UNIT - I

Recommended allowances - RDA for Indians, basis for requirement, computation of allowance based on energy expenditure, components of energy expenditure. General concepts about growth and development through different stages of life.

UNIT - II

Nutrition in Pregnancy - Stages of gestation, maternal weight gain - nutritional problems and dietary management, importance of nutrition during and prior to pregnancy.

UNIT III

Nutrition during Lactation - Physiology of lactation - nutritional composition of breast milk, nutritional concerns during lactation, special foods during lactation, dietary modification - Nutrition in Infancy-Infant feeding, nutritional needs - Feeding problems.

UNIT IV

Nutrition in school children - feeding school children and factors to be considered. Planning a menu, feeding problems, packed lunch - Nutrition during Adolescence - changes in growth and development, hormonal influences.

UNIT V

Nutrition and work efficiency, Menopausal and post menopausal women, hormonal changes, nutritional requirement, planning a menu - Physiological changes in aging - Psycho-social and economical factors affecting eating behavior, social situation, knowledge and belief.

TEXT BOOK

1. Martin S.R., 1963. **Robert's Nutrition Work with Children**, The University of Chicago Press, Chicago.

REFERENCE BOOKS

1. Jelliffe D.B., 1966. **Assessment of Nutrition Status of the Community**, WHO, Geneva.

15PBC1EC	ELECTIVE -I: DRUG AND ENVIRONMENTAL TOXICOLOGY	SEMESTER -I
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Hours per week: 3

Total Credits: 3

CONTENTS

OBJECTIVE:

To expose students to the toxicological effects of drugs and the environment sources

UNIT I:

Definition and scope of toxicology. Basis for general classification and nature. Dose-response relationship synergism and antagonism. Determination of ED₅₀ and LD₅₀. Acute and chronic exposures. Factors influencing toxicity. Pharmacodynamics and chemodynamics.

UNIT II

Biochemical basis of toxicity - Mechanisms of Toxicity Disturbances of excitable membrane function. Altered calcium homeostasis. Covalent binding to cellular macromolecules and genotoxicity. Tissue specificity of toxicity.

UNIT III:

Principles and procedures of testing for acute toxic effects. Toxicity testing-genetic toxicity testing and mutagenesis assays- In vitro test systems. In vivo mammalian mutation tests. DNA Repair assays. Chromosome damage test.

UNIT IV:

Mechanism of action drugs: Receptor theory of drug action. Mechanism of action of antibiotics, sulfonamides and antimalarial drugs. Adverse drug reactions and drug interactions

UNIT V:

Food toxicology, metal toxicity, occupational toxicology and assessment of occupational hazards.

TEXT BOOK:

1. *Satoskar, R.S and Bhandarkar S.D.* 2000. **Pharmacology and Pharmacotherapeutics**, Thirteenth edition. Vol I and II,. Popular Prakeshan Private Ltd. Mumbai.

REFERENCE BOOK:

1. *De, A.K .* 2002. **Environmental Chemistry**, Fourth edition, New age international (p) Ltd. Publishers, New Delhi.

15PBC23A	MICROBIAL BIOCHEMISTRY	SEMESTER -II
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Total Credit: 4
Hours per week:
5

CONTENTS

OBJECTIVES:

At the end of this course, students will be able to:

1. Demonstrate an understanding of the major mechanisms of metabolism, energy exchanges and homeostasis in cells.
2. Recognize the linkage between the structures, chemical properties and chemical processes of certain molecules and macromolecules, and their roles in cells and biological processes, and in certain diseases.
3. Gain an understanding of the applications of biotechnology in diverse fields such as agriculture, medicine and the environment and the significance of these developments.

UNIT-I

Transport of sugars into bacterial cell - the bacterial phosphotransferase system. Growth - balanced and unbalanced; measurement of growth; continuous culture, fed batch culture; growth and environment; growth cycle of bacterial culture; growth of single cells - cell cycle. Energy yielding metabolism - carbohydrates - EMP, HMP, TCA - importance in bacteria. Phosphoketolase pathway, ED pathway, characteristics of electron transport in bacteria

UNIT-II

Fermentations: alcoholic fermentation, propionic acid, formic acid, butyric acid and lactic acid fermentation; oxidation of aliphatic and aromatic hydrocarbons; metabolism of one carbon and two carbon compounds. Bacterial Chemotaxis and quorum sensing.

Amino acid biosynthesis; biosynthesis of cell wall - peptidoglycan, teichoic acid, lipids; biosynthesis of straight and branched chain fatty acids, unsaturated fatty acids and cyclopropane fatty acids. Synthesis of triacylglycerols, phospholipids, glycolipids and polyisoprenoids. Metabolism of purines and pyrimidines.

UNIT-III

Bioprocess technology - screening for industrially important microbes, strain improvement for better yield; design of fermenter- parts of the fermenter and their functions; types of fermentation processes. Analysis of batch and continuous bioreactions; stability of microbial reactors; Tower fermenter; air lift fermenter; specialized bioreactors; solid substrate fermentation and media formulation. Inocula preparation; Recovery and purification of products; monitoring of downstream processing.

UNIT-IV

Microbial products - production of organic acids - source, production of microbial process, recovery and applications.

Production of organic acids - source, recovery and uses of citric acid and lactic acid.

UNIT-V

Production of antibiotics - source, production, recovery and uses of penicillin, tetracycline, amoxicillin.

Production of bioinsecticides from bacteria and fungi; production of bacterial and fungal polysaccharides; commercial production of xanthan gum.

TEXT BOOKS

1. *Alexander V.*, 1995. **Microbial biotechnology**, W.H. Freeman Publishers.
2. *Stanbury*, 1995. **Principles of fermentation technology**, 2nd edition, Pergamon Publishers.
3. *Ratledge*, 2001, **Basic biotechnology**, 1st edition, Kristiansen Cambridge University Press.

4. *Gupta*, 1998. **Elements of biotechnology**, Rastogi Publication.

REFERENCE BOOKS

1. *Schuler, Karg*, 2005. **Bioprocess engineering – basic concepts** 1st edition, Prentice Hall,
2. *Balasubramanian*, 2000. **Concepts in biotechnology**, Universities Press (India) Ltd.
3. *Freshney*, 2010. **Culture of animal cells: a manual of basic techniques**, 6th edition –Wiley Liss, Blackwell USA.

15PBC23B	IMMUNOLOGY	SEMESTER -II
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Total Credits: 4
Hours per week: 5

CONTENTS

OBJECTIVES:

1. Give students a key understanding of the molecular and cellular components that comprise the immune system, including their function and interaction.
2. Enable students to learn diseases caused by disorders of the immune system (failure, aberrant action, and malignant growth of the cellular elements of the system),
3. Give the students, the latest methods of detecting disease-causing pathogens, its treatment using novel vaccines.

UNIT I

Experimental Animal Models: inbred strains, SCID mice, nude, knockout mice. hemolytic plaque assay. Cells of the immune system: haematopoiesis. haematopoietic growth factors. Regulation of haematopoiesis, clinical uses of stem cells. Lymphoid cells - Lymphoblasts CD antigens, T cell membrane molecules. T-cell receptors. Null cells, granulocytes adhesion molecules.

UNIT II

Antigens : B cell epitopes, T cell epitopes, Haptens : viral and bacterial antigens. factor influencing immunogenicity, adjuvant technology; Immunoglobulins: domains classes and biological active antigenic determinants on Immunoglobulins. Immunoglobulins superfamily, Monoclonal Antibodies, gene rearrangements in immunoglobulins. Antigen - antibody interactions in vivo - cross reactivity Antigen - antibody interaction in vivo -- precipitants, agglutinants, RIA, ELISA - techniques and applications.

UNIT III

Complement Activation: Pathways regulation of complement system, Biological consequence of complement activation, complement deficiencies. Cytokines: IL, IFN, TNF, CSF, Cytokine, receptors, Cytokine antagonists, Cytokines related diseases. B&T cell maturation, activation, proliferation & differentiation. Antibody engineering.

UNIT IV

Hypersensitivity reactions - Type I, II, III & IV. Hypersensitivity disease. Cell mediated immunity: CTL mediated cytotoxicity, NK cell mediated toxicity. delayed type hypersensitivity. Immunological tolerance. Vaccines: Active and passive immunization, whole organism vaccines, recombinant vector vaccines, DNA vaccines, Synthetic peptide vaccines, multivalent sub-units vaccines. Immunodeficiency diseases.

UNIT V

Autoimmunity: Autoimmune disease in human, animal models, mechanism for induction of autoimmunity, Therapy. Transplantation immunology: clinical manifestation, therapy and bone-marrow transplants. organ-transplants. Cancer immunology: Tumor antigens, immune response to tumors, tumor evasion, Cancer immuno therapy. AIDS: Structure of HIV, destruction of T cells, immunological symptoms of AIDS. AIDS vaccine, gene therapy for treatment.

TEXT BOOKS

1. *Richard A Goldsby, Thomas J. Kindt, Barbara A Osborne and Janis Kuby*, 2003. **Immunology**, 5th Edition, W.H. Freeman and Company.
2. *Nandini Shetty*, 2005. **Immunology**, Revised 2nd Edition, New Age International Publishers.
3. *Ananthanarayanan R and Yayaraman Panikar*, 2013. **Text book of microbiology**, 9th Edition, University Press (India) Private Ltd.

REFERENCE BOOKS

1. *Kannan I*, 2007. **Immunology**, MJP Publishers.
2. *Ian R. Tizard*, 2004. **Immunology (An Introduction)**, 4th Edition, Thomson Publishers.

15PBC23C	ADVANCED CLINICAL BIOCHEMISTRY	SEMESTER -II
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Total Credit: 4
Hours per week: 5

CONTENTS

OBJECTIVES:

1. Given information Common chemical pathology tests include: AST,ALT,GTT, Alkaline phosphatases , Bilirubin, CSF etc.
2. Course emphasized human metabolism , students developed knowledge of metabolic changes during the fed, fasting and starved state.
3. A substantial no of medical cases were included to demonstrate the relevance of biochemistry to health and disease viz., Biochemical markers of disease and clinical significance of steroid, protein and thyroid hormones

UNIT I

Hemoglobin Metabolism – anabolism and catabolism –Porphyrins and Porphyrins-Classification Intermittent Porphyria,Hemoglobin derivatives, Normal and abnormal hemoglobin, Hemoglobinopathies-Sickle cell anemia, Cooleys anemia, Thalassemia- Major and Minor, Presence of Blood in Urine, Hemolytic diseases of Newborn. Coagulation factors, Deficiency of Coagulation factors, Diseases due to deficiency of Coagulation factor, Prothrombin Time, Partial Thromboplastin time, Fibrinogen and Fibrinogen degradation Products.

UNIT II

Collection of Blood –Preservatives, Collection of 24 hours urine – Preservatives, Test for Urinary Compounds in various diseases and Clinical Significance with reference to Creatinine, Protein, Calcium,

Copper, Oxalate, Potassium, Sodium, Phosphorous, Urea, Uric acid, VMA, 5-hydroxy indole acetic acid, 17-ketosteroids, Catecholamines, amylase and Bence Jones proteins.

Body fluids-Cerebrospinal fluid (CSF), Ascitic fluid (peritoneal), Pleural fluid-Chemical Composition, analysis of fluids in diseases - Transudate, exudates. Sweat analysis- Cystic fibrosis.

UNIT III

Clinical Enzymology - Functional and Nonfunctional enzymes- Definition, assay of nonfunctional enzymes and clinical significance of Transaminases-SGOT, SGPT, Creatinine kinase and its Isoenzymes, LDH and its Isoenzyme, ALP and its isoenzyme, ACP, Isocitrate Dehydrogenase, Glucose-6-Phosphate dehydrogenase, 5-NT, Gamma-GT, amylase, Choline esterase.

UNIT IV

Mineral Metabolism- Sources, Daily requirements, Biochemical functions, Deficiency and manifestation of Calcium, Phosphorous, Sodium, Potassium, Chloride and Bicarbonate, Ionic balance in the human body, Trace elements and their biological functions-Iron, Zinc, Copper, Magnesium and Manganese. Heavy Metal Poisoning- Lead, Mercury and Aluminium.

UNIT V

Oncology - Cancer markers in Oral cancer, Prostate cancer, Colorectal cancer, Breast Cancer and Gastrointestinal tract cancer, Ovarian cancer, Pancreatic cancer. Alpha fetoprotein, Carcino embryonic antigens, Beta-HCG, ca 125, ca 15.3, ca 19.9 and PSA.

Free radicals in Diseases - Introduction, Types of free radicals, free radical induced lipid peroxidation and antioxidants (Enzymic - SOD, Glutathione peroxidase, Glutathione reductase, Non Enzymic - Ascorbic acid, Tocopherol, Reduced Glutathione). Radio isotopes - Examples of isotopes and applications and uses in Medicine.

TEXT BOOKS:

1. *William J. Marshal, Stephen K. Bangert*, 2000. **Clinical Biochemistry metabolic and Clinical aspects**, 2nd edition. Churchill Livingstone.
2. *Gerhad Meiserbag, Willian H.Singh*, 1998. **Principles of medical Biochemistry**. A Time Mirror company.
3. *A.F.Smith G.J. Beckori*, 2004. **Cinical Biochemistry**. Sixth edition. Blackwell Science.
4. *R.Luxtion, G.J. Palister*, 1999. **Clinical Biochemsitry**. B.H. Publishers.

REFERENCE BOOK

1. *Mayne*, 1994. **Clinical chemistry in diagnosis and treatment**, 6th edition, ELBS Publications.
2. *Varley*, 1980. **Practical clinical biochemistry, volume I and II**, 5th edition, CBS Publishers.
3. *Burtis*, 1999. **Teitz text book of clinical biochemistry**, 3rd edition - William Heinmann medical books, Ltd. Philadelphia

15PBC23D	MOLECULAR BIOLOGY	SEMESTER -II
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Total Credit: 4
Hours per week: 5

CONTENTS

OBJECTIVES:

1. Given information on the cell, DNA, RNA, proteins, how cells read the genome,(from DNA to protein), and control of gene expression ,

UNIT-I

Molecular structure of genes and chromosomes; molecular definition of gene - pro and eukaryotic transcription units. Chromosomal organization of genes and noncoding DNA - protein coding genes. Tandemly repeated genes, single sequence DNA. Mobile DNA - mobile elements. Bacterial insertion sequence, bacterial transposons, viral retrotransposons, non-viral retrotransposons.

Structural organization of eukaryotic chromosomes - histone proteins, chromatin. Functional elements of eukaryotic chromosomes. Mutations - ty pes.

UNIT-II

DNA replication, repair and recombination. General features of chromosomal replication. DNA replication machinery - eukaryotes and prokaryotes. Role of topoisomerases in DNA replication. DNA damage and repair - all types. R ecombination - Holliday model, Rec BCD enzyme, Rec A protein, Messelson model, site specific recombination.

UNIT-III

Prokaryotic transcription - initiation, elongation and termination (rho dependent and rho independent). Lac operon and trp operon. Transcriptional control of gene expression. Overview of eukaryotic gene control and RNA polymerases. Regulatory sequences in protein coding genes TATA box, initiators, proximal elements, distant enhancer

sites. Phages : control of gene expression at transcription and translation levels. Role of chromatin in regulatory gene expression and gene slicing. Transcription initiation by RNA polymerase II, I and III. Regulation of transcription - factor control, lipid soluble hormones and polypeptide hormones. Transcription of HIV genome - antitermination mechanism. Mitochondrial and chloroplast DNA - transcription by organelle specific RNA polymerases

UNIT-IV

Post RNA transcriptional gene control. Processing of eukaryotic pre mRNA, hnRNA proteins, RNA binding motifs, splicing, snRNA, spliceosome. RNA editing, macromolecular transport across the nuclear envelope. Nuclear pore complex, cytoplasmic polyadenylation, degradation of mRNA, regulation of processing of rRNA and tRNA, Micro RNAs

UNIT-V

Genetic code - wobble hypothesis. Protein sorting and targeting of mitochondria and chloroplast proteins. Synthesis and targeting of peroxisomal proteins. Overview of secretory pathway. Translocation of secretory products across ER membrane. Insertion of proteins into ER membrane. Posttranslational modification - protein glycosylation in ER and Golgi complex. Receptor mediated endocytosis. Translation inhibitors

TEXT BOOKS

1. *Twyman*, 1998. **Advanced molecular biology**, Second edition, Viva publication.
2. *Lewin*, 2004. **Genes VIII**, Prentice Hall.

REFERENCE BOOKS

1. *Alberts*, 2002. **Molecular biology of the cell**, 4th edition, Garland Science Publications.
2. *Watson*, 2004. **Molecular biology of the gene**, 5th edition, Pearson Education.

15PBC23P	PRACTICAL - II :BIOCHEMISTRY-II	SEMESTER -II
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Total Credit: 4
Hours per week: 5

CONTENTS

Genetic engineering and molecular biology:

1. Agarose gel electrophoresis of DNA
2. Preparation of competent *E. coli* - Transformation (demonstration)
3. Plasmid DNA isolation from *E. coli*

Immunology:

4. Immunodiffusion - single radial and double diffusion
5. Immunoelectrophoresis
6. Estimation of Immunoglobulins
7. Agglutination antibodies
8. Identifying blood group and Rh typing

Separation techniques:

9. Separation of amino acids by paper chromatography - circular, ascending and descending
10. Separation of amino acids/lipids/sugars by TLC
11. Separation of plant pigments by column chromatography

Bioinformatics

12. Sequence and Structural Database
13. BLAST and Clustal W
14. Gene Prediction using GenMark and GenScan

REFERENCE BOOKS

1. *K Mani and Vijayraja*, 2004. **Bioinformatics - A practical approach**, **Aparna Publishing House**, First Edition, Coimbatore
2. *Varley*, 1980. **Practical clinical biochemistry, volume I and II**, 5th edition, CBS Publishers.
3. *Richard A Goldsby, Thomas J. Kindt, Barbara A Osborne and Janis Kuby*, 2003. **Immunology**, 5th Edition, W.H. Freeman and Company.
4. *Burtis*, 1999. **Teitz text book of clinical biochemistry**, 3rd edition - William Heinmann medical books, Ltd, Philadelphia.

15PBC2EA	ELECTIVE - II: ANIMAL TISSUE CULTURE	SEMESTER -II
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Total Credit: 4
Hours per week: 5

CONTENTS

OBJECTIVES:

1. Understand terminologies on animal cell cultivation.
2. Explain how to set up and maintain animal cells in vitro culture.

UNIT-I

Animal cells; Culture media: Balanced salt solution and simple growth medium, Physical, Chemical and metabolic functions of different constituents of culture medium.

UNIT-II

Types of cell culture: primary and established culture, organ culture, tissue culture, three dimensional culture and tissue engineering.

UNIT-III

Biology and characterization of cultured cells: tissue typing, cell-cell interaction, measuring parameters of growth, measurement of cell death, apoptosis and its determination, Cytotoxicity assay.

UNIT-IV

Embryology: collection and preservation of embryo, culturing of embryos, gametogenesis and fertilization in animals. Stem cell - isolation, identification, expansion, differentiation and uses.

UNIT-V

Transgenic animal production and application, transgenic animals as models for human diseases, transgenic animals in live stock improvement, transgenesis in industry.

TEXT BOOKS:

1. Sudha Gargal, 2001. **Principles and Practice of Animal Tissue Culture**, 1st Edition, , University press, Hyderabad
2. Aruni. A, Wilson, 2000. **Animal tissue Culture**, 1st Edition, MJP publishers.

REFERENCE BOOKS

1. John R W. masters, 2000. **Animal Cell Culture**, 3rd Edition, oxford University Press.
2. Jennie P Mathew, 2006. **Animal Cell Culture Methods**, 1st Edition, Elseveir, New Delhi.

15PBC2EB	ELECTIVE -II: NUTRITIONAL BIOCHEMISTRY	SEMESTER -II
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Total Credit: 4
Hours per week: 5

CONTENTS

OBJECTIVE

To learn the various metabolic cycles and analyze the significance of biochemical findings.

UNIT I

Biological oxidation: Enzymes and co-enzymes involved in oxidation and reduction, respiratory chain, phosphates in biologic oxidation and energy capture, role of respiratory chain and mechanism of phosphorylation.

UNIT II

Metabolism of carbohydrate : Glycolysis, Gluconeogenesis, TCA cycle, HMP shunt, bioenergetics, disorders of carbohydrate metabolism - galactosemia, glycogen storage disease, pentosuria, abnormal level in blood glucose

UNIT III

Metabolism of lipids - Biosynthesis and oxidation of saturated and unsaturated fatty acids, glycerides, phospholipids and cholesterol, bioenergetics, disorders of lipid metabolism, lipoproteins and their significance.

UNIT IV

Protein and amino acid metabolism - Biosynthesis of protein, general catabolism of aminoacids, deamination, transamination, urea cycle, disorders of aminoacid metabolism - phenyl ketonuria, cystinuria, albinism, alkaptonuria, maple syrup disease.

UNIT V

Metabolism of nucleic acids - Biosynthesis of purine and pyrimidine nucleotides, DNA replication and repair, biochemical importance of cyclic AMP. Disorders of urine and pyrimidine metabolism - gout, aciduria, xanthinuria. Structure and properties of DNA, RNA - mRNA, tRNA, rRNA. Functional tests - Gastric, liver, renal and endocrine.

TEXT BOOKS

1. *Devlin D.T.* 1997. Text book of Biochemistry with Clinical Correlations, John Wiley and Sons, New York.
2. *Plummer D.T.* 1997. An Introduction to Practical Biochemistry, Tata Mc Graw Hill Publishing Company, New Delhi

REFERENCE BOOK:

1. *Eccles R.* 1993, Electrolytes, Body fluids and Acid Base balance, Edward Arnold - A division of Hodder and Stoughton, London.

15PBC2EC	ELECTIVE -II: MOLECULAR BASIS OF CLINICAL DISORDERS	SEMESTER -II
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Total Credit: 4
Hours per week: 5

CONTENTS

OBJECTIVES:

To understand the cellular and molecular basis of clinical diseases associated with blood cells and nutritional disorders

UNIT- I

Acute inflammation-Vascular changes-cellular events-chemical mediators of inflammation-chronic inflammation-morphologic patterns in acute and chronic inflammation-systemic effects of inflammation

UNIT- II

Normal development of blood cells-anemias-hemolytic-G6PD deficiency-sickle cell-thalassemias-paroxysmal nocturnal hemoglobinuria-megaloblastic-iron deficiency - chronic disease

UNIT- III

Benign and malignant neoplasm-differentiation and Anaplasia-Invasion and metastasis-epidemiology of cancer incidence- molecular basis of cancer-biology of tumor growth-carcinogenic agents & their cellular interactions

UNIT- IV

Environmental and Nutritional diseases: Magnitude of environmental problem-air pollution-chemical and drug injury-adverse drug reactions - carcinogens- malnutrition-nutritional excesses and imbalances-obesity-diet and systemic diseases.

UNIT- V

Hepatic injury-Hepatitis a through E-Alcohol liver disease-Drug and toxin induced liver disease- cirrhosis- pregnancy associated-transplantation associated- adenomas and primary carcinoma.

TEXT BOOK

1. *Varley, 1980. Practical clinical biochemistry, volume I and II, 5th edition, CBS Publishers.*

REFERENCE BOOK

1. *Goodman and Gilman, 2006. Pharmacological Basis of therapeutics. 11th edition, McGraw Hill publishers.*

15PBC33A	BIOSTATISTICS AND RESEARCH METHODOLOGY	SEMESTER -III
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Total Credit: 4
Hours per week: 5

CONTENTS

OBJECTIVES:

1. To provide knowledge and skills sufficient to allow students to understand the role of statistics in research.
2. To develop skill in the basic methods of data gathering and analysis.
3. To provide sufficient background to be able to interpret statistical results in research papers.

UNIT I

Organising a statistical survey - Planning and executing the survey. Source of data - Primary and secondary data, Collection -- observation; interview; enquiry forms, questionnaire schedule and check list. Classification and tabulation of data. Diagrammatic & graphic presentation of data.

UNIT II

Measures of central tendency; arithmetic mean, median, mode, quartiles, deciles and percentiles. Measures of variation: range, quartile, deviation, mean deviation, standard deviation. Correlation analysis: Scatter diagram, Karl Peason's coefficient of correlation and Spearman's rank method. Regression analysis.

UNIT III

Probability -- definition, concepts, theorems (proof of the theorems not necessary) and calculations of probability. Theoretical, distributions. Binomial - 'Poisson and normal distribution. Normal-importance, properties, conditions and constants of the distribution (proof not necessary). Simple problems.

UNIT IV

Sampling distribution and test of significance: Testing of hypothesis errors in hypothesis testing, standard error and sampling distribution. sampling of variables (large samples and small samples). Student's 't' distribution and its applications. Chi - square test & goodness of fit. Analysis of variance one way and two-way classification, Duncans Multiple Range Test. Design of experiment - completely randomized block design randomized clock design.

UNIT V

Research :General-Introduction , types and classification of research- diagnostic, descriptive, exploratory research ethics. Topology for literature search- scientific methods- components of scientific methods. Formulation of research paper. Research design- types of research design - histological design , descriptive design , formation of hypothesis, synopsis writing.

TEXT BOOKS

1. *Gupta S.P. 2004. Statistical Methods*, 32nd edition, Sultan Chand and Sons publications, New Delhi.
2. *Pillai R.S.N and Bagavathi, 2012. Statistical Theory and Practises*. 7th edition, S. Chand and company Ltd, New Delhi.

REFERENCE BOOKS

1. *Ajai S Gaur and Sanjaya S. Gaur, 2008. Statistical methods for practice and Research*, Response Books publications.
2. *Yadav S.K.S, 2002. Statistics Theory and Practice*, 1st edition, Sanjeeva Prakashan publication.

15PBC33B	METABOLISM AND METABOLIC REGULATION	SEMESTER -III
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Total Credit: 4
Hours per week: 4

CONTENTS

OBJECTIVES:

On successful completion of the course the students should have

1. Understood catabolic and anabolic pathways of carbohydrate, lipids, amino acids and porphyrin metabolism
2. Learnt the role of plant hormones and biosynthesis of secondary metabolites and its application.

UNIT I

Carbohydrate Metabolism:-

An overview and energetics of glycolysis and gluconogenesis - Regulation of glycolysis and gluconogenesis - phosphofructokinase, hexokinase and pyruvate kinase as regulatory enzymes in glycolysis; hormone regulation. Anaplerotic reactions 'filling up reactions. Gluconeogenesis: Regulation by allosteric and substrate level control mechanisms. TCA - cycle - steps: Regulation at branch points :-Pyruvate dehydrogenase, alpha - keto glutarate dehydrogenase, and citrate synthase. Glycogen metabolism - Regulation of glycogen phosphorylase; glycogen synthase by effectors, covalent modification and hormones.

UNIT II

Lipid metabolism

An overview of fatty acid anabolism and catabolism. Regulation of fatty acid synthesis - Control of acetyl CoA carboxylase line on fatty acid synthetase complex: Role of hormones; effect of diet on fatty acid synthesis. Regulation of biosynthesis of triacylglycerols, cholesterol, phosphotidyl choline, phosphotidyl ethanolamine and sphingomyelin. Biosynthesis and regulation of prostaglandins, Eicosanoids, Thromboxanes leukotrienes.

UNIT III

Amino acid metabolism:

An overview on Gamma -glutamyl cycle. An overview -Methionine as methyl donor (SAM pathway! An overview & regulation of urea cycle. Regulation of alpha-keto glutarate family, pyruvate family. 3-Phosphoglycerate family, Aspartate family and Aromatic family of amino acids. Allosteric regulation of glutamine synthase.

UNIT IV

An overview on porphyrin metabolism: Regulation of biosynthesis and degradation hemoglobin, chlorophyll and cytochrome. Nucleic acid metabolism: Pathways of purines and pyrimidines biosynthesis (both de novo and salvage pathways) and degradation. Regulation of purine biosynthesis: PRPP aminotransferases. Regulation of pyrimidine biosynthesis: Aspartate carbamoyl transferase. Regulation of deoxyribonucleotides by activators and inhibitors.

UNIT V

Elucidation of metabolic pathways-Analysis of single step pathway and Multistep pathway, Mutant study-Complementation for metabolic steps analysis. Integration of metabolic pathways.

Plant metabolism: Hormones: Biosynthesis of - Indole acetic acid, Gibberellins, cytokinins, Ethylene, salicylic acid. Pathways of synthesis of secondary metabolites and its application. Alkaloids, Flavonoids and Terpenoids.

TEXT BOOKS

1. Robert K Murra, 2005. **Harpers Illustrated Biochemistry**, 26th Edition, Lange Medical Publications
2. Geoffrey Zubay, 1993. **Biochemistry**, 3rd Edition, Wm.C.Brown Publishers.
3. Donald Voet, Judith G. Voet and Charlotte W.Pratt, 1999. **Fundamentals of Biochemistry**, John Wiley and Sons, Inc .

4. *Buchanan*, 2000. **Biochemistry and Molecular Biology of Plants**,
1st Edition, IK International Pvt Ltd.

REFERENCE BOOKS

1. *Jeremy M.Berg, John L.Tymoczko and Lubert Stryer*, 2012.
Biochemistry, 7th Edition, W.H.Freeman and Company
2. *David L.Nelson and Michael M.Cox*, 2005. **Lehninger Principles of Biochemistry**, 4th edition, W.H.Freeman and Company.
3. *Reginald H Garret and Charles M Grisham*, 1995. **Biochemistry**,
Sounders College Publishers.

15PBC33C	GENETIC ENGINEERING	SEMESTER -III
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Total Credit: 4
Hours per week: 5

OBJECTIVES:

1. Learnt the advent of DNA research and the ability to change gene expressions, so as it is now possible to change human capacities, whether they be physical, cognitive, or emotional.
2. Learnt about the potentially momentous biotechnological applications of GM, for example, Cloning, Vectors, transgenic animals, treating diseases etc.

UNIT-I

Introduction to genetics. Transmission genetics. Mendelian genetics. Mendelian analysis of inheritance. Genes, chromosomes, alleles, homozygous, heterozygous and mechanism of Mendelian inheritance. Mendel's laws. Linkage - definition, simple measurement and salient features. Salient features of autosomal dominant, recessive, codominance; X-linked recessive, codominant and dominance; Y-linked characters. Extranuclear inheritance.

UNIT-II

Restriction endonucleases - types and functions; restriction mapping. Nucleic acid probes and their applications - cloned probes, oligonucleotide probes; labeling of nucleic acid probes. Nucleic acid hybridization techniques - liquid and dot blot technique; Southern and Northern hybridization; *in situ* hybridization; whole mount *in situ* hybridization. FISH. Polymerase chain reaction - types and applications. DNA fingerprinting, Chemical synthesis of genes, DNA sequencing.

UNIT-III

Cloning vectors - salient features. Plasmids as vectors - properties, natural plasmids, pBR 322, pSC 101, pUC, bluescript. Mechanism of cloning in plasmid vectors. Bacteriophage vectors - λ phage λ -vector -

packing of λ -vector *in vitro*. Cosmid vectors, cosmid cloning. DNA (single stranded) vectors – development of M13 vector, pEMBL vector, λ 2AP viral vectors. SV 40, retrovirus, adenovirus, recombinant vaccinia virus vectors. Baculo virus vector for insects. Transposons as vectors. High capacity cloning vectors – bacterial artificial chromosomes, phage P1, yeast artificial chromosomes and PACs.

UNIT-IV

Cloning strategies – genomic and cDNA cloning. cDNA library. Expression vectors – vectors for maximizing protein synthesis, fusion proteins. Expression vectors – expression of cloned genes in *E. coli*. Cloning and expression of cloned genes in *Bacillus subtilis*. Cloning in yeasts; yeast expression vectors, overexpression in yeast. Expression in baculovirus system. Cultured insect cell expression systems; mammalian cell expression systems. Recombination, selection and screening methods and processes.

UNIT-V

Gene transfer methods in animal cells – calcium phosphate coprecipitation, electroporation, microinjection, using viral vectors. Transfer, cotransfer, selectable markers like TK, PSV, PRSV and reporter genes. Gene targeting in animal cells; transfer and expression of cloned genes in *Drosophila*. Gene knockout. Methods for production of transgenic animals (mice, sheep, goat, fish, pig, cow *etc.*) – retroviral, DNA microinjection and engineered stem cell methods. Applications of transgenic animals; transgenic animals as models/in the prevention of human diseases like cystic fibrosis, muscular dystrophy and anticancer therapy.

TEXT BOOKS

1. Primrose S.B and Twyman R.M, 2012. **Principles of Gene Manipulation and Genomics**, Seventh Edition, Blackwell Publishers.
2. Gardner, Simmons, Snustad, 1991. **Principles of Genetics, Eighth Edition**, John Wiley and Sons, Inc, Canada.

REFERENCE BOOKS

1. *William S Klug, Michael R Cummings, 2004. **Concepts of Genetics**, Seventh Edition, Pearson Education Ptd .Ltd, Indian Branch, Delhi.*
2. *Ernst L Winnacker. 2003. From Genes to Clones, **Introduction to Gene Technology**, 2003, Panima Publishing Corporation, New Delhi.*

15PBC33D	ENDOCRINOLOGY	SEMESTER -III
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Total Credit: 3
Hours per week: 4

CONTENTS

OBJECTIVES:

1. Provided much information related to Pituitary, Thyroid, Pancreatic, adrenal and gonadal hormones and Various disorders related to each hormones.
2. Learnt about the mechanism of action of various hormones with its effect on human due to their hypo and hyper secretion.
3. Also learnt the biochemical changes occurring in pregnancy, parturition and lactation. ; Human infertility-reason and therapy.

UNIT I

Hormones- Introduction, chemical structure. Hormones and homeostasis. Neuroendocrine integration in homeostasis. Classes of chemical messengers. Hormone secretion. Transport and clearance. Hormones and behavior. Feed back control of secretion. Mechanism of hormone action -receptors. second messengers. Cytosolic hormone receptors: Eicosonoids and hormone action. calmodulin. Hormone bioassay-RIA, ELISA.

UNIT II

Pituitary hormones- Anatomy of pituitary gland, hormones of the pituitary, pathophysiology. Endocrine hypothalamus- structure, hypophysiotropic hormones, control of hypothalamic hormone secretion. Feed back mechanisms. mechanism of action. Neurohypophysis: Synthesis and chemistry of N.H. hormone, control of neurohypophyseal hormone secretion. Roles and mechanism of action of oxytocin, vasopressin. Pathophysiology. Growth hormones: somatotropins and somatomedins, pathophysiology. Growth factors: neurotropic growth factors, hematopoietic growth factors, epidermal growth factor.

UNIT III

Thyroid gland:- Synthesis and chemistry of hormones, control of thyroid hormone secretion, circulation and metabolism, physiological roles, mechanism of action. Pathophysiology. Parathyroid gland: synthesis, chemistry and metabolism of parathyroid gland hormones, control of secretion. Physiological role and vitamin D. Mechanism of action of calcium homeostasis, pathophysiology. Melanotropic hormones-chemistry, role of MSH and mechanism of action. Pathophysiology. Pineal gland - melatonin hypothesis, melatonin secretion and circulation, proposed role of pineal, mechanism of action.

UNIT IV

Pancreas:- Endocrine pancreas, insulin, glucagons, somatostatin. Pancreatic peptide - chemistry, physiological roles and mechanism of action. Catecholamines - synthesis, chemistry and metabolism. Neurohormones:- endorphins-source, chemistry, control of secretion; physiological roles. Mechanism of action and pathophysiology.

UNIT V

Reproductive endocrinology:-

Male reproductive system:- source, synthesis, chemistry and metabolism of androgens, Physiological roles and mechanism of action. Pathophysiology.

Female reproductive system:- Ovarian steroid hormone synthesis, physiological role.

Mechanism of action, Neuroendocrine control of organ function. pathophysiology.

Endocrinology of pregnancy, parturition and lactation, sex differentiation and development, puberty and hormone control. Human infertility - reasons, therapy and treatment.

TEXT BOOKS

1. *Mac E Handley*, 1984. **Endocrinology**, 4th edition, Hadley, Prentice Hall.
2. *Guyton*, 2003. **Text book of medical physiology** 10th edition -Hall, Saunders Publishing Co.

15PBC33E	PHARMACEUTICAL CHEMISTRY AND NEUROCHEMISTRY	SEMESTER -III
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Total Credit: 3
Hours per week: 4

CONTENTS

OBJECTIVES:

After the completion of this course the student would have understood

1. Various routes of Drugs administration, its distribution, metabolism and excretion.
2. Genetically engineered drugs for AIDS and cancer and novel drug delivery systems Effect of drugs on central nervous system and associated diseases

UNIT-I

Drugs - sources, dosage forms and routes of administration. Drugs - structural features and pharmacological activity, prodrug concept. Absorption, factors modifying drug absorption. Distribution, metabolism and excretion of drugs - phase I, II reactions, action of cytochrome P450. Drug receptors - localization, types and subtypes, models and theories. G-protein coupled receptor and ion-channel linked receptors. Examples of drug-receptor interactions. Agonists and antagonists.

UNIT-II

Drug tolerance and drug dependence. Principles of basic pharmacokinetics. Adverse response to drugs, drug intolerance, pharmacogenetics, drug allergy, tachyphylaxis, drug abuse, vaccination against infection, factors modifying drug action and effect. Assay of drug potency: chemical, bioassay and immunoassay.

UNIT-III

Biotechnology and Pharmacy

Genetically engineered protein and peptide agents. Novel drug delivery systems - chronomodulated drug delivery systems; non-conventional routes of administration, anti-AIDS drug development,

oncogenes as targets for drugs, multidrug resistance phenotypes, production of secondary metabolites by plant culture. Genome based medicine. The role of bioinformatics in genome based therapy. A very brief account of pharmacogenomics.

UNIT-IV

Stem cells –Definition, concepts and properties. Embryonic stem cells and adult stem cells- generation , culture , maintenance, identification and differentiation, similarities and differences, advantages and disadvantages of stem cells. Stem cell based therapies for autoimmune diseases, diabetes and heart failure. Ethical legal issue in stem cell research.

UNIT-V

Brain – neurotransmitters, encephalins and endorphins; general function of autonomic and somatic nervous system; cholinergic transmission and receptors; adrenergic transmission and receptors; muscarinic receptors. Non-steroidal and anti-inflammatory drugs; adrenergic blocking drugs; cholinergic blocking drugs; muscarinic blocking drugs; Parkinson's disease; Alzheimer's disease. Neurodegenerative disorders – amyotrophic lateral sclerosis, senile dementia, Schizophrenia, Huntington's disease,

TEXT BOOKS

1. *Satoskar R S*, 2010. **Pharmacology and pharmacotherapeutics**, 21st Edition, Popular Prakashar, Mumbai.
2. *William O Foye*, 2008. **Principles of medicinal chemistry** 6th Edition, Waverks Pvt. Ltd. New Delhi.

REFERENCE BOOKS

1. Rang and Date, 2007. **Pharmacology**, 6th Edition, Churchill Livingstone Elsevier USA.
2. *Gary Walsh*, 2011. **Biopharmaceuticals Biochemistry and Biotechnology**, 2nd Edition, Walsh Wiley India Pvt Ltd.

15PBC33P	PRACTICAL - III: BIOCHEMISTRY -III	SEMESTER -III
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Total Credit: 3
Hours per week: 4

CONTENTS

Colorimetric experiments:

1. Isolation and estimation of starch from potato
2. Isolation and estimation of glycogen from liver
3. Isolation and estimation of ascorbic acid from fruit
4. Estimation of β -carotene from carrot
5. Estimation of thiamine from cereals/fruits
6. Estimation of riboflavin
7. Estimation of lactose from milk
8. Estimation of RNA – UV and visible methods
9. Estimation of DNA from liver – UV and visible methods
10. Estimation of fructose in fruits

Enzyme studies:

11. Isolation , purification (precipitation methods, dialysis and chromatography), properties, kinetics and inhibitor studies of
 - a. amylase
 - b. peroxidase
16. Estimation of bacteria – growth curve of bacteria and generation time

TEXT BOOK:

1. *Rober Switzer, Iliam Grarity*, 1999. **Experimental Biochemistry**, 3rd Edition, WH Freeman and company.
2. *John M.Clark. Jr.* 1994. **Experimental Biochemistry**, WH Freeman and Company.

REFERENCE BOOK:

1. *David T.Plummer*, 1998. **An Introduction to Practical Biochemistry**, 3rd Edition, Tata McGraw Hill Publishing company ltd.
2. *Keith Wilson, John Walker*, 2010. **Principle of Practical Biochemistry**, 7th edition, Cambridge University Press.

15PBC3EA	ELECTIVE - III: BASICS OF MOLECULAR BIOLOGY TECHNIQUES	SEMESTER -III
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Total Credit: 3
Hours per week: 4

CONTENTS

OBJECTIVES:

1. Choose appropriate experimental strategy for research in basic and molecular biology
2. Distinguish between different molecular biology techniques that are used to isolate, separate, and probe for specific proteins, nucleic acids, and their interactions

UNIT-I

Rapid DNA sequencing techniques and strategies details of a range of methodologies, e.g. plus and minus, dideoxynucleotide, partial ribose substitution, Maxims and Gibert. Use of thin gels, resolution etc. interpretation of DNA sequences. Role of counter ions, deep and narrow grooves, single standard DNA, A, B and Z DNA etc. Chirality of the helix, syn / antiparallel complementary strands.

UNIT II

Physical properties of RNA: Classes of RNA, rRNA, tRNA, mRNA, HnRNA etc. Structure and methods of isolation and fractionation, gel electrophoresis and Dnases, Rnases, Phosphodiesterases. Rapid RNA sequencing techniques: plus and minus. Interpretation of RNA sequence. Methods of distinguishing double and single standard DNA.

UNIT -III

Reassociation kinetics: cot values, experimental procedure, qualitative significance, use of $Ag + cesium$ sulphate. Satellite DNA : C-value paradox, possible functions of satellite DNA, mechanical strength, gene library, suppressor mutation, centromeric DNA, split genes. Chromatin: Histone and non-histone proteins, general properties of histones, packing density. Nucleosomes, size variable linker, role of H1. Solenoid structure. Transcriptionally active chromatin.

UNIT -IV

Movable genes: Transposons and associated inverted repeats. The cassette model, transforming DNA and plant genes. Retrovirus life cycle. Strategies for cloning in plasmid vectors, features of commonly used vectors, their purification and characterization. Identification of bacterial colonies that contain recombinant plasmids. Bacteriophage ϕ vectors, growth, purification. Cloning in Bacteriophage λ vectors.

UNIT -V

Agarose gel and polyacrylamide gel electrophoresis, detection and extraction of DNA from gels. Construction and analysis of c-DNA: Protocols and strategies for c-DNA cloning. Analysis of genomic DNA by southern hybridization. Amplification of DNA by the Polymerase Chain Reaction. Preparation of radiolabelled DNA and RNA probes. Synthetic oligonucleotide probes. Expression of cloned genes in cultured cells. Screening expression with antibodies and oligonucleotides.

TEXT BOOKS

1. *Sambrook Fritsch J and Maniatis*, 2001. **Molecular Cloning**: Vol I,II,III, 3rd Edition, Cold Spring Harbor Laboratory Press, New York.
2. *Roger, L.Miesfield*, 1999. **Applied Molecular Genetics**, John Wiley and Sons Inc Publications.
3. *Brown TA*, 2001. **Gene Cloning and DNA Analysis**, 4th edition, Blackwell Scientific Publications, London.

REFERENCE BOOKS

1. *James D Watson*, 1992. **Recombinant DNA**, 2nd edition, WH freeman Company, New York.
2. *Helan Hruezer*, 2001. **Recombinant DNA and Biotechnology**, , 1st edition, ASM Publishers, Washington.

15PBC3EB	ELECTIVE - III: NUTRITION AND CLINICAL NUTRITION	SEMESTER -III
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Total Credit: 3
Hours per week:4

CONTENTS

OBJECTIVE:

1. To enable students to know various wet lab and in silico tools for handling proteomic studies.

UNIT I

Basic Concepts: Composition of Human body. Nutritional value of foods and effect of processing. Energy content and its measurement in foods. Thermogenic effect of foods - Role of food proteins: Requirements and allowances.

UNIT II

Proteins as building material, amino acid inter relationships. Protein quality and methods of determination. Factors affecting protein metabolism, Nitrogen balance studies and factors affecting it.

UNIT III

Primary Nutritional Diseases: Protein energy malnutrition, starvation, obesity, vitamin deficiency disorders and biochemical basis of causation and diagnosis of nutritional anaemias.

UNIT IV

Diet and nutrition in India: Assessment of nutritional status - Factors affecting digestion and absorption of food - Effects of irradiation , cooking, refining, sprouting and fermentation on nutritional quality of food

UNIT V

Dietary fiber- chemical composition and importance - Physiological effects and metabolic adaptation during exercise - Nutritional management of inborn errors of metabolism

TEXT BOOKS

1. Swaminathan, M. 1974. Essentials of food and nutrition Vol. II, Applied aspects, Ganesh Publishers, Madras

REFERENCE BOOKS

1. James Orten and Otto Neuhaus, 2003. Human biochemistry, 10th edition, CV Mosby Company, London

15PBC3EC	ELECTIVE - III : CANCER BIOLOGY AND THERAPY	SEMESTER -III
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Total Credit: 3
Hours per week: 4

OBJECTIVE:

To understand mechanisms of cancer development and the therapeutical approaches

UNIT - I

Introduction - Growth characteristics of cancers cells; Types of growth-hyperplasia, dysplasia, anaplasia and neoplasia. Nomenclature of neoplasms. Differences between benign and malignant tumors.

UNIT- II

Cancer biology and biochemistry- Aberrant metabolism during cancer development; Tumor markers; cellular protooncogenes- oncogene activation. Signal transduction in cancer - Role of transcription factors.

UNIT- III

Carcinogenesis- radiation and chemical carcinogenesis- stages in chemical carcinogenesis- Initiation, promotion and progression - Free radicals, antioxidants in cancer

UNIT- IV

Cell Cycle Regulation-Tumor suppressor genes p53, p21. Role of DNA methylation in gene silencing- epigenetic silencing of tumor-suppressor genes; Apoptosis in cancer-Cell death by apoptosis-role of caspases.

UNIT- V

Strategies of anticancer drug therapy - chemotherapy - gene therapy. Immunotherapy and Radiotherapy; Stem Cells and Cancer.

TEXT BOOK:

1. McKinnell R. G. , Parchment R. E., Perantoni A. O, Barry Pierce, Damjanov. I., 2006. **The Biological Basis of Cancer**, Second Edition, Cambridge University Press, United Kingdom.

REFERENCE BOOK:

1. Robert A. Weinberg, 2006. **The Biology of Cancer**, First edition, Taylor and Francis Inc, United Kingdom.

15PBC43P	PRACTICALS - IV: BIOCHEMISTRY -IV	SEMESTER- IV
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Total Credit: 4
Hours per week: 5

CONTENTS

Clinical microbiology:

1. Isolation of pure culture – serial dilution, pour plate, spread plate, streak plate methods, and slab culture techniques for long term storage
2. Colony morphology – colony counting
3. Staining techniques – simple, differential, negative, acid fast, spore, capsule and fungal staining
4. Antibiotic sensitivity disc – phenol coefficient method
5. Estimation of bacteria – growth curve of bacteria and generation time

Plant tissue culture:

1. Preparation of media
2. Cleaning of tissue culture glasswares
3. Methods of sterilization
4. Surface sterilization of field grown plant tissue
5. Callus induction
6. Introduction of plant tissue culture
7. Regeneration of shoot and root from callus culture
8. Initiation of suspension culture

TEXT BOOKS

1. Robert H Smith, Robert H Smith, 2005. **Plant Tissue Culture- Techniques and Experiments**, Academic press, New Delhi.

REFERENCE BOOKS

1. *Kumar.U*, 2001. **Methods in plant tissue culture**, Agrobios (India) - Jodhipur .
2. *Razdan, M.K*, 1983. **An Introduction to plant tissue culture**, Oxford and IBH - New Delhi.

15PBC4EP	ELECTIVE PRACTICAL - I: CELL CULTURE AND MOLECULAR TECHNIQUES	SEMESTER -IV
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Total Credit: 4
Hours per week: 5

CONTENTS

PLANT TISSUE CULTURE

- 1) PTC laboratory organization
- 2) Sterilization procedures
- 3) Preparation of PTC medium
- 4) Callus induction
- 6) Micro propagation
- 7) Artificial seed production
- 8) Mitotic Preparation -Onion root tip

ANIMAL TISSUE CULTURE

- 1) Preparation of ATC medium and membrane filtration
- 2) Preparation of primary culture from chick embryo
- 3) Isolation of DNA from animal cell
- 4) Quantification of DNA- Spectrophotometric method

METHODS IN MOLECULAR BIOLOGY

- 1) Isolation of genomic DNA and RNA
- 2) Isolation of plasmid DNA and estimations by DNP method
- 3) Polymerase chain reaction

TEXT BOOKS

1. *Robert H Smith*, 2005. **Plant Tissue Culture, Techniques and Experiments**, Academic press, New Delhi.
2. *Sudha Gargal*, 2005. **Principles and Practice of Animal Tissue Culture**, 1st Edition, University press, Hyderabad
3. *Sadasivam S and Manickam*, 1996. **Biochemical Methods**, 2nd Edition, New Age International Publishers Pvt Ltd.

REFERENCE BOOKS

1. *Kumar.U*, 2001. **Methods in plant tissue culture**, Agrobios (India) - Jodhipur .
2. *Jennie P Mathew*, 2006. **Animal Cell Culture Methods**, Elseveir, 1st Edition, New Delhi.

15PBC4EQ	ELECTIVE PRACTICAL-I: NUTRITIONAL SCIENCE	SEMESTER -IV
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Total Credit: 4
Hours per week: 5

1. Ashing of food and preparation of ash solution.
2. Estimation of calcium in food.
3. Estimation of phosphorus in food.
4. Estimation of iron in food.
5. Estimation of ascorbic acid in cabbage by dye method.
6. Estimation of thiamine in food
7. Estimation of Protein in food
8. Estimation of Fat
9. Estimation of Carbohydrate
10. Estimation of Vitamin A and carotene
11. Estimation of Antioxidants

REFERENCE BOOK

1. Swaminathan, M, 1974. **Essentials of food and nutrition**, Vol. II, Applied aspects, Ganesh Publishers, Madras.