MASTER OF SCIENCE (BIOCHEMISTRY)

REGULATIONS

ELIGIBILITY

A Bachelors degree in science with Biochemistry, Microbiology, Biotechnology, Chemistry, Botany, Zoology, Nutrition, B.Sc Agriculture and Life sciences as main subject of this University or any other University or any other qualification accepted as equivalent thereto are eligible for admission to M.Sc Biochemistry course.

DURATION OF THE COURSE

The course shall extend over a period of two years comprising of four semesters with two semesters in one academic year. There shall not be less than 90 working days for each semester. Examination shall be conducted at the end of every semester for the respective subjects.

OBJECTIVE OF THE COURSE

- The two year M.Sc., programme is designed to help the student to be the pioneering and resourceful personalities in the field of life science.
- The ultimate aim is to enable the students to develop an interdisciplinary approach for understanding the life science problems at the molecular level. In addition, the present curriculum gives scope for vertical and horizontal mobility in the education system, so that the students can enter different modules to update their knowledge depending upon the employment opportunities in each area.
- Various IDC and practical courses have been designed not only to enable the students to appreciate scientific basis of various life processes but also to train them for self-employment. The practical training will develop their reasoning ability to critically evaluate the results obtained from the projects.
- The present curriculum aimed to cater the global demand for skilled and trained manpower in various areas like Research and Development, Quality control labs, Industries, Biopharmaceutical companies and in field of teaching.

SCHEME OF EXAMINATION

Subject Code	Subject	Hours of Instruction	Exam Duration (Hours)	Max Marks			Credit Points
				CA	CE	Total	
First Semester							
Part A							
15PBCM101	Core I: Chemistry of Biopolymers	5	3	25	75	100	5
15PBCM102	Core II: Analytical Biochemistry	4	3	25	75	100	4
15PBCM103	Core III: Enzyme Catalysis and Regulation	5	3	25	75	100	5
15PBCM104	Core IV: Molecular Biology	5	3	25	75	100	5
15PBCEL101	Elective: I Cellular Biochemistry	5	3	25	75	100	5
15PBCMP101	Core Practical I: Analytical Biochemistry and Molecular Biology	4	6	40	60	100	3
Part B							
15PBCSS101	Technical Skill I: Biochemical Calculations (100 % Internal Evaluation)	1	-	100	-	100	1
Non Credit							
15PLS101	Career Competency Skills I	1	-	-	-	-	-
Total		**30**				**700**	**28**
Second Semester							
Part A							
15PBCM201	Core V: Human Physiology (Self Study & 100% External Evaluation)	-	3	-	100	100	2
15PBCM202	Core VI: Plant Biochemistry	4	3	25	75	100	4
15PBCM203	Core VII: Intermediary Metabolism and Regulation	5	3	25	75	100	5

15PBCM204	Core VIII: Recombinant DNA technology	5	3	25	75	100	5
	Elective II	3	3	25	75	100	3
15PBCMP201	Core Practical II: Plant Biochemistry and rDNA Technology	4	6	40	60	100	3
Optional Papers							
15PMBBCI201	IDC I: Fundamentals of Microbiology and Clinical Microbiology	3	3	25	75	100	3
15PMBBCIP201	IDC Practical I: Fundamentals of Microbiology and Clinical Microbiology	2	3	40	60	100	2
15PBTBCI201	IDC I: Plant Tissue Culture Technology	3	3	25	75	100	3
15PBTBCIP201	IDC Practical I: Plant Tissue Culture Technology	2	3	40	60	100	2
Part B							
15PBCSS201	Technical Skill II: CSIR, ICMR - NET (Online & 100 % Internal Evaluation)	1	3	100	-	100	1
15PVE201	Value Education: Human Rights	2	3	25	75	100	2
Non Credit							
15PLS201	Career Competency Skills II	1	-	-	-	-	-
Total		**30**				**1000**	**30**
Third Semester							
Part A							
15PBCM301	Core IX: Clinical Biochemistry	5	3	25	75	100	5

15PBCM302	Core X: Molecular Immunology and Immunotechnology	5	3	25	75	100	4
15PBCM303	Core XI: Biostatistics, Research Methodology, Bioethics and IPR	4	3	25	75	100	4
15PBCEL301	Elective III : Molecular Genetics	5	3	25	75	100	4
15PBCMP301	Core Practical III: Clinical Biochemistry and Immunology	4	3	40	60	100	3
Optional Papers							
15PMBBCI301	IDC II: Industrial Microbiology	3	3	25	75	100	3
15PMBBCIP301	IDC Practical II: Industrial Microbiology	2	3	40	60	100	2
15PBTBCI301	IDC II: Animal Tissue Culture Technology	3	3	25	75	100	3
15PBTBCIP301	IDC Practical II: Animal Tissue Culture Technology	2	3	40	60	100	2
Part B							
15PBCSS301	Technical Skill III : CSIR, ICMR –NET (Online & 100 % Internal Evaluation)	1	3	100	-	100	1
15PBCIT301	Internship Training	-	-	100	-	100	1
Total		**29**				**900**	**27**
Fourth Semester							
Part A							
15PBCM401	Core XII: Hormonal Biochemistry and Biochemical Pharmacology (100%Internal Evaluation)	4	3	100	-	100	4
15PBCPR401	Project & Viva-Voce	-	-	50	150	200	7
Total		**4**				**300**	**11**
Grand Total						**2900**	**96**

ELECTIVE SUBJECT

The elective subjects I and III respectively given in the first and third semester are compulsory.

The students shall choose any one of the following subjects as Elective II in the Second semester.

S.No	Subject code	Subject
1.	15PBCEL201	Neuroscience
2.	15PBCEL202	Environmental Biochemistry
3.	15PBCEL203	Food Processing and Quality Control

FOR COURSE COMPLETION

Student shall complete:

- Value Education: Human Rights in II semester.
- IDC in II and III semester.
- Three Technical Skill Courses in I, II and III semesters.
- Self study and external evaluation subject in II semester and internal evaluation from the core subject in IV semester.
- Internship Training in III semester.
- Elective subjects in I, II and III semesters.
- Project & Viva-Voce in IV semester.

TOTAL MARKS AND CREDIT DISTRIBUTION

S.NO	COMPONENET	MARKS	CREDITS
1.	PART A: Core subjects, Elective and IDC	2400	90
2.	PART B: Value Education, Technical Skill, Internship Training	500	6
TOTAL		**2900**	**96**

15PBCM101	CORE I: CHEMISTRY OF BIOPOLYMERS	SEMESTER - I

Total Hours: 50

OBJECTIVE:

To make the learners to:

1. Understand the correlation between the structural properties and functions of Macromolecules.

CONTENTS

UNIT - I **(10 Hours)**

Carbohydrates: Polysaccharides - Occurrence, structure, properties, importance of storage polysaccharides – (starch and glycogen) and structural polysaccharides – Cellulose. A brief account on chitin, pectin, hemicelluloses – xylans, mannans and Agar-Agar. Occurrence, structure, properties and importance of mucopolysaccharides (Glucosaminoglycans-hyaluronic acid, chondrotin sulphate and heparin). Glycoproteins- proteoglycans, Bacterial cell wall polysaccharides, N-linked (Ribonuclease B) and O –linked (Mucins), ABO blood group antigens and sialic acid.

UNIT - II **(10 Hours)**

Structural Organization of Proteins: Nomenclature of aminoacids (one letter and three letter code). Proteins **–** Classification. Peptide bond. Primary structure and its determination, Conformation of proteins - Ramachandran plot. Secondary structure-α-helix, other polypeptide helices (3_{10}, π helix, poly glycine conformations), β-pleated sheets. Super secondary structures – β bend, β-α-β, β - hairpin motif, α - α motif, β barrels. Tertiary structure-organization and forces involved in stabilizing protein structure (Electrostatic, hydrogen bonds, hydrophobic and disulphide bonds. Quaternary structure-subunit Interactions and symmetry (cyclic, dihedral and rotational).

UNIT - III **(10 Hours)**

Protein dynamics: Conformational properties of Structural proteins (fibrous proteins-α-keratin, collagen – single amino acid change and its defects). Elementary details of role of accessory proteins (PDI and molecular chaperones) Globular proteins – role of PDI and molecular chaperones in folding. Hemoglobin- mechanism

of oxygen binding and cooperativity, Bohr's effect, CO_2 transport and effect of 2, 3-BPG.

Protein Evolution: Hemoglobin - Gene duplication - evolution of globin genes. Variants of hemoglobin: Sickle cell anemia-pathological effect and evolutionary benefit. A brief account on conformation of Cytochrome.

UNIT - IV **(10 Hours)**

Lipids: Classification- physical and chemical properties of lipids. Structure and importance of simple lipids, compound lipids and derived Lipids (fatty acids, plant, animal and fungal sterols). TAG as efficient energy reservoir. Structure and importance of eicosanoids (prostaglandins and leukotrienes). Lipoproteins – classification, composition and functions. Properties of lipid aggregates-liposomes, micelles and bilayers.

UNIT - V **(10 Hours)**

Nucleic Acids: Structure of DNA - Watson and Crick model. Types of DNA - A, B and Z DNA. Properties of DNA - buoyant density, viscosity, denaturation, renaturation, Tm, hypo and hyperchromism. Cot curve value. Super Coiled DNA - superhelix topology-linking number-twist-writhing number. Interwinding and relaxation of supercoiled DNA. DNA -Protein interactions-histone and Non-histone proteins – protein motifs - leucine zipper, zinc finger, HLH motif.

Miscellaneous alternative conformation of DNA - slipped mispaired DNA, parallel stranded DNA and anisomorphic DNA. RNA - Types, structure and functions of mRNA, tRNA, rRNA, snRNA, hnRNA. Brief account on micro RNA and SiRNA.

TEXT BOOKS:

1. *Christopher K. Mathews., Van Holde, K. E.* and *Kevin G. Ahern*. 2005. **Biochemistry.** [Third Edition]. Pearson Education, New Delhi **(UNIT-I & III)**.
2. *Donald Voet* and *Judith, G. Voet.* 2011. **Biochemistry**. [Fourth Edition]. John Wiley and Sons, New York**. (UNIT I-V)**
3. *Nelson David, L.* and *Cox, M. M.* 2011. **Lehninger Principles of Biochemistry**. [Fifth Edition]. Macmillan/ Worth, New York **(UNIT-IV& V).**

REFERENCE BOOKS:

1. *Jeremy M. Berg., John L. Tymoczko* and *Lubert Stryer*. 2007. **Biochemistry.** [Sixth Edition]. W H Freeman and Co., New York.
2. *Geoffrey L. Zubay., William W. Parson and Dennis E. Vance.* 1995. **Biochemistry.** [Fourth Edition]. WMC. Brown Publishers, England.
3. *Reginald H. Garrette and Charles M. Grisham.* 2005. **Principles of Biochemistry.** [Third Edition]**.** Thomson Brooks/Cole, Australia.

15PBCM102	CORE II: ANALYTICAL BIOCHEMISTRY	SEMESTER - I

Total Hours: 40

OBJECTIVES:

To enable the students:

1. To gain the numerical skill in biochemical techniques.
2. To study the principles and applications of biochemical techniques.

CONTENTS

UNIT - I **(9 Hours)**

General Principles of Biochemical Investigations: *In vivo* and i*n vitro* studies. Methods of Cell disruption and homogenization. Cell and tissue culture – Equipment for cell culture-cell culture hoods and CO_2 incubator. Good cell culture practices. Aseptic techniques – identification and eradication of bacterial and fungal contamination. Types of animal cell and their characteristics in culture – primary cell cultures, Continuous cell line, cell culture media and growth requirements for animal cell, preparation of animal cell culture medium, subculture of cells, cell quantification, seeding cells into culture plates, maintenance of cells in culture, growth kinetics of animal cells in culture, cryopreservation of cells, determination of cell viability.

pH - determination of pH- pH meter, H-H equation, pKa, Equilibrium constant. Buffers - Definition & biological importance.

UNIT - II **(9 Hours)**

Centrifugation: Basic principles of Sedimentation, Types of Centrifuges, Types of Rotors, Care and maintenance of centrifuge. Preparative ultracentrifugation – techniques (Differential, isopycnic and density gradient centrifugation) and practical applications (subcellular fractionation). Analytical ultracentrifugation - Instrumentation and application- Molecular weight determination.

Electrophoresis – General Principle and factors affecting electrophoretic mobility. Principle, instrumentation and applications of Paper, Gel – Agarose, PAGE (Native PAGE, SDS-PAGE). Isoelectric Focusing. Pulsed Field Electrophoresis, 2D gel electrophoresis.

UNIT - III **(8 Hours)**

Chromatographic Techniques: Principle, Instrumentation and Applications of chromatographic techniques - Partition chromatography (Paper, TLC and HPTLC) and column chromatography (Ion- Exchange, Molecular sieving, Affinity, Adsorption, GLC, HPLC, and FPLC).

UNIT - IV **(7 Hours)**

Spectroscopic techniques I: Basic Principle - properties of EMR, interaction of EMR with matter. Colorimetry - Beer - Lambert's Law. Instrumentation and applications of Atomic absorption spectroscopy (UV-Visible), Atomic emission (flame photometry and spectrofluorimetry). FRET/FRL (elementary details).

UNIT - V **(7 Hours)**

Spectroscopic techniques II: Principle, Instrumentation and Applications of Vibrational spectroscopy- IR. NMR- Principle, Instrumentation and Applications. X-ray crystallography (Principle and Applications only).

Mass Spectrometric Technique - Principle, Instrumentation and Applications. GC-MS, MALDI TOF- (Principle and Applications only).

TEXT BOOKS:

1. *Keith Wilson* and *John Walker*. 1995. **Principles and Techniques of Practical Biochemistr**y. Cambridge University Press, New York. **(UNIT-I, II, III, IV & V)**.
2. *Avinash Upadhyay., Kakoli Upadhyay* and *Nirmalendhe Nath*. 2003. **Biophysical Chemistry: Principles and Techniques**. Himalaya Publishers, Mumbai. **(UNIT - I)**.

REFERENCE BOOK:

1. *Rodney F. Boyer.* 1993. **Modern Experimental Biochemistry.** [Second Edition], Benjamin-Cummings Publishing, Redwood City, CA.

15PBCM103	CORE III: ENZYME CATALYSIS AND REGULATION	SEMESTER - I

Total Hours: 50

OBJECTIVES:

To enable the students:

1. To obtain knowledge about catalytic strategies of enzymes and enzyme kinetics.
2. To understand the significance of enzyme regulation in normal cellular functions.
3. To learn the immobilization process and industrial applications of enzymes.

CONTENTS

UNIT - I **(10 Hours)**

Introduction: IUB Classification and Nomenclature, Enzyme Units, specific activity. Enzyme specificity-Types. Active site – features. Determination of 3D structure of active site. Identification of binding and catalytic sites - trapping ES complex, enzyme modification (affecting aminoacid side chain, treatment with proteases, site directed mutagenesis and changing the pH). Theories of Enzyme action - Lock and Key, Induced fit (Hexokinase). Characteristics and applications of Isoenzymes (LDH) and Abzymes. Brief account on non- protein enzymes (Ribozymes, DNAzyme) and extremozymes.

UNIT - II **(10 Hours)**

Enzyme Kinetics- MM Equation. Reciprocal plots - LB Plot, Eadie Hofstee Plot, Hanes plot. Km, Vmax and their significance. Enzyme Turn over (kcat), Significance of kcat. Factors affecting Enzyme activity - pH, temperature, substrate concentration and enzyme concentration. Bisubstrate reactions-ordered, random order and ping-pong mechanisms.

Enzyme Inhibition- Reversible inhibition - Types, kinetics, determination of Inhibitor constant and LB Plot. Irreversible inhibition – Inhibition by DFP and Iodoacetamide. Suicide inhibition- Inhibition of thymidylate synthase.

UNIT - III **(10 Hours)**

Enzyme catalysis: Mechanism of enzyme catalysis - Acid-base and covalent catalysis -Chymotrypsin, Metal ion catalysis - Carbonic anhydrase (Zn^{2+}). Serine protease – Aspartyl protease- HIV protease. Structure, functions and mechanism of action of Coenzymes (Synthesis not required). Nicotinamide nucleotides, Flavin nucleotides, CoA, TPP, Pantothenic acid, PLP, Folic acid and Biotin.

UNIT - IV **(10 Hours)**

Enzyme Regulation: Allosteric regulation - Allosteric enzyme-multi subunits - Regulatory & catalytic subunits. Sigmoidal Kinetics – MWC model and its significance. Cooperativity- Hill's Equation, Scatchard plot, R and T states, K and V series of enzymes. Aspartate transcarbamoylase (ATCase) as a model allosteric enzyme.

Covalent modification of enzymes: Phosphorylation (glycogen phosphorylase and glycogen synthase), adenylation (glutamine synthetase). Proteolytic cleavage (chymotrypsinogen and fibrinogen), methylation and uridylation.

Multi enzyme complex: Structure, mechanism of action and regulation of Pyruvate dehydrogenase.

UNIT - V **(10 Hours)**

Isolation and Purification of Enzymes: Extraction of soluble and membrane bound enzymes. Purification of enzymes (Ion exchange chromatography, Gel filtration chromatography and Affinity chromatography). Principle of ammonium sulphate precipitation. Criteria of purity, purification summary.

Enzyme techniques: Methods of immobilization – physical - adsorption, ionic binding, covalent binding, entrapment and cross liking. Biosensors **-** Colorimetric, Amperometric, Optical and Immunosensors. Enzymes in medicine and industry. Artificial enzymes - protein and nonprotein synzymes (Elementary details).

TEXT BOOK:

1. *Palmer, T.* and *Bonner, P. L.* 2008. **Enzymes (Biochemistry, Biotechnology, Clinical Chemistry).** [Second Edition]. East-West Press Pvt. Ltd., New Delhi.

REFERENCE BOOKS:

1. *Nicholas C. Price* and *Lewis Stevans.* 1998. **Fundamentals of Enzymology**. [Second Edition]. Oxford University Press, New Delhi.
2. *Jeremy M .Berg., John L Tymoczko* and *Lubert Stryer*. 2007. **Biochemistry.** [Sixth Edition]. W H Freeman and Co, New York

15PBCM104	CORE IV: MOLECULAR BIOLOGY	SEMESTER - I

Total Hours: 50

OBJECTIVES:

To enable the students to learn

1. The molecular mechanism of replication, transcription and translation of the genetic material.
2. Molecular mechanism in the regulation of gene expression

CONTENTS

UNIT – I **(10 Hours)**

Molecular structure of genes and chromosomes: Structural organization of prokaryotic chromosome, plasmid. Structural organization of eukaryotic chromosome– nucleosomes. Higher order organization - 30 nm fiber and higher order structure. Genome –definition. chromatin- centromeres, telomeres. Molecular definition of gene. Organization of genes (introns, exons, protein coding and non-protein coding genes) in the Chromosome. Nonfunctional DNA- moderately and highly repetitive sequences. Brief account on organelle DNAs.

UNIT - II **(10 Hours)**

DNA Replication: Mechanisms of replication. Steps in prokaryotic and eukaryotic DNA Replication. Enzymes involved in replication. Replication of chromosome ends – telomerase. Recombination- Holliday model, Rec BCD Enzyme, Rec A Protein. Inhibitors of replication. Mechanism of DNA repair-direct reversal, base excision, nucleotide excision, mismatch, recombinational and SOS response.

UNIT - III **(10 Hours)**

Transcription: Prokaryotes -Structure and function of RNA polymerases. Organisation of promoter sequences. Steps in prokaryotic transcription. Eukaryotic transcription – assembly of general transcription complex. Steps in eukaryotic transcription. Inhibitors of transcription. RNA processing in prokaryotes and eukaryotes. RNA Replicase and Reverse transcriptase.

UNIT - IV **(10 Hours)**

Genetic Code: Decipheration of genetic code -contributions of Nirenberg, Matthaei and Khorana. Salient features of genetic code. Wobble hypothesis and biological

significance of degeneracy. Mitochondrial genetic code. Mutation-point, Frameshift, Spontaneous Induced, Visible and suppressor. Replica plating.

Translation in Prokaryotes and Eukaryotes : tRNA and its adaptor function, activation of amino acids. Aminoacyl t-RNA synthetase, Ribosomes and its composition. Formation of initiation complex, elongation and termination. Post translational modification- folding–chaperones and processing. Inhibitors of translation. Brief account on protein sorting and targeting.

UNIT - V **(10 Hours)**

Regulation of Gene Expression: General principle of gene regulation-housekeeping and constitutive genes. Prokaryotes-specificity factors, repressors and activators. Operon concept – structural and regulatory proteins. Lac operon (enzyme induction and repression). Trp operon -Attenuation. Translational control-synthesis of r-proteins in *E.coli.* Transcriptional control in Eukaryotes – Euchromatin and heterochromatin. Chromatin remodeling by HATs and HDACs. A brief account on TATA box, proximal elements, distant enhancer sites, activators & repressors. Intercellular and Intracellular signals-steroid receptor, HRE, CRE and CREB. Activation of STAT transcription factors by JAK kinases.

TEXT BOOKS:

1. *Harvey Lodish., Arnold Berk* and *Paul Matsudaira.* 2008. **Molecular Cell biology**. [Fifth Edition]. W. H. Freeman and Company, New York **(UNIT - I).**
2. *Nelson David, L. and Cox, M.M.* 2011. **Lehninger Principles of Biochemistry**. [Fifth Edition]. W. H. Freeman and Company, New York **(UNIT - II, III, IV & V).**
3. *Brown, T.A***.** 2007**. Genomes 3.** Taylor and Francis, New York.

REFERENCE BOOKS:

1. *Benjamin Lewin*. 2010. **Genes IX.** Oxford University Press, London.
2. *Robert F.*Weaver. 1999. **Molecular Biology.** McGraw Hill, Boston.

15PBCEL101	ELECTIVE I: CELLULAR BIOCHEMISTRY	SEMESTER - I

Total Hours: 50

OBJECTIVES:

To enable the learners to understand

1. The structural and functional organization of cell membrane.
2. The molecular basis of cellular interaction and cell signaling.
3. The biology and genetic basis of cancer

CONTENTS

UNIT - I **(10 Hours)**

Visualization, fractionation and applications of cultured cells: Microscopy - Principle and Applications. Light Microscopy - visualizing cell structure and localizing proteins within cells. Phase contrast microscopy - visualizing unstained living cells. Fluorescence microscopy – expression of fluorescence proteins in live cells and organisms, determination of intracellular Ca^{2+} level and H^{+} levels. Immunoflourescence microscopy-detection of specific proteins in fixed cells. Electron microscopy – TEM, SEM – methods and applications. Isolation of cells - Flow cytometry. Primary cell culture and cell lines – study of cell differentiation.

UNIT - II **(10 Hours)**

Biomembranes and Membrane Transport: Membrane structure – Fluid mosaic model; Membrane Lipids – Composition, Fluidity, Asymmetry; Membrane Proteins – Types, orientation, mobility. Glycophorin and Bacteriorhodopsin. Interaction of proteins with membranes; Membrane carbohydrates – cell surface carbohydrates – Lectins.

Transport - Passive & facilitated diffusion; Active transport – ATP powered pumps (Na^{+} / K^{+} ATPase, Ca^{2+}/ ATPase); ABC proteins – bacterial permease; Cotransport by symporters and antiporters – Na^{+} linked symporters & antiporters; Movement of water – aquaporins. Transepithelial transport – osmosis, transport of glucose & amino acids.

UNIT - III **(10 Hours)**

Cell-Cell Interaction - Cell matrix adhesion - ECM, hyaluronans, proteoglycans, laminin, integrins, fibronectins. Cell-Cell adhesion, specialized junctions, desmosomes, gap junctions, tight junctions, adhesion molecules-cadherins and connexins.

Cell Cycle - Over view of Cell cycle and its control in mammalian cells. Check points in cell cycle regulation. Apoptosis**-** pathways, regulators and effectors in apoptosis.

UNIT - IV **(10 Hours)**

Cell Signaling: General Concept: Definition of ligand, receptors, endocrine, autocrine, paracrine signaling and signaling by plasma membrane attached proteins. Receptor concept. Intracellular signal transduction- second messengers (cyclic nucleotides, Ca^{2+}, Ion channels and phosphoslipids). Integrating responses of cells to environmental influences – Integrated regulation of glycogenolysis by Insulin and Glucagon. G-protein coupled receptors-structure, types and functions. Receptor tyrosine kinases, Ras and MAP kinase pathways.

UNIT - V **(10 Hours)**

Cancer Biology and Genetic basis of Cancer: Introduction, Carcinogens- Physical, chemical and biological agents. Mechanism of carcinogenesis. Morphological and biochemical changes of cancer cells. Genetic basis - Role of oncogenes- mechanism. Protooncogenes, activation of Protooncogenes. Tumour suppressor genes (p53 & RB1). Inherited mutation-hereditary retinoblastoma and loss of heterozygosity (Mis-segregation and mitotic recombination). Aberrations in signaling pathway (Hedgehog signals). Brief account on the role of telomerase in immortalization of cancer cells.

TEXT BOOK:

1. *Harvey Lodish., Arnold Berk* and *Paul Matsudaira*. 2004. **Molecular Cell Biology.** [Fifth Edition]. W.H. Freeman and Company, New York.

REFERENCE BOOKS:

1. *Gerald Karp.* 2000. **Cell and Molecular Biology.** John Wiley and Sons, New York.
2. *Benjamin Lewin.* 2007. **Cells.** [Ninth Edition]**.** Jones and Bartlett Publishers, Sudbury, MA 01776, United States.

3. *Robert K. Murray., Daryl K. Granner., Peter A. Mayes* and *Victor W. Rodwell*. 2002. **Harper's Biochemistry.** [Twenty fifth Edition]. Mc Graw Hill Publishers, New York.
4. *Bruce Alberts., Dennis Bray., Julian Lewis., Martin Raff., Keith Robert* and *James D. Watson.* 1994. **Molecular Biology of the Cell.** [Third Edition]. Garland Publishers, New York.

15PBCMP101	CORE PRACTICAL I: ANALYTICAL BIOCHEMISTRY AND MOLECULAR BIOLOGY	SEMESTER - I

LIST OF EXPERIMENT

I. Biochemical Techniques

1. Isolation and Estimation of Glycogen by Colorimetric method.
2. Isolation and Separation of Lecithin from Egg yolk by TLC.
3. Separation of Amino acids by Paper Chromatography (Ascending, Descending and Circular).
4. Separation of leaf pigments by Column chromatography technique.

II. Enzyme Extraction and Purification

1. Extraction of Peroxidase from turnip.
2. Fractionation of Peroxidase by ammonium sulphate precipitation
3. Desalting by dialysis
4. Purification of Peroxidase by Gel chromatography
5. Characterization of Peroxidase by SDS-PAGE
6. Isoenzymic pattern of Peroxidase
7. Purification summary, table and interpretation.

III. Enzyme Kinetics

1. Effect of pH, temperature on Peroxidase activity.
2. Effect of substrate concentration on Peroxidase activity and determination of Km & Vmax – LB plot.

IV. Immobilization of Enzymes

1. Immobilization of Peroxidase by matrix entrapment.

V. MOLECULAR BIOLOGY

1. Isolation of Genomic DNA from Plant.
2. Plasmid DNA isolation from Bacterial cell.
3. Quantification of isolated DNA.

REFERENCE BOOKS:

1. *Sadasivam, S.* and *Manickam, A*. 2010. **Biochemical Methods.** [Third Edition]. New Age International (P) Ltd., New Delhi.
2. *David T. Plummer*. 1988. **Practical Biochemistry**. [Third Edition]. Tata McGraw Hill Publishers, New Delhi.

15PBCSS101	TECHNICAL SKILL I: BIOCHEMICAL CALCULATIONS (100 % INTERNAL EVALUATION)	SEMESTER - I

Total Hours: 15

OBJECTIVES:

1. To make the students to understand the basic calculations in biochemistry
2. To apply the mathematical concepts in biology

CONTENTS

UNIT - I **(3 Hours)**

Unit of Measurements**,** Strength of the solutions – Normality, molarity, molality, percentage solutions.

UNIT - II **(3 Hours)**

Preparation and handling of solutions –Stock, working and dilutions. Preparation of buffers.

UNIT - III **(3 Hours)**

pH and pKa, Half life and disintegration time – simple problems. Interconversion of percentage transmittance and absorbance.

UNIT - IV **(3 Hours)**

Enzyme kinetics -Km, Turn over, Vmax, substrate concentration, Enzyme concentration. Nucleotide- Base pair calculations.

UNIT - V **(3 Hours)**

Simple reasoning problems.

TEXT BOOKS:

1. *Jain, J. L.* 2002. **Fundamentals of Biochemistry.** [Fifth Edition]. S.Chand & Company Ltd., New Delhi.
2. *Nelson David, L.* and *Cox, M.M.* 2011. **Lehninger Principles of Biochemistry**. [Fifth Edition]. Macmillan/ Worth, New York.

15PLS101	CAREER COMPETENCY SKILLS I	SEMESTER – I

Total Hours: 15

OBJECTIVE:

To enhance employability skills and to develop career competency

UNIT – I **(3 Hours)**

Solving Simultaneous Equations Faster - Number System: HCF, LCM - Decimals – Percentages- Averages

UNIT – II **(3 Hours)**

Powers and Roots -Problems on Trains- Problem on ages-Boats and Streams

UNIT – III **(3 Hours)**

Calendar-Clocks -Pipes and cisterns-Permutations and Combinations-Seating Arrangements

UNIT – IV **(3 Hours)**

Syllogism – Assertion and Reasons – Statements and Assumptions – Identifying Valid Inferences – Identifying strong arguments and weak arguments – Statements and Conclusions.

UNIT – V **(3 Hours)**

Reading comprehension – Self Introduction – News Paper Review – Book Review

15PBCM201	CORE V: HUMAN PHYSIOLOGY (SELF STUDY & 100% EXTERNAL EVALUATION)	SEMESTER - II

OBJECTIVES:

To enable the students to learn about

1. Physiological processes taking place in the vital organs of human body.
2. The biochemistry of various classes of hormones.
3. The biochemical changes occurring in pregnancy, parturition, lactation and sex determination.

CONTENTS

UNIT – I

Digestive system:

Parts of the digestive System and their role in digestion –Mouth, Stomach, pancreas, liver, gall bladder and intestine. Digestion and Absorption of carbohydrates, lipids and proteins. Gastrointestinal hormones – Gastrin, Secretin, Cholecystokinin, GIP, VIP.

UNIT - II

Respiratory System : Diffusion of gases in lungs, transport of oxygen from lungs to tissues through blood. Transport of CO_2 from tissues to lungs through blood. Factors affecting transport of gases. Chloride shift.

UNIT - III

Cardio Vascular System: Heart - Structure of heart, cardiac cycle, blood pressure and its control. Cardiac conduction systems.

Blood: Composition and functions; Hematopoiesis. Mechanism of blood coagulation. Composition and functions of Lymph and CSF.

UNIT – IV

Excretory System: Anatomy and histology of the kidneys, Structure of nephron. Renal physiology - Glomerular filtration, tubular reabsorption and tubular secretion. Mechanism of urine formation.

Electrolytes: Distribution of water and electrolytes in the body. Regulation of water and electrolyte balance. Acidosis and alkalosis.

UNIT –V

Reproductive System: Female Reproductive System: Internal Organs- Structure and functions of Vagina, uterus, Uterine tubules and ovaries. Menstrual cycle.

Male Reproductive System: Structure of Testes, Seminal vesicles, ejaculatory ducts and prostrate gland. Functions of male reproductive system

TEXT BOOKS:

1. *Kathleen, J.W. Wilson* and *Anne Waugh*. 1998. **Ross and Wilson Anatomy and Physiology in health and illness**. [Eight Edition]. Churchchill Livingstone, New York. **(UNIT - I).**
2. *Gerald J. Tortora* and *Sandra Reynolds.* 2003. **Principles of Anatomy and Physiology.** [Tenth Edition]. John Wiley and Sons. Inc. Pub. New York.**(UNIT - II).**
3. *Robert K. Murray., Peter A. Mayes., Peter A. Mayes* and *Victor W. Rodwell*. 2003. **Harper's Biochemistry.** [Twenty Fifth Edition]. Appleton and Lange Stanford, New York. **(UNIT - III, IV & V).**

REFERENCE BOOKS:

1. *Arthur C. Guyton* and *John. E. Hall*. 2007. **Text Book of Medical Physiology.** [Eleventh Edition]. Elsevier Publications, New Delhi.
2. *Francis S. Greenspan* and *John D. Baxter*. 1994. **Basic and Clinical Endocrinology.** [Fourth Edition]. Appleton and Lange Paramount Publishing Business and Professional Group, USA.
3. *Abraham White., Philip Handler and Emil L. Smith.* 1983. **Principles of Biochemistry.** [Sixth Edition]. Tata Mc Graw – Hill Publishing Company, New Delhi.

15PBCM202	CORE VI: PLANT BIOCHEMISTRY	SEMESTER - II

Total Hours: 50

OBJECTIVES:

To enable the students to learn about

1. The biochemical basis of plant functions.
2. The know the defensive mechanism in plants
3. The medicinal values of plants.

CONTENTS

UNIT – I **(10 Hours)**

Photosynthesis: Photosynthetic pigments – Structure and function. Light absorption and energy conversion, Organization of thylakoid membrane. Light & dark reactions: Light reactions - Photo system I and II, Hill's reaction, Z-scheme, Q-cycle, Photophosphorylation -cyclic and non-cyclic. Dark reactions - calvin cycle and CAM plants, Carbon reaction in C4 plants - Hatch-Slack pathway. Comparison of mitochondrial and chloroplast electron transfer. Inhibitors of photosynthesis. Biochemical basis and role of Photorespiration.

UNIT - II **(10 Hours)**

Plant growth hormones: Chemistry, biosynthesis, mode of action, distribution and physiological effects of Auxins, Gibberllins, Cytokinins, Absisic acid and Ethylene. Physiology and biochemistry of seed germination, glyoxalate cycle. Seed Dormancy - types of dormancy. Biochemistry of Senescence and Fruit ripening.

UNIT - III **(10 Hours)**

Nitrogen Fixation and Sulphate Assimilation: Nitrogen cycle and Nitrogen Fixation: Symbiotic nitrogen fixation - Rhizobium, nodule formation, leg hemoglobin, Non-symbiotic nitrogen fixation, biochemistry of N_2 fixation - Nitrogenase complex. Nitrate reduction, nitrite reduction and ammonia assimilation. Genetic manipulations for nitrogen fixation.

Sulfur uptake and transport, reductive sulfate assimilation pathway. Biosynthesis of glutathione and its role as antioxidant and detoxifying agent.

UNIT - IV **(10 Hours)**

Secondary Metabolites of Plants: Structure and functions of terpenoids, alkaloids, lignins and flavonoids. Phytopharmaceuticals: Carbohydrates and derived products. Drugs containing glycosides, tannins, lipids, terpenoids. Peptide drugs. Alkaloidal drugs. Natural pesticides, Antibiotics and Allergenic Extracts -immunomodulators - Adaptogens.

UNIT – V **(10 Hours)**

Plant Biotechnology: Plant Tissue culture: Types- Callus culture, Organ culture and suspension culture. Protoplast culture - isolation of protoplast. Somatic hybridization -mechanisms and applications. Production of haploid plants - androgenesis and gynogenesis. Applications of haploid plants. Somaclonal variations - isolation and applications of somaclonal variants. Micro propagation- Techniques and applications. Applications of PTC.

TEXT BOOKS:

1. *Buchanan, B.B., Wilhelm Gruissem* and *Russell L. Jones*. 2001. **Biochemistry and Molecular Biology of Plants.** IK International Pvt. Ltd., New Delhi. (**UNIT - I, II and III)**.
2. *Kokate, C.K., Purohit A.P.* and *Gokhale, S. B*. 2008. **Pharmacognosy.** Nirali Prakashan (**UNIT-IV).**
3. *Glick R. Bernard* and *Pasternak J. Jack.* 2007. **Molecular Biotechnology**. [Third Edition]. ASM press, Washington D.C. (**UNIT - V).**

REFERENCE BOOKS:

1. *William G. Hopkins*. 2004. **Introduction to Plant Physiology**. [Third Edition]. John Wiley & Sons, USA.
2. *Peter B. Kaufmann*. 1999. **Natural Products from Plants**. C.R.C. Press Boca Raton, Florida.
3. *Dey, P. M.* and *Harborne, J. B.* 1997. **Plant Biochemistry.** [First Edition]. Academic Press, USA.

15PBCM203	CORE VII: INTERMEDIARY METABOLISM AND REGULATION	SEMESTER – II

Total Hours: 50

OBJECTIVES:

To ensure that the students should

1. Have a sound knowledge in metabolism of the animal system.
2. Have focus on the mechanism of energy transformations in various metabolic pathways and their regulation.

CONTENTS

UNIT - I **(10 Hours)**

Bioenergetics and Basic concepts of metabolism: Thermodynamics and biochemical equilibria – laws of thermodynamics, free energy, ΔG - Endergonic and exergonic reactions, group transfer potential and ATP as energy currency of the cell.

Biological oxidation – reduction reactions and redox potential. Electron transport chain, oxidative phosphorylation - mechanism & control of ATP production. ATP synthase. Inhibitors of ETC & oxidative phosphorylation, Uncouplers. Shuttle systems (Malate-Aspartate, Glycerol-3-phosphate).

UNIT - II **(10 Hours)**

Carbohydrate metabolism: Glycolysis- fate of pyruvate, regulation. Role of fructose 2, 6, bi phosphate in liver and muscle. Metabolism of hexoses (Fructose and Galactose) other than glucose. TCA cycle - metabolic sources of acetyl CoA, regulation & amphibolic nature of the TCA cycle. Anaplerotic reactions. HMP pathway - significance. Glycogen metabolism. Role of calcium and hormones in regulation of glycogen metabolism. Gluconeogenesis. Control of blood glucose - reciprocal regulation of glycolysis and gluconeogenesis.

UNIT - III **(10 Hours)**

Lipid metabolism: Biosynthesis of saturated and unsaturated fatty acids, fattyacid elongation system. Regulation of acetyl CoA carboxylase. Role of hormones in lipogenesis. Biosynthesis of TAG and phospholipids and their regulation. Ketone body - Synthesis and utilization. Cholesterol - biosynthesis and regulation. Biosynthesis of bile acids. Fatty acid oxidation – alpha, beta and omega. Oxidation of unsaturated fattyacids. Role of carnitine cycle in regulation of β-oxidation.

UNIT - IV **(10 Hours)**

Amino Acid Metabolism: Biosynthesis of nutritionally non essential amino acids (serine and proline). Degradation of proteins- catabolism of amino acids– Transamination, deamination, decarboxylation. Biogenic amines and their importance. Transport of nitrogen to liver, urea cycle & its regulation, Krebs bicycle. Catabolism of the carbon skeletons of amino acids – ketogenic (Leu, Trp and Phe) & glucogenic amino acids (Thr, Met, His). Specialised products from amino acids (creatinine & serotonin). Integration of carbohydrate, protein and fat metabolism.

UNIT - V **(10 Hours)**

Nucleotide metabolism –*De novo* Synthesis of purine and pyrimidine nucleotides and regulation. Salvage pathways. Formation of deoxyribonucleotides - mechanism of action of ribonucleotide reductase. Catabolism of purine and pyrimidine nucleotides. Uricotelic, ureotelic and ammonotelic organism.

Metabolic interrelationships of tissues in various nutritional and hormonal states- well fed state, fasting, pregnancy, exercise, obesity, diabetes mellitus and stress.

TEXT BOOKS:

1. *Nelson David, L.* and *Cox, M.M.* 2011. **Lehninger Principles of Biochemistry**. [Fifth Edition]. Macmillan/ Worth, New York **(Thermodynamics).**
2. *Robert K. Murray., Daryl K. Granner., Peter A. Mayes* and *Victor W. Rodwell*. **Harper's Biochemistry.** [Twenty fifth Edition]. Mc Graw Hill Publishers, New York.
   (UNIT - I, II, III, IV & V).
3. *Thomas M. Devlin*. 1997. **Textbook of Biochemistry. [**Fourth Edition]. John Wiley, Inc Publication, New York **(Metabolic interrelationships of tissues).**

REFERENCE BOOKS:

1. *Donald Voet* and *Judith G. Voet*. 2001. **Biochemistry.** [Second Edition]. CBS John Wiley and Sons, New York .
2. *Reginald H. Garrette and Charles M. Grisham.* 2005. **Principles of Biochemistry.** [Third Edition]**.** Thomson Brooks/Cole, Australia.

15PBCM204	CORE VIII: RECOMBINANT DNA TECHNOLOGY	SEMESTER – II

Total Hours: 50

OBJECTIVES:

To set a platform for the students

1. To understand the concept of rDNA technology and to acquire a comprehensive knowledge about the cloning and expression strategies.
2. To apply the recent advances in gene manipulation to enhance existing ones or produce a new product.

CONTENTS

UNIT - I **(10 Hours)**

Techniques of Gene manipulation: Isolation and purification of Nucleic Acids. Agarose Gel Electrophoresis, Southern, Northern and Western hybridization. Preparation of nucleic acid probes - radioactive and non-radioactive labelling. PCR – principle, types (Inverse, RT, anchored and real time quantitative PCR) and applications. DNA sequencing- Sanger's and Maxam & Gilbert methods. Microarray (Elementary details).

Enzymes involved in genetic manipulation: Restriction endonuclease (nomenclature, types, recognition sites, applications) DNA polymerase, DNA Ligase, Alkaline phosphatase, Reverse transcriptase, Nuclease, Terminal transferase, Polynucleotide kinase.

UNIT - II **(10 Hours)**

Vectors used in gene cloning : Plasmid vectors – General features, properties of natural (Ti plasmid), artificial (pBR -pBR322 & pBR327 and pUC -7, 8 vectors). Bacteriophage vectors – life cycle, Lamda phage (charon 4A and λgt WES λB) and M13 vectors (mp 1), Cosmids (PHC 79), phagemids. BAC. Yeast Vectors. - vectors based on 2μm circle and YAC. Shuttle vectors. Viral vector for plants – Gemini virus, Insect Cells- Baculovirus. Vectors for animal cells- Retro virus.

UNIT – III **(10 Hours)**

Gene transferring methods and Cloning strategies: Introduction of DNA into cells – chemical (Ca-phosphate precipitation, PEG & DEAE dextran mediated transformation) and physical methods (Microinjection, biolistic transformation,

liposome mediated, electroporation). Construction and screening of genomic DNA and cDNA libraries. Selectable markers & reporter genes. Identification & selection of recombinants- insertional inactivation, immunochemical methods, south-western screening for DNA binding protein, colony hybridization, plus-minus screening, HRT and HART.

UNIT – IV **(10 Hours)**

Expression vectors: expression cassettes, Promoters-strong and regulatable promoters. Construction of expression vector using pBAD. Maximizing the expression of cloned genes. Maximizing gene expression systems in *E.coli,* yeast, insect cell and mammalian cells. Problems caused in expression of eukaryotic genes in prokaryotic host. Expression of fusion proteins - Growth hormone. DNA finger printing.

UNIT – V **(10 Hours)**

Production of transgenic plants: Plant transformation using Viral vectors and Agrobacterium. Applications of transgenic plants- insect resistance, virus resistance, herbicide resistance, stress tolerant, Plants as bioreactors- antibodies. Genetic engineering of fruit ripening. Transgenic plants with improved nutrition-Golden rice.
Transgenic animals-methods of production- retroviral, microinjection & ES cell methods. Applications of transgenic animals – transgenic animals as disease models, animal bioreactors, pharming animals.
Gene therapy- Somatic cell gene therapy, Germ cell gene therapy. *Ex vivo* gene therapy-ADA deficiency, Cystic fibrosis and Lesch- Nyhan syndrome. *In vivo* gene therapy - Cancer and AIDS.

TEXT BOOKS:

1. *Bernard R.Glick and Jack J.Pasternak.* 2007. **Molecular Biotechnology**. Principles and Applications of Recombinant DNA. [Third edition]. ASM press. Washington. (**UNIT – II to V).**
2. *Ernst-L.Winnacker*. 1987. **From Genes to clones, Introduction to gene technology. (UNIT- II).**
3. *Sandy B. Primrose, Richard M. Twyman* and *Robert W. Old.* 2001. **Principles of Gene Manipulation.** [Sixth Edition]. Blackwell Science, USA **(UNIT – I, III & V).**

REFERENCE BOOKS:

1. *Joseph Sambrook* and *David William Russel.* 2001. **Molecular Cloning: A Laboratory Manual, Vol. 1, 2 and 3.** [Third Edition]. Cold Spring Harbor Laboratory Press, New York.
2. *Smita Rastogi and Neelam Pathak.* 2010. **Genetic Engineering**. Oxford University press, New york.

15PBCEL201	ELECTIVE II: NEUROSCIENCE	SEMESTER - II

Total Hours: 50

OBJECTIVES:

To enable the students

1. To gain knowledge about the structure and functions of the nervous system.
2. To have basic understanding of the functions of various sensory organs in human system.
3. To learn the biochemical aspects behind diseases associated with the nervous system and effect of drug therapy.

CONTENTS

UNIT - I **(11 Hours)**

Nervous system: Classification. General functions of autonomic and somatic nervous system. Neuron - Structure, Properties - excitation and action potential. Neuroglia - structure and properties Receptors - sensory. Synapse-properties and functions. Neurotransmitters-structure and types. Receptors for neurotransmitters - cholinergic, adrenergic, nicotinic and muscarinic. Conduction of nerve impulse (excitatory and inhibitory transmission).

UNIT - II **(10 Hours)**

Brain and Spinal cord: Chemistry**,** Structure and functions. Brain metabolism and metabolic adaptation. Neuro hormones and neuromodulators.

Biochemical aspects of behavior, sleep, learning and memory.

UNIT - III **(10 Hours)**

Sensory systems: Somatic sensation –Perception of pain. Analgesia system in the brain and spinal cord.

Special senses – Vision - photoreceptors, Visual cycle - Rod cell adaptation. Color vision-role of cone cell. Color blindness. Mechanism of hearing. Biochemical aspects of taste and smell.

UNIT - IV **(10 Hours)**

Neurodegenerative disorders: Dementia, Schizophrenia, Huntington's disease, Parkinsonism and Alzhemier's disease. Neuromuscular diseases – Muscular dystrophy, Tetanus and botulism.

UNIT - V **(9 Hours)**

Pharmacology of nervous System: CNS depressants (sedative, hypnotics), CNS stimulants, analgesics, antipsychotics and mood stabilizing drugs. Drug therapy Huntington's disease, Parkinsonism and Alzhemier's disease.

TEXT BOOKS:

1. *Arthur C.Guyton and John E. Hall*. 2007**. Text Book of Medical Physiology**. [Eleventh Edition]. Elsevier Publications, New Delhi. **(UNIT - I, III & IV).**
2. *Gerald. J. Tortora* and *Sandra Reynolds.* 2003. **Principles of Anatomy and Physiology. [**Tenth Edition]. John Wiley and Sons. Inc. Pub. **New York.(UNIT-II).**
3. *Tripathi, K. D*. 1999. **Essentials of Medical Pharmacology.** [Fourth Edition]. Jaypee Brothers Medical Publishers. New Delhi **(UNIT - V).**

REFERENCE BOOKS:

1. *George I. Siegel*, 2000. **Basic Neurochemistry.** [Seventh Edition]. Academic Press, New Delhi.
2. *Kathleen J. W. Wilson* and *Anne Waugh*. 1998. **Anatomy and Physiology in Health and Illness.** [Eighth Edition]. Churchchill Livingstone, New York.

15PBCEL202	ELECTIVE II: ENVIRONMENTAL BIOCHEMISTRY	SEMESTER – II

Total Hours: 40

OBJECTIVES

To enable the students

- To know about the fundamentals of environment.
- To understand the environmental problems and management of natural resources to public health.

UNIT-I **(10 Hours)**

Soil Nutrients and Fertility: Essential and beneficial elements, nutrients in soil-water, air, macro and micronutrients, organic and inorganic components of soil. Testing of soil characteristics- physical and chemical.

Waste water management: Sewage water –composition, types. Soil sickness. Eutrophication. Waste water treatment -aerated lagoon, activated sludge, anaerobic digestion. Sludge and solid waste management – composting - organisms involved in composting-methods of composting. Vermicomposting.

UNIT – II **(8 Hours)**

Environmental toxicology: Radiation, sources of radiation exposure, Biological effects of radiation. Chemical toxicants: Biological effects of chemical toxicants- Pb, Hg, Fl, DDT, Ecotoxicology. LD and ED values of major toxicants. Ecological changes and diseases.

UNIT - III **(7 Hours)**

Biodegradation –Definition, factors affecting, Role of enzymes in biodegradation and bioconversion of natural organic wastes -lignocelluloses by xylanase, cellulase and laccase. Biodegradation of aliphatic and aromatic hydrocarbons, pesticides, herbicides and polychlorinated biphenyls.

Bioremediation: Definition. Metabolic effect of microorganisms on xenobiotics. Types of bioremediation reactions – aerobic, anaerobic and sequential.

UNIT – IV **(7 Hours)**

Biofertilizers and Bioplastics: Biofertilizers – nitrogen fixing and phosphate solubilizing bacteria. Organic fertilizer. Biopesticides –types (bacteria, virus, fungi and plant). Biopolymers – synthesis of polysaccharides (Xanthan) and polyhydroxy butyrate. Bioplastics.

UNIT - V **(8 Hours)**

Biofuels – types, formation and uses of biodiesel and bioalcohols, Biohydrogen-microbial fuel cells (bacteria, algae and fungi). Biomethanation.

Bioleaching-advantages, disadvantages, types, methods-tank and heap. Application of nanomaterials in electronics, biomedical field, agriculture, environment and material science.

Natural therapies- Chelation, detoxification and protection

TEXT BOOKS:

1. *Sharma, P.D.* 2007. **Ecology and Environment.** Rastogi publications, Meerut.
2. *Indu Shekhar Thakur.* 2011. **Environmental Biotechnology: Basic Concepts and Applications**. [Second Edition]. I.K. International Publishing House Pvt. Ltd., New Delhi.

REFERENCE BOOKS:

1. *Nilangshu Mukherjee and Tapash Ghosh.* 1995. **Agricultural microbiology.** Kalyani publishers, New Delhi. **(Unit I)**
2. *Satyanarayana, U.* 2008. **Biotechnology.** Books and Allied Pvt. Ltd., Kolkata. **(UNIT – II, III & V).**

15PBCEL203	ELECTIVE II: FOOD PROCESSING AND QUALITY CONTROL	SEMESTER - II

Total Hours: 50

OBJECTIVES

- To make the students to understand the biochemical processes of food and the role of Food additives and colors in food.
- On successful completion of the paper the students will get an insight to become an entrepreneur.

UNIT - I **(10 Hours)**

Food Processing: Scope and importance; historical developments; High temperature processing - thermal (cooking, blanching, pasteurization, sterilization, evaporation and dehydration). Low temperature processing - refrigeration (changes of foods during refrigeration storage), freezing.

UNIT – II **(10 Hours)**

Food Preservation: Importance, principles, methods – temporary, permanent. Preservation by salting, sugar (jam), chemicals, drying, antibiotics and irradiation, cold, use of heat.

Food additives: Definition, antioxidants, emulsifiers, sweeteners, colours, flavours.

Unit –III **(10 Hours)**

Food Storage: Refrigeration storage: requirements of refrigeration storage, refrigeration load, chilling and refrigeration, cold storage.

Freezing and frozen storage: freezing curves, slow and quick freezing, factors determining freezing rate, freezing methods, changes in food during freezing, frozen food storage and freeze drying in food processing.

UNIT - IV **(10 Hours)**

Evaluation of Food Quality: Sensory Evaluation of Foods-Appearance, colour, flavour, odour, taste, mouth feel. Types of tests-difference tests-paired comparison test, rating test-ranking test, sensitivity threshold test, descriptive test.

Objective evaluation-Definition, advantage and disadvantages. Test for objective evaluation.

UNIT-V: **(10 Hours)**

Food Laws and Standards: Prevention of food adulteration act, standard- ISI, Agmark. HACCP- microbiological, chemical and physical hazards, steps in HACCP, critical limits for control measures.

TEXT BOOK:

1. *Hosahalli Ramaswamy* and *Michele Marcotte.* 2009. **Food processing – Principles and Applications.** Taylor & Francis group, Newyork.

REFERENCE BOOKS:

1. *Manoranjan Kalia and Sangeetha Sood.* 1999. **Food Preservation and Processing.** Kalyani Publishers, New Delhi.
2. *Sreelakshmi. B.* 1997. **Food Science.** New Age International Pvt. Ltd., New Delhi.
3. *Sunetra Roday.* 2011. **Food hygiene and sanitation**. Tata McGraw Hill Education, Pvt. Ltd., New Delhi.

15PBCMP201	CORE PRACTICAL II: PLANT BIOCHEMISTRY AND rDNA TECHNOLOGY	SEMESTER - II

LIST OF EXPERIMENT

I. PLANT BIOCHEMISTRY

1. Estimation of chlorophyll from leaves.
2. Extraction of secondary metabolites from known medicinal plants by using water and methanol as solvents.
3. Qualitative analysis of secondary metabolites extracted from known medicinal plants – Phenols, flavonoids, alkaloids, glycosides and steroids.
4. Quantitative analysis of secondary metabolites – flavonoids and phenols.
5. TLC analysis of secondary metabolites extracted from known medicinal plants.
6. Isolation and estimation of beta-carotene from carrot.
7. Isolation and estimation of Vitamin C from citrus fruit.
8. Induction and Maintenance of callus using Explants.
9. Micro propagation
10. Isolation and culture of protoplast.

II. RECOMBINANT DNA TECHNOLOGY

1. Restriction digestion analysis of DNA.
2. Bacterial transformation.
3. PCR – Gene amplification. (Demonstration)

REFERENCE BOOKS:

1. *Sambrook J., Fritsch, E.F.* and *Maniatis, T.* 2000. **Molecular Cloning: A Laboratory Manual.** [Third Edition]. Cold Spring Harbor Laboratory Press, New York.
2. *Kokate, C.K., Purohit, A.P.* and *Gokhale, S.B.* 2008. **Phytochemical Methods.** Nirali Prakashan, New Delhi.

15PMBBCI201/ 15PMBBTI201	INTER DISCIPLINARY COURSE I : FUNDAMENTALS OF MICROBIOLOGY AND CLINICAL MICROBIOLOGY	SEMESTER - II

Total hours: 50

OBJECTIVES:

To familiarize the students with:

1. Basics in Microbiology
2. Basics in Microbial techniques.

CONTENTS

UNIT – I **(10 Hours)**

Definition and scope of Microbiology – Sterilization – Principles – dry heat and moist heat – radiation – filtration – chemical agents. Antibiotics – Mode of Action - Penicillin.

UNIT – II **(10 Hours)**

Media preparation – Liquid media, solid media, enriched media and differential medium. Pure culture techniques – Pour Plate, Streak Plate and Spread Plate techniques. Staining techniques – Gram's, Ziehl-Neelsen, Spore and Capsule staining.

UNIT – III **(10 Hours)**

Collection, transportation and processing of clinical specimens. Host parasite relationship – Normal flora. Morphology, culture, biochemical, pathogenicity, lab diagnosis and control of *Staphylococcus aureus* and *Escherichia coli*.

UNIT – IV **(10 Hours)**

General characteristic features of Fungi. Epidemiology, pathogenicity, lab diagnosis and treatment of Candidosis. General characteristic features of Protozoa. Pathogenicity, clinical manifestation and diagnosis of *Entamoeba histolytica*.

UNIT – V **(10 Hours)**

General characteristic features of viruses, cultivation of viruses. Properties, pathogenicity, diagnosis and treatment of Hepatitis virus A and B.

TEXT BOOKS:

1. *Ananthanarayan, R. and Jayaram Paniker, C.K.* 2007. **Text Book of Microbiology**. [Seventh Edition]. Orient Longman Ltd., Chennai.
2. *Lansing M Prescott, John P Harley and Donald A Klein.* 2007. **Microbiology**. [Seventh Edition]. Mc Graw Hill, New York.

REFERENCE BOOKS:

1. *Madigan, M.T., Martinko, J.M. and Parker, J.* 2000. **Brock Biology of Microorganisms**. [Twelfth Edition]. Pearson Benjamin Cummings, San Francisco, USA.
2. *Mackie and McCarthy* 1994. **Medical Microbiology.** [Fortieth Edition]. Churchill Livingstone, New York.

15PMBBCIP201/ 15PMBBTIP201	**INTER DISCIPLINARY COURSE PRACTICAL I: FUNDAMENTALS OF MICROBIOLOGY AND CLINICAL MICROBIOLOGY**	**SEMESTER - II**

LIST OF EXPERIMENT

1. Staining techniques - Preparation of Stains.
2. Smear preparation - Heat fixation - Simple staining procedure.
3. Differential staining procedure - Gram's staining.
4. Determination of motility - Hanging drop method.
5. Preparation of Enriched media-Blood agar. Selective media –EMB agar. Differential media- Mac Conkey agar.
6. Pure culture technique: Pour plate method.
7. Spread plate method.
8. Streak plate method – Single line, Quadrant, T-streak, Continuous.
9. Identification of pathogenic organisms – *E. coli* and *S. aureus.*

REFERENCE BOOK:

1. *James G. Cappucino and Sherman Natalie* 2005. **Microbiology – A Laboratory Manual**. [Seventh edition]. Pearson education India, New Delhi.

15PBTBCI201/ 15PBTMBI201	INTER DISCIPLINARY COURSE I: PLANT TISSUE CULTURE TECHNOLOGY	SEMESTER - II

Total Hours: 40

OBJECTIVE:

1. To understand the basic techniques in plant tissue culture.

CONTENTS

UNIT – I **(7 Hours)**

Introduction to Plant cells, Types of plant cells, Principles of plant tissue culture, Tissue culture media, Growth regulators and Sterilization techniques.

UNIT – II **(8 Hours)**

Callus and suspension culture, Micropropagation, Meristem culture, Somatic embryogenesis, Protoplast isolation, Fusion of protoplast, Somaclonal variations.

UNIT – III **(9 Hours)**

Agrobacterium mediated gene transfer; *Agrobacterium* based vectors, direct gene transfer methods - electroporation, microinjection, particle bombardment.

UNIT – IV **(10 Hours)**

Genetic engineering for quality improvement-Protein, lipids, carbohydrates, and vitamins, Production of resistant plants - Herbicide resistance, Insect resistance (Bt approach), Abiotic stress tolerance plant production - Drought, temperature and salt.

UNIT – V **(6 Hours)**

Secondary metabolites from plants – Alkaloids, flavonoids and phenolic compounds, Germplasm conservation.

TEXT BOOKS:

1. *Bhojwani, S.S., and Razdan, M.K.* 2008. **Plant Tissue Culture – Theory and Practice.** Elsevier Publishers, New Delhi.
2. *Jain, V.K.* 2013. **Fundamentals of Plant Physiology**. [Fifth Edition]. S. Chand and Company, NewYork.
3. *Trivedi, P.C.* 2004. **Advances in Plant Physiology**. [Third Edition]. I.K. International Publications Pvt Ltd, New Delhi.

REFERENCE BOOKS:

1. *Chawla, H.S.* 1998. **Biotechnology in Crop Improvement.** International Book Distribution Co., New Delhi.
2. *Hopkins, W.G. and Hiiner, N.P.A.* 2004. **Introduction to Plant Physiology.** [Third Edition]. John Wiley and Sons, New Jersey, USA.

15PBTBCIP201/ 15PBTMBIP201	INTER DISCIPLINARY COURSE PRACTICAL I: PLANT TISSUE CULTURE TECHNOLOGY	SEMESTER - II

LIST OF EXPERIMENT

1. Media preparation
2. Hormone stock solution preparation
3. Callus induction
4. Micropropagation
5. Protoplast isolation
6. Synthetic seed preparation

REFERENCE BOOKS:

1. Aneja, K.R. 2003. **Experiments in Microbiology, Plant pathology and Biotechnology.** [Fourth Edition]. New age international.
2. *Bhojwani, S.S. and Razdan, M.K*. 2008. **Plant Tissue Culture – Theory and Practice**. Elsevier Publishers, New Delhi.

15PVE201	VALUE EDUCATION: HUMAN RIGHTS	SEMESTER- II

Total Hours: 25

OBJECTIVE:

1. To make the students to understand the concepts of human rights.

CONTENTS

UNIT – I **(5 Hours)**

Human Rights: Definition - Historical Evolution - Classification of Rights - Universal Declaration of Human Rights - International Covenants on Economic and Social Rights - Constitutional Provision for Human Rights - Fundamental Rights - Directive Principles of the State Policy - Indian Constitution.

UNIT – II **(5 Hours)**

Civil and Political Rights: Right to Work - Right to Personal Freedom - Right to Freedom of Expression - Right to Property - Right to Education - Right to Equality - Right to Religion - Right to Form Associations and Unions - Right to Movement - Right to Family - Right to Contract - Right to Constitutional Remedies - Right to Vote and Contest in Elections - Right to Hold Public Offices - Right to Petition - Right to Information - Right to Criticise the Government - Right to Democratic Governance.

UNIT – III **(5 Hours)**

Economic Rights: Right to Work - Right to Adequate Wages - Right to Reasonable Hours of Work - Right to Fair Working Conditions - Right to Self Government in Industry - Customer Rights - Social and Cultural Rights - Right to Life - Right to Clean Environment.

UNIT – IV **(5 Hours)**

Women's Rights: Right to Inheritance - Right to Marriage - Divorce and Remarry - Right to Adoption - Right to Education - Right to Employment and Career Advancement - Rights Relating to Dowry - Right for Equality - Right for Safe Working Conditions - Children's Rights - Right to Protection and Care - Right to Education - Issues Related with Infanticide - Street Children - Child Labour - Bonded Labour - Refugees Rights - Minority Rights - Dalit Rights - Tribal Rights - Nomads Rights.

UNIT – V **(5 Hours)**

Human Rights Violation: International, National, Regional Level Organizations to Protect Human Rights - UNO - National Commission for Human Rights - State Commissions - Non Governmental Organizations and Human Rights - Amnesty Terrorism and Human Rights - Emergency and Human Rights - Judiciary and Human Rights - Media and Human Rights - Police and Human Rights.

REFERENCE BOOK:

1. Paul Singh. **Human Rights and Legal System.** Himalaya Publishing House, New Delhi.

15PLS201	CAREER COMPETENCY SKILLS II	SEMESTER – II

Total Hours: 15

OBJECTIVE:

To enhance employability skills and to develop career competency

CONTENTS

UNIT – I **(3 Hours)**

Assertiveness and Self Confidence-Career Opportunities-Industry expectations (Skill set)

UNIT – II **(3 Hours)**

Campus to Corporate-Effective Communication

UNIT – III **(3 Hours)**

Situational Dialogues / Role Play (Telephonic Skills) - Oral Presentations-Prepared -'Just A Minute' Sessions (JAM)

UNIT – IV **(3 Hours)**

Body Language-Dress code-Telephone etiquettes- Email etiquettes-Group Discussion-Creativity-Presentation skills

UNIT – V **(3 Hours)**

Interviewing Techniques- Do's and Don'ts of Interview- Mock Interview.

15PBCM301	CORE IX: CLINICAL BIOCHEMISTRY	SEMESTER - III

Total Hours: 50

OBJECTIVE:

1. To impart a thorough knowledge about the biochemical basis of various diseases and disorders to the learners.

CONTENTS

UNIT - I **(10 Hours)**

Disorders of metabolism: Carbohydrate: Hyper and hypoglycemia. Inborn errors of metabolism - Glycogen storage diseases, Galactosemia, fructose intolerance and fructosuria, pentosuria.

Lipid metabolism: Hypo and hyper cholesterolemia, lipid storage diseases- Gaucher's disease, Tay-Sach's and Niemann-Pick disease, fatty liver. Obesity - Causes, types, metabolic changes and treatment.

Protein metabolism: Plasma protein and their significance, Agammaglobulinemia, multiple myeloma, proteinuria. Inborn errors of metabolism - alkaptonuria, albinism, phenyl ketonuria.

Nucleotide metabolism - Hypo and hyperuricemia, orotic aciduria. Gout, Lesch Nyhan syndrome.

UNIT - II **(10 Hours)**

Diabetes Mellitus: Glucose Homeostasis- role of tissues and hormones. Diabetes mellitus - classification (Type I, II and Gestational diabetes). Altered metabolic profile - Lipid, protein and glycoprotein. Complications - acute (diabetic keto acidosis and diabetic coma) and long term complications (Neuropathy, nephropathy, retinopathy, diabetic foot, atherosclerosis and diabetic gangrene). Diagnosis - GTT. Management – diet and therapy.

Atherosclerosis: Risk factors – cholesterol (LDL, HDL), Hypertension, cigarette smoke, obesity, free radicals. Prevention and management.

UNIT - III **(10 Hours)**

Liver function tests: Diseases of the Liver - Hepatitis - types, Jaundice and its (varieties). Cirrhosis. Cholestatic liver diseases. Biliary tract diseases- gall stones.

Disorders of Bilirubin metabolism-Dubin Johnson's syndrome, Rotors syndrome, Gilbert's syndrome and Crigler Najjar Syndrome. Liver function Tests (Test based on bile pigment level, carbohydrate metabolism, plasma protein and test based on detoxification and excretory function).

Kidney function tests: Biochemical changes in acute and chronic renal failure. Normal and abnormal urinary constituents. Glomerular diseases-Glomerulonephritis and Nephrotic syndrome. Kidney function tests – based on GFR (clearance test-Creatinine, Urea and inulin), based on renal plasma flow (paraamino hippurate and filtration fraction), based on tubular function (concentration and dilution tests).

UNIT – IV **(10 Hours)**

Clinical Enzymology and Endocrinology: Factors affecting enzymes level in plasma or serum, Enzymes in health and diseases. Biochemical diagnosis of diseases by enzyme assays – AST, ALT, GST**,** CPK, cholinesterase, ALP and LDH. Digestive enzymes – Amylase, lipase, trypsin and chymotrypsin.

Amniotic fluid analysis, CSF analysis.

General principles of hormone assay and clinical significance of steroid, protein and thyroid hormones (Experimental detail not required).

UNIT - V **(10 Hours)**

Disorders of erythrocyte metabolism: Hemolytic disorder from enzyme abnormalities (enzymes of EMP, HMP and glutathione pathway)**,** Rapoport-Luebering cycle. Hemoglobin – Thalassemia and related conditions - causes and structural variation. Stem cells and its applications (Elementary details).

Free radicals and Antioxidants: Free radicals, Reactive oxygen species, Lipid peroxidation, Free radical scavenger system – enzymic, non – enzymic, preventive and chain breaking antioxidants. Respiratory diseases and skin diseases.

TEXT BOOK:

1. *Carl A. Burtis*. 2001. **Tietz Text Book of Clinical Chemistry**. [Third Edition]. W.B. Saunders Company, New Delhi.

R**EFERENCE BOOKS**

1. *Vasudevan, D.M.* and *Sreekumari, S*. 2007. **Text Book of Biochemistry for Medical Students**. [Fifth Edition]. Jaypee Publishers, New Delhi. *Thomas M. Devlin*. 1997.
2. *Thomas M. Devlin*. 1997. **Textbook of Biochemistry with Clinical Correlation. [**Fourth Edition]. John Wiley, Inc.Publication, New York.
3. *David. E. Metzler*. 2006. **Biochemistry. Volume I and II**. [Second Edition]. Academic Press, New Delhi.

15PBCM302	CORE X: MOLECULAR IMMUNOLOGY AND IMMUNOTECHNOLOGY	SEMESTER - III

Total Hours: 50

OBJECTIVES:

To enable the students to study about the

1. Physical, chemical and physiological characteristics of the components of the immune system.
2. Aspects of the immune system in health and disease states.
3. Applications of immunotechniques.

CONTENTS

UNIT – I **(10 Hours)**

Components of immune system: Organs of immune system- functions of thymus, bone marrow, lymph nodes and spleen, mucosal and cutaneous associated lymphoid tissue. Lymphoid cells (T cells, T cell receptors, co-receptors, B cells and null cells), mononuclear cells, granulocytic cells, mast cells and dendritic cells. Cytokines - structure, secretion and function of IL, IFN and TNF.

UNIT - II **(10 Hours)**

Antigens: Immunogenicity and factors influencing immunogenicity, adjuvants, epitopes, haptens and mitogens.

Antibody: structure, subclasses and functions, variable region gene rearrangements and generation of antibody diversity. Monoclonal antibodies - production and applications. **Complement cascade**: Biological consequence of complement activation and regulation.

MHC: organization, MHC molecule and genes, cellular distribution. Antigen processing and presentation.

UNIT – III **(10 Hours)**

Immune Response Activation of T cells – clonal selection theory. Cell-mediated and humoral effector responses, hypersensitive reactions – Type I, II, III and IV, Mechanism, clinical manifestation and treatment. Respiratory allergy and asthma.

UNIT - IV **(10 Hours)**

Immune system in health & disease: Vaccines – passive and active immunization (DNA vaccines and synthetic peptide vaccines). Autoimmunity- mechanism for induction, autoimmune disease in human- myasthenia gravis. Immunodeficiency diseases- Immune system in AIDS- destruction of CD4+ T cells, immunological abnormalities. Transplantation immunology: mechanism of graft acceptance and rejection, immuno suppressive therapy. Tumor immunology - tumor associated antigen, immune response to tumors, tumor immunotherapy.

UNIT - V **(10 Hours)**

Immunotechniques: Antigen - Antibody interactions: Antibody affinity, antibody avidity, precipitation – radial and double immunodiffusion, immunoprecipitation and agglutination. Complement fixation test, RIA, ELISA, western blotting, immunofluorescence and immunoelectrophoresis.

Experimental animal models: Inbred strains, SCID mice, Nude mice and knock out mice.

TEXT BOOKS:

1. *Charles A. Janeway* and *Paul, J. R.* 1994. **Immunobiology. [**Fourth Edition], Travels Blackwell Scientific Publishers, New York (**UNIT - I).**
2. *Kuby Richard, A. Goldsby., Thomas J. Kint* and *Barbara. A. Osborne.* 2000. **Immunology.** [Fourth Edition], W.H. Freeman and Company, New York **(UNIT – II, III & IV).**
3. *Ivan M.Roitt and Peter J. Delves.* 2005. **Roitt's Essential Immunology.** [Tenth Edition]. Blackwell Scientific Publishers, New York **(UNIT - V).**

REFERENCE BOOKS:

1. *Ivan Roitt J. Brostoff* and *David Mole.* 1998. **Immunology.** [Fourth Edition]. Mosby Times Mirror Int. Pub. Ltd., New York.
2. *Tizard, K.* 1984. **Immunology: An Introduction.** Saunders College Publishing, New Delhi.
3. *Roitt, I. M.* 1988. **Essential Immunology**. Blackwell Scientific Publishers, New York.

15PBCM303	CORE XI: BIOSTATISTICS, RESEARCH METHODOLOGY, BIOETHICS AND IPR	SEMESTER - III

Total Hours: 50

OBJECTIVES:

1. To learn about bioethics and biosafety in biology lab.
2. To know about on Intellectual Property Right and patents.
3. To familiarize the application of biostatistics in biology.

CONTENTS

UNIT –I **(10 Hours)**

Biostatistics –Meaning, importance and usefulness, Variables –Scale and Measurements, Data –Primary data and secondary data –Methods of collecting primary data –sources of secondary data - Diagrammatic and graphical Representation of data - Measures-Mean, Standard deviation, Co-efficient of variation –Normal distribution-Properties and its importance.

UNIT-II **(10Hours)**

Probability –Definition –Simple problems based on addition theorem and multiplication theorem and Bayes theorem. Correlation -Karl Pearson and rank correlation -Regression -Simple linear regression, Concept of partial and multiple correlations (Three variables only).

UNIT-III **(10Hours)**

Test of significance -Population, sample –Sampling Methods –Point estimation and interval estimation (Concept only) Hypothesis –Simple hypothesis –Standard error – t-test, chi-square test of independent of attributes, ANOVA -One way classification and two way classification and its interpretation. Introduction to Statistical software.

UNIT - IV **(10 Hours)**

Research methodology: Meaning (biological research) – Importance and objective. Constraints - steps in research process-selection and statement of problem, formulation of hypothesis, review of literature, pilot study. Principles and methods

of research designs - experimental and non-experimental design, Data collection - processing and analysis of data - Hypothesis testing. Preparing, writing and documentation of research report, plagiarism. Role of computers in biological research and practice.

UNIT - V **(10 Hours)**

Bioethics & Biosafety: Definition, need of Bioethics. Applications of Bioethics. Bioweapons-Research concerns. Biosafety – Definition, Biosafety level I, level II, level III & level IV, applications of Biosafety. Good laboratory practices, Good manufacturing practices, Good clinical practices. Introduction To Intellectual Property: IPR – Definition, Other forms of IPR - Copyright - Trademark - Designs

TEXT BOOKS:

1. *Gupta, S. P.* 2006. **Statistical Methods**. Sultan Chand and Sons Publishers, New Delhi. **(UNIT – I & II).**
2. *Kothari, C. R.* 1990. **Research Methodology – Methods and Techniques**. New Age Publications. New Delhi **(UNIT - III).**
3. *Gurumani, N.* 2006. **Research Methodology for Biological Sciences**. MJP publishers, Chennai. **(UNIT - III).**
4. *Satheesh, M. K.* 2011. **Bioethics and Biosafety**. I.K. International, New Delhi. **(UNIT – IV & V).**

REFERENCE BOOKS:

1. *Zar, J. H.* 1993, **Biostatistics Analysis**. Prentice Hall, New Jersey.
2. *Daniel, J.* 1994. **Biostatistics.** A Foundation for Analysis in Health Science. [Sixth Edition]. John Wiley and Sons, New York.

15PBCEL301	ELECTIVE III: MOLECULAR GENETICS	SEMESTER - III

Total Hours: 50

OBJECTIVE:

To make the learners:

1. To understand the Mendelian principle of inheritance, mapping of genome, evolution and behavioral basis of different organisms.

CONTENTS

UNIT - I **(10 Hours)**

Mendelian Genetics: Mendelism - Monohybrid crosses and Principle of segregation. Dihybrid crosses and principle of independent assortment. Extension of Mendelian genetic principles- Multiple alleles. Allelic variation and Gene function – Incomplete dominance and co dominance, testing gene mutations for allelism, variations among the effects of mutations. Gene action - Influence of the environment. Gene interactions – Epistasis.

UNIT – II **(10 Hours)**

Complex patterns of Inheritance-Effects of inbreeding and correlations between relatives. Chromosome theory of inheritance- sex chromosome and sex linkage. Principles of segregation and independent assortment. Sex chromosome and sex determination-human beings and drosophila. Sex linked genes in human beings-Hemophilia and mental retardation.

UNIT - III **(10 Hours)**

Variation in chromosomal structure and Number: Variation in chromosomal structure-Types of chromosomal aberrations - deletion, duplication, inversion and translocation. Fragile sites in human chromosome - fragile – X syndrome. Variation in chromosomal number - Monoploidy Polyploidy and aneuploidy.

Transposons : Transposable genetic elements in bacteria and eukaryotes. McClintock's contribution. Genetic and evolutionary significance of Transposable elements.

UNIT – IV **(10 Hours)**

DNA polymorphism: Definition and classes-SNPs, STRs, VNTRs. Applications of molecular markers - Identifying RFLP marker linked Cystic fibrosis and Sickle cell genes - DNA typing – Paternity case – forensic investigation.

Mapping of Genomes: Genetic mapping- Linkage analysis - Gene mapping by human pedigree analysis. Physical mapping-Restriction mapping.

UNIT - V **(10 Hours)**

Behavioral Genetics: Genetic control of Behavior-genetic analysis of behavior in Drosophila, Chromosome abnormalities and insights into human behavior and complex human behaviors (Huntington's disease, Schizophrenia and autism)

Population and evolutionary Genetics: Emergence of evolutionary theory and population genetics – Hardy-Weinberg law, natural selection, genetic variation in natural populations, speciation and human evolution.

TEXT BOOKS:

1. *William S. Klug* and *Michael R. Cummings.* 2000. **Concepts of Genetics.** [Sixth Edition]. Prentice Hall International, Inc. **(UNIT - I).**
2. *Peter Snustad* and *Michael J. Simmons*. 2000. **Principles of Genetics**. [Second Edition]. John Wiley and Sons, Inc. New York **(UNIT - II, III & V).**
3. *Peter J. Russell.* 2006. **Genetics: A Molecular Approach.** [Second Edition]. Benjamin Cummings, New York **(UNIT - IV).**
4. *Brown, T.A***.** 2007**. Genomes 3.** Taylor and Francis, New York **(Genome mapping).**

15PBCMP301	CORE PRACTICAL III: CLINICAL BIOCHEMISTRY AND IMMUNOLOGY	SEMESTER - III

LIST OF EXPERIMENT

I. CLINICAL BIOCHEMISTRY

2. Collection and preservation of blood.
3. Estimation of glucose in Blood - Nelson Somogyi method
4. Determination of SOD -
5. Determination of glutathione peroxidase-
6. Estimation of thiobarbituric acid reactive substances (TBARS) in serum
7. Estimation of A : G ratio in serum - Biuret method
8. Estimation of Blood Urea – DAM method
9. Estimation of serum cholesterol - Zak's method
10. Estimation of serum triglycerides
11. Estimation of lipoproteins
12. Estimation of creatine & creatinine in blood and urine -Jaffe's method
13. Estimation of bilirubin - Diazo method
14. Determination of serum AST and ALT
15. Electrophoretic separation of LDH isoenzymes.

II. IMMUNOTECHNOLOGY

1. Immunodiffusion - Single, Ouchterlony
2. Immunoelectrophoresis – Rocket immunoelectrophoresis
3. VDRL
4. Widal test
5. Dot ELISA

REFERENCE BOOKS:

1. *Harold Varley*. 1980. **Practical Biochemistry, Volume I & II.** [Fifth Edition]. CBS Publishers, New Delhi.
2. *Ivan M. Roitt* and *Peter J .Delves.* 2005. **Roitt's Essential Immunology**. [Tenth Edition]. Blackwell Scienitfic Publishers, New York.

15PMBBCI301/ 15PMBBTI301	INTER DISCIPLINARY COURSE II : INDUSTRIAL MICROBIOLOGY	SEMESTER- III

Total Hours : 40

OBJECTIVES:

1. To learn the basics of bioprocess techniques.
2. To know about fermentor design and production of various fermented products.

CONTENTS

UNIT – I **(8 Hours)**

Introduction to bioprocess technology - Historical development of industrial microbiology – screening techniques – primary and secondary – preservation of industrial cultures – objective – Lyophilization and Cryogenic storage. Strain improvement – rDNA technology - strain development for various fermentation process.

UNIT - II **(8 Hours)**

Media for industrial fermentation – formulation – sterilization – fermentation types – solid state and submerged fermentation – Downstream processing - Foam separation – Precipitation - Filteration – Cell disruption – physico – mechanical and chemical. Solvent recovery and drying.

UNIT – III **(8 Hours)**

Fermentor – component parts of fermentor – Body construction - stirring and mixing – scale up window – control of pH, temperature, foam and pressure – types of bioreactors – Air lift and cylindro conical bioreactors.

UNIT - IV **(8 Hours)**

Microbial production of fermented products – Wine. Organic acid – Citric acid and Lactic acids. Vitamin – Vitamin B_{12}. Enzyme – α-amylase

UNIT – V **(8 Hours)**

Microbial production of antibiotic – Penicillin - Streptomycin; Vaccines – BCG; Toxoid – Tetanus Toxoid – Preparation of antisera.

TEXT BOOKS:

1. *Stanbury, P.F., Whitaker, A., and Hall, S.J., 2005.* **Principles of Fermentation technology.** Reed Elsevier India Ltd., New Delhi.
2. *Cruegar, W and Cruegar, A.* 1989. **Biotechnology**: **A Textbook of Industrial Microbiology**. Panima Publishing Corporation, New Delhi.

REFERENCE BOOKS:

1. *Michael J Waites, John S Roackey, Neil L. Morgan and Garry Highton.* 2006. **Industrial Microbiology – An Introduction**. Blackwell Science Ltd., USA.
2. *Hugo, W.B. and Russell, A.D.* 1998. **Pharmaceutical Microbiology.** [Sixth Edition]. Blackwell Scientific Company Ltd., USA.

15PMBBCIP301/ 15PMBBTIP301	INTER DISCIPLINARY COURSE PRACTICAL II: INDUSTRIAL MICROBIOLOGY	SEMESTER - III

LIST OF EXPERIMENT

1. Screening of antibiotic producing organisms from soil.
2. Screening of amylase enzyme producing organisms from soil.
3. Antibiotic sensitivity disc preparation.
4. MIC determination by filter paper disc assay.
5. Antibiotic susceptibility method – Kirby Bauer method.
6. Evaluation of disinfectant – Phenol Coefficient method. (Demonstration)
7. Wine production (demonstration)

REFERENCE BOOK:

1. *Aneja, K.R.,* 2002. **Experiments in Microbiology, plant pathology, tissue culture and mushroom culture production technology**. [Third edition]. New Age International Publishers (P) Ltd. New Delhi.

15PBTBCI301/ 15PBTMBI301	INTER DISCIPLINARY COURSE II: ANIMAL TISSUE CULTURE TECHNOLOGY	SEMESTER - III

Total Hours: 40

OBJECTIVE:

1. To understand the basic techniques in Animal tissue culture.

CONTENTS

UNIT – I **(8 Hours)**

Introduction to Animal tissue culture, Applications of tissue culture, Designing the tissue culture laboratory – washing and sterilization area, Storage area and Tissue culture room, Equipments in tissue culture laboratory – Inverted Microscope, Centrifuge, Laminar flow benches, CO_2 incubator.

UNIT – II **(8 Hours)**

Glassware and other plastic ware in tissue culture – Substrate materials for growing cells, Tissue culture vessels. Tissue culture media – Properties and special requirements, Complete media, Conditioned media.

UNIT – III **(8 Hours)**

Type of tissue culture –Primary explant culture, Isolation of tissues and disaggregation methods, Cell culture, Organ culture.

UNIT – IV **(8 Hours)**

Cell culture **-** Transformation, Differentiation and Dedifferentiation, Growth curve of cells, Types of microbial contamination, Stem cell culture.

UNIT – V **(8 Hours)**

Applications of Animal cell culture technology – Somatic cell fusion, Transgenic fish and sheep.

TEXT BOOK:

1. *Sudha Gangal*, 2010. **Principles and Practice of Animal Tissue Culture**. [Second Edition]. University Press (India) Pvt. Ltd.

REFERENCE BOOK:

1. *Freshney, R.I.* 2005. **Culture of Animal Cells: A manual of basic technique.** [Fifth Edition]. John Wiley and Sons, New Jersey.

15PBTBCIP301/ 15PBTMBIP301	**INTER DISCIPLINARY COURSE PRACTICAL II: ANIMAL TISSUE CULTURE TECHNOLOGY**	**SEMESTER - III**

LIST OF EXPERIMENT

1. Sterilization techniques in Animal cell culture.
2. Media preparation for Animal Cell Culture.
3. Primary culture of Chick embryo fibroblast.
4. Trypsinization and subculturing.
5. Determination of viability of cells using Trypan blue stain.

REFERENCE BOOK:

1. *Freshney, R.I.* 2005. **Culture of Animal Cells: A manual of basic technique.** [Fifth Edition]. John Wiley and Sons, New Jersey.

15PBCM401	CORE XII: HORMONAL BIOCHEMISTRY AND BIOCHEMICAL PHARMACOLOGY (100% INTERNAL EVALUATION)	SEMESTER - IV

Total Hours: 45

OBJECTIVES:

To enable the students to gain a thorough knowledge about

1. The pharmacodynamics and pharmacokinetics of the drugs
2. The challenges in designing a drug
3. The methods in the drug development.

CONTENTS

UNIT - I **(8 Hours)**

Mechanism of receptor action: Hormones – Introduction and classification. Mechanism of action of group I and group II hormones**.** Drug receptor interaction: G - Protein coupled receptors, ion channel receptors, Enzymatic receptors, Receptors regulating gene expression. Involvement of binding forces in drug receptor interaction. Drug action not mediated by receptors. Affinity, Dose response relationships - LD_{50}, ED_{50} and IC_{50}.

UNIT - II **(8 Hours)**

Peptide Hormones: Chemistry, Physiological role, regulation and pathophysiology of Hypothalamus, Pituitary hormones and Pancreatic hormones (Insulin, glucagon).

Thyroid and Parathyroid Hormones: Chemistry, synthesis, physiological role, regulation and pathophysiology of thyroid and Parathyroid hormones.

Adrenal gland hormones: Chemistry, synthesis, physiological role, regulation and pathophysiology of adrenocortical hormones (Glucocorticoid & Mineralocorticoid) and Adrenal medullary hormones (Catecholamines**)**.

UNIT - III **(10 Hours)**

Male reproductive Hormones: Biosynthesis, chemistry, physiological role and mechanism of action of male sex hormones in Spermatogenesis, regulation and pathophysiology.

Female reproductive Hormones: Biosynthesis, chemistry, physiological role and pathophysiology of estrogen and progesterone. Mechanism of action of female sex

hormones in menstrual cycle. Endocrinology of pregnancy, parturition and lactation. Sex differentiation.

UNIT - IV **(10 Hours)**

Drugs: Classification of drugs – based on their source – plant, animal, mineral and synthetic. Based on action. Routes of drug administration. Mechanism of absorption and distribution of drugs. Drug elimination. Factors influencing drug absorption and elimination of drugs.

UNIT – V **(9 Hours)**

Drug Metabolism: Drug metabolism: Phase I- role of cytochrome P450 and Phase II reactions. Factors affecting drug metabolism.

New Drug Development: Challenges. Lipinskis Rule. Drug development-serendipity and screening. Identification of drug targets. Structure based drug design.

TEXT BOOKS:

1. *Tripathi, K. D*. 1999. **Essentials of Medical Pharmacology.** [Fourth Edition]. Jaypee Brothers Medical Publishers, New Delhi **.**
2. *Jeremy M. Berg., John L. Tymoczko* and *Lubert Stryer*. 2006. **Biochemistry.** [Sixth Edition]. W.H. Freeman and Company, New York**.**
3. *Robert K. Murray., Peter A. Mayes., Peter A. Mayes* and *Victor W. Rodwell*. 2003. **Harper's Biochemistry.** [Twenty Fifth Edition]. Appleton and Lange Stanford, New York.
4. *Francis S. Greenspan*. and *John D. Baxter*. 1994. **Basic and Clinical Endocrinology.** [Fourth Edition]. Appleton and Lange Paramount Publishing Business and Professional Group, USA.

GUIDELINES

1. SUBMISSION OF RECORD NOTE BOOKS AND PROJECT DISSERTATION:

Candidates appearing for Practical Examinations and Project Viva-voce shall submit Bonafide Record Note Books/ Dissertation prescribed for Practical/ Project Viva-voce Examinations, otherwise the candidates will not be permitted to appear for the Practical/ Project Viva-voce Examinations.

2. PASSING MINIMUM AND INTERNAL MARK DISTRIBUTION (Theory, Practical and Project)

A). THEORY

The candidate shall be declared to have passed the Examination, if the candidate secure not less than 40 marks put together out of 100 in the Comprehensive Examination in each theory paper with a passing minimum of 38 marks in External out of 75.

Internal Marks Distribution [CA- Total Marks: 25]

Attendance	: 5 Marks
Assignment	: 5 Marks
Seminar	: 5 Marks
Internal Examinations	: 10 Marks
Total	**: 25 Marks**

B. (i) THEORY (If Internal Evaluation is for 100 Marks)

The candidate shall be declared to have passed the Examination, if the candidate secures not less than 50 marks out of 100 in the Comprehensive Examination (Internal Evaluation only).

Internal Marks Distribution [CA- Total Marks: 100]

Attendance	: 10 Marks
Assignment	: 20 Marks (2 Assignments Compulsory)
Seminar	: 10 Marks
Internal Examinations	: 60 Marks
Total	**: 100 Marks**

(ii) PRACTICAL

The candidate shall be declared to have passed the Examination, if the candidate secure not less than 50 marks put together out of 100 in the Comprehensive Examination in each Practical paper with a passing minimum of 30 marks in External out of 60.

Internal Marks Distribution [CA- Total Marks: 40]

Experiment	: 10 Marks (10-12 Experiments)
Attendance	: 5 Marks
Record	: 5 Marks
Internal Examinations	: 20 Marks
Total	**: 40 Marks**

Internal Marks Distribution [CA- Total Marks: 100]

Experiment	: 20 Marks (10-12 Experiments)
Attendance	: 10 Marks
Record	: 10 Marks
Internal Examinations	: 60 Marks
Total	**: 100 Marks**

(iii) ASSESSMENT OF TECHNICAL SKILL (Internal Evaluation only)

The candidate shall be declared to have passed the Examination, if the candidate secures not less than 50 marks out of 100 in the internal evaluation.

Biochemical Calculations

Assignment (5)	: 50 Marks
Test (3)	: 30 Marks
Workbook Submission	: 10 Marks
Attendance	: 10 Marks
Total	**: 100 Marks**

(iv). ASSESSMENT OF TECHNICAL SKILL (Internal Evaluation only)

The candidate shall be declared to have passed the Examination, if the candidates secure not less than 50 marks out of 100 in the internal evaluation.

Technical Skill: CSIR, ICMR –NET (Online test)

Assignment (3)	: 30 Marks
Online Test (3)	: 60 Marks
Attendance	: 10 Marks
Total	**: 100 Marks**

(v). ASSESSMENT OF INTERNSHIP TRAINING

Hundred percent (100%) of the marks allotted for Internship training shall be assessed internally by the supervisor in the Department.

Attendance (Certificate given by the appropriate designated authority)	: 10 Marks
Submission of the training report	: 50 Marks
Presentation of the training report	: 20 Marks
Viva Voce	: 20 Marks
Total	**: 100 Marks**

(vi). PROJECT WORK

- The project work shall be carried out by each student in the IV semester and has to complete the work at the end of the Semester.
- Upon completion of the project work the candidate will be required to appear for a Viva-Voce conducted by an external examiner.
- The Student has to attend 3 reviews before completing his/her Project.
- Two reviews will be reviewed by internal subject experts and one review by External Resource Person.
- A candidate failing to secure the prescribed passing minimum in the issertation shall be required to resubmit the dissertation with the necessary modifications.

MARK DISTRIBUTION PATTERN

Comprehensive Examination (CE) : 150 Marks
Continuous Assessment (CA) : 50 Marks

The candidate shall be declared to have passed the Examination, if the candidate secure not less than 100 marks put together out of 200 in the Comprehensive Examination in each Project with a passing minimum of 75 marks in External out of 150.

<u>Internal Mark Distribution</u> [CA - Total Marks: 50 Marks]

1.	Research work done	: 20 Marks
2.	Attendance	: 5 Marks
3.	Observation Note	: 10 Marks
4.	Review	: 15 Marks (Three Reviews)
	Total	**: 50 Marks**

<u>External Mark Distribution</u> [CE - Total Marks: 150 Marks]

1.	Project report	: 100 Marks
2.	Presentation	: 25 Marks
3.	Viva Voce	: 25 Marks
	Total	**: 150 Marks**

Question paper pattern for Core practical

(Maximum marks: 60) Time: 6 Hours

Two experiments (2x20)	: 40
Spotters (5x2)	: 10
Viva-Voce	: 10
Total	**: 60 Marks**

KEY FOR EVALUATION OF PRACTICAL EXAMINATION

1. **Qualitative analysis (20 Marks)**

Procedure	: 15
Results	: 05

2. **Quantitative analysis (20 Marks)**

Principle	: 03
Procedure	: 03
Tabular Column	: 02
Graph	: 02
Results	: 10

3. **For Separation technique (20 Marks)**

Principle	: 05
Procedure	: 05
Observation	: 05
Results	: 05

IDC PRACTICALS

Comprehensive Examination (CE): 60 Marks
Continuous Assessment (CA) : 40 Marks

Question paper pattern for IDC practical
(Maximum marks: 60) Time: 3 Hours

One experiment (1x30)	: 30 Marks
Spotters (10x2) (may include simple biochemical calculations in case of Diagnostic Biochemistry)	: 20 Marks
Viva Voce	: 10 Marks
Total	**: 60 Marks**

KEY FOR EVALUATION OF PRACTICAL EXAMINATION

1. **Qualitative analysis (30 Marks)**

Procedure	: 20 Marks
Results	: 10 Marks

2. **Quantitative analysis (30 Marks)**

Principle	: 05 Marks
Procedure	: 05 Marks
Tabular Column	: 05 Marks
Graph	: 05 Marks
Results	: 10 Marks

2. QUESTION PAPER PATTERN AND MARK DISTRIBUTION

THEORY

Question Paper Pattern and Mark Distribution **(For 75 marks)**

1. PART – A (5 x 5 = 25 Marks)

Answer ALL questions

One question from each UNIT with Internal Choice

2. PART – B (5 x 10 = 50 Marks)

Answer ALL questions

One question from each UNIT with Internal Choice

Question Paper Pattern and Mark Distribution **(For 100 marks)**

1. PART – A (5 x 5 = 25 Marks)

Answer ALL questions

One question from each UNIT with Internal Choice

2. PART – B (5 x 15 = 75 Marks)

Answer ALL questions

One question from each UNIT with Internal Choice

CAREER COMPETENCY SKILLS
METHODOLOGY OF ASSESSMENT

1. On Line Objective Examination (Multiple Choice questions) - Semester I

- 100 questions-100 minutes
- Twenty questions from each UNIT.
- On line examination will be conducted at the end of the III Semester.

2. Viva -Voce Semester II

- A Student has to come in proper dress code and he/she should bring 2 copies of Resume for the Viva Voce.
- A student may be asked to
    - Give Self Introduction
    - Submit the resume to the examiner(s) and answer the questions based on it.
    - Speak on any given topic for at least two minutes.
    - Give a presentation for 10 minutes on a topic of their choice.
    - Sit with other students in a Group for a Discussion.

INRDISCIPLINARY COURSE OFFERED

S.No.	Subject Code	Subject	Offered for the students of
SEMESTER II			
1.	15PBCMBI201/ 15PBCBTI201	IDC I: Diagnostic Biochemistry	M.Sc Microbiology/ M.Sc Biotechnology
2.	15PBCMBIP201/ 15PBCBTIP201	IDC Practical I: Diagnostic Biochemistry	M.Sc Microbiology/ M.Sc Biotechnology
SEMESTER III			
3.	15PBCMBI301/ 15PBCBTI301	IDC II: Pharmaceutical Biochemistry	M.Sc Microbiology/ M.Sc Biotechnology
4.	15PCMBI301/ 15PBCBTIP301	IDC Practical II : Pharmaceutical Biochemistry	M.Sc Microbiology/ M.Sc Biotechnology
5.	15PBCPHI301	IDC II: Molecular BioPhysics	M.Sc Physics