MASTER OF SCIENCE (BIOCHEMISTRY)

VISION

To develop highly qualified competitive professionals required for both academics and industries with excellent leadership, communication and teamwork skills.

MISSION

- To provide basics and latest concepts in biochemistry to the young minds.
- To offer excellent opportunities to acquire hands on experience in Research-oriented education in Biochemistry.

PROGRAMME EDUCATIONAL OBJECTIVES (PEO)

PEO 1: To intend in providing quality education to the students to be more inventive and adaptable personalities in the field of Life Science.

PEO 2: To enable the students to develop an interdisciplinary approach for understanding the life science problems at the molecular level.

PEO 3: To provide guidance in developing the students' reasoning ability to assess and relate the biochemical issues related to environment and society.

PROGRAMME OUTCOMES (PO)

After completion of the programme, the graduates will be able to

PO 1: Demonstrate excellence in the field of Biochemistry by understanding the fundamentals of biochemical principles

PO 2: Expertise in problem solving, critical thinking and analytical reasoning in the field of science

PO 3: Appreciate and practice the ethical principles in scientific research

PO 4: Deliver excellence in their field of career with constant updations

PO 5: Excel themselves to appear for discipline specific competitive exams

PROGRAM SPECIFIC OUTCOMES (PSO)

After completion of the programme, the graduates will be able to

PSO 1: Apply the knowledge of science in the domain of Biochemistry and understand the functions of biological molecules through the study of their molecular structure.

PSO 2: Realize the chemical and regulatory processes of major cellular functions.

PSO 3: Discriminate the integration between different components of living system, physiological homeostasis and the effect of its alterations.

PSO 4: Use current biochemical and molecular techniques to plan and carry out experiments and get conclusion drawn from experimental data.

PSO 5: Identify, explore and develop a successful career both in industrial and higher education domains.

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 Periyar 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/be 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.

MAXIMUM DURATION FOR THE COMPLETION OF THE PG PROGRAMME

The maximum duration for completion of the PG Programme shall not exceed 8 semesters.

SCHEME OF EXAMINATION

Subject Code	Subject	Hours of Instruction	Exam Duration (Hours)	Max Marks			Credit Points
				CA	CE	Total	
First Semester							
Part A							
18PBCM101	Core I: Chemistry of Biopolymers	5	3	25	75	100	5
18PBCM102	Core II: Analytical Biochemistry	5	3	25	75	100	5
18PBCM103	Core III: Enzyme Catalysis and Regulation	5	3	25	75	100	5
18PBCM104	Core IV: Molecular Biology	5	3	25	75	100	5
18PBCM105	Core V: Cellular Biochemistry	5	3	25	75	100	5
18PBCMP101	Core Practical I: Analytical Biochemistry and Molecular Biology	4	6	40	60	100	3
Non Credit							
18PLS101	Career Competency Skills I	1	-	-	-	-	-
	Total	**30**				**600**	**28**
Second Semester							
Part A							
18PBCM201	Core VI: Intermediary Metabolism and Regulation	6	3	25	75	100	5
18PBCM202	Core VII: Plant Biochemistry	5	3	25	75	100	5
	Elective I	5	3	25	75	100	5
18PBCMP201	Core Practical II: Plant Biochemistry	5	6	40	60	100	3

Optional Papers							
18PMBBCI201	IDC I: Clinical Microbiology	3	3	25	75	100	2
18PMBBCIP201	IDC Practical I: Clinical Microbiology	3	3	40	60	100	2
18PBTBCI201	IDC I: Plant Tissue Culture Technology	3	3	25	75	100	2
18PBTBCIP201	IDC Practical I: Plant Tissue Culture Technology	3	3	40	60	100	2
Part B							
18PVE201	Value Education: Human Rights	2	3	25	75	100	2
Non Credit							
18PLS201	Career Competency Skills II	1	-	-	-	-	-
Total		**30**				**700**	**24**
Third Semester							
Part A							
18PBCM301	Core VIII: Clinical Biochemistry	6	3	25	75	100	5
18PBCM302	Core IX: Biostatistics and Research Methodology	5	3	25	75	100	4
	Elective II	5	3	25	75	100	5
18PBCMP301	Core Practical III: Clinical Biochemistry	6	6	40	60	100	3
18PBCMP302	Core Practical IV: Statistical Software	2	3	40	60	100	2

Optional Papers							
18PMBBCI301	IDC II: Industrial Microbiology	3	3	25	75	100	2
18PMBBCIP301	IDC Practical II: Industrial Microbiology	3	3	40	60	100	2
18PBTBCI301	IDC II: Animal Tissue Culture Technology	3	3	25	75	100	2
18PBTBCIP301	IDC Practical II: Animal Tissue Culture Technology	3	3	40	60	100	2
Total		**30**				**700**	**23**
Fourth Semester							
Part A							
18PBCM401	Core X: Human Physiology and Neuroscience	5	3	25	75	100	4
18PBCM402	Core XI: Hormonal Biochemistry and Biochemical Pharmacology	5	3	25	75	100	5
18PBCPR401	Project & Viva-Voce	6	-	50	150	200	6
Total		**16**				**400**	**15**
					Grand Total	**2400**	**90**

ELECTIVE SUBJECT

The students shall choose any one of the following subjects as Elective I and II in the Second and Third semesters respectively.

ELECTIVE I

S.No	Semester	Subject code	Subject
1.	Second	18PBCEL201	Recombinant DNA Technology
2.		18PBCEL202	Food Processing And Quality Control

ELECTIVE II

S.No	Semester	Subject code	Subject
1.	Third	18PBCEL301	Molecular Immunology and Immunotechnology
2.		18PBCEL302	Molecular Genetics

FOR COURSE COMPLETION

Student shall complete:

- Value Education: Human Rights in II semester.
- IDC in II and III semester.
- Elective subjects in II and III semesters.
- Project & Viva-Voce in IV semester.
- Career Competency Skills in I and II semester.

TOTAL MARKS AND CREDIT DISTRIBUTION

S.NO	COMPONENET	MARKS	CREDITS
1.	PART A: Core subjects, Elective, IDC and Project	2300	88
2.	PART B: Value Education	100	2
TOTAL		**2400**	**90**

18PBCM101	CORE I: CHEMISTRY OF BIOPOLYMERS	SEMESTER – I

Course Objectives:

The Course aims

- To understand the correlation between the structural properties and functions of Macromolecules.
- To gain knowledge about the role of biomolecules in human life.

Credits: 5 **Total Hours: 50**

UNIT	CONTENTS	Hrs	CO
I	**Carbohydrates:** Polysaccharides - Occurrence, structure, properties, importance of storage polysaccharides – (starch and glycogen) and structural polysaccharides – Cellulose, 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.	10	CO1
II	**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	10	CO2

	structure-subunit Interactions and symmetry (cyclic, dihedral and rotational).		
III	**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 co-operativity, Bohr's effect 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. Cytochrome and its Conformation.	**10**	**CO3**
IV	**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.	**10**	**CO4**
V	**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	**10**	**CO5**

	mispaired DNA, parallel stranded DNA and anisomorphic DNA. RNA - Types, structure and functions of mRNA, tRNA, rRNA, snRNA, hnRNA. 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.

2. *Donald Voet* and *Judith, G. Voet.* 2011. **Biochemistry**. [Fourth Edition]. John Wiley and Sons, New York**.**

3. *Nelson David, L.* and *Cox, M. M.* 2011. **Lehninger Principles of Biochemistry**. [Fifth Edition]. Macmillan/ Worth, New York**.**

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.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Illustrate the complex structure of polysaccharides, their properties and role in Bacterial Cell wall and Blood group substances
CO2	Explain the classification of proteins and the forces involved in the structural organization of the same
CO3	Analyze various structural proteins, their evolution and their biological importance
CO4	Assess the classification, structure and the role of various lipids in biological system
CO5	Explore the types, interactions and significance of genetic materials

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	M	H	L	M
CO2	H	M	H	L	M
CO3	H	M	H	L	M
CO4	H	M	H	L	M
CO5	H	M	H	L	M

H-High; M-Medium; L-Low

18PBCM102	CORE II: ANALYTICAL BIOCHEMISTRY	SEMESTER – I

Course Objectives:

The Course aims

- To study the principles and applications of biochemical techniques.
- To demonstrate advanced knowledge and understanding the applied concepts of analytical techniques.
- To develop technical skills in research and knowledge on instrumentation.

Credits: 5 **Total Hours: 50**

UNIT	CONTENTS	Hrs	CO
I	**General Principles of Biochemical Investigations:** *In vivo* and i*n vitro* studies. Methods of Cell disruption and homogenization. **pH and buffers**: pH - Definition, H-H equation and its derivation. Measurement of pH - use of indicators and pH electrode- Reference electrodes – Standard hydrogen electrode, Calomel electrodes, Silver/ Silver Chloride electrode and glass electrodes. pH meter. Buffers - Definition and importance of buffers in biological system.	10	CO1
II	**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	10	CO2

	electrophoresis.		
III	**Chromatographic Techniques:** Principle, Instrumentation and Applications of chromatographic techniques - Partition chromatography (Paper, GLC and HPLC) and Adsorption chromatography (Ion- Exchange, Molecular sieving, Affinity, Column, TLC, HPTLC and FPLC). Circular Dichroism – Principle, Instrumentation and applications.	**10**	**CO3**
IV	**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).	**10**	**CO4**
V	**Spectroscopic techniques II:** Principle, Instrumentation and Applications of Vibrational spectroscopy- IR. NMR- Principle, Types and Applications. X-ray crystallography (Principle and Applications only). Mass Spectrometric Technique - Principle, Instrumentation and Applications. GC-MS, MALDI TOF- (Principle and Applications only).	**10**	**CO5**

Text Books

1. *Keith Wilson* and *John Walker*. 1995. **Principles and Techniques of Practical Biochemistr**y. Cambridge University Press, New York.

2. *Avinash Upadhyay., Kakoli Upadhyay* and *Nirmalendhe Nath*. 2003. **Biophysical Chemistry: Principles and Techniques**. Himalaya Publishers, Mumbai.

Reference Book

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

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Explain the basic concepts of pH and buffers for the study of Biochemical nature of cells
CO2	Customize the techniques in separation of Biological components based on the principle of centrifugation and electrophoresis
CO3	Perform chromatographic techniques for the partition of cellular components
CO4	Apply the techniques for the quantification of components using light spectrum
CO5	Analyze the components using electromagnetic techniques

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	M	M	H	H
CO2	H	H	M	H	H
CO3	H	H	M	H	H
CO4	H	H	M	H	H
CO5	H	H	M	H	H

H-High; M-Medium; L-Low

18PBCM103	CORE III: ENZYME CATALYSIS AND REGULATION	SEMESTER – I

Course Objectives:

The Course aims

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

Credits: 5 **Total Hours: 50**

UNIT	CONTENTS	Hrs	CO
I	**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 amino acid side chain, treatment with proteases, site directed mutagenesis and changing the pH). Theories of Enzyme action - Lock and Key, Induced fit (Hexokinase). **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.	10	CO1
II	**Enzyme Kinetics-** MM Equation. Reciprocal plots - LB Plot, EadieHofstee 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.	10	CO2

	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.		
III	**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.	**10**	**CO3**
IV	**Enzyme Regulation:** Allosteric regulation - Allosteric enzyme- multi subunits - Regulatory & catalytic subunits. Sigmoidal Kinetics – MWC model and its significance. Cooperativity- Hill's Equation, Scatchard plot. 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.	**10**	**CO4**
V	**Enzyme Applications**: Methods of immobilization – physical - adsorption, ionic binding, covalent binding, entrapment and cross liking. Biosensors **-** Calorimetric, Amperometric, Optical and Immunosensors. Artificial enzymes -protein and nonprotein synzymes (Elementary details). Applications of enzymes in Leather, Textile, Food and Beverage industries. Role of enzymes in Clinical diagnosis and therapeutics.	**10**	**CO5**

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.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Characterize the enzymes in each enzymatic class, examples of such enzymes and their isolation and purification procedures in practice
CO2	Assess the relationship between properties and structure of the enzymes, their mechanism of action and kinetics of enzymatic reactions
CO3	Recite the enzyme catalysis and role of coenzymes
CO4	Relate the regulatory mechanisms of enzyme activity which involve in the maintenance of body's homeostatsis
CO5	Choose the correct enzymes for application in industry by realizing their future potential

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	H	H	L	M
CO2	H	H	H	L	M
CO3	M	H	H	L	M
CO4	L	H	H	L	H
CO5	L	H	H	L	H

H-High; M-Medium; L-Low

18PBCM104	CORE IV: MOLECULAR BIOLOGY	SEMESTER – I

Course Objectives:

The Course aims

- To get a complete insight on molecular mechanism of replication, transcription and translation of the genetic material.
- To enable the students to know about the Molecular mechanism in the regulation of gene expression

Credits: 5 **Total Hours: 50**

UNIT	CONTENTS	Hrs	CO
I	**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. Organelle DNAs.	**10**	**CO1**
II	**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.	**10**	**CO2**
III	**Transcription:** Prokaryotes -Structure and function of RNA polymerases. Organisation of promoter sequences. Steps in prokaryotic transcription. Eukaryotic transcription – assembly of	**10**	**CO3**

	general transcription complex. Steps in eukaryotic transcription. Inhibitors of transcription. RNA processing in prokaryotes and eukaryotes. RNA Replicase and Reverse transcriptase.		
IV	**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. Protein sorting and targeting.	**10**	**CO4**
V	**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. TATA box, proximal elements, distant enhancer sites, activators & repressors.	**10**	**CO5**

Text Books

1. *Harvey Lodish., Arnold Berk* and *Paul Matsudaira.* 2008. **Molecular Cell biology**. [Fifth Edition]. W. H. Freeman and Company, New York**.**

2. *Nelson David, L. and Cox, M.M.* 2011. **Lehninger Principles of Biochemistry**. [Fifth Edition]. W. H. Freeman and Company, New York**.**

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.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Understand the basis of genetic framework in living cells
CO2	Explore the molecular mechanisms for the synthesis of DNA and its repair mechanisms
CO3	Summarize the molecular mechanism of transcription
CO4	Demonstrate the synthesis of proteins by translation machinery
CO5	Assess the process of gene regulation by various molecular mechanisms

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	M	M	L	M
CO2	H	M	H	L	M
CO3	H	M	L	L	M
CO4	H	M	L	L	M
CO5	H	H	H	L	H

H-High; M-Medium; L-Low

18PBCM105	CORE V: CELLULAR BIOCHEMISTRY	SEMESTER – I

Course Objectives:

The Course aims

- To obtain knowledge on the structural and functional organization of cell membrane.
- To educate the molecular basis of cellular interaction and cell signaling.
- To provide an insight on biology and genetic basis of cancer

Credits: 5 **Total Hours: 50**

UNIT	CONTENTS	Hrs	CO
I	**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.	10	CO1
II	**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	10	CO2

	antiporters – Na^+ linked symporters & antiporters; Movement of water – aquaporins. Transepithelial transport – osmosis, transport of glucose & amino acids.		
III	**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.	**10**	**CO3**
IV	**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.	**10**	**CO4**
V	**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). Role of telomerase in immortalization of cancer cells.	**10**	**CO5**

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]. McGraw 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.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Identify the ways by which the cells are organized
CO2	Recite the various components of cells involved in the functional association of them
CO3	Relate the role of signaling molecules in cell-cell interactions
CO4	Illustrate the significance of cell signaling pathways in cellular functions
CO5	Interpret the alterations in cellular interactions and their subsequent consequences

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	L	L	H	M
CO2	H	H	L	L	M
CO3	H	H	H	L	M
CO4	H	H	H	L	M
CO5	H	H	H	H	H

H-High; M-Medium; L-Low

18PBCMP101	CORE PRACTICAL I: ANALYTICAL BIOCHEMISTRY AND MOLECULAR BIOLOGY	SEMESTER – I

Course Objectives:

The Course aims

- To understand the basic concepts of techniques in isolation, identification and estimation of biomolecules.
- To gain knowledge on enzyme immobilization and molecular techniques

Credits: 3 **Total Hours: 64**

S.No.	EXPERIMENT	Hrs	CO
I. Biochemical Techniques			
1.	Isolation and Estimation of Glycogen by Colorimetric method.	4	CO1
2.	Isolation and Separation of Lecithin from Egg yolk by TLC	4	CO1
3.	Separation of Amino acids by Paper Chromatography (Ascending, Descending and Circular).	4	CO1
4.	Separation of leaf pigments by Column chromatography technique.	4	CO1
II. Enzyme Extraction and Purification			
5.	Extraction of Peroxidase from turnip.	4	CO2
6.	Fractionation of Peroxidase by ammonium sulphate precipitation.	4	CO2
7.	Desalting by dialysis.	4	CO2
8.	Purification of Peroxidase by Gel chromatography.	4	CO2
9.	Characterization of Peroxidase by SDS-PAGE.	4	CO2
10.	Isoenzymic pattern of Peroxidase.	4	CO2
11.	Purification summary, table and interpretation.	4	CO2
III. Enzyme Kinetics			
12.	Effect of pH, temperature on Peroxidase activity.	4	CO3

13.	Effect of substrate concentration on Peroxidase activity and determination of Km & Vmax – LB plot.	4	CO3
IV. Immobilization of Enzymes			
14.	Immobilization of Peroxidase by matrix entrapment.	4	CO4
V. Molecular Biology			
15.	Isolation of Genomic DNA from Plant.	4	CO5
16.	Plasmid DNA isolation from Bacterial cell.	4	CO5
17.	Quantification of isolated DNA.	4	CO5

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.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Implicate isolation and separation techniques
CO2	Extract and purify the enzymes
CO3	Determine the factors affecting the rate of enzyme catalyzed reaction
CO4	Perform enzyme immobilization techniques
CO5	Apply the techniques of isolation and quantification of DNA

18PLS101	CAREER COMPETENCY SKILLS – I	SEMESTER – I

Course Objectives:

The course aims

- To impart knowledge on the Aptitude.

To enhance employability skills and to develop career competency.

Total Hours: 15

UNIT	CONTENTS	Hrs	CO
I	Solving Simultaneous Equations Faster – Number System : HCF, LCM – Square roots and Cube roots - Averages	3	CO1
II	Problems on Numbers –Problems on Ages	3	CO2
III	Calendar – Clocks – Pipes and Cisterns	3	CO3
IV	Time and Work – Time and Distance	3	CO4
V	Ratio and Proportion – Partnership – Chain Rule	3	CO5

Text Book

1	*Aggarwal R.S. 2013.* **Quantitative Aptitude. [Seventh Revised Edition].** S.Chand & Co., New Delhi.

Reference Book

1	*Abhijith Guha,* **Quantitative Aptitude for Competitive Examinations**, 5th Edition, Tata McGraw Hill, 2015, New Delhi.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Carry out mathematical calculations using shortcuts.
CO2	Calculate Problems on Ages with shortcuts.
CO3	Understand the core concepts of Pipes & Cisterns, Calendar & Clocks.
CO4	Obtain knowledge on shortcuts to Time & Work and Time & Distance.
CO5	Calculate Ratio & Proportion, Partnership with shortcuts.

18PBCM201	CORE VI: INTERMEDIARY METABOLISM AND REGULATION	SEMESTER – II

Course Objectives:

The Course aims

- To have a sound knowledge in metabolism of the animal system.
- To focus on the mechanism of energy transformations in various metabolic pathways and their regulation.

Credits: 5 **Total Hours: 60**

UNIT	CONTENTS	Hrs	CO
I	**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).	12	CO1
II	**Carbohydrate metabolism:** Glycolysis- fate of pyruvate, regulation. Role of fructose 2, 6, bi phosphate in liver and muscle. 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.	12	CO2
III	**Lipid metabolism:** Biosynthesis of saturated and unsaturated fatty acids, fattyacid elongation system. Regulation of acetyl CoA carboxylase. Role of hormones in lipogenesis. Biosynthesis of	12	CO3

	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. Role of carnitine cycle in regulation of β-oxidation.		
IV	**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). Specialized products from amino acids (creatinine& serotonin). Integration of carbohydrate, protein and fat metabolism.	**12**	**CO4**
V	**Nucleotide metabolism** –*De novo* Synthesis of purine and pyrimidine nucleotides and regulation. Salvage pathways. Formation of deoxyribonucleotides - mechanism of action of ribonucleotidereductase. 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.	**12**	**CO5**

Text Book

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]. McGraw Hill Publishers, New York.

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.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Describe the mechanism of working of various energy transfer reactions in living system.
CO2	Correlate the pathways of carbohydrate metabolism
CO3	Explain the synthesis and utilization of lipid molecules in living organism
CO4	Figure out the anabolic and catabolic reactions of amino acids
CO5	Illustrate the synthesis of nucleotides and its regulation

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	H	M	L	M
CO2	H	H	M	L	M
CO3	H	H	M	L	M
CO4	H	H	M	L	M
CO5	H	H	M	L	M

H-High; M-Medium; L-Low

18PBCM202	CORE VII: PLANT BIOCHEMISTRY	SEMESTER–II

Course Objectives:

The Course aims

- To know the biochemical basis of plant functions.
- To understand the defensive mechanism in plants
- To acquire knowledge on medicinal values of plants.

Credits: 5 **Total Hours: 50**

UNIT	CONTENTS	Hrs	CO
I	**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.	10	CO1
II	**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.	10	CO2
III	**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.	10	CO3

	Sulfur uptake and transport, reductive sulfate assimilation pathway. Biosynthesis of glutathione and its role as antioxidant and detoxifying agent.		
IV	**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 -immuno modulators - Adaptogens.	**10**	**CO4**
V	**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.	**10**	**CO5**

Text Book

1. *Buchanan, B.B., Wilhelm Gruissem* and *Russell L.Jones*. 2001. **Biochemistry and Molecular Biology of Plants.** IK International Pvt. Ltd., New Delhi.

2. *Kokate, C.K., Purohit A.P.* and *Gokhale, S. B.* 2008. **Pharmacognosy.** Nirali Prakashan.

3. *Glick R. Bernard* and *Pasternak J. Jack.* 2007. **Molecular Biotechnology**. [Third Edition]. ASM press, Washington D.C.

Reference Book

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.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Explain the basic concepts in photosynthesis
CO2	Evaluate the impact of enzymes and hormones in plant growth and maintenance.
CO3	Describe the stages of biochemical events that occur in plants.
CO4	Analyze the various synthetic mechanisms and the role of several plant metabolites.
CO5	Explore the use of various techniques for the production of superior plants with improved qualities.

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	H	H	L	M
CO2	H	H	H	M	M
CO3	H	H	H	M	M
CO4	H	H	M	H	H
CO5	H	H	M	H	H

H-High; M-Medium; L-Low

18PBCEL201	**ELECTIVE I: RECOMBINANT DNA TECHNOLOGY**	**SEMESTER–II**

Course Objectives:

The Course aims

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

Credits: 5 **Total Hours: 50**

UNIT	CONTENTS	Hrs	CO
I	**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. **Enzymes involved in genetic manipulation:** Restriction endonuclease (nomenclature, types, recognition sites, applications), DNA Ligase, Alkaline phosphatase, Reverse transcriptase, Nuclease, Terminal transferase, Polynucleotide kinase.	**10**	**CO1**
II	**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.	**10**	**CO2**

III	**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, south-western screening for DNA binding protein, colony hybridization, plus-minus screening, HRT and HART.	**10**	**CO3**
IV	**Expression vectors:** expression cassettes, Promoters-strong and regulatable promoters. 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.DNA finger printing. **Gene therapy-** Somatic cell gene therapy, Germ cell gene therapy. *Ex vivo* gene therapy-ADA deficiency, Cystic fibrosis and Lesch- Nyhan syndrome.	**10**	**CO4**
V	**Production of transgenic plants:** Plant transformation using Viral vectors andAgrobacterium. 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. **Bioethics:** Definition, need of Bioethics. Applications of	**10**	**CO5**

	Bioethics. Introduction To Intellectual Property: IPR – Definition, Other forms of IPR - Copyright - Trademark – Designs.		

Text Books

1. *Bernard R.Glick and Jack J.Pasternak.* 2007. **Molecular Biotechnology**. Principles and Applications of Recombinant DNA.[Third edition]. ASM press. Washington.
2. *Ernst-L.Winnacker*. 1987. **From Genes to clones, Introduction to gene technology.**
3. *Sandy B. Primrose, Richard M. Twyman* and *Robert W. Old.* 2001. **Principles of Gene Manipulation.** [Sixth Edition]. Blackwell Science, USA.
4. *Satheesh, M. K.* 2011. **Bioethics and Biosafety**. I.K. International, New Delhi.

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.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Apply the basic techniques in gene manipulation and various enzymes used in gene transfer
CO2	Explore the types, characteristic features and applications of cloning vectors
CO3	Pertain the recent advances in gene transfer and cloning strategies to produce a new product
CO4	Discriminate the significance and applications of expression vectors
CO5	Describe the importance of bioethics and IPR while carrying out research

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	L	M	M	H	H
CO2	L	M	M	H	H
CO3	L	M	M	H	H
CO4	L	M	M	H	H
CO5	L	M	M	H	H

H-High; M-Medium; L-Low

18PBCEL202	ELECTIVE II: FOOD PROCESSING AND QUALITY CONTROL	SEMESTER–II

Course Objectives:

The Course aims

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

Credits: 5 **Total Hours: 50**

UNIT	CONTENTS	Hrs	CO
I	**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.	10	CO1
II	**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.	10	CO2
III	**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.	10	CO3
IV	**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.	10	CO4

	Objective evaluation-Definition, advantage and disadvantages. Test for objective evaluation.		
V	**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.	**10**	**CO5**

Text Book

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

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.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Explain the concept of food processing
CO2	Employ the principles and methods of food preservation
CO3	Portray the various methods employed in food storage
CO4	Evaluate the food quality by using various techniques
CO5	Implicate the food laws and standards for safety production of food products and appraise themselves as a successful entrepreneur in the field of food technology

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	L	M	M	H	H
CO2	L	M	M	H	H
CO3	L	M	M	H	H
CO4	L	M	M	H	H
CO5	L	L	L	H	H

H-High; M-Medium; L-Low

18PBCMP201	**CORE PRACTICAL II: PLANT BIOCHEMISTRY**	**SEMESTER–II**

Course Objectives:

The Course aims

- To learn about the extraction and estimation of secondary metabolites.
- To expose PTC and recombinant DNA techniques to students.

Credits: 3 **Total Hours: 65**

S.No.	**EXPERIMENT**	**Hrs**	**CO**
I. Plant Biochemistry			
1.	Estimation of chlorophyll from leaves	5	CO1
2.	Extraction of secondary metabolites from known medicinal plants by using water and ethanol as solvents	5	CO1
3.	Qualitative analysis of secondary metabolites extracted from known medicinal plants – Phenols, flavonoids, alkaloids, glycosides and steroids	5	CO1
4.	Quantitative analysis of secondary metabolites – flavonoids and phenols	5	CO1
5.	TLC analysis of secondary metabolites extracted from known medicinal plants	5	CO1
6.	Isolation and estimation of beta-carotene from carrot	5	CO1
7.	Isolation and estimation of Vitamin C from citrus fruit	5	CO1
8.	Induction and Maintenance of callus using Explants	5	CO2
9.	Micro propagation	5	CO2
10.	Isolation and culture of protoplast	5	CO2
II. Recombinant DNA Technology			
11.	Restriction digestion analysis of DNA	5	CO3
12.	Bacterial transformation	5	CO3
13.	PCR – Gene amplification. (Demonstration)	5	CO3

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.** NiraliPrakashan, New Delhi

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Extract and quantify phytoconstituents
CO2	Perform plant tissue culture techniques
CO3	Apply DNA techniques in genetic recombination

18PMBBCI201	**IDC I: CLINICAL MICROBIOLOGY**	**SEMESTER – II**

Course Objectives:

The Course aims

- To enable the learners to know basics in clinical microbiology.
- To learn the diagnosis of infectious diseases.
- To know about the modern approaches in clinical microbiology.

Credit: 04 **Total Hours:40**

UNIT	CONTENTS	Hrs	CO
I	Infection -sources of infection - transmission of infection -types of infection. Classification of microbes based on hazard –Types of diseases - disease carriers.	**08**	**CO1**
II	Collection and transport of clinical specimens-urine, pus, faeces, sputum and blood.	**08**	**CO2**
III	Microbiological examination of sputum, pus, faeces and urine. Diagnosis of anaerobic infections.	**08**	**CO3**
IV	Serological diagnosis of microbial diseases: Antigen tests-Agglutination test for pregnancy, Elek's gel precipitation test, ELISA. Antibody tests - WIDAL, ASO. Monoclonal antibodies in clinical microbiology.	**08**	**CO4**
V	Molecular diagnosis of infectious diseases - tuberculosis, malaria, AIDS. RFLP as a molecular marker in disease diagnosis.	**08**	**CO5**

Text Books

1. *Ananthanarayan,R. and Jayaram Paniker, C.K.*2008.**Textbook of Microbiology**. [Seventh edition]. University Press (India) Private Limited, Hyderabad.
2. *Monica Cheesbrough* 1994. **Medical Laboratory Manual for Tropical countries**. Volume II: Microbiology. ELBS Publishers.
3. *Sathyanarayana, U*. 2010. **Biotechnology**. Books and Allied (P) Ltd, Kolkatta.

Reference Book
1. *Jawetz, E, Melnic, J.K. and Adelberg, E.A*. 1998. Review of Medical Microbiology, Lange Medical Publications, U.S.A.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Evaluate the infectious disease caused by microorganisms.
CO2	Apply the methods of collection and processing of clinical samples.
CO3	Apply the preliminary detection of pathogens for disease diagnosis.
CO4	Assess the serological detection of pathogens.
CO5	Develop diagnose the disease based on molecular methods.

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	H	H	H	H
CO2	M	H	H	H	H
CO3	M	M	H	H	H
CO4	M	M	H	H	H
CO5	H	H	H	H	H

H-High; M-Medium; L-Low

18PMBBCIP201	IDC PRACTICAL I: CLINICAL MICROBIOLOGY	SEMESTER – II

Course Objectives:

The course aims

- To learn the basic techniques in clinical microbiology.
- To acquire knowledge on identification of clinical pathogens.

Credit: 02 **Total Hours:20**

Expt	CONTENTS	Hrs	CO
1.	Colony morphology of pathogenic bacteria on selective media.	**3**	**CO1**
2.	Morphological characterization of pathogenic bacteria by differential staining.	**2**	**CO1**
3.	Identification of pathogenic bacteria by preliminary test, biochemical test and special test. a)*Staphylococcus aureus* b)*Pseudomonas aeruginosa*	**5**	**CO1**
4.	Culture methods of fungi i. Media usage–PDA, SDA, Corn meal agar	**5**	**CO2**
5.	Examination of fungi by Lactophenol cotton blue stain.	**5**	**CO2**
6.	Examination of *Candida albicans* - Gram's stain, Germ tube test.	**5**	**CO2**

Reference Books

1. *Gerald Collee, J. Barie P.Marmion, Andrew, G. Fraser and Anthony Simmons*. 1996. **Mackie and MacCartney Practical Medical Microbiology.** Fourteenth edition. Churchill Livingstone Publishers.
2. *Sundararaj, T.* **Microbiology Laboratory Manual.** Dr.A.L.Mudaliyar Post Graduate Institute of Basic Medical Sciences, Chennai.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Identify and detect the pathogenic bacteria based on the morphological and physiological studies.
CO2	Evaluate the mycological diseases.

18PBTBCI201	IDC I: PLANT TISSUE CULTURE TECHNOLOGY	SEMESTER- II

Course Objectives:

The Course aims

- To understand the basic techniques in plant tissue culture.

Credits: 4 **Total Hours: 40**

Unit	Contents	Hrs	CO
I	Introduction to Plant cells, Types of plant cells, Principles of plant tissue culture, Tissue culture media, Growth regulators and Sterilization techniques.	**7**	**CO1**
II	Callus and suspension culture, Micropropagation, Meristem culture, Somatic embryogenesis, Protoplast isolation, Fusion of protoplast, Somaclonal variations.	**8**	**CO2**
III	*Agrobacterium mediated* gene transfer, *Agrobacterium* based vectors, direct gene transfer methods - electroporation, microinjection, particle bombardment.	**9**	**CO3**
IV	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.	**10**	**CO4**
V	Secondary metabolites from plants – Alkaloids, flavonoids and phenolic compounds, Germplasm conservation.	**6**	**CO5**

Text Book

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

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Simplify the types of plant cells and will able to utilize various sterilization techniques
CO2	Utilize the micro propagation and isolation of plant tissue
CO3	Analyze the techniques for Transfer gene by biological and physical method
CO4	Contrast the benefits and develop the genetically modified crops
CO5	Demonstrate the Extraction and identification of secondary metabolites

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	L	L	M	M	H
CO2	L	L	M	M	H
CO3	L	M	M	M	H
CO4	M	M	M	H	H
CO5	H	H	H	H	H

18PBTBCIP201	IDC PRACTICAL I: PLANT TISSUE CULTURE TECHNOLOGY	SEMESTER -II

Course objectives:

The Course aims

- To get hands on experience on Plant tissue culture.

Credit:02 **Total Hours: 24**

S.No	EXPERIMENT	Hrs	CO
1.	Media preparation	**06**	**CO1**
2.	Hormone stock solution preparation	**06**	
3.	Callus induction	**03**	
4.	Micropropagation	**03**	
5.	Protoplast isolation	**03**	
6.	Synthetic seed preparation	**03**	

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.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Prepare media for plant tissue culture and cultivate the plant tissues/cells.

18PVE201	VALUE EDUCATION: HUMAN RIGHTS	SEMESTER - II

Course Objectives:

The Course aims

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

Credits: 2 **Total Hours: 25**

UNIT	CONTENTS	Hrs	CO
I	**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.	5	CO1
II	**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.	5	CO2
III	**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.	5	CO3
IV	**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 –	5	CO4

	Child Labour-Bonded Labour - Refugees Rights - Minority Rights - Dalit Rights-Tribal Rights-Nomads Rights.		
V	**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	**5**	**CO5**
Reference Book			
1.	*Paul Singh.* **Human Rights and Legal System.** Himalaya Publishing House, New Delhi.		

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Understand the core principles of human rights philosophy
CO2	Know the importance and functions of human rights commission
CO3	Apply their rights for democracy, human rights and gender equality
CO4	Know the rights from the Governance, economic and social development through various Acts
CO5	Understand the right to information Act, rights for women, children, Nomads, refugees and various sector of people in our country

18PLS201	CAREER COMPETENCY SKILLS – II	SEMESTER - II

Course Objectives:

The Course aims

- To enhance employability skills and to develop career competency.

Total Hours: 15

UNIT	CONTENTS	Hrs	CO
I	Interview Skills – Types of Interview – Groundwork before Interview – Abide by the dress code – Importance of Body language in Interviews – Tell Us about yourself – Do's and Don'ts of an interview – Concluding an Interview – A Mock Interview.	**5**	**CO1**
II	Resume Preparation – Difference between a Resume and CV – The main body of Resume – The Career objective in Resume – A Fresher's Resume – Antiquity of Soft Skills – Classification of Soft Skills – Personality Analysis – Interpersonal Skills.	**5**	**CO2**
III	Body Language – Emotion displayed by Body Language – Group Discussion – Group Discussion types – Guidelines Do's and Don'ts during a Group Discussion – Concluding the Discussion – The technique of Summing Up.	**5**	**CO3**
IV	Speaking Skills – Effective Speaking Guidelines – Reading Skills – Types of Reading Skills – Barriers to Speed Reading – Listening Skills – Stages of Listening – Types of Listening – Barriers to Listening – Beware of Pitfalls – Avoid Errors : Indianisms in English – Most common errors in the world – Similar but not Quite the same – Words that are Singular or Couple.	**5**	**CO4**
V	Avoid Pitfalls: of Beware Self-improvement - Facilitating Laboratory: Language Techniques and Concepts E-learning	**5**	**CO5**

Text Book

1. *Barun K. Mitra. 2011.* **Personality Development and Soft skills**. [Second Edition]. Oxford University Press, New Delhi

Reference Book	
1.	*S.P. Dhanavel. 2015,* **English and Soft Skills**. [Second Edition]. Orient Black Swan Publishers, New Delhi

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Understand the types of Interviews, Dress Code and Styles
CO2	Develop Resume content and structures.
CO3	Improve body language skills.
CO4	Know how to represent self through communication.
CO5	Attain the different level of Learning Skills.

18PBCM301	**CORE VIII: CLINICAL BIOCHEMISTRY**	**SEMESTER–III**

Course Objectives:

The Course aims

- To impart a thorough knowledge about the biochemical basis of various diseases and disorders to the learners.
- To enable the students to develop practical and interpretative skills to contribute effectively in diagnostic and clinical biochemistry

Credits: 5 **Total Hours: 60**

UNIT	CONTENTS	Hrs	CO
I	**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.	**12**	**CO1**
II	**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	**12**	**CO2**

	therapy. **Atherosclerosis:** Risk factors – cholesterol (LDL, HDL), Hypertension, cigarette smoke, obesity, free radicals. Prevention and management.		
III	**Liver function tests:** Diseases of the Liver - Jaundice and its types. 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- Nephrotic syndrome. Kidney function tests – based on GFR (clearance test - Creatinine, Urea and inulin), based on renal plasma flow (paraaminohippurate and filtration fraction), based on tubular function (concentration and dilution tests).	**12**	**CO3**
IV	**Clinical Enzymology:** Factors affecting enzymes level in plasma or serum, Enzymes in health and diseases. Biochemical diagnosis of diseases by enzyme assays – AST, ALT, CPK, cholinesterase, ALP and LDH. Digestive enzymes – Amylase, lipase. **Amniotic fluid and CSF analysis**: Collection, composition of Amniotic fluid and CSF, their analysis for detection of diseases.	**12**	**CO4**
V	**Disorders of erythrocyte metabolism**: Rapoport- Luebering cycle. Hemoglobin – Normal and Abnormal hemoglobin, Thalassemia and related conditions - causes and structural variation. Stem cells and its applications. **Free radicals and Antioxidants**: Free radicals, Reactive oxygen	**12**	**CO5**

	species, Lipid peroxidation, Free radical scavenger system – enzymic, non – enzymic, antioxidants. Role of antioxidants in skin diseases.		

Text Book

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

Reference Books

1. *Vasudevan, D.M.* and *Sreekumari, S*. 2007. **Text Book of Biochemistry for Medical Students**. [Fifth Edition]. Jaypee Publishers, New Delhi.

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.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Explain the basis for the onset of metabolic disorders.
CO2	Analyze the altered physiological profile in metabolic disorders like diabetes mellitus
CO3	Explore the functioning of kidney and liver and their biochemical changes in diseased condition
CO4	Pertain the enzyme and fluid analysis in diagnosis of diseases
CO5	Describe the role of free radicals and antioxidants in diseases

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	L	H	M	L	M
CO2	L	H	M	H	H
CO3	L	H	M	H	H
CO4	L	H	M	H	H
CO5	L	H	M	M	M

H-High; M-Medium; L-Low

18PBCM302	**CORE IX: BIOSTATISTICS AND RESEARCH METHODOLOGY**	**SEMESTER–III**

Course Objectives:

The Course aims

- To learn the strategies of research field and also to provide knowledge to understand the role of statistics in research.

Credits: 5 **Total Hours: 50**

UNIT	CONTENTS	Hrs	CO
I	**Statistics:** Introduction – Definition of Statistics – Functions of Statistics – Applications and Limitations of Statistics. **Collection of data**: Primary and Secondary data – Methods of collecting primary data – Sources of secondary data. **Classification and Tabulation of data**: Types of classification – Tabulation of data – Parts of a table - Types of tables. **Diagrammatic and Graphical Representation:** Types of diagrams – Graphs – Graphs of frequency distributions. **Measures of Central Tendency:** Arithmetic Mean (except weighted mean and corrected values) – Median – Mode – Merits and demerits. **(Volume 1: Chapters 1, 3, 5 6 and 7)**	**10**	**CO1**
II	**Measures of Dispersion:** Mean deviation – Standard deviation – Coefficient of variation. **Correlation Analysis:** Types of correlation – Methods of Correlation - Karl Pearson's Coefficient – Rank correlation coefficient. **Regression Analysis:** Regression lines (except graphing) – Regression equations. **(Volume 1: Chapters 8, 10 and 11)**	**10**	**CO2**
III	**Test of Hypothesis:** Population – Sample – Procedure of testing hypothesis – Types of errors – Standard error - t test – Chi-square	**10**	**CO3**

	test of independence of attributes. **Analysis of Variance:** One way classification – Two way classification. **(Volume 2: Chapter 3, 4 and 5)**		
IV	**Research**– Planning and Classification, Components of research report, Essential steps in research. Problem Identification & Formulation, Research Question, **Hypothesis**- Qualities of a good Hypothesis, Null Hypothesis & Alternative Hypothesis. Experimental design. Literature collection – and its importance.	**10**	**CO4**
V	Preparing proposal for a research project. Scientific Research report writing– writing Introduction, Review of literature, Materials and methods, Results, Table, Figures, Discussion, Citing and listing references. Format of a Thesis. Preparation of manuscript for publication. Scientific information-Introduction, Writing proposals, scientific papers and figures. Plagiarism.	**10**	**CO5**

Text Books

1. *Gupta, S.P*. 2006. **Statistical Methods**. Sultan Chand and Sons Publishers, New Delhi. **(UNIT I - III)**

2. *Gurumani, N.*2006. **Research Methodology**. MJP Publishers. (**UNIT IV**).

3. *Gurumani*, N. 2016. Scientific thesis writing and paper presentation. MJP Publishers. (**UNIT V**)

Reference Books

1. *Gurumani, N.* 2008. **An Introduction to Biostatistics** [second revised edition]. MJP Publishers Chennai.

2. *Antonisamy, B., Solomon Christopher and Prasanna Samuel.* 2010. **Biostatistics: Principles and Practice**. Tata McGraw Hill Education Private Limited. New Delhi.

3. *Padmini E.* 2007. **Biochemical Calculations & Biostatistics**. [First Edition]. Books and Allied (P) Ltd., Kolkata.

4.	*Kothari,C.R.* 1990. **Research Methodology–Methods and Techniques**. New Age Publications. New Delhi

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Learn the importance of statistics and Understand the concepts of measures of central tendency and measures of dispersion
CO2	Gain knowledge on correlation and regression analyses
CO3	Test the research statements through ANOVA
CO4	Select the appropriate procedure for carrying out their research work
CO5	Understand the concepts in writing thesis, proposal and result interpretation

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	L	L	L	H	H
CO2	L	L	L	H	H
CO3	L	L	L	H	H
CO4	L	M	M	H	H
CO5	L	M	M	H	H

H-High; M-Medium; L-Low

18PBCEL301	**ELECTIVE II: MOLECULAR IMMUNOLOGY AND IMMUNOTECHNOLOGY**	**SEMESTER–III**

Course Objectives:

The Course aims

- To make the students aware of the physical, chemical and physiological characteristics of the components of the immune system.
- To introduce the aspects of the immune system in health and disease states.
- To highlight the applications of immunotechniques.

Credits: 5 **Total Hours: 50**

UNIT	CONTENTS	Hrs	CO
I	**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.	**10**	**CO1**
II	**Antigens:** Antigenicity and Immunogenicity - 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.	**10**	**CO2**
III	**MHC**: organization, MHC molecule and genes, cellular distribution. Antigen processing and presentation. **Immune Response:** Activation of T cells – clonal selection theory. Cell-mediated and humoral effector responses. Hypersensitivity reactions – Types, Mechanism, clinical manifestation and treatment. Respiratory allergy and asthma.	**10**	**CO3**

IV	**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, and immunological abnormalities. Transplantation immunology: mechanism of graft acceptance and rejection, immuno suppressive therapy. Tumor immunology - tumor associated antigen, immune response to tumors, tumor immunotherapy.	**10**	**CO4**
V	**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 knockout mice.	**10**	**CO5**

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

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Explain the fundamental ways by which the immune system protects the living organisms
CO2	Describe about the classification, properties and functions of processes that enable our immune system to respond to evolving threats
CO3	Appreciate the biochemical basis of hypersensitivity reactions
CO4	Illustrate the use of vaccination in prevention of diseases; mechanism of immunodeficiency and autoimmune diseases
CO5	Explore new, immunology-based disease diagnosis techniques and processes

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	L	H	H	L	M
CO2	L	H	H	L	M
CO3	L	H	H	L	M
CO4	L	H	M	M	H
CO5	L	L	L	H	H

H-High; M-Medium; L-Low

18PBCEL302	**ELECTIVE II: MOLECULAR GENETICS**	**SEMESTER–III**

Course Objectives:

The Course aims

- To make the learners to understand the Mendelian principle of inheritance, mapping of genome and evolution.
- To gain knowledge on the Behavioral basis of different organisms

Credits: 5 **Total Hours: 50**

UNIT	CONTENTS	Hrs	CO
I	**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	10	CO1
II	**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	10	CO2
III	**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	10	CO3

	significance of Transposable elements.		
IV	**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.	**10**	**CO4**
V	**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	**10**	**CO5**

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).**

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Describe the chemical basis of heredity, human genome and its relationship to health and disease
CO2	Illustrate the patterns of inheritance
CO3	Pertain the genetic variations in the chromosomal structure and their aberrations
CO4	Appraise the evolutionary significance of Transposable elements
CO5	Improve the level of genetic literacy about the behavioral and evolutionary genetic analysis

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	L	M	M	H	H
CO2	L	M	M	H	H
CO3	L	M	M	H	H
CO4	L	M	M	H	H
CO5	L	M	M	H	H

H-High; M-Medium; L-Low

18PBCMP301	**CORE PRACTICAL III: CLINICAL BIOCHEMISTRY**	**SEMESTER – III**

Course Objectives:

The Course aims

- To understand the basics in collection and handling of biological samples and their quantification by colorimetric and immunological methods

Credits: 3 **Total Hours: 90**

S.No.	**EXPERIMENT**	**Hrs**	**CO**
I. Clinical Biochemistry			
1.	Collection and preservation of blood	6	CO1
2.	Estimation of glucose in Blood - Nelson Somogyi method	6	CO1
3.	Determination of SOD	6	CO1
4.	Estimation of A : G ratio in serum - Biuret method	6	CO1
5.	Estimation of Blood Urea – DAM method	6	CO1
6.	Estimation of serum cholesterol - Zak's method	6	CO1
7.	Estimation of creatine&creatinine in blood and urine -Jaffe's method	6	CO1
8.	Estimation of bilirubin - Diazo method	6	CO1
9.	Determination of serum AST and ALT	6	CO1
10.	Electrophoretic separation of LDH isoenzymes	6	CO1
II. Immunotechnology			
11.	Immunodiffusion - Single, Ouchterlony	6	CO2
12.	Immunoelectrophoresis – Rocket immunoelectrophoresis	6	CO2
13.	VDRL	6	CO2
14.	Widal test	6	CO2
15.	Dot ELISA	6	CO2

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 Scientific Publishers, New York

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Understand the principle and procedure in the determination of clinically important biomarkers in diagnosis of diseases
CO2	gain sound knowledge about basic immunotechniques

18PBCMP302	CORE PRACTICAL IV: STATISTICAL SOFTWARE	SEMESTER – III

Course Objectives:

The Course aims

- To give a good grip on concepts in analyzing the data using statistical software

Credits: 2 **Total Hours: 24**

PROGRAM	CONTENTS	Hrs	CO
1.	Diagrams and graphs	3	CO 1
2.	Measures of Central Tendency	3	CO 2
3.	Measures of Dispersion	3	CO 2
4.	Correlation Coefficient (Karl Pearson and Spearman Rank Method)	3	CO 3
5.	Regression lines	3	CO 3
6.	Small Sample Test (t and F)	3	CO 4
7.	Chi-square Test for Independence of Attributes.	3	CO 4
8.	ANOVA (one way and two way classification)	3	CO 4

Reference Books

1. *Shentan J. Coakes, Lyndall Steed and Peta Dzidic.* **SPSS 13.0 version for Windows analysis without Anguish.** John Wiley & Sons, Australia.

2. *Andy Field.* 2006. **Discovering Statistics using SPSS.** [Second Edition]. SAGE Publications.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO 1	Demonstrate the data in diagrammatic and graphical representation
CO 2	Find the averages and measures dispersion
CO 3	Calculate correlation and regression for huge amount data
CO 4	Gain knowledge about test of significance

18PMBBCI301	**INTER DISCIPLINARY COURSE II: INDUSTRIAL MICROBIOLOGY**	**SEMESTER–III**

Course Objectives:

The Course aims

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

Credits: 2 **Total Hours: 40**

UNIT	CONTENTS	Hrs	CO
I	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 processes.	**8**	**CO1**
II	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.	**8**	**CO2**
III	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.	**8**	**CO3**
IV	Microbial production of fermented products – Wine. Organic acid – Citric acid and Lactic acids. Vitamin – Vitamin B12. Enzyme – α-amylase.	**8**	**CO4**
V	Microbial production of antibiotic – Penicillin - Streptomycin; Vaccines – BCG; Toxoid – Tetanus Toxoid – Preparation of antisera.	**8**	**CO5**

Text Books	
1.	*Stanbury, P.F., Whitaker, A., and Hall, S.J.,* 2005. **Principles of Fermentation technology.** Reed Elsevier India Ltd., New Delhi.
2.	*Patel, A.H.,* 2005. **An Introduction to Industrial Microbiology.** MacMillan India Ltd., Chennai.
3.	*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.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Recall the basics and importance of industrially important microbes.
CO2	Apply the techniques for the formulation of media for microbial products.
CO3	Develop the suitable conditions for maximum product yield.
CO4	Apply fermentation technology for production of microbial products.
CO5	Demonstrate chemotherapeutic drugs production under *invitro* conditions.

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	L	L	L	H	H
CO2	L	L	L	H	H
CO3	L	M	M	H	H
CO4	L	M	M	H	H
CO5	H	H	H	H	H

H-High; M-Medium; L-Low

18PMBBCIP301	**IDC PRACTICAL II: INDUSTRIAL MICROBIOLOGY**	**SEMESTER –III**

Course Objectives:

The course aims

- To learn the basic techniques in industrial microbiology.
- To acquire knowledge on antibiotics and its susceptibility.

Credit: 02 **Total Hours: 30**

Experiment	**CONTENTS**	**Hrs**	**CO**
1.	Screening of antibiotic producing organisms from soil.	**3**	**CO1**
2.	Screening of amylase enzyme producing organisms from soil.	**2**	**CO1**
3.	Antibiotic sensitivity disc preparation.	**5**	**CO1**
4.	MIC determination by filter paper disc assay.	**5**	**CO2**
5.	Antibiotic susceptibility method- Kirby Bauer method.	**5**	**CO2**
6.	Evaluation of disinfectant- Phenol Coefficient method.	**5**	**CO2**
7.	Wine production	**5**	**CO1**

Reference Books

1.	*Gerald Collee, J. Barie P.Marmion, Andrew, G. Fraser and Anthony Simmons*. 1996. **Mackie and MacCartney Practical Medical Microbiology.** Fourteenth edition. Churchill Livingstone Publishers.
2.	*Sundararaj, T.* **Microbiology Laboratory Manual.** Dr.A.L.Mudaliyar Post Graduate Institute of Basic Medical Sciences, Chennai.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Assess antibiotic and enzyme production and produce industrially important products.
CO2	Evaluate the susceptibility of antibiotics and disinfectants.

18PBTBCI301	INTER DISCIPLINARY COURSE II: ANIMAL CELL CULTURE TECHNOLOGY	SEMESTER - III

Course Objectives

- To understand the basic techniques in Animal cell culture.

Credits: 2 **Total Hours: 40**

UNIT	CONTENTS	Hrs	CO
I	Introduction to Animal cell culture, Applications of cell culture, Designing the cell culture laboratory – washing and sterilization area, Storage area and cell culture room, Equipments in tissue culture laboratory – Inverted Microscope, Centrifuge, Laminar flow benches, CO2 incubator.	**08**	**CO1**
II	Glassware and other plastic ware in tissue culture – Substrate materials for growing cells, cell culture vessels, culture media – Properties and special requirements, Complete media, Conditioned media.	**08**	**CO2**
III	Type of cell culture - Isolation of primary explants culture, Isolation of cells and disaggregation method cell culture, organ culture.	**08**	**CO3**
IV	Cell culture - Transformation, Differentiation and Dedifferentiation, Growth curve of cells, Types of microbial contamination, Stem cell culture.	**08**	**CO4**
V	Applications of Animal cell culture technology – Somatic cell fusion, Transgenic fish and sheep.	**08**	**CO5**

Reference Books

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

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

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Handle animal cells and familiar with instruments
CO2	Prepare animal tissue culture media for culturing animal cells
CO3	Disaggregate the animal tissues
CO4	The differentiation of cells and stem cells
CO5	Apply the animal cell culture technology in day to day life

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	M	L	H	M
CO2	M	H	L	H	M
CO3	M	L	M	H	H
CO4	H	M	H	H	M
CO5	M	M	M	H	M

H-High; M-Medium; L-Low

18PBTBCIP301	IDC PRACTICAL II: ANIMAL CELL CULTURE TECHNOLOGY	SEMESTER -III

Course objectives:

The Course aims

- To get hands on experience on Animal cell culture.

Credits: 2 **Total Hours: 24**

S.No	EXPERIMENT	Hrs	CO
1.	Sterilization techniques in Animal cell culture	**06**	**CO1**
2.	Media preparation for Animal cell culture	**06**	
3.	Primary culture of Chick embryo fibroblast	**03**	**CO2**
4.	Trypsinization and subculturing	**06**	
5.	Determination of viability of cells using Trypan blue stain.	**03**	**CO3**

Reference Book

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

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Sterilize the media and utensils for Animal cell culture
CO2	Cultivate the animal cells and maintain it for further studies.
CO3	Analyze viable cells

18PBCM401	**CORE X: HUMAN PHYSIOLOGY AND NEUROSCIENCE**	**SEMESTER – IV**

Course Objectives:

The Course aims

- To provide knowledge on physiological processes taking place in the vital organs of human body.
- To impart the biochemical aspects behind diseases associated with the nervous system and effect of drug therapy

Credits: 4 **Total Hours: 50**

UNIT	CONTENTS	Hrs	CO
I	**Cardiovascular System**: Comparative anatomy of heart structure, myogenic heart, specialized tissue, ECG – its principle and significance, cardiac cycle, heart as a pump, blood pressure, neural and chemical regulation **Respiratory system** - Comparison of respiration in different species, anatomical considerations, transport of gases, exchange of gases, waste elimination, neural and chemical regulation of respiration.	**10**	**CO1**
II	**Digestive system** - Digestion, absorption, energy balance, BMR. **Nervous system** - Neurons, action potential, gross neuroanatomy of the brain and spinal cord, central and peripheral nervous system, neural control of muscle tone and posture. **Sense organs** - Vision, hearing and tactile response.	**10**	**CO2**
III	**Excretory system** - Comparative physiology of excretion, kidney, urine formation, urine concentration, waste elimination, micturition, regulation of water balance, blood volume, blood pressure, electrolyte balance, acid-base balance. **Thermoregulation** - Comfort zone, body temperature – physical, chemical, neural regulation, acclimatization	**10**	**CO3**

IV	**Brain and Spinal cord: C**hemistry**,** Structure and functions. Brain metabolism and metabolic adaptation. Neuro hormones and neuromodulators. Biochemical aspects of behavior, sleep, learning and memory.	**10**	**CO4**
V	**Neurodegenerative disorders:** Dementia, Schizophrenia, Huntington's disease, Parkinsonism and Alzhemier's disease. Neuromuscular diseases – Muscular dystrophy, Tetanus and botulism. **Pharmacology of nervous System:** CNS depressants (sedative, hypnotics), CNS stimulants	**10**	**CO5**

Text Books

1. *Arthur C. Guyton and John E. Hall*. 2007**. Text Book of Medical Physiology**. [Eleventh Edition]. Elsevier Publications, New Delhi

2. *Gerald. J. Tortora* and *Sandra Reynolds.* 2003. **Principles of Anatomy and Physiology. [**Tenth Edition]. John Wiley and Sons. Inc. Pub. New York

3. *Tripathi, K. D*. 1999. **Essentials of Medical Pharmacology.** [Fourth Edition]. Jaypee Brothers Medical Publishers. New Delhi

4. *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

5. *Kumar Pushkar and Dr.A.P.Singh***. CSIR-UGC NET/JRF/SET Life Sciences.** UPKAR PRAKASHAN, Agra.

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

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Clarify the physiological role of cardiovascular system and diffusion and transport of gases among various tissues
CO2	Interpret the basic framework of nervous system and the working of sensory responses
CO3	Infer the biochemical aspects of excretion and thermoregulation
CO4	Explain the structure and functions of brain and spinal cord
CO5	Demonstrate the causes and complications of degenerative disorders of nervous system

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	M	H	M	M
CO2	M	M	H	M	M
CO3	M	M	H	M	M
CO4	M	M	H	M	M
CO5	M	M	H	M	M

H-High; M-Medium; L-Low

18PBCM402	**CORE XI: HORMONAL BIOCHEMISTRY AND BIOCHEMICAL PHARMACOLOGY**	**SEMESTER–IV**

Course Objectives:

The Course aims

- To study about the pharmacodynamics and pharmacokinetics of the drugs
- To inculcate about the challenges in designing a drug
- To get aware on the methods in the drug development

Credits: 5 **Total Hours:50**

UNIT	CONTENTS	Hrs	CO
I	**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}.	**10**	**CO1**
II	**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**)**.	**10**	**CO2**
III	**Male reproductive Hormones**: Biosynthesis, chemistry, physiological role and mechanism of action of male sex	**10**	**CO3**

	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		
IV	**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	**10**	**CO4**
V	**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	**10**	**CO5**

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

COURSE OUTCOMES (CO)

After the completion of the course, the student will be able to

CO1	Describe the classification and mechanism of action of hormones
CO2	Illustrate the chemistry, synthesis and significance of peptide, thyroid and adrenal gland hormones
CO3	Analyze the significance of hormones in Spermatogenesis, pregnancy, parturition, lactation
CO4	Discriminate the classification and pharmacodynamics of drugs
CO5	Explore the new challenges in the development of efficient mediators to combat diseases and pharmacokinetics of drugs

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	H	H	L	M
CO2	H	H	H	L	M
CO3	H	H	H	L	M
CO4	H	L	M	L	H
CO5	H	L	M	H	H

H-High; M-Medium; L-Low

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) 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
Attendance	: 5 Marks
Record	: 5 Marks
Internal Examinations	: 20 Marks
Total	**: 40 Marks**

(C) 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 dissertation shall be required to resubmit the dissertation with the necessary modifications.

MARK DISTRIBUTION PATTERN

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

Internal Mark Distribution [CA - Total Marks: 50 Marks]

1. Research work done : 20 Marks
2. Attendance : 5 Marks
3. Observation Note : 10 Marks
4. Review : 15 Marks

Total : 50 Marks

External Mark Distribution [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**

CAREER COMPETENCY SKILLS

- **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 I Semester.
- **Viva Voce – Semester II**
  - The student has to come in proper dress code and he/she should bring 2 copies of resume for the Viva Voce
  - The 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.

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

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

INRDISCIPLINARY COURSE OFFERED

S.No.	Subject Code	Subject	Offered for the students of	Instruction Hours
SEMESTER II				
1.	18PBCMBI201/ 18PBCBTI201	IDC I: Diagnostic Biochemistry	M.Sc Microbiology/ M.Sc Biotechnology	3
2.	18PBCMBIP201/ 18PBCBTIP201	IDC Practical I: Diagnostic Biochemistry	M.Sc Microbiology/ M.Sc Biotechnology	3
SEMESTER III				
3.	18PBCMBI301/ 18PBCBTI301	IDC II: Pharmaceutical Biochemistry	M.Sc Microbiology/ M.Sc Biotechnology	3
4.	18PCMBI301/ 18PBCBTIP301	IDC Practical II : Pharmaceutical Biochemistry	M.Sc Microbiology/ M.Sc Biotechnology	3

18PBCMBI201/ 18PBCBTI201	**INTERDISCIPLINARY COURSE I: DIAGNOSTIC BIOCHEMISTRY**	**SEMESTER–II**

Course Objectives:

The Course aims

- To enable the students to develop practical and interpretative skills to contribute effectively in diagnostic haematology and clinical biochemistry

Credits: 2 **Total Hours: 40**

UNIT	CONTENTS	Hrs	CO
I	**Clinical Laboratory:** Introduction, types and set-up. Basic laboratory safety, hazards in the clinical laboratory, safety with chemical/reagents, first aid in laboratory accidents. SI units. Universal work precautions for lab personnels. Medical laboratories in the developing countries. Fundamental chemistry - Indicators, solutes, solvents and solutions. Percentage, molar and normal solution with simple biochemical calculations	8	CO1
II	**Clinical Haematology:** Ways of obtaining blood, Anticoagulants, Blood collection system, estimation of haemoglobin- Sahli's and Cyanmethaemoglobin method, packed cell volume and erythrocyte sedimentation rate, blood cell counts – WBC and RBC. Blood film examination, stain preparation and staining, rapid diagnostics – automation in haematology, bleeding time, clotting time	8	CO2
III	**Urine analysis and Stool examination:** Physicochemical characteristics of urine, preservation of specimen, gross examination of urine and chemical examination of urine-tests for glucose, proteins, aminoacids, ketone bodies, bile salts, bile pigments. Stool examination – Specimen collection, test for occult blood, microscopic examination of stool	8	CO3
IV	**Clinical Chemistry and Enzymology:** Diabetes Mellitus -	8	CO4

	Introduction, screening tests, diagnostic tests - insulin tolerance test. Estimation of glucose in blood, GTT, and glycosylated haemoglobin. Estimation and interpretation of cholesterol, urea, creatinine and protein in biological samples. Enzymology – Role of Alkaline and Acid phosphatase in diagnosis of diseases		
V	**Organ function tests:** Liver function test: Functions of the Liver, Tests based on abnormalities of bile pigments (Jaundice). Renal Function: Functions of the kidney, clearance test (Creatinine and urea), dilution test, phenol red test, principles of precise tests of renal function – Glomerular filtration rate, renal plasma flow and maximal tubular capacity	**8**	**CO5**
Text Books			
1.	*Ramnik Sood.* 2006. **Medical Laboratory Technology.** [First Edition]. Jaypee Brother's Medical Publishers Ltd., New Delhi		
2.	*Kanai. L. Mukherjee.* 2005. **Medical Laboratory Technology, Volume I.** Tata McGraw- Hill Publishing Co. New Delhi		

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Practice the safe laboratory processes and reagent preparations
CO2	Explain the general concepts of specimen handling methods and analysis of blood cells in clinical labs
CO3	Recite the handling and analytical procedures of urine and stool samples
CO4	Describe the general concepts and methods in diagnosis of clinical disorders
CO5	Perform various laboratory procedures to assess the functional status of the organs

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H,H	M,H	L,H	H,M	H,M
CO2	H,H	M,H	L,M	H,M	H,M
CO3	H,M	M,M	L,L	H,L	H,L
CO4	H,M	M,M	L,L	H,L	H,L
CO5	H,H	M,H	L,H	H,H	H,H

H-High; M-Medium; L-Low

18PBCMBIP201 / 18PBCBTIP201	**INTERDISCIPLINARY COURSE PRACTICAL I: DIAGNOSTIC BIOCHEMISTRY**	**SEMESTER – IV**

Course Objectives:

The Course aims

- To enable the students to develop practical knowledge in handling and testing the biological samples

Credits: 2 **Total Hours: 24**

S.No.	**EXPERIMENT**	**Hrs**	**CO**
I. Clinical haematology			
1.	Enumeration of WBC and RBC	3	1
2.	Estimation of haemoglobin (Sahli's method)	3	1
3.	Erythrocyte sedimentation rate (Westergren's method)	3	1
II. Blood analysis			
4.	Estimation of glucose in blood (Nelson Somogyi's method).	3	2
5.	Estimation of urea in blood (DAM method).	3	2
6.	Estimation of creatinine in blood (Jaffe's method).	3	2
III. Urine analysis			
7.	Estimation of creatinine in urine (Jaffe's method).	3	2
8.	Qualitative analysis of normal and abnormal constituents in urine	3	3

Reference Books

1. *Harold Varley*. 1980. **Practical Biochemistry. Volume I & II.** [Fifth Edition]. CBS Publishers, New Delhi

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Perform blood cell analysis procedures
CO2	Estimate the presence of metabolites in blood and urine
CO3	Use the tests to identify normal and abnormal constituents in urine by qualitative analysis

18PBCMBI301/ 18PBCBTI301	**INTERDISCIPLINARY COURSE II: PHARMACEUTICAL BIOCHEMISTRY**	**SEMESTER–III**

Course Objectives:

The Course aims

- To enable the students to learn about Pharmacodynamics and pharmacokinetics of drugs.
- To make the students aware of Plant therapeutics

Credits: 2 **Total Hours: 40**

UNIT	CONTENTS	Hrs	CO
I	**Drugs**: History of Drugs, Definition-Nomenclature. Classification of drugs based on their source – Plant, animal, mineral and synthetic, based on action. Routes of drug administration, Drug absorption- mechanism. Factors influencing drug absorption	**8**	**CO1**
II	Distribution and elimination of drugs. Factors influencing drug distribution and elimination. Mechanism of drug action- Physical, Chemical, Enzymes, Receptors. Drug-Receptor interactions: Receptor – Definition. Agonists, partial aganoists, inverse agonists and antagonists. Forces involved in drug-receptor interaction. Drug action not mediated through receptor. Dose response relationship (LD50 and ED50)	**8**	**CO2**
III	Adverse drug reactions- Definition, Classification and drug induced side effects, biological effects of drug abuse and drug dependence, drug tolerance and intolerance. Drug discovery- Animal toxicity studies and clinical evaluation Phase I-IV (Elementary details)	**8**	**CO3**
IV	Phytomedicine: History, Definition and Scope of Phytomedicine. Indian Medicinal systems– Ayurveda, Siddha and Unani. Medicinal properties and active principles of plant parts (leaves, flowers, roots, seeds, rhizome, bark etc). Role of medicinal and	**8**	**CO4**

	aromatic plants in national economy.		
V	Secondary metabolites of plants - Alkaloids, flavonoids and terpenoids, phenols – occurrence, distribution and functions. (Synthesis not required). Extraction of Phytopharmaceuticals or crude drugs – (Aqueous, Methonol and Chloroform extracts) maceration, percolation (soxhlet) extraction - Analysis of phytochemicals (carbohydrates, aminoacids, proteins, phenols, flavonoids, alkaloids tannins, glycosides, saponins and terpenoids).	**8**	**CO5**

Text Books

1. *Tripathi, K. D*. 1999. **Essentials of Medical Pharmacology.** [Fourth Edition]. Jaypee Brothers Medical Publishers, New Delhi **(UNIT - I, II & III).**

2. *Kokate, C. K., Purohit, A. P.* and *Gokhale, S.B.* 2007. **Pharmocognosy.** [Thirty Seventh Edition]. Nirali Prakasham, Pune. **(UNIT – IV & V)**

Reference Books

1. *Satoskar, R. S., Nirmala N. Rege* and *Bhandarkar S.D,* 2011. **Pharmacology and Pharmacotherapeutics** [Twenty-Second edition]. Popoular Prakashan Pvt Ltd, Mumbai

2. *Roseline, A.* 2011**. Pharmacognosy.** M.J.P Publishers, Chennai

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Describe the drug sources, classification and its pharmacodynamics
CO2	Explain the mechanisms of action and fate of drugs inside living organisms
CO3	Analyze the effects of adverse drug reactions
CO4	Appreciate the various medical systems that utilize phytoconstituents as medicines
CO5	Explore the new strategies in the development of efficient drugs to combat diseases from plants

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H,M	M,M	M,M	H,M	H,M
CO2	H,M	M,M	M,M	H,M	H,M
CO3	H,M	M,M	M,M	H,M	H,M
CO4	H,H	M,H	M,H	H,H	H,H
CO5	H,H	M,H	M,H	H,H	H,H

H-High; M-Medium; L-Low

18PBCMBIP301/ 18PBCBTIP301	**INTERDISCIPLINARY COURSE PRACTICAL II: PHARMACEUTICAL BIOCHEMISTRY**	**SEMESTER – III**

Course Objectives:

The Course aims

- To enable the students to understand the basic concepts in extraction, screening, quantification process of secondary metabolites

Credits: 2 **Total Hours: 24**

S.No.	EXPERIMENT	Hrs	CO
1.	Extraction of phytoconstituents of neem leaves using water and methanol as solvents- Maceration and Soxhlet extraction	3	1
2.	Preliminary phytochemical screening for the presence of following constituents (i) Carbohydrates (ii) Lipids (iii) Proteins and Amino acids (iv) Phenols (v) Flavonoids (vi) Anthraquinones (vii) Alkaloids (viii) Terpenoids (xi) Glycosides (x) Saponins	6	1
3.	Quantitative estimation of proteins (Lowry's method).	3	2
4.	Quantitative estimation of carbohydrates (Anthrone method).	3	2
5.	Quantitative estimation of phenols (Singleton and Rossi's method).	3	2
6.	Isolation and partial purification of phytoconstituents (Phenol and Flavonoids) using Chromatographic techniques (TLC)	6	2

Reference Books	
1.	*Kokate, C.K., Purohit, A.P.* and *Gokhsale, S.B.* 2008. **Phytochemical Methods.** Nirali Prakasham, Pune

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO1	Extract and screen the presence of various plant metabolites
CO2	Quantify the presence of biomolecules and secondary metabolites in samples