MASTER OF SCIENCE
BIOCHEMISTRY

SYLLABUS 2018-19

(OUTCOME BASED EDUCATION)

Dr. N.G.P. ARTS AND SCIENCE COLLEGE
(An Autonomous Institution, Affiliated to Bharathiar University, Coimbatore)
Approved by Government of Tamil Nadu and Accredited by NAAC with 'A' Grade (2nd Cycle)
Dr. N.G.P.- Kalapatti Road, Coimbatore-641048, Tamil Nadu, India
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MASTER OF SCIENCE IN BIOCHEMISTRY

ELIGIBILITY

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

PROGRAMME EDUCATIONAL OBJECTIVES:

1. Instill inquisitiveness in students to explore realms of modern biology (Molecular genetics, Marine biochemistry, Pharmaceutical biochemistry, and Immunology, Enzymology and Clinical biochemistry) through interdisciplinary cutting edge research.

2. Empower students to acquire, develop and demonstrate skills in bio-instrumentation, bio-statistical and bio-informatic software and tools, and in the fields of Industrial Biochemistry, and Nanotechnology and Cancer biology to meet the relevant demands of traditional and emerging industries.

SCHEME OF EXAMINATIONS (Choice Based Credit System- CBCS)

Course Code	Course	Hours of Instruction	Exam Duration (Hrs)	Max Marks			Credit Points
				CA	CE	Total	
First Semester							
17PBC13A	Biopolymers	4	3	25	75	100	4
17PBC13B	Bioinstrumentation	4	3	25	75	100	4
17PBC13C	Enzymes and Enzyme Technology	4	3	25	75	100	4
17PBC13D	Cellular Biochemistry	4	3	20	55	75	4
17PBC13E	Molecular Biology	4	3	20	55	75	4
17PBC13P	Practical-I: Biochemistry-I	6	6	40	60	100	3
	Elective-I	4	3	25	75	100	4
		30				**650**	**27**
II-Semester							
17PBC23A	Immunology and Immuno-techniques	5	3	25	75	100	4
17PBC23B	Microbial Biochemistry	5	3	25	75	100	4
17PBC23C	Metabolism and Metabolic Regulation	5	3	25	75	100	4
17PBC23D	Plant Biochemistry	5	3	25	75	100	4
17PBC23P	Practical-II: Biochemistry-II	6	6	40	60	100	3

20/12/19

BoS Chairman/HoD
Department of Biochemistry
Dr. N. G. P. Arts and Science College
Coimbatore – 641 048

Academic Council
Dr. N.G.P. Arts and Science College
Dr. V. Rajendran
CHAIRMAN

	Elective-II	4	3	25	75	100	4
		30				**600**	**23**
III-Semester							
18PBC33A	Biostatistics and Research Methodology	4	3	25	75	100	4
18PBC33B	Clinical Biochemistry	4	3	25	75	100	4
18PBC33C	Genetics and Genetic Engineering	4	3	25	75	100	4
18PBC33D	Hormonal Regulation and Signal Transduction	4	3	25	75	100	4
	Project	4	-	-	-		
18PBC33P	Practical-III: Biochemistry-III	6	6	40	60	100	3
	Elective-III	4	3	25	75	100	4
		30				**600**	**23**
Semester IV							
17PBC43V	Project	16	6	60	90	150	8
18PBC43A	Bio-ethics, Bio-safety and IPR	4	3	20	55	75	4
17PBC43P	Practical-IV Biochemistry-IV	6	6	30	45	75	3
	Elective-IV	4	3	40	60	100	2
	Total	**30**				**400**	**17**
	Grand Total	**120**				**2250**	**90**

LIST OF ELECTIVES

ELECTIVE – I

(Student shall select any one of the following **Course** as Elective-I in first semester)

S.No	Course Code	Name of the Course
1.	18PBT1EA	Biodiversity & Bioprospecting
2.	17PMB1EA	Principles of Quality Assurance
3.	17PBC1EA	Cancer: Biology, Diagnosis and therapy

ELECTIVE – II

(Student shall select any one of the following **Course** as Elective-II in second semester)

S.No	Course Code	Name of the Course
1.	18PBT2EA	Organic farming
2.	17PMB2EA	Pharmaceutical Quality Control
3.	17PBC2EA	Biochemistry of Toxicology

ELECTIVE – III

(Student shall select any one of the following subject as Elective-III in third semester)

S.No	Course Code	Name of the Course
1.	18PBT3EA	Stem Cell Technology
2.	17PMB3EA	Food Microbiology and Food quality control
3.	18PBC3EA	Nutrition and clinical nutrition

ELECTIVE – IV

(Student shall select any one of the following subject as Elective-IV in fourth semester)

S.No	Course Code	Name of the Course
1.	18PBT4EP	Practical-Applied Biotechnology
2.	18PMB4EP	Practical-Microbiological Laboratory Techniques
3.	18PBC4EP	Practical-Nutritional Science

Total Credit Distribution

Course	Credits	Total		Credits	Cumulative Total
Core	4	11x 100	1100	44	90
Core	4	3 x 075	225	12	
Core Practical	3	3 x 100	300	9	
Core Practical	1	1 x 75	75	3	
Project Work	8	1 x 150	150	08	
Electives	4	3 x 100	300	12	
Elective (practical)	2	1 x 100	100	02	
			2250	**90**	**90**

FOR PROGRMME COMPLETION

Students have to complete the following courses:

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

Earning Extra credits is not mandatory for programme completion

Extra Credits

S.No	Course	Credit	Total credits
1.	Publication with ISSN Journal	1	**1**
2.	Hindi/Other Foreign language	1	**1**
3.	Paper Presented in Sponsored National/ International Seminar/conference/ workshop	1	**1**
4.	Online Courses Prescribed By Department/ Self study paper	1	**1**
5.	Representation– Academic/Sports /Social Activities/ Extra Curricular Activities at University/ District/ State/ National/ International	1	**1**
Total			**5**

Rules:

The students can earn extra credit only if they complete the above during the programme period (I- to III-semester) and based on the following criteria. Proof of completion must be submitted in the beginning of IV-semester. (Earning Extra credits is not mandatory for programme completion).

1. Publication with ISSN Journal by a student and co-authored by staff member will be given one credit extra.
2. Student can opt Hindi/ French/ Other foreign Language approved by certified Institutions to earn one credit. The certificate (Hindi) must be obtained from **Dakshina Bharat Hindi Prachar Sabha** and He/ she has to enroll and complete during their programme period (I- to III-**semester).**
3. Award winners in Paper Presentation in Sponsored International Seminar/conference/Participation in short term workshop (minimum 5 days) will be given one credit extra.
4. Student can earn one credit, if they complete any one online certification courses/ Self study paper prescribed by the concerned department. List of online courses Prescribed by the Department: NPTEL, Spoken Tutorial, Khan academy, Course era.com and Udemy**.**
5. Award Winners in Social Activities/ Extra Curricular/ Co-Curricular Activities/ Representation in Sports at University/ District/ State/ National/ International level can earn one credit extra.

Self study paper offered by the Biochemistry Department

S. No.	Semester	Course Code	Course Title
1.	III	17PBCSS1	Inheritance Biology
2.		17PBCSS2	Evolution and Behaviour

PROGRAMME OUTCOMES (PO):

On successful completion of the programme, following are expected outcomes.

PO Number	PO Statement
PO1	Postgraduates are cognizant of progressive principles and concepts in diverse branches of modern biology that govern the integrity of dynamic bio-molecular assembly in varied life forms. Alumni are expressive of mastered wisdom to peers and public to expedite basic understanding of issues of social importance through practice and investigation.
PO2	Postgraduates are comprehensive of complex of biological systems, and they have broadened and perfected competency and skills in principal and contingent areas of modern biology. Thereby, alumni as an individual or as a team member can address, investigate, design, develop and demonstrate solutions to important issues facing humanity and preserve natural ecosystems.
PO3	Postgraduates are advantaged to identify and exploit functionally crucial areas in diverse branches of modern biology, and combine it with modern tools to investigate, design, develop, demonstrate and familiarize solutions to both basic and applied research questions in areas of industry, medicine, agriculture, pharmacy, food technology, biotechnology, etc. Alumni are valuable performers as an individual or in a team.
PO4	Postgraduates are competent to enroll in research programs and modeled to receptive of successful career options in diverse branches of modern biology as scholars, managers, counselors, writers, technical experts, field experts, teachers, entrepreneur and a responsible citizen.

	Alumni have acquired and developed skills to manage projects and finances as individual or as a team member. While discharging duties at varied capacities, postgraduates are inculcated to keep sustainable environment as a goal, and follow ethics of professional stature.
PO5	Postgraduates are infused with metamorphic qualities of education, and inspired to develop scientific temperament and lead a scientific way of life in facing socio-economical challenges that will benefit the society. Alumni are adept at evaluating their learning's to worldwide events. Thereby, they continue their learning lifelong.

17PBC13A	BIOPOLYMERS	SEMESTER-I

PREAMBLE:

- This course offers an overview of structural organization and functional properties of bio-molecules.
- Students can gain an in-depth knowledge and understanding on the structure and functions of biological important macromolecules.

COURSE OUTCOMES:

On successful completion of the course, students will be able to

CO number	CO Statement	Knowledge Level
CO1.	Examine the structure and functions of complex polysaccharides. Assess the importance of carbohydrate containing proteins, homo and heteropolysaccharides.	K_4 & K_5
CO2.	Determine the structure of protein. Explain elaborately the different structural levels of proteins	K_4 & K_5
CO3.	Value the importance of complex lipids. Infer the functions of saturated and unsaturated fatty acids	K_4 & K_5
CO4.	Give an opinion on the different forms of DNA& RNA. Explain various hypotheses.	K_4 & K_5
CO5.	Justify the structure and functions of	K_4 & K_5

	important Biological molecules. Explain the role of lipid peroxidation and antioxidant.	

MAPPING WITH PROGRAMME OUTCOMES:

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	**S**	**S**	**M**	**M**	**M**
CO2	**S**	**S**	**S**	**M**	**M**
CO3	**S**	**S**	**S**	**M**	**M**
CO4	**S**	**S**	**M**	**M**	**M**
CO5	**S**	**S**	**S**	**M**	**S**

L-Low; M-Medium and S-Strong.

17PBC13A	BIOPOLYMERS	SEMESTER-I

TotalCredits: 4
Hours per week: 4

CONTENTS

UNIT–I Biology of Sugars

Homo polysaccharides: Structure and biological functions of starch, cellulose, chitin, fructans, mannans, xylans, and galactans. Hetero polysaccharides: Structure and biological importance of sugar derivatives- glycosaminoglycans, proteoglycans. Glycoprotein – Blood group and bacterial cell wall polysaccharides, O- linked and N- linked oligosaccharides and Lectins.

UNIT-II Biology of Proteins

Primary structure- determination of amino acid sequence of proteins. The peptide bond: Ramachandran plot. Secondary structure- weak interactions involved- alpha helix and beta sheet and beta turns structure. Pauling and Corey model for fibrous proteins. Collagen triple helix. Super secondary structures- helix-loop-helix. Tertiary structure- alpha and beta domains. Quaternary structure- structure of hemoglobin. Solid state synthesis of peptides. Protein folding.

UNIT-III Biology of Lipids

Lipids- classification- saturated and unsaturated fatty acids, phospholipids- classification, structure and functions. Ceramides and sphingomyelins.Eicosanoids, Structure and functions of prostaglandins, thromboxanes, leukotrienes.Types and functions of plasma lipoproteins.

Amphipathic lipids- membranes, micelles, emulsions and liposomes. Steroids- cholesterol structure and biological role- bile acids, bile salts.

UNIT-IV Biology of Nucleic Acids

DNA double helical structure. A, B and Z forms of DNA. Triple and quadruple structures. Chemicals that react with DNA, DNA sequencing procedures- Maxam Gilbert method and Sanger's dideoxy methods. Renaturation and denaturation. DNA bending: The Wedge model and Junction model, Protein induced bending. Crucifrom DNA, Left handed DNA. Types of RNA, Secondary and tertiary structure of RNA.

UNIT-V Biology of Heterocyclic Compounds

Hetero cyclic rings of biologically important compounds. Structure and biological importance of pyridine, pyrole, quinolene, pyrimidine, purine, pteridine, thiazole, imidazole and indole ring containing compounds. Porphyrine - structure and biologically important compounds containing porphyin ring.

TEXT BOOKS:

1. *Nelson, D.L. and Cox, M.M. 2008.* **Lehninger Principles of Biochemistry,** 5th edition. W.H. Freeman and Company, New York.
2. *Rodwell, V.W., Bender, D.A., Botham, K.M., Kennelly, P. and Weil, P.A.* 2015. **Harper's Illustrated Biochemistry**, 30th edition. The McGraw-Hill Inc.
3. *Richard R Sinden,* 1994. **DNA Structure and Function,** Academic Press.

REFERENCE BOOKS:

1. Berg, J.M., Tymoczko, J.L., Gatto Jr, G.J. and Stryer, L. 2015. Biochemistry, 8th edition, W.H. Freeman and Company, New York.
2. *Geoffrey Zubay,*1993. **Biochemistry,** 3rd Edition.Wm.C.Brown Publishers.
3. *Voet, D. and Voe*t *J.G.* (2011). **Biochemistry,** 4th edition, John Wiley and Sons, New York.
4. *Garrett, R.H. and Grisham, C.M.* (2017). **Biochemistry,** 6th edition, Brooks/Cole Cengage Learning, Boston.

17PBC13B	BIOINSTRUMENTATION	SEMESTER-I

PREAMBLE:

- This course offers an overview of the scientific basis of instruments, the advantages and limitations of conventional and modern bio-analytical techniques.
- Students can gain an in-depth knowledge and understanding of the key analytical techniques used in the areas of Spectroscopy, Centrifugation, Microscopy, Chromatography, Electrophoresis, Biophysics and Radioisotopes.

COURSE OUTCOMES:

On successful completion of the course, students will be able to

CO number	CO Statement	Knowledge Level
CO1.	Distinguish the principles, instrumentation and applications of conventional and recent techniques in the field of spectroscopy. Explain the principle and importance of advanced analytical techniques like ESR, NMR and MS.	K4 & K5
CO2.	Distinguish the preparative and analytical ultracentrifugation techniques. Compare and contrast the principles, instrumentation, and applications of conventional and advanced microscopic methods.	K4 & K5

CO3.	Evaluate the advantages and disadvantages of ancient and recent techniques in chromatography.	K4 & K5
CO4.	Assess and explain the importance of different types of electrophoresis and blotting techniques.	K4
CO5.	Examine the different biophysical techniques like X ray diffraction, ORD and CD. Understand the basics of radioactivity and examine the benefits of using radio-isotopic techniques.	K3, K4 & K5

MAPPING WITH PROGRAMME OUTCOMES:

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	**S**	**S**	**M**	**S**	**S**
CO2	**S**	**S**	**M**	**S**	**S**
CO3	**S**	**S**	**M**	**S**	**S**
CO4	**S**	**S**	**M**	**S**	**S**
CO5	**S**	**S**	**M**	**S**	**S**

L-Low; M-Medium and S-Strong.

17PBC13B	BIOINSTRUMENTATION	SEMESTER-I

Total Credits: 4
Hours per week: 4

CONTENTS

UNIT–I Spectroscopic techniques

Principle, instrumentation and applications of UV-Visible, IR, Fluorescence spectrophotometry, Colorimetry, Turbidimetry, Luminometry and Flame emission spectrometry. Principle and applications of Electron Spin Resonance, Nuclear Magnetic Resonance, Mass and Raman Spectroscopy.

UNIT- II Centrifugation techniques and Microscopy

Principle, technique and applications of preparative ultracentrifugation-differential centrifugation, density gradient centrifugation (caesium chloride and sucrose density gradients) and analytical ultracentrifugation.

Basic principles, instrumentation and applications of Light, Compound microscope, Fluorescence microscopy, Phase contrast microscopy, Scanning electron microscopy (SEM), Transmission electron microscopy (TEM) and Confocal microscopy.

UNIT- III Chromatographic techniques

Principle, technique and applications of paper, TLC, HPTLC, column, affinity, ion-exchange, gel filtration, hydrophobic interaction and adsorption chromatography. Principle, components, limitations and applications of GC, GC-MS, HPLC, RP-HPLC and FPLC.

UNIT- IV Electrophoresis and Blotting techniques

Principle, technique and applications of paper, gels - Agarose, Native and SDS-PAGE, 2D PAGE, Isoelectric focusing, Denaturing gels for RNA, Urea-PAGE, Electrophoresis in DNA sequencing, Peptide mapping, N-terminal sequencing of proteins, Next generation sequencing.

Principle, technique and applications of western, southern and northern blotting. Chemiluminescence and Phosphorimaging.

UNIT- V Biophysical and Radio-isotopic methods

Principles and applications of X-ray diffraction, ORD and circular dichroism. Radioisotopes in Biochemistry, Types of radiation, half-life and units of radioactivity, Detection and measurement of radioactivity– Principle, instrumentation and applications of Liquid scintillation counter and Geiger-Muller counter. Autoradiography and its applications.

TEXT BOOKS:

1. *Boyer R. F,* 2012. **Modern experimental biochemistry,** 3rd edition, Pearson Education Inc and Dorling Kindersley Publishers.
2. *Sheehan D,* 2009. **Physical Biochemistry – Principles and Applications,** 2nd edition, John Wiley and Sons.
3. *Wilson and Walker,* 2010. **Principles and Techniques of Biochemistry and Molecular Biology,** 7th edition, Cambridge University Press.
4. *PelczarJr, Chan and Krieg* 2012. **Microbiology,** 5th edition, Tata McGraw Hill.

REFERENCE BOOKS:

1. *Sawhney and Singh,* 2015. **Introductory Practical Biochemistry**, 11th edition, Narosa Publishing house.
2. *Cooper T. G,* 2011. **The tools of Biochemistry**, John Wiley and Sons**.**
3. *Srivastava S,* 2010. **Molecular Techniques in Biochemistry and Biotechnology**, 1st edition, New Central Book Publishers.

17PBC13C	ENZYMES AND ENZYME TECHNOLOGY	SEMESTER-I

PREAMBLE:

- This course offers an overview on activity and kinetics of enzymes, their mechanism of action and regulation, and prospect of enzymes utilization.
- Students can gain an in-depth knowledge and understanding on methods of enzymes isolation and purification; enzyme kinetics and regulation, and applications of enzymes in fields of industry, agriculture and medicine.

COURSE OUTCOMES:

On successful completion of the course, students will be able to

CO number	CO Statement	Knowledge Level
CO1.	Examine the structural and functional properties of enzymes. Experiment methods of enzymes isolation and purification. Measure the enzyme activity.	K3, K4 & K5
CO2.	Understand and prove the kinetics of enzyme-mediated reactions. Distinguish different types of enzyme inhibition and its kinetics. Solve simple problems related to enzyme kinetics.	K4 & K5

CO3.	Evaluate the enzyme specificity. Determine the mechanism of enzymes action. Understand the regulation of enzyme activity.	K4 & K5
CO4.	Describe elaborately how enzymes can be used in industry. Value the importance of enzymes in clinical diagnostics and therapeutics.	K4 & K5
CO5.	Develop immobilized enzymes using different methods and appraise its applications. Propose a minor project on enzyme isolation, purification and application.	K4, K5 & K6

MAPPING WITH PROGRAMME OUTCOMES:

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	**S**	**S**	**S**	**M**	**M**
CO2	**S**	**S**	**S**	**S**	**S**
CO3	**S**	**S**	**S**	**S**	**S**
CO4	**S**	**S**	**S**	**S**	**S**
CO5	**S**	**S**	**S**	**S**	**S**

L-Low; M-Medium and S-Strong.

17PBC13C	ENZYMES AND ENZYME TECHNOLOGY	SEMESTER-I

Total Credits: 4
Hours per week: 4

CONTENTS

UNIT–I Classification, Purification and Active Site

Nomenclature and classification of enzymes, isolation and purification of enzymes- by different methods, criteria of purity- specific activity. Multi-enzyme complex-occurrence, isolation and properties. Measurement of enzyme activity- two point assay, kinetic assay, using radio-labelled substrates. Active site- determination of active site amino acids- chemical probe, affinity label, and site-directed mutagenesis, intrinsic and extrinsic regulations. Structure of active site investigation. Coenzymes and cofactors in enzyme catalyzed reaction.

UNIT-II Enzyme Kinetics and Inhibition

Kinetics of single substrate enzyme- catalysed reactions- Michaelis-Menten equation, importance of V-max, Km, MM equation, and turnover number; Lineweaver- Burk plot, Eadie- Hofstee plot, Hanes- Woolf plot and Eisenthal and Cornish - Bowden plot. Kinetics of Allosteric enzymes-MWC and KNF models Hill' equation coefficient. Sequential and non-sequential bisubstrate and multi-substrate reactions. Enzyme inhibition-types and kinetic differentiation. Simple problems related to enzyme kinetics.

UNIT-III Mechanism of Enzyme Action and Regulation

Enzyme specificity, Mechanism of enzyme action- general acid-base catalysis, covalent catalysis, proximity and orientation effects, role of metal ion in enzyme catalysis, mechanism of serine proteases-

chymotrypsin, lysozyme, and ribonuclease. Metal activated enzymes and metalloenzymes. Role of metal ions in carbonic anydrase, superoxide dismutase, carboxy peptidase. Regulation of enzyme activity-covalently modified regulated enzymes, allosteric enzymes, isozymes.

UNIT-IV Industrial and Clinical Uses of Enzymes

Enzymes applications in food and allied industries- sources of industrial enzymes, thermophilic enzymes, amylases, glucose isomerases, cellulose degrading enzymes, lipases, proteolytic enzymes in meat and leather industry, detergents and cheese production.

Clinical enzymology- Enzymes as thromblytic agents, anti-inflammatory agents, digestive aids. Therapeutic use of asparginase, streptokinase. Enzymes and isoenzymes in diagnosis- LDH, CK, transaminases, phosphateases, amylase and cholinesterase.

UNIT-V Immobilized Enzymes and Biosensors

Immobilized enzymes-various methods of immobilization, kinetics and applications of immobilized enzyme. Enzymes as diagnostic reagents. Biosensors: Principle, technique and mechanism of Biosensors. Calorimetric biosensors, potentiometric biosensors, Amperometric biosensors, optic biosensors, and immune-sensors. Enzyme engineering: Artificial enzymes. Antioxidant enzymes.

TEXT BOOKS:

1. *Palmar, T. 2004.* **Understanding enzymes,** 1st edition, East West Press Pvt. Ltd., New Delhi.
2. *Bhatt S.M.* 2014. **Enzymology and Enzyme technology**, 15th edition, S. Chand publishing Ltd, New Delhi.
3. *Nelson, D.L. and Cox, M.M. 2008.* **Lehninger Principles of Biochemistry,** 5th edition. W.H. Freeman and Company, New York.
4. *Asokan P.* 2006. **Enzymes**, 1st edition, Chinnaa publications.
5. *Choudhary, N.L. and Singh, A.* 2012. **Fundamentals of Enzymology**, 1st edition, Oxford Book Company.

REFERENCE BOOKS:

1. *Palmer, T. and Bonner, P.L.* 2004. **Enzymes: Biochemistry, Biotechnology, Clinical chemistry**, 1st edition, East West Press Pvt. Ltd., New Delhi.
2. *Price, N.C. and Stevens, L.* 1999. **Fundamentals of Enzymology**, 3rd edition, Oxford University Press.
3. Berg, J.M., Tymoczko, J.L., Gatto Jr, G.J. and Stryer, L. 2015. **Biochemistry**, 8th edition, W.H. Freeman and Company, New York.
4. *Voet, D. and Voe*t *J.G.* (2011). **Biochemistry,** 4th edition, John Wiley and Sons, New York.

17PBC13D	CELLULAR BIOCHEMISTRY	SEMESTER-I

PREAMBLE:

- This course offers an overview on cellular organization and function.
- Students can gain an in-depth knowledge and understanding on cellular transport, communication, division, death and cancer.

COURSE OUTCOMES:

On successful completion of the course, students will be able to

CO number	CO Statement	Knowledge Level
CO1.	Distinguish the composition and orientation of macromolecules constituting bio-membranes. Explain methods and models to investigate bio-membranes structure and function.	K4 & K5
CO2.	Distinguish various types of transport system in cells. Compare and contrast different transport process in cells.	K4 & K5
CO3.	Evaluate pathways of energy generation and utilization, cytoskeleton organization in a cell.	K4 & K5
CO4.	Assess and explain molecules of cellular integration and pathways of cellular communication.	K4
CO5.	Examine cell division events and process of cell death. Understand events leading to cellular transformation.	K3, K4 & K5

MAPPING WITH PROGRAMME OUTCOMES:

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	M	M
CO2	S	S	S	M	M
CO3	S	S	S	M	M
CO4	S	S	S	M	M
CO5	S	S	S	M	M

L-Low; M-Medium and S-Strong.

17PBC13D	CELLULAR BIOCHEMISTRY	SEMESTER-I

Total Credits: 4
Hours per week: 4

CONTENTS

UNIT-I Membrane Biology

Bio-membrane structure- fluid mosaic model; Membrane lipids- fluidity, Asymmetry phase transition, Liposomes, Scott Syndrome. Membrane proteins- Types, Orientation, Mobility- Experiments, flippases, proteins or RBC membrane, Bacteriorhodopsin, Porins-aquaporin. RBC ghosts, solubilisation of proteins, lipid anchored proteins. Carbohydrates- cell surface carbohydrates-Lectins.

UNIT-II Membrane Transport

Membrane transport- Overview, Passive diffusion, Facilitated diffusion in erythrocytes. Carriers and Ion-Channels. Ion cone. Gradients. Uniporter Catalyzed transport. Active transport systems. Transport process driven by ATP-Ion Pumps:Calcium, APT ase; Na^+K^+ATPase; Mechanism, Gastric H^+K^+ATP ase; Mechanism, Gastric H^+K^+ ATP ase, ATP ases that transport peptides and drugs. ABC superfamily- Bacterial PM permeases, Mammalian MDR proteins: Transport process driven by light and ion gradients. Co-transport by Symporters and antiporters. Group translocation Osmosis and Receptor mediated endocytosis.

UNIT-III Cell Energetics and Cytoskeleton

Mitochondria- Reduction potentials, electron transport chain Overview, Complexes, Q-cycle, Cyt-C oxidase complex, Translocation of Protons and the establishment of a proton, motive force Machinery for ATP formation. Chemi-osmotic mechanism, APT Synthase Experiments,

inhibitions of OP. Uncouplers. Microfilaments- Action- Structures, Assembly, Myosin. Microtubules- Organization and dynamics, Kinesin and dynem. Cilia and Flagella- Structure and functions, Intermediary fi1aments. Striated muscle- structure, excitation- contraction.

UNIT- IV Cellular Integration

Cell-Cell and Cell-matrix adhesion: An overview.Cell-Cell, interaction: ECM; Collagen, hyaluronan&proteolycans, laminin, integrins and fibronectins. Cell-Cell adhesion:

Specialised junctions- Desmosomes, Gap junctions, Adhesion molecules-Cadherins-Connexins. Cell-Cel1 signaling- Signaling molecules and their receptors: functions of cell surface receptors, pathways of intracellular signal transduction, second messengers. (G-protein coupled receptors, receptor tyrosine kinases. Ras. MAP kinases.

UNIT-V Protein Transport and degradation

Protein targeting: post-translational modifications in prokaryotes and eukaryotes, role of signal peptide, role of endoplasmic reticulum (protein targeting- signal sequence hypothesis, targeting of proteins to different compartment of mitochondria, ER, plasma membrane, lysosomes, peroxisomes and chloroplast) translocation, heat shock proteins, molecular chaperons, glycosylation, SNAPs and SNAREs, bacterial signal sequences, mitochondrial, chloroplast and nuclear protein transport, endocytosis-viral entry, ubiquitin TAG protein destruction.

TEXT BOOKS:

1. *Rodwell, V.W., Bender, D.A., Botham, K.M., Kennelly, P. and Weil, P.A*. 2015. **Harper's Illustrated Biochemistry**, 30th edition. The McGraw-Hill Inc.
2. *Verma, P.S.* and *Agarwal, V.K*. 2014. **Cell Biology, Genetics, Molecular Biology**, **Evolution and Ecology**, 1st edition, S. Chand and Company Limited, New Delhi.
3. *Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K. and Walltre, P.* 2015. **Molecular Biology of the cell**, 6th edition, Taylor and Francis Company.
4. *Kar, G., Iwasa, J. and Marshall, M. 2016*. **Karp's Cell and Molecular Biology: Concepts and Experiments,** 8th edition, John Wiley and Sons, USA.

REFERENCE BOOKS:

1. *Harvey Lodish, Arnold Berk, Paul Matsudaira, Chris A. Kaiser, Monty Krieger, Matthew P. Scott, Lawrence Zipursky, and James Darnell*. 2016. **Molecular Cell Biology** 8th edition, WH Freeman and Company, New York.
2. *Cooper*, *G.M. and Hausman, R.E.* 2007. **The Cell: A Molecular Approach,** 4th edition, Sinauer Associates, Inc., USA.

17PBC13E	MOLECULAR BIOLOGY	SEMESTER-I

PREAMBLE:

- This course offers an overview of basic structure and functioning of genetic materials.
- Students can gain an in-depth knowledge and understanding of mechanism of DNA replication, repair, transcription, and protein synthesis and gene regulation at the molecular level.

COURSE OUTCOMES:

On successful completion of the course, students will be able to

CO number	CO Statement	Knowledge Level
CO1.	Compare experimental evidences that proved DNA as the genetic material. Explain evidences that support duplication of DNA in pro- and eukaryotes.	K3, K4 &K5
CO2.	Justify and value the machineries that perform transcriptional and post-transcriptional events in pro-and eukaryotic cells.	K4&K5
CO3.	Explain and judge the importance of genetic code in translational and post-translational processes both in pro- and eukaryotes.	K4& K5
CO4.	Determine protein targeting to different compartments of eukaryotic cells. Propose a research project on heat shock proteins and molecular chaperons. Discuss about gene expression and regulation.	K5 &K6
CO5.	Discuss elaborately on theoretical aspects of mutagenesis. Develop a research project on cancer biology.	K5 &K6

MAPPING WITH PROGRAMME OUTCOMES:

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	S	S
CO2	S	S	M	S	S
CO3	S	S	M	S	S
CO4	S	S	S	S	S
CO5	S	S	S	S	S

L-Low; M-Medium and S-Strong.

17PBC13E	MOLECULAR BIOLOGY	SEMESTER-I

Total Credits: 4
Hours per week: 4

CONTENTS

UNIT-I Chromosome Structure

Eukaryotic and Prokaryotic chromosomes: structure, banding pattern, c-value, complexity heterochromatin, centromere, nuclear organizer, telomeres, Kinetic complexity of DNA, cot curve, and classes of DNA sequences. Structure of nucleosome, histones, non-histone proteins, and their properties, role of histones in chromatin folding, concept of gene. Evidences for DNA as genetic material: Types of replication, Demonstration of evidence for semi conservative replication- Meselson and Stahl experiment.

UNIT-II Replication and Recombination

Replication in prokaryotes: replications in circular chromosomes- Cairns model, rolling circle model. Inhibitors of replication, replication in RNA virus, plasmid replication, retroviruses, temporal control of replication. Eukaryotic replication. DNA recombination: Homologous, site specific and transposition, Homologous recombination: Holliday Model, Messelsson- Radding Model, Rec BCD pathway. Site-specific recombination: Lambda phage integration, and excision rearrangement, of immunoglobulin genes. Transposition: Prokaryotic transposition, conservative and replicative transposition. Eukaryotic transposable elements, yeast and Drosophila transposons.

UNIT-III Transcription

Transcription- definition, coding strand, template strand, sense strand and antisense strand, promotor, foot-printing experiment, DNA-dependent RNA polymerase, role of Prinbnow box, template binding, prokaryotic transcription, Rho-dependent and independent transcription, posttranscriptional processing in prokaryotes, alternative splicing, RNA editing. Eukaryotic transcription, post-transcriptional modifications of eukaryotic RNAs, RNA splicing, introns and splicing reactions, exons, spacer sequences, enhancers. Transcriptional regulation in eukaryotes-hormonal (steroid hormone receptors), phosphorylation (Stat proteins).

UNIT-IV Translation and gene regulation

Genetic code- definition, deciphering of the genetic code, codon dictionary, salient features of genetic code. Structure of t-RNA, activating enzymes, binding of amino acids to t-RNA, wobble mechanism and its significance, composition of prokaryotic and eukaryotic ribosomes, leader region, Shine-Dalgarno sequence, reading frame-shift, prokaryotic and eukaryotic protein biosynthesis- initiation, elongation, translocation and termination, polysomes. Inhibitors of protein synthesis. Gene expression and regulations, molecular mechanism of regulation, prokaryotes-operon model, lac, trp, arabinose operons, repression and attenuation, eukaryotes- C-value paradox, repetitive DNA, gene dosage and gene amplifications.

UNIT-V DNA Damage and Repair

Mutagenesis and replication fidelity, numerical mutations involving full chromosome set - causes, structural chromosome mutations- balanced and unbalanced- causes, karyotype mixing, misincorporation of

nucleotides during DNA synthesis, transient and spontaneous chemical changes in DNA, frameshift mutagenesis, DNA damage- different types, DNA repair - direct reversal repair, direct repair of nicks, excision repair, nucleotide excision repair, mismatch repair, long and short patch mismatch repair, recombination error, SOS response and mutagenic repair.

TEXT BOOKS:

1. *Verma P.S.* and *Agarwal V.K.* 2014. **Cell Biology, Genetics, Molecular Biology**, **Evolution and Ecology**, S. Chand Publications, New Delhi.
2. *Kar, G., Iwasa, J. and Marshall, M. 2016*. **Karp's Cell and Molecular Biology: Concepts and Experiments,** 8th edition, John Wiley and Sons, USA.
3. *Voet, D. and Voe*t *J.G.* 2011. **Biochemistry,** 4th edition, John Wiley and Sons, New York.

REFERENCE BOOKS:

1. Robert, F. 2005. **Molecular biology**, 3rd edition, McGraw-Hill.
2. Twyman, R.M. 1998. **Advanced molecular biology,** 2nd edition, Viva Books Pvt Ltd., New Delhi.
3. Lewin, B. (2000). **Genes VII**, Oxford University Press, Cell Press, London.
4. *Cooper*, *G.M. and Hausman, R.E.* 2007. **The Cell: A Molecular Approach,** 4th edition, Sinauer Associates, Inc., USA.

17PBC13P	PRACTICAL-I: BIOCHEMISTRY-I	SEMESTER-I

Total Credits: 3
Hours per week: 6

PREAMBLE:

- This course offers an overview of experimental aspects involving biomolecules, cell biology, enzymes and molecular biology.
- Students can gain an in-depth knowledge and understanding on isolation and characterization of biomolecules, proteins, nucleic acids, enzymes and cells in a laboratory environment.

CONTENTS

Biopolymers:

1. Isolation and estimation of starch from potato.
2. Isolation and estimation of cholesterol from egg yolk.
3. Isolation and estimation of casein from milk.
4. Isolation and estimation of DNA and RNA from goat liver (genomic) and Bacteria (plasmid) (Spectrophotometric, DNA by DPA and RNA by orcinol).

REFERENCE:

1. 1. **An introduction to Practical Biochemistry, 3rd Edition, 1988**. By David T. Plummer Tata McGraw-Hill Education.
2. **Lab Manual in Biochemistry, Immunology and Biotechnology, 2008.** By Arti Nigam. Tata McGraw-Hill Education (India).

Cell Biology:

1. Observation of prokaryotic and eukaryotic cells with the help of light microscope.
2. Cell counting and viability (Yeast/Bacteria).
3. Mitosis and cell cycle in Onion root-tip cell.
4. Determination of osmotic fragility of a cell (Goat RBC).

REFERENCE:

1. **The World of the Cell**, **8th Edition, 2012**. By Becker WM, Kleinsmit LJ, Hardin J and Bertoni GP. Pearson/Benjamin-Cummings, Boston, USA.

Molecular Biology:

1. Agarose gel electrophoresis of genomic and plasmid DNA.
2. Restriction digestion of DNA (genomic and plasmid).
3. Denaturation (thermal) of DNA and UV absorption studies (demonstration).
4. PCR Technique (demonstration).
5. Determination of N- and C-terminal amino acids (demonstration).
6. Desalting of proteins by dialysis.
7. Proteins separation or purification by gel filtration using sephadex G-25.

REFERENCE:

1. **Molecular Cloning: a laboratory manual vol-1, 2 & 3, 2001**. By Sambrook J & Russell D.W. CSHL Press.

Enzymes: Cellulase

1. Estimation of enzyme activity.
2. Effect of pH on enzyme activity.
3. Effect of Temperature on enzyme activity.
4. Effect of substrate concentration on enzyme activity.
5. Determination of K_m & V_{max} of an enzyme.
6. Enzyme inhibition studies.

REFERENCE:

1. **Practical Enzymology, 2nd edition, 2012**. By Bisswanger H. John Wiley & Sons.

Suggested Readings:

1. **Methods in Enzymology,** Vol. I and II. By S.P.Colowick and N.O.Kaplan eds.
2. **Basic Biochemical Methods,** 2nd ed. By R.R.Alexander and J.M.Griffith.
3. **Hawk's Physiological Chemistry**. By Bernard L Oser.
4. **An Introduction to Practical Biochemistry.** By David T. Plummer.
5. **Laboratory Manual in Biochemistry.** By S. Jayaraman.
6. **Practical Biochemistry.** By Clarke and Switzer.
7. **Methods in Enzymatic analysis**, Vol I-III. By Bergmeyer H.U.

18PBT1EA	ELECTIVE- I: BIODIVERSITY & BIOPROSPECTING	SEMESTER – I

Total Credits: 4
4 Hours / Week

Preamble

1. To learn the importance of biodiversity and various methods of conservation.
2. To identify the Bioprospecting potentials of available natural resources.

Course Outcomes:

On successful completion of the course, students will be able to:

CO Number	CO Statements	Knowledge Level
CO1	To understand about the biodiversity species, conservation methods of the species then organization involved for the conservation	K3, K4, K5
CO2	Elucidate the Biodiversity Data Requirements, Web Resources for Biodiversity Informatics and Major Bioinformatic Resources	K4, K5
CO3	Focus on Major areas of Bio-prospecting and Natural products from plants	K3, K4, K5
CO4	Elucidate Screening for bioactive compounds and highlight drug discovery and product development	K4, K5
CO5	To understand the role of various techniques in drug development and regulatory legislation in Bioprospecting	K3, K4, K5

Mapping with Programme Outcomes

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	S	M	M	M	M
CO2	S	S	M	M	M
CO3	S	S	S	S	M
CO4	S	S	S	S	S
CO5	S	S	S	S	S

S-Strong: M-Medium; L-Low

18PBT1EA	ELECTIVE- I: BIODIVERSITY & BIOPROSPECTING	SEMESTER – I

Total Credits: 4
4 Hours / Week

CONTENTS

UNIT-I
Biodiversity

*Biodiversity – definition, history, mapping and Human impacts, maintaining biodiversity. **Organizations involved for Conservation in India**- ENVFOR, AWBI, CEEINDIA, ENVIS, NBA, NCF – INDIA, NBPGR and WWF - INDIA. **Sustaining Biodiversity-** The Species and Ecosystem Approach, Sustaining Aquatic Biodiversity.

Case Studies: Cockroaches: Nature's Ultimate Survivors, Where have all the honey bees gone?

UNIT-II
Biodiversity Data Requirements

*Botanical Survey of India, Zoological Survey of India, National Parks, Wildlife Sanctuaries, Parks and Zoos. **Biodiversity Data Requirements-** Taxonomic and Historical Data – Museum and Herbarium, Molecular Data- Geonomics and Barcode Data. Spatial datasets. Data Standards: TDWG, DELTA, Darwin core, Barcode Data Standards. Indian Biodiversity Portal. **Web Resources for Biodiversity Informatics-** GBIF, Catalogue of Life, OBIS, MANIS, COP, UNEP-WCMC, ITIS, FAO, GLCF, NCBI Taxonomy, IBIS.

Case Studies: New trends in biodiversity informatics (particulate any one kind of species).

UNIT-III
Bio-prospecting

*Bio prospecting-definition, history, values of Bioresources and current Practices **Major areas of Bio-prospecting:** Chemical prospecting, Bionic prospecting and Gene prospecting. Bioresources mapping, inventorisation and monitoring of biological diversity. Biodiversity prospecting – the INBio experiences, contracts for Bioprospecting. **Natural products from plants:** Antitumor agents, Cardiotonics, Antiinflammatory drugs, Antimalarial drugs and analgesic drugs.

Case Study: Antimalarial and Antiinflammatory drugs from natural sources.

UNIT-IV

Screening for bioactive Compounds

Antimicrobials, Bioprospecting for industrial enzymes, plant growth promoting agents, Bioprospecting novel antifoulants and anti-biofilm agents from microbes. Bioprospecting of marine organisms. **Drug discovery and product development:** Discovery from traditional medicine. Modern tools in drug discovery.

Case Study: Antimicrobial drugs from marine sources.

UNIT-V

Role of techniques in drug analysis

*HPLC, GC - LC and GC Mass spectrometry, FTIR, NMR. Product development procedures and policies. **Regulating Bioprospecting:** Rules and regulations in patenting of products. Approval and IPR. Drug R&D and the structure of the industry, International policy dimensions of Bioprospecting, Transaction costs and their impact on the market for Bioprospecting, Intellectual property rights on traditional medicinal knowledge, Scope.

Case Study: Analysis of Traditional medicine for therapeutic purpose

(Note;*Self study)

TEXT BOOKS:

1. *Alan T. Bull.*2004. **Microbial Diversity and Bioprospecting.** ASM Press.
2. *Kevin J. Gaston, John I. Spicer*. 2004. **Biodiversity: An Introduction.** Second Edition. Blackwell Publishing Company.

REFERENCE BOOKS:

1. *Londa Schiebinger.* 2007. **Plants and Empire - Colonial Bioprospecting in the Atlantic World.** 1st Edition. Harvard University Press.
2. *Vanessa Sunkel*. 2010. **Marine Bioprospecting and Natural Product Research.** LAP Lambert Academic Publishing.
3. *Russell Paterson, Nelson Lima.* 2017. **Bioprospecting - Success, Potential and Constraints**. Springer International Publishing *Padmashree Gehl Sampath.* 2005. **Regulating Bioprospecting:**

Institutions for drug research, access, and benefit-sharing. United Nations University Press.

4. *G. Tyler miller, Jr, Scott E. Spoolman*. 2007. **Essentials of Ecology**. Fifth Edition. Yolanda Cossio Publishers

17PMB1EA	ELECTIVE I- PRINCIPLES OF QUALITY ASSURANCE	SEMESTER – I

PREAMBLE:

To understand the quality assurance in microbiology laboratory, role of quality assessment in diagnostic procedures and significance of quality management and standards.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	• Knows the definition of quality assurance, able to design microbiology laboratory and control of quality.	K2
CO2	• Understands the quality assessment of laboratory environments and able to maintain records and reports.	K2
CO3	• Importance of quality assessment in sterilization and disinfection, preservation and quality control of media and stains.	K2
CO4	• Elucidates the quality assessment of disposal on decontaminated matters and gains knowledge o=n biological references and standards.	K2
CO5	• Clearly able to categorize good laboratory practices with management of laboratory hazards and first aid procedures.	K2

MAPPING WITH PROGRAMME OUTCOMES

CO5/ PO5	PO1	PO2	PO3	PO4	PO5
CO1	M	M	S	S	S
CO2	M	M	M	S	S
CO3	M	S	S	S	S
CO4	M	M	M	S	S
CO5	S	M	S	S	S

S-Strong, M-Medium, L-Low

17PMB1EA	ELECTIVE I- PRINCIPLES OF QUALITY ASSURANCE	SEMESTER – I

Total Credits: 4

Hours per week: 4

CONTENTS

UNIT - I

Quality assurance – Introduction and overview – Definition. Designing of microbiology laboratory – Control of quality – Applications.

UNIT - II

Quality assessment of Equipments, chemicals, glass wares and laboratory environments – Quality management – Maintenance of records and reports.

UNIT - III

Quality assurance in sterilization and disinfection - Preservation of stock cultures, media and diagnostic kits – Quality control of media and stains.

UNIT - IV

Quality assessment of disposal – decontaminated matters and other biological effluents – Quality management in transportations of cultures. National control of biologicals – Biological references and standards.

UNIT - V

Good laboratory practices – Management of laboratory hazards and knowledge in First aid procedures.

TEXT BOOKS:

1. *Rajesh Bhatia and Rattan lalIchhpujani*. 1995. I ed. "**Quality assurance in Microbiology".**
2. *Anne. A. Hurley.* 2001. **Principles of Quality Control.** John Wiley and sons**.**

17PBC1EA	ELECTIVE-I: CANCER: BIOLOGY, DIAGNOSIS AND THERAPY	SEMESTER-I

PREAMBLE:

- This course offers an overview on cancer, mutations causing cancer, repair mechanism and multiples of diagnostic and treatment methods for cancer.
- Students can gain an in-depth knowledge and understanding on the basic principles of cancer development and available therapeutic approaches.

COURSE OUTCOMES:

On successful completion of the course, students will be able to

CO number	CO Statement	Knowledge Level
CO1.	Compare and contrast benign and malignant tumors. Explain morphological characteristics of cancer cells.	K4 & K5
CO2.	Justify molecular basis of the cancer. Distinguish interdisciplinary areas in cancer biology. Elaborate the carcinogenetic process.	K4, K5 & K6
CO3.	Discuss about molecular mechanism of oncogenesis and tumor biology. Compare and explain the role of cell cycle in cancer. Value the importance of nutrition given to cancer patients.	K4, K5 & K6
CO4.	Judge the role of tumor suppressor genes and apoptosis. Elaborate on epigenetics.	K5 & K6
CO5.	Elaborate on the choice of diagnosis and therapy available for cancer patients.	K5 & K6

MAPPING WITH PROGRAMME OUTCOMES:

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	S	S
CO2	S	S	M	S	S
CO3	S	S	S	S	S
CO4	S	S	M	S	S
CO5	S	S	S	S	S

L-Low; M-Medium and S-Strong.

17PBC1EA	ELECTIVE-I: CANCER: BIOLOGY, DIAGNOSIS AND THERAPY	SEMESTER-I

Total Credits: 4
Hours per week: 4

CONTENTS

UNIT-I Introduction

Introduction: Cancer cell-morphology and growth characteristics. Types of growth-hyperplasia, dysplasia, anaplasia and neoplasia. Types and prevalence of cancer. Nomenclature of neoplasms, classification based on origin/organ. Differences between benign and malignant tumors.

UNIT-II Carcinogenesis

Cancerepidemiology. Cancer endocrinology. Cancercausing agents-radiation, viruses, chemicals. Multistep carcinogenesis: Initiation, Promotion, Progression. Para-neoplastic syndromes. Mutation- definition, significance, rates and frequency. Mutagenic agents. Molecular basis of mutagenesis, induced and spontaneous mutations, crossing over and segregation. Various types of mutations- addition, deletion, inversion, reciprocal, translocation, insertional translocation and frame-shift mutations. Chemical carcinogenesis- genetic and epigenetic carcinogens, pro-carcinogens and co-carcinogens, promoters and initiators, testing for carcinogenecity, Ames test. Cancer biology and biochemistry-aberrant metabolism during cancer development.

UNIT-III Tumor Markers and Signal Transduction

Oncogenes- RNA and DNA tumor viruses, retroviruses and viral oncogenes. Src and Ras gene, mechanism and characteristic of cell transformation. Molecular mechanism of oncogenesis- proto oncogenesis, oncogene, oncoproteins, tumour suppressor genes involved in cancer.

Tumormarkers; cellular proto-oncogenes-oncogene activation. Radiation-effect of ionising radiations on DNA, chromosomal aberrations. Genetic basis of cancer, metastasis, use of tumor markers in detection and monitoring of cancer**.** Signal transduction in cancer: cell- cell interactions, cell adhesion-invasion and metastasis - VEGF signaling and angiogenesis; role of transcription factors. Growth factors-EGF, TNF-α and TGF-β and growth factor receptors. Free radicals and antioxidants in cancer. Diet and cancer.

UNIT-IV Cell Cycle, Cell Death and Cancer

Cell Cycle Regulation cancer: control of the cell cycle-cyclins and CDKs, and tumor suppressor genes p53, p21 Rb, BRACA1 and BRACA2. Telomeres, and Immortality; Epigenetics- role of DNA methylation in gene silencing- epigenetic silencing of tumor-suppressor genes. Role of DNA-methylation in gene silencing-epigenetic silencing of tumor-suppressor genes; Death-signaling pathways-mitochondrial and death receptor pathways, apoptosis and cancer (Intrinsic and extrinsic pathways). Mechanism of apoptosis. Impact of apoptosis on oncogenesis. Principles and methods of cancer diagnosis-biochemical, genetic, cytotoxic, cell growth and viability tests.

UNIT-V Cancer Diagnosis and Cancer Therapy, Stem Cells and Cancer

Diagnostics of cancer by histo-pathlogy, MRI scan, PET-scan, cytogenetis test, kariotype, FISH. Strategies of anticancer drug therapy–chemotherapy-gene therapy. Immuno-therapy and Radiotherapy. Immune therapy, surgical therapy and biologic therapy. Principles of cancer biomarkers and their applications. Stem Cells and Cancer.

TEXT BOOKS:

1. *McKinnell R. G, Parchment R. E., Perantoni A. O, BarryPierce,Damjanov.I,*.2006. **The Biological Basis of Cancer**, Second Edition, Cambridge University Press, United Kingdom.
2. **The Biology of Cancer**: R. A. Weinberg. Garland Science. 2006.
3. Franks,L.M. and Teich,N.M. 1991. **An introduction to Cellular and Molecular Biology of cancer,** 2nd Edition, Oxford University Press.
4. Vincent,T. *et al*., 2011. **Principles and Practice of Oncology: Primer of the Molecular Biology of Cancer**, 1st Edition, Lippincott Williams and Wilkins.

REFERENCE BOOKS:

1. Weinberg,R.A. 2013. **The Biology of Cancer**, 2nd Edition, Garland Science.
2. Hesketh,R. 2013. **Introduction to Cancer Biology**, Cambridge University Press.
3. Pelengaris,S. and Khan,M. 2002. **The Molecular Biology of Cancer**, 2nd Edition, Wiley Blackwell.

17PBC23A	IMMUNOLOGY AND IMMUNO-TECHNIQUES	SEMESTER-II

PREAMBLE:

- This course offers an overview on the ability of our immune system to defend against invading pathogens in a logical fashion and characteristics of antigens, antibodies and the nature of antigen-antibody reactions.
- Students can gain an in-depth knowledge and understanding of immune-pathology, immunotherapy and learn techniques practiced in the immunology field.

COURSE OUTCOMES:

On successful completion of the course, students will be able to

CO number	CO Statement	Knowledge Level
CO1.	Understand the formation of immune cells and its regulation. Illustrate the cells involved in immune response. Compare the membrane molecules of immune cells. Explain development of T-cells and B-cells for immune action. Distinguish types of immune responses. Outline clonal-selection.	K2 &K4
CO2.	Illustrate epitopes of B-cell and T-cell. Differentiate anti-genicity and immunogenicity. Understand the application of haptens and adjuvants. Understand the structure &types of Ab. and TCR. Evaluate the genetic basis of antibody and TCR.	K3, K4 &K5

	Evaluate the antigen recognition by MHC. Demonstrate factors and forces of antigen antibody interaction.	
CO3.	Compare different pathways of complement activation and analyze its consequence. Explain cytokines function. Distinguish various mechanism of cell-mediated cytotoxicity. Predict the diseases caused by immunodeficiencies. Demonstrate the immunological response to infection. Illustrate the treatment and vaccine for AIDS.	K3, K4 &K5
CO4.	Predict allergic responses and types. Understand about immunological tolerance. Evaluate animal models for experiments. Explain breakthroughs in transplantation immunology and cancer immunology for the better understanding. Analyze mechanism of autoimmune disorder.	K4 &K5
CO5.	Distinguish different types of vaccines. Analyze and estimate molecules by several types of immune-techniques. Demonstrate the production of antibodies by immune-technology and its application for immunotherapy.	K4 &K5

MAPPING WITH PROGRAMME OUTCOMES:

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	**S**	**S**	**S**	**M**	**M**
CO2	**S**	**M**	**S**	**M**	**M**
CO3	**S**	**S**	**S**	**S**	**M**
CO4	**S**	**S**	**S**	**S**	**S**
CO5	**S**	**M**	**S**	**S**	**S**

L-Low; M-Medium and S-Strong.

17PBC23A	IMMUNOLOGY AND IMMUNO-TECHNIQUES	SEMESTER-II

Total Credits: 4
Hours per week: 5

CONTENTS

UNIT-I

Cells of Immune System and Immune Responses

Cells of Immune System: Haematopoiesis, haematopoietic growth factors, Regulation of haematopoiesis, Lymphoid cells-T-cells, B-cells-lymphoblast and null cells, granulocytes, monocytes and macrophages, CD antigens and membrane molecules of immune cells. Development, maturation, activation and differentiation of T-cells and B-cells, adhesion molecules. Immune Responses: Humoral and cell-mediated immune responses, primary and secondary immune response, cells and molecules involved in innate and adaptive immune response. Theory of clonal selection.

UNIT-II

Antigens,Antigen Recognition, Immuno-globulins and Antigen antibody interaction

Antigens: B-cell epitopes, T-cell epitopes, antigenicity and immunogenicity, factor influencing immunogenicity, Haptens, adjuants; Immunoglobulins: Structure and functions, Isotype, allotypes, Idiotypes; classes, Immunoglobulins superfamily, Gene rearrangement and antibody diversity. T-cell receptor and its diversity. Antigen Recognition: MHC-Genetic organization and inheritance, Antigen processing and presentation (Cytosolic and Endocytic pathway). Antigen antibody interaction: forces involved in Ag-Ab interaction, Factors governing antigen-antibody interactions: affinity, avidity, valency, cross reactivity.

UNIT-III

Complement, Cytokines, Cytotoxicity, Immune Responses to Infections and AIDS Complement Activation: Complement activation pathways (classical, alternative and Lectin), Biological consequence of complement activation. Cytokines: IL. IFN, TNF, CSF- role in immune regulation, Cytokine receptors, Cytokine antagonists. Cell mediated cytotoxicity: mechanism of T cell and NK cell mediated lysis, antibody dependent cell mediated cytotoxicity and macrophage mediated cytotoxicity. Immune responses to infections: bacteria (tuberculosis) and parasites (malaria). Primary and secondary immunodeficiency diseases. AIDS: Structure of HIV, destruction of T cells, immunity to HIV virus, AIDS vaccine, gene therapy for treatment.

UNIT-IV

Hypersensitivity, Autoimmunity, Animal Models, Transplantation and Cancer immunology Hypersensitivity reactions: Type I, II, III& IV. Immunological tolerance. Autoimmunity: Autoimmunity: general mechanism, (organ specific, non-organ specific), Autoimmune disease in human-Rheumatoid arthritis, Myasthenia gravis, Systemic lupus erythematosus. Experimental Animal Models: inbred strains, SCID mice, nude, knockout mice. Transplantation immunology: Immunologic Basics of Graft rejection, MHC antigens in Cancer immunology: transplantation and HLA tissue typing, Immunosuppressive Therapy. Tumor antigens, Immune response to tumor antigens, Tumor evasion of the immune system, Cancer immunotherapy.

UNIT-V Vaccines and Immuno-techniques

Vaccines: Active and passive immunization, whole organism vaccines, recombinant vector vaccines, DNA vaccines, synthetic peptide vaccines, multivalent sub-units vaccines. Immunotechniques: Hybridomatechnology-Introduction, Antibody engineering (production of monoclonal antibodies), Immunotherapy with genetically engineered antibodies. Detection of molecules using agglutination, precipitation, immune-diffusion, immune-electrophoresis, ELISA, RIA, western blot, immune-precipitation, flow-cytometry/cell sorting and immune-fluorescence microscopy, immune-histochemistry.

TEXT BOOKS:

1. *Richard A Goldsby, Thomas J.Kindt, Barbara A Osborne and Janis Kuby,* 2003. **Immunology**, 5th Edition, W.H.Freeman and Company.
2. *Ian R.Tizard,* 2004. **Immunology (An Introduction),** 4th Edition, Thomson Publishers.
3. *Ananthanarayanan R and YayaramanPanikar,* 2013. **Text book of microbiology,** 9th Edition, University Press (India) Private Ltd.

REFERENCE BOOKS:

1. *Nandini Shetty,* 2005. **Immunology,** Revised 2nd Edition, New Age International Publishers.
2. *P.J. Delves, S.J. Martin, D.R. Burton and I.M. Roitt* 2006. **Roitt's Essential Immunology**, 11th edition, Wiley-Blackwell, USA.

17PBC23B	MICROBIAL BIOCHEMISTRY	SEMESTER-II

PREAMBLE:

- This course offers an overview on major metabolic and energy exchange pathways in microbial cell homeostasis.
- Students can gain an in-depth knowledge and understanding on applications and significance of biotechnology in diverse areas of agriculture, medicine and environmental biology.

COURSE OUTCOMES:

On successful completion of the course, students will be able to

CO number	CO Statement	Knowledge Level
CO1.	Examine the importance of microbial nutrition. Determine bacterial growth and its growth kinetics.	K3,K4 & K5
CO2.	Evaluate and explain elaborately the central metabolic pathways existing in microbes.	K5 & K6
CO3.	Compare different types of fermentation technology. Design fomenters for the production of industrially important microbes.	K5 & K6
CO4.	Value the application of microbes in agriculture, mining, and energy production and food industry.	K5
CO5.	Discuss in detail the production of antibiotics, amino acids, vitamins and single cell protein from microbial source.	K5

MAPPING WITH PROGRAMME OUTCOMES:

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	S	S
CO2	S	S	M	S	S
CO3	S	S	S	S	S
CO4	S	S	M	S	S
CO5	S	S	M	S	S

L-Low; M-Medium and S-Strong.

17PBC23B	MICROBIAL BIOCHEMISTRY	SEMESTER-II

Total Credits: 4
Hours per week: 5

CONTENTS

UNIT-I

Microbial Nutrition, Medium, Growth and Measurement

Microbial Nutrition- nutritional requirements and nutrients uptake by microbial cells; nutritional groups of microorganisms (autotrophs, heterotrophs and mixotrophs). Growth media- synthetic, complex, selective, enrichment and differential media. Microbial Growth- different phases of growth in batch cultures, synchronous, continuous and biphasic growth. Factors influencing microbial growth. Methods for measuring microbial growth– Direct microscopy, viable count estimates, turbidometry and biomass. Transport of sugars into bacterial cell– the bacterial phosphotransferase system. Growth cycle of bacterial culture; growth of single cells– cell cycle.

UNIT-II

Microbial Energy and Synthesis Biology

Energy yielding metabolism– carbohydrates– EMP, HMP, TCA– importance in bacteria. Phosphoketolase pathway, ED pathway, characteristics of electron transport in bacteria. Metabolism of one carbon and two carbon compounds. Bacterial Chemotaxis and quorum sensing.

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

UNIT-III

Fermentation Technology

Fermentation technology– Principles of fermentation, surface, submerged and solid-state fermentations. Batch, fed batch, semi-continuous and continuous culture techniques. Design and operation of fermentors, Agitation and aeration, Types of fermentors continuous stirred tank fermentor (CSTF), air-lift fermentor, Types of reactions in fermentations, Selection and characteristics of industrial microorganisms, Primary and secondary metabolites, Strategies for strain improvement and maintenance of the industrial strains, Raw materials, different types of fermentation media, Recovery of products, steps in downstream processing, Bioreactors.

UNIT-IV

Industrial and Agricultural Fermentation Technology

Genetically modified organisms. Microbial products- production of organic acids: Acetic acid, lactic acid, and citric acid. Bio-fuel production- Ethanol and Butanol, Enzymes- amylase, proteases, streptokinase, Production of biogas from agricultural wastes. Production of bio-insecticides from bacteria and fungi; Microbiology of food-food spoilage, controlling food spoilage, types of food borne diseases, microbiology of fermented food, Applied environmental microbiology- water purification and sanitary analysis. Waste water treatment. Bio-degradation, bioremediation and bio-augumentation.

UNIT-V Bio-Pharmaceuticals

Production of antibiotics – source, production, recovery and uses of penicillin, tetracycline, amoxicillin. Production of bacterial and fungal

polysaccharides; Commercial production of xanthan gum. Single cell protein-production and application. Amino acids- glutamic acid, lysine, threonine, phenylalanine**.** Vitamins - B12, B2, and vitamin-C.

TEXT BOOKS:

1. Alexander V., 2007. **Microbial biotechnology**, 2nd edition, W.H. Freeman Publishers.
2. *Stanbury,* P. 2007. **Principles of fermentation technology,** 2nd edition, Butterworth-Heinemann.
3. Ratledge, C. and Kristiansen, B. 2001, Basic biotechnology, 2nd edition, Cambridge University Press.
4. Gupta, P.K. 2010. **Elements of biotechnology**, 2nd edition, Rastogi Publication.

REFERENCE BOOKS:

1. Shuler, M.L. and Kargi, F. 2009. **Bioprocess engineering–** basic concepts, 2nd edition, Prentice Hall.
2. Balasubramanian, D. 1996. **Concepts in biotechnology**, 1st edition, Universities Press (India) Ltd.

17PBC23C	METABOLISM AND METABOLIC REGULATION	SEMESTER-II

PREAMBLE:

- This course offers an overview of energy generation and utilization in a biological system.
- Students can gain an in-depth knowledge and understanding of bioenergetics, and catabolic and anabolic pathways of biologically vital macromolecules.

COURSE OUTCOMES:

On successful completion of the course, students will be able to

CO number	CO Statement	Knowledge Level
CO1.	Apply the bioenergetics principles for energy balance sheet calculation of metabolic pathways.	K3
CO2.	Demonstrate the carbohydrate metabolism and interpret its pattern in various physiological conditions.	K2, K5
CO3.	Illustrate the lipid metabolism and relate it with clinical lab findings.	K2, K4
CO4.	Explain and justify amino acids and nucleic acid metabolic pathways and their regulations.	K5
CO5.	Predict and map clinically the pattern of disease with altered metabolism.	K6

MAPPING WITH PROGRAMME OUTCOMES:

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	M	M
CO2	S	S	S	S	M
CO3	S	M	S	S	S
CO4	S	S	S	S	M
CO5	S	S	S	S	S

L-Low; M-Medium and S-Strong.

17PBC23C	METABOLISM AND METABOLIC REGULATION	SEMESTER-II

Total Credits: 4
Hours per week: 5

CONTENTS

UNIT-I Bioenergetics

Free energy and entropy. Phosphoryl group transfers and ATP. Enzymes involved in redox reactions. The electron transport chain–organization and role in electron capture. Electron transfer reactions inmitochondria. Oxidative phosphorylation- F1/F0 ATPase- structure andmechanism of action. The chemiosmotic theory. Inhibitors of respiratory chain and Oxidative phosphorylation–uncouplers, ionophores. Regulation of oxidative phosphorylation. Mitochondrial transport systems- ATP/ADPexchange, malate/glycerophosphate shuttle.

UNIT-II Carbohydrate Metabolism

Glycolysis and gluconeogenesis– pathway, keyenzymes and co-ordinate regulation. Pyruvate dehydrogenase complex and the regulation of this enzyme through reversible covalent modification. The citricacid cycle and regulation. The pentose phosphate pathway. Metabolism of glycogen and regulation. Metabolism of galactose and fructose.The glyoxylate cycle. Cori cycle. Anaplerotic reactions.

UNIT-III Lipid Metabolism

Lipid metabolism: Lipogenesis- control of acetyl CoA carboxylase-Role ofhormones-Effect of diet on fatty acid biosynthesis. Regulation ofbiosynthesis of triacylglycerol, phospholipids and cholesterol. Metabolism of triacylglycerol during stress. α, β and ω, Oxidation of fatty acids– Role of carnitine cycle in the regulation of β -oxidation.

Ketogenesis and its control. Lipoprotein metabolism exogenous and endogenous pathways. Biosynthesis and regulation of Eicosanoids.

UNIT-IV Amino acids and Nucleic acids metabolism

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

Nucleic acid metabolism: Pathways of purines and pyrimidines biosynthesis (both de novo and salvage pathways) and degradation. Regulation of purine biosynthesis: PRPP aminotransferases. Regulation of pyrimidine biosynthesis: Aspartate carbamoyltransferase. Regulation of deoxyribonuclcotides by activators and inhibitors.

UNIT-V Porphyrin and Integrated Metabolism

Porphyrin metabolism: Regulation of biosynthesis and degradation hemoglobin, chlorophyll and cytochrome. Elucidation of metabolic pathways**:** Analysis of single step pathway and Multistep pathway, Mutant study-Complementation for metabolic steps analysis. Integration of metabolism: Metabolic profile of the liver, adipose tissue and brain. Metabolic interrelationships in various nutritional and hormonal states-obesity, aerobic, anaerobic endurance, exercise, pregnancy, lactation, IDDM, NIDDM and starvation.

TEXT BOOKS:

1. 1.*Rodwell, V.W., Bender, D.A., Botham, K.M., Kennelly, P. and Weil, P.A.* 2015. **Harper's Illustrated Biochemistry**, 30th edition. The McGraw-Hill Inc.
2. *Geoffrey Zubay,* 1993. **Biochemistry,** 3rd Edition, Wm.C.Brown Publishers.
3. *Voet, D. and Voe*t *J.G.* (2011). **Biochemistry,** 4th edition, John Wiley and Sons, New York.
4. Buchanan, B.B., Gruissem, W. and Jones, R.L. 2007. **Biochemistry and Molecular Biology of Plants,** 1st edition, , John Wiley & Sons.

REFERENCE BOOKS:

1. Berg, J.M., Tymoczko, J.L., Gatto Jr, G.J. and Stryer, L. 2015. **Biochemistr**y, 8th edition, W.H. Freeman and Company, New York.
2. *Nelson, D.L. and Cox, M.M. 2008.* **Lehninger Principles of Biochemistry,** 5th edition. W.H. Freeman and Company, New York.
3. *Garrett, R.H. and Grisham, C.M.* (2017). **Biochemistry,** 6th edition, Brooks/Cole Cengage Learning, Boston.

17PBC23D	PLANT BIOCHEMISTRY	SEMESTER-II

PREAMBLE:

- This course offers an overview of various metabolic pathways and their applications in plant productivity.
- Students can gain an in-depth knowledge and understanding of plant cell physiology and its organelles, metabolism of carbon, nitrogen and sulphur compounds, plant therapeutics and gene transfer technology.

COURSE OUTCOMES:

On successful completion of the course, students will be able to

CO number	CO Statement	Knowledge Level
CO1.	Illustrate the organization of plant genomes and photosynthetic structures, and identify the photosynthetic efficiency of plants.	K2 & K3
CO2.	Analyze and assess the interrelationship between metabolic pathways of various plant species.	K4 & K5
CO3.	Combine and formulate research proposals in areas of seed germination, fruit ripening and stress responses.	K6
CO4.	Demonstrate the roles of plant hormones and secondary metabolites, and to apply the knowledge in designing new strategies for commercial production of plant hormones and secondary metabolites.	K2, K3 & K6
CO5.	Choose the proper genetic engineering tools for developing strategies for crop improvement.	K5 & K6

MAPPING WITH PROGRAMME OUTCOMES:

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	S	S
CO2	S	S	S	S	S
CO3	S	S	S	S	S
CO4	S	S	S	S	S
CO5	S	S	S	S	S

L-Low; M-Medium and S-Strong.

17PBC23D	PLANT BIOCHEMISTRY	SEMESTER-II

Total Credits: 4
Hours per week: 5

CONTENTS

UNIT-I Structure and Functions of Plant Cell and Sub-cellular Organelles

Structure of plant genes. Organisation of plant chromatin. The nuclear, chloroplast and mitochondrial genomes. Interaction between nuclear and organellar genome. Structure of plant cell membrane and cell wall. Photosynthesis: Structure & function of chloroplast system. Photosynthetic pigments and their functions, Photo system-I & II. Photosynthetic electron transport and photophosphorylation.

UNIT-II Carbon and Nitrogen Metabolism in Plants

Calvin cycle (C3 plants), Hatch slack pathway (C4 plants), Crassulacean acid metabolism. Overview of lipid and protein metabolism in plants; bioluminescence in Gonyaulax**.** Role of photorespiration in plants; biochemical basis of PR pathway– C2 cycle; pathways of glucose oxidation in plants; starch biosynthesis and degradation; metabolic transport between organelles. Nitrogen metabolism: Development and structure of root nodules, Role of nod factors in nodule development. Structure of plant nitrogenase system, Symbiotic nitrogen fixation and its regulation. Formation and assimilation of ammonia. Sulphur chemistry and functions; reductive sulfate assimilation pathway. Synthesis and function of glutathione and its derivatives.

UNIT-III Transport in Plant cells

Uptake, transport and translocation of water, ions, solutes and macromolecules from soil, through cells, across membranes, through xylem and phloem; transpiration. Biochemistry of seed development, dormancy, biochemical changes during germination of seeds. Biochemistry of fruit development and ripening, Senescence. Structure and function of phytochrome,cryptochromes and phototropins, hormonal regulation of flowering, photoperiodism, and vernilization. Responses of plants to biotic (pathogen and insects) and abiotic (water, temperature and salt) stresses.

UNIT-IV Plant Hormones and Secondary Metabolites

Plant hormones: biosynthesis, structure and biochemical mode of action of auxins, gibberellins, cytokinins, abscisic acid and ethylene. Secondary metabolites: classification, biosynthesis and functions of terpenoids, alkaloids, Phenolics, Flavonoids, Coumarins. Strategies and approaches for the overproduction of plant secondary metabolites. Secondary metabolites in clinical, cosmetic and food industries (each with any two examples).

UNIT-V Plant Molecular Biology and Biotechnology

Plant molecular biology and biotechnology: DNA polymorphism– Importance of RFLP, RAPD and SCAR in plant breeding management. Application of tissue culture for plant improvement, cryopreservation. General principles of gene cloning. Isolation and characterization of plant genes and promoters. Different methods of gene transfer –direct and vector mediated. Gene silencing. Site directed mutagenesis. Molecular analysis of transformants. Potential applications of plant genetic

engineering for crop improvement – Genetic engineering of plant for disease resistance (Bt-cotton & Bt-Brinjal), Cytoplasmic Male Sterility, Edible oil, Biodegradable plastics. Delay of fruits ripening (Tomato).

TEXT BOOKS:

1. Goodwin, T.W. and Mercer, E.I. 1997. **Introduction to Plant Biochemistry**, 2nd edition, Pergamon Press.
2. Slater, A., Scott, N.W. and Fowler, M.R. 2008. **Plant biotechnology**, 2nd Edition, Oxford University Press, New York.
3. *Primrose S.B.* 2001.**Principles of gene manipulation**, 6th edition, Blackwell Scientific Publishers, Oxford.
4. Sinha, R.K. 2013. **Modern Plant Physiology**, 2nd revised edition, Alpha Science International Limited.

REFERENCE BOOKS:

1. *Bob B Buchanan,* 2007. **Biochemistry and molecular biology of plants,** First edition, I.K. International Pvt. Ltd., New Delhi.
2. *P.J. Lea, L.L. Castle and Lea,* 1999. **Plant Biochemistry and Molecular Biology**–2nd Edition, John Wiley & Sons.

17PBC23P	PRACTICAL-II: BIOCHEMISTRY-II	SEMESTER-II

Total Credits: 3
Hours per week: 6

PREAMBLE:

- This course offers an overview on practical aspects of immunology, microbiology, metabolism and plant biochemistry.
- Students can gain an in-depth knowledge and understanding of protein based immune-assays, microbial cell culture and characterization methods, methodologies involving the quantification of metabolites.

CONTENTS

Immunology:

1. Agglutination reactions- active bacterial agglutination- Widal test.
   - passive agglutination- Latex agglutination test.
2. Precipitation reactions on gel-Double Immuno diffusion to check antigen cross reactivity.
3. Immuno-electrophoresis of serum proteins.
4. Preparation of antigen from microbes and isolation by SDS-PAGE.
5. Detection of specific antigens by Indirect ELISA technique
6. Identification of specific antigens by Immuno-blotting technique.
7. Coombs test

REFERENCE:

1. **A Practical Guide to Cellular and Molecular Research Methods in Immunology, 2004, 5th Edition**. By Gordon JR. Sakatchewan.

Microbiology:

1. Introduction to sterilization techniques- sterilization of glass wares, autoclaving, preparation of liquid and solid media.
2. Isolation of Bacteria and fungi from soil samples- serial dilution techniques.
3. Establishment of pure culture by spread, streak and pour plate techniques.
4. Identification of bacteria by morphological, staining (simple & Gram's staining) and biochemical characteristics.
5. Measurement of bacterial population by spectrophotometer (growth curve) and colony counting methods.
6. *In-vitro* antibiotic sensitivity test for selected bacterial cultures.
7. Methods for preserving microbial cultures: slant, glycerol stock and lyophilization.

REFERENCE:

1. **Microbiology A Laboratory Manual**, 6th Edition, 2004. By Cappuccino Sherman.

Metabolism:

1. Estimation of urea by Di-acetyl monoxide method.
2. Estimation of uric acid.
3. Estimation of creatinine in urine.
4. Estimation of pyruvate by DPNH (2,4-dinitrophenylhydrazine) method.

REFERENCE:

1. *Varley, H.* 2005. **Practical, Clinical Biochemistry**, 4th edition, CBS publishers & Distributors Pvt Ltd.

Plant Biochemistry:

1. Isolation of chloroplast and estimation of total chlorophyll, chlorophyll-a and chlorophyll-b pigments from leaves.
2. Quantification of Gibberllins in germinating seeds.
3. Assay of amylase in germinating seeds.
4. Determination of protein quantity under different stress conditions.
5. Separation of plant pigments by chromatographic methods.
6. Estimation of phenols in plant tissues.
7. Estimation of peroxidase in plant tissues

REFERENCE:

1. **Biochemical Methods, 2nd edition, 1996**. By Sadasivam S and Manickam A. New Age International Publishers, New Delhi.

Suggested readings:

1. **Practical Biochemistry**: **An Introductory Course** by Fiona Frais.
2. **Methods in Enzymology,** Vol. I and II. By S.P.Colowick and N.O.Kaplan eds.
3. **Basic Biochemical Methods,** 2nd ed. By R.R.Alexander and J.M.Griffith.
4. **Hawk's Physiological Chemistry**. By Bernard L Oser.
5. **Laboratory Manual in Biochemistry.** By S. Jayaraman.

18PBT2EA	ELECTIVE- II: ORGANIC FARMING	SEMESTER - II

Total Credits: 4
4 Hours / Week

PREAMBLE:

- The importance of organic farming and standardization/certification process has been highlighted.

COURSE OUTCOMES

On successful completion of the course, students will be able to:

CO Number	CO Statement	Knowledge Level
CO1	Know about the basic of organic farming national and international level	K2, K3
CO2	Understand the farming systems and its management	K3, K4
CO3	Imparts knowledge on the plant protection and weed management	K3, K4, K5
CO4	In depth understanding of Organic crop production practices	K4, K5
CO5	Focus on Organic Certification and terrace farming technology	K4, K5

Mapping with Programme Outcomes

COs/Pos	PO1	PO2	PO3	PO4	PO5
CO1	S	M	M	S	S
CO2	M	S	S	S	S
CO3	S	S	S	S	S
CO4	S	S	S	S	S
CO5	S	S	S	S	S

S-Strong: M-Medium; L-Low

18PBT2EA	ELECTIVE- II: ORGANIC FARMING	SEMESTER – II

Total Credits: 4
4 Hours / Week

CONTENTS

UNIT - I

Concept of organic farming

Introduction: Farming, *organic farming, concept and development of organic farming. Principles of organic farming, types of organic farming, biodynamic farming. Benefits of organic farming, need for organic farming, conventional farming v/s organic farming Scope of organic farming; Tamil nadu, National and International status. Agencies and institutions related to organic agriculture. Requirements for organic farming, farm components for an organic farm.

Case Study: Conventional farming methods

UNIT - II

Organic plant nutrient management

Organic farming systems, soil tillage, land preparation and mulching. Choice of varieties. Propagation- seed, planting materials and seed treatments, *water management Green manuring, composting- principles, stages, types and factors, composting methods, Vermi composting Bulky organic manures, concentrated organic manures, organic preparations, organic amendments and sludges. Bio-fertilizers- types, methods of application, advantages and disadvantages, standards for organic inputs- fertilizers

Case Study: Benefits of vermicompost to different types of soil.

UNIT - III

Organic plant protection

Plant protection- cultural, mechanical, botanical pesticides, control agents. *Weed management, Standards for organic inputs- plant protection.

Case Study: Pesticides and its causes to plants

UNIT - IV

Organic crop production practices

Organic crop production methods- rice, coconut. Organic crop production methods- vegetables- okra, amaranthus, cucurbits. Livestock component in organic farming. Sustainable Agriculture-Apiculture, Mushroom cultivation.

Case Study: Organic food and its benefits

UNIT - V

Organic Certification

Farm economy: Basic concept of economics- demand & supply, economic viability of a farm. Basic production principles, reducing expenses, ways to increase returns, cost of production system. Benefit/ cost ratio, *marketing, imports and exports. Policies and incentives of organic production. Farm inspection and certification. Terrace farming.
(Note: * Self study)

TEXT BOOKS:

1. *Palaniappan SP & Anandurai K. 1999.* **Organic Farming–Theory and Practice.** Scientific Publishers, Jodhpur.

REFERENCE BOOKS:

1. *A.K. Sharma. 2002.* **A hand book of Organic Farming**. Agro-Bios.
2. *S. A. Solaimalai, 2003.* Farming system : Theory and Practice. Manohar Publishers & Distributors, New Delhi.
3. *Joshi, M. 2014.* **New Vistas of Organic Farming** 2nd Ed. Scientific Publishers, Jodhpur.

17PMB2EA	ELECTIVE II- PHARMACEUTICAL QUALITY CONTROL	SEMESTER – II

PREAMBLE:

The Course aims to build the concepts regarding:

- Sterility in pharmaceutical products
- role of a qualified microbiologist in Pharma Industry
- Validation and its importance in quality assurance of pharmaceutical products.

Course Outcomes

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	• Identify and analyse unexpected results during routine analyses and help to provide solutions based on scientific and regulatory considerations by implementing preventive action and corrective actions programs.	K3
CO2	• Acquire a working knowledge of Indian GMP (Good Manufacturing Practice) requirements to the manufacture of pharmaceuticals, blood products, and natural health products	K3
CO3	• Interpret the requirements for testing of raw materials, in-process samples, and finished product in accordance with pharmacopoeia compendia standards.	K3
CO4	• Operate, validate, and calibrate a variety of laboratory equipment used in pharmaceutical industrial labs. • Assess instruments malfunction and troubleshoot analytical equipment	K3

	failure in compliance with regulatory requirements.	
CO5	• Understand the concept of quality systems and compliance in the regulated industry and the role of quality assurance. • Understand the use of controlled documentation.	K2

MAPPING WITH PROGRAMME OUTCOMES

CO5/ PO5	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	M	M	M	S	S
CO2	S	S	M	S	S
CO3	S	S	S	S	S
CO4	S	S	S	S	S
CO5	S	S	S	S	S

S-Strong, M-Medium, L-Low

17PMB2EA	ELECTIVE II- PHARMACEUTICAL QUALITY CONTROL	SEMESTER – II

Total Credits: 4
Hours per week: 4

CONTENTS

UNIT - I

An introduction to pharmaceutical microbiology. WHO good manufacturing practices: main principles for pharmaceutical products- Quality management in the drug industry: philosophy and essential elements- Heating Ventilation and air-conditioning systems for non-sterile pharmaceutical dosage forms- Validation- Water for pharmaceutical use.

UNIT - II

Types of spoilage, Factors affecting microbial spoilage – assessment of microbial spoilage – preservation. Ecology of microorganisms as it affects the pharmaceutical industry – Sterilization control - methods of sterility testing- sterilization monitors and Quality assurance of products**.**

UNIT - III

Sterile pharmaceutical products – injections, Non-injectable sterile fluids, ophthalmic preparations, dressings & implants. The microbiological quality and regulatory requirements for natural and nutraceutical products - The regulatory control and quality assurance of immunological products, Containment system integrity – sterile products, Regulatory guidelines (microbiology) for veterinary

antimicrobial products- Microbiological quality and regulatory requirements for bio therapeutics and manufactured products,

UNIT - IV

The role of the Qualified Person in microbiological quality assurance, Safety in microbiology, Rapid enumeration and identification methods, Selection and use of cleaning and disinfection agents in pharmaceutical manufacturing, Measurement of biocide effectiveness, International disinfectant testing protocols, Prevention and elimination of microbial bio films in the manufacturing environment using Clean-in-Place, Cleanroom design, operation and regulatory standards.

UNIT - V

Microbiological quality assurance. Validation of aseptic processing and media fills, the role of the microbiologist in HACCP, Auditing the pharmaceutical microbiology department.

TEXT BOOKS:

1. World Health Organization. 2007. **Quality assurance of pharmaceuticals A compendium of guidelines and related materials** Volume 2, 2nd updated edition Good manufacturing practices and inspection.
2. *W.B.Hugo&A.D.Russel*, 2007. **Pharmaceutical Microbiology**, 4th Edition, Blackwell Scientific Publications.

17PBC2EA	ELECTIVE-II: BIOCHEMISTRY OF TOXICOLOGY	SEMESTER-II

PREAMBLE:

- This course offers an overview of the biochemical basis of toxicology and the effects & metabolism of toxins.
- Students can gain an in-depth knowledge and understanding of general toxicology, methods of toxicity testing, toxins from microbes, carcinogenic & teratogenic toxins, pesticide, metal and chemical toxicology.

COURSE OUTCOMES:

On successful completion of the course, students will be able to

CO number	CO Statement	Knowledge Level
CO1.	Value the importance of toxicology. Explain about factors, which influence toxicity.	K5
CO2.	Distinguish and evaluate the biochemical effects of toxic agents on cellular macromolecules and tissues.	K4 & K5
CO3.	Compare and perceive different genetic methods used for testing toxicity.	K4 & K5
CO4.	Examine the effects and metabolism of various microbial toxins, teratogens and carcinogens.	K4
CO5.	Justify the mode of action of toxic pesticides, heavy metals, chemicals and air pollutants.	K5

MAPPING WITH PROGRAMME OUTCOMES:

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	S	S
CO2	S	S	M	S	S
CO3	S	S	S	S	S
CO4	S	S	M	S	S
CO5	S	S	M	S	S

L-Low; M-Medium and S-Strong.

17PBC2EA	ELECTIVE-II: BIOCHEMISTRY OF TOXICOLOGY	SEMESTER-II

Total Credits: 4
Hours per week: 4

CONTENTS

UNIT-I Introduction to Toxicology

Definition and scope of toxicology, Classification of toxic agents. Dose-response relationship: Synergism and Antagonism - Determination of ED50 and LD50. Acute and chronic exposures, Factors influencing toxicity - Abiotic and Biotic factors, Chemical interactions - Bioaccumulation and Bio-magnification.

UNIT-II Biochemical basis of Toxicology

Mechanisms of Toxicity, Interaction of toxicant with target molecules - Disturbance of excitable membrane function. Altered calcium homeostasis. Covalent binding to cellular macromolecules. Tissue specificity of toxicity - Metabolism of haloalkanes, haloalkenes and their toxic effects on tissues.

UNIT-III Principles and procedures of testing for acute toxic effects

Toxicity testing- Genetic toxicity testing and mutagenesis assays- *In-vitro* test systems- Bacterial mutation tests: Reversion test and Fluctuation tests. *In-vivo* mammalian mutation tests- Host mediated assay and Dominant lethal test. Use of drosophila in toxicity testing. DNA Repair assays, Chromosome damage test. Toxicity testing in animals.

UNIT-IV Effects and Metabolism of toxins

Fungal toxins, Mycotoxins - Aflatoxins, Bacterial toxins- Exotoxins (types-I, -II and -III) and Endotoxins, Viral toxins, Algal toxins, Teratogens, Carcinogens, Mutagens, Snake venom toxin, Spider, Scorpion and Jellyfish toxins, Antivenom. Xenobiotic metabolism: Phase 1– III reactions, Cytochrome-P450's.

UNIT-V Pesticide toxicology, Metal toxicology, Chemical toxicology, Air and water pollutants

Mechanism and site of action of Chlorinated organics (DDT, BHC), organophosphates and carbamates. Mode of action of toxic heavy metals - arsenic, mercury, cadmium and lead. Biochemical effects of ozone, peroxyacetyl nitrate (PAN), carbon monoxide, nitrogen oxides, sulphur dioxide and cyanide. Common air pollutants, water pollutants and their sources, air pollution due to methyl-isocyanate (MIC) and asbestos. Case studies.

TEXT BOOKS:

1. *Duffus and Worth*, 2006. **Fundamental Toxicology**, Royal Society of Chemistry.
2. *De A.K*, 2017. **Environmental Chemistry,** Eighth edition, Newage International Publishers, NewDelhi.
3. *Manahan and Stanley*, 2003. **Toxicological Chemistry and Biochemistry**, CRC Press.

REFERENCE BOOKS:

1. *Klaassen and Watkins III,* 2015. **Casarett and Doull's Essentials of Toxicology**, Third edition, McGraw Hill.
2. *Cockerham and Shane*, 1993. **Basic Environmental Toxicology**, CRC Press.
3. *Marrsand Turner*, 1999. **General and Applied Toxicology**, Third edition, John Wiley and Sons.

18PBC33A	BIOSTATISTICS AND RESEARCH METHODOLOGY	SEMESTER –III

PREAMBLE:

- Provide knowledge and skills sufficient to allow students to understand the role of statistics in research.
- Develop skill in the basic methods of data gathering and analysis.
- Provide sufficient background to be able to interpret statistical results in research papers.
- Develop sufficient knowledge of probability and probability distributions to support further studies in statistics and operations research.

COURSE OUTCOMES:

On successful completion of the course, students will be able to

CO number	CO Statement	Knowledge Level
CO1.	Organize a statistical survey Explain methods of collection, classification, tabulation, analysis and presentation of data. Elaborate the range of research methods available to the researcher for collecting and analyzing qualitative and quantitative data.	**K3, K4 & K5**
CO2.	Explain and interpret data using measures of central tendency, measures of variation, and correlation regression analysis.	**K5 & K6**
CO3.	Discuss the utility of sampling theory, probability theory, and theoretical distributions in conducting research.	**K5**
CO4.	Measure and apply various tests of significance to different areas for the purpose of making	**K5**

	estimation and inferences based on available data.	
CO5.	Discuss the objectives of research and to explain the process of research Explain how to plan and conduct a research project. Explain how to formulate and present research findings and recommendations.	**K5 & K6**

MAPPING WITH PROGRAMME OUTCOMES:

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	**S**	**S**	**M**	**S**	**S**
CO2	**S**	**S**	**M**	**S**	**S**
CO3	**S**	**S**	**S**	**S**	**S**
CO4	**S**	**S**	**M**	**S**	**S**
CO5	**S**	**S**	**M**	**S**	**S**

L-Low; M-Medium and S-Strong.

18PBC33A	BIOSTATISTICS AND RESEARCH METHODOLOGY	SEMESTER –III

Total Credits: 4
Hours per week: 4

CONTENTS

UNIT I

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

UNIT II

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

UNIT III

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

UNIT IV

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

UNIT V

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

TEXT BOOKS

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

REFERENCE BOOKS

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

18PBC33B	CLINICAL BIOCHEMISTRY	SEMESTER-III

PREAMBLE:

- This course offers an overview on human metabolism and changes that occur at different physiological and non-physiological states.
- Students can gain an in-depth knowledge and understanding on the relevance of biochemistry to health and disease viz., Biochemical markers of disease and clinical significance of steroid, protein and thyroid hormones.

COURSE OUTCOMES:

On successful completion of the course, students will be able to

CO number	CO Statement	Knowledge Level
CO1.	Explain about the factors that influence disorders associated with hemoglobin. Evaluate the deficiency of coagulation factors in blood coagulation.	K4 & K5
CO2.	Examine and distinguish the different types of body fluids, collection, preservation and analysis.	K4
CO3.	Justify the importance of enzymes in clinical diagnosis.	K5
CO4.	Value the importance nutrients human biology and disease.	K5
CO5.	Perceive the usefulness of organ specific clinical diagnosis and treatment.	K5

MAPPING WITH PROGRAMME OUTCOMES:

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	S	S
CO2	S	M	S	S	M
CO3	S	S	S	S	S
CO4	S	S	S	S	S
CO5	S	M	S	S	M

L-Low; M-Medium and S-Strong.

18PBC33B	CLINICAL BIOCHEMISTRY	SEMESTER-III

Total Credits: 4
Hours per week: 4

CONTENTS

UNIT I

Specimen collection and processing: Collection of blood by various methods, anticoagulants. Collection of urine-timed urine specimens, urine preservatives. Stool-chemical examination and clinical significance, detection of short chain fatty acids. Amniotic fluid: Origin, collection, composition and analysis of amniotic fluid. Ascitic fluid (peritoneal), pleural fluid and sweat. Automation in the clinical biochemistry: Precision, reliability, reproducibility and other factors in quality control.

UNIT II

Blood and coagulation: deficiency of coagulation factors, disturbances of blood clotting mechanisms, systematic analysis of hemorrhagic disorders-coagulation and prothrombin time, determination, porphyrias-erythropoietic and hepatic , hemoglobin-anemia, abnormal hemoglobins and their identification (sickle cell anemia, Cooleys anemia; Thalassemia-Major and Minor); Presence of Blood in Urine, Hemolytic diseases of Newborn.

UNIT III

Disorders of carbohydrate metabolism: glycogen storage diseases, galactosemia, fructose intolerance and fructosuria. Blood sugar homeostasis: role of tissues and hormones in the maintenance of blood

sugar. Hypoglycemia, hyperglycemia, glycosuria. Diabetes mellitus-classification, metabolic abnormalities, diagnosis and management.

Disorders of lipid metabolism: lipoproteinaemias. Lipid storage diseases-Gaucher's, Tay Sach's and Niemann Pick disease. Fatty liver and Atherosclerosis.

Disorders of amino acid metabolism**:** Aminoaciduria, Hartnup disease, Phenylketonuria, alkaptonuria, albinism, cystinuria, cystinosis, homocystinuria and maple syrup urine disease.

Disorders of purine and pyrimidine metabolism: Hyperuricemia, Hyporuricemia and gout and orotic aciduria.

UNIT IV

Gastric function tests: stimulation tests-insulin and pentagastrin. Qualitative and quantitative analysis of gastric and duodenal contents-malabsorption syndromes. Peptic ulcer, gastritis and Zollinger Ellison syndrome.

Liver function tests: Jaundice- Causes, consequences, biochemical findings, treatment in jaundice, hepatitis and cirrhosis. Tests related to excretory (bile pigments) synthetic (plasma proteins, prothrombin time) detoxifying (hippuric acid, NH3, aminopyrine) and metabolic (galactose) functions. Gall stones.

Renal function tests: Biochemical changes and laboratory findings in acute and chronic renal failure - clearance of tests - urinary calculi, renal hypertension - principles of peritoneal and hemodialysis - urinalysis for normal and abnormal constituents.

UNIT V

Clinical Enzymology: Serum enzymes and isoenzymes in health and disease-Transaminases (SGOT and SGPT), Acid and Alkaline

Phosphatases, Creatinine kinase, amylase, Hexokinase, Aldolases, LDH, Isocitrate Dehydrogenase, Glucose-6-Phosphate dehydrogenase, Choline esterase, Lipoprotein Lipase. Antioxidant enzymes – SOD, Catalase, GPX and GR. Therapeutic enzymes: Thrombolytic enzyme, wound healer and erythropoiesis stimulator.

TEXT BOOKS:

1. *William J. Marshal, Stephen K. Bangert,* 2014. **Clinical Biochemistry: metabolic and Clinical aspects,** 3rd edition. Churchill Livingstone.
2. *Gerhad Meiserbag & Willian H. Simmons* 2016. **Principles of Medical Biochemistry.** Elsevier Health Sciences.
3. *R.Luxton,* 2008. **Clinical Biochemsitry.** Scion Publishing Limited, Oxfordshire.

REFERENCE BOOK

1. *Mayne PD,* 1994. **Clinical chemistry in diagnosis and treatment,** 6th edition, Hodder Arnold Publications.
2. *Gowenlock AH,* 2006. ***Varley's*** **Practical clinical biochemistry,** 6th edition, CBS Publishers.
3. *Rifai N,* 2017. **Teitz Text book of clinical chemistry and molecular diagnosis,** 6th edition – Elsevier Health Sciences.

18PBC33C	GENETICS AND GENETIC ENGINEERING	SEMESTER –III

PREAMBLE:

- This course offers an overview of DNA research and the ability to change Gene Expressions.
- Students can gain an in-depth knowledge and understanding on biotechnological applications of Genetic Engineering, for example, Cloning, Vectors, transgenic animals, treating diseases etc.

COURSE OUTCOMES:

On successful completion of the course, students will be able to

CO number	CO Statement	Knowledge Level
CO1.	Distinguish the transmission and Mendelian genetics. Compare the recessive and dominance in Mendelian inheritance.	K_4 & K_5
CO2.	Explain the role of restriction endonucleases in Restriction mapping. Support of nucleic acid probes in application of genetic engineering techniques.	K_4 & K_5
CO3.	List of different types Vectors and its applications.	K_4 & K_5
CO4.	Explain the cloning techniques. Distinguish Cultured insect cell expression systems; mammalian cell expression systems.	K_4 & K_5
CO5.	Analyze the expression of cloned genes by gene transfer techniques in animal cells. Applications of transgenic animals as models in the prevention of human diseases like cystic fibrosis, muscular dystrophy and anticancer therapy.	K_4 & K_5

MAPPING WITH PROGRAMME OUTCOMES:

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	M	M
CO2	S	S	S	M	M
CO3	S	S	S	M	M
CO4	S	S	M	M	M
CO5	S	S	S	S	S

L-Low; M-Medium and S-Strong

18PBC33C	GENETICS AND GENETIC ENGINEERING	SEMESTER –III

Total Credit: 4
Hours per week: 4

CONTENTS

UNIT-I

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

UNIT-II

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

UNIT-III

Cloning vectors and Cloning strategies – salient features. Plasmids vectors , Bacteriophage vectors, Cosmid vectors, DNA (single stranded) vectors, viral vectors. Transposons as vectors. High capacity cloning vectors – bacterial artificial chromosomes, phage P1, yeast artificial

chromosomes and PACs. Genomic and cDNA cloning. cDNA library

UNIT-IV

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

UNIT-V

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

TEXT BOOKS

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

REFERENCE BOOKS

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

18PBC33D	HORMONAL REGULATION AND SIGNAL TRANSDUCTION	SEMESTER-III

PREAMBLE:

- The goal of this course is to provide students knowledge on the endocrine system, its specific secretions and various disorders related to each hormone due to their hypo and hyper secretion.

COURSE OUTCOMES:

On successful completion of the course, students will be able to

CO number	CO Statement	Knowledge Level
CO1.	Explain the cellular and molecular mechanisms of how hormones are synthesized and secreted, and act by binding to their specific receptors on the target cells	**K2**
CO2.	Explain how hormones regulate various aspects of normal physiology and how impairment of hormone synthesis, secretion and/or actions can result in endocrine disorders	**K2**
CO3.	Develop a differential diagnosis for various endocrine conditions	**K6**
CO4.	Evaluate results of laboratory studies ordered for endocrine conditions and review and critique a journal article in the area of endocrinology	**K5**
CO5.	Provided an case study, able to predict and map the clinical disease pattern with hormone levels	**K6**

MAPPING WITH PROGRAMME OUTCOMES:

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	S	S
CO2	S	S	S	S	S
CO3	S	S	S	S	S
CO4	S	S	S	S	S
CO5	S	S	S	S	S

L-Low; M-Medium and S-Strong.

18PBC33D	HORMONAL REGULATION AND SIGNAL TRANSDUCTION	SEMESTER-III

Total Credits: 4
Hours per week: 4

CONTENTS

UNIT I

Introduction: Hormones and homeostasis. Neuroendocrine Integration in homeostasis. Classes of chemical messengers. Hormone secretion. Transport and clearance. Feed back control of secretion.

Signal transduction. Plasma membrane receptors, adenylate kinase, Role of G Proteins, protein kinases, tyrosine kinases, inositol phosphates, calcium and calmodulin. Steroid hormone receptors.

UNIT II

Hypothalamus and Pituitary hormones- Biochemistry and mechanism of action.Regulation of synthesis and secretion. Hypo and hyper activity of pituitary hormones-gigantism, dwarfism, acromegaly, diabetes insipidus, syndrome of inappropriate ADH secretion.

Growth factors: neurotropic growth factors, hematopoietic growth factors, epidermal growth factor.

UNIT III

Thyroid hormones- synthesis, secretion, transport and mechanism of action. Metabolic fate and biological actions.Antithyroid agents.Thyroid diseases, thyrotoxicosis, goiter, hypothyroidism, Graves' disease, Hashimoto's disease.Thyroid function tests.

Parathyroid Hormone, Calcitonin and Vitamin D- Biological actions, regulation of calcium and phosphorus metabolism, Pathophysiology

UNIT IV

Pancreatic hormones:- Insulin, glucagons, somatostatin. Pancreatic peptide – chemistry, physiological roles and mechanim of action.

Adrenal hormones- Adrenal cortex- glucocorticoids and mineralocorticoids-synthesis, secretion, transport and mechanism of action.Metabolic fate and biological actions.Adrenal androgens-metabolic effect and functions.Adrenal medulla- catecholamines-synthesis, secretion, transport and mechanism of action.Metabolic fate and biological actions. Abnormal secretion of adrenal hormones-Addison's disease, Cushing's syndrome, Congenital adrenal hyperplasia, phaeochromocytoma.

UNIT V

Gonadal hormones- Androgens and estrogens-synthesis, secretion, transport and mechanism of action.Metabolic fate and biological actions. Ovarian cycle, Pregnancy, Biochemical changes in pregnancy.Human infertility – reasons, therapy and treatment.

Hormones from other organs and tissues.

Synthesis, chemistry functions of Melanocyte stimulating hormones (MSH) Melatonin, Neurohormones-Enkephalins and Endorphins and gastrointestinal hormones.

TEXT BOOKS

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

REFERENCE BOOK

1. *Rodwell, V.W., Bender, D.A., Botham, K.M., Kennelly, P. and Weil, P.A.* 2015. **Harper's Illustrated Biochemistry**, 30th edition. The McGraw-Hill Inc.

18PBC33P	PRACTICAL-III: BIOCHEMISTRY-III	SEMESTER-III

Total Credits: 3
Hours per week: 6

PREAMBLE:

- This course offers an overview of the experimental aspects involving Advanced Clinical Biochemistry and Genetic Engineering.
- Students can gain an in-depth knowledge and understanding by identifying the various constituents of serum and urine and also from recombinant DNA methods.

CONTENTS

Advanced Clinical Biochemistry:

1. Estimation of blood glucose.
2. Estimation of haemoglobin in blood.
3. Estimation of blood cholesterol.
4. Estimation of serum calcium.
5. Estimation of creatine in serum and urine.
6. Estimation of serum bilirubin.
7. Assay of serum AST (SGOT) and ALT (SGPT).
8. Assay of serum acid and alkaline phosphatase.
9. Assay of serum lactate dehydrogenase.
10. Assay of serum amylase.
11. Estimation of serum total proteins and albumin.
12. Glucometer (demonstration)

REFERENCE:

1. *Varley, H.* 2005. **Practical Clinical Biochemistry**, 4th edition, CBS publishers.
2. *Burtis and Bruns*, 2014. **Teitz fundamentals of Clinical Chemistry and Molecular Diagnostics,** 7th edition, Saunders.

GENETIC ENGINEERING:

1. Preparation of competent cells
2. Calcium chloride mediated transformation.
3. Culture *of E. coli* cells and isolation of plasmid DNA from *E. coli*.
4. Isolation of genomic DNA from *E. coli*.
5. Estimation of the concentration of DNA obtained from *E. coli* – UV Spectrophometer.
6. Separation of chromosomal and plasmid DNA isolated from *E. coli* by Agarose gel electrophoresis.
7. Restriction mapping of digested chromosomal and plasmid DNA.

REFERENCE:

1. *Green and Sambrook,* 2014. **Gene Cloning Laboratory manual,** 4th edition, CSHL Press.
2. *Carson, Miller and Witherow,* 2012. **Molecular Biology Techniques: A classroom laboratory manual**, Academic Press.

Suggested Reading:

1. *Plummer, D. T.* 2000. **An introduction to Practical Biochemistry,** Tata McGraw Hill Publishing Co.
2. *Jayaraman, J.* 2011. **Laboratory Manual in Biochemistry**, New Age International private limited.
3. *Pattabiraman, T. N.* 2015. **Laboratory Manual and Practical Biochemistry**, 4th edition, All India Publishers.
4. *Sawhney and Singh*, 2014. **Introductory Practical Biochemistry**, 5th edition, Narosa Publishing House.

18PBT3EA	ELECTIVE - III: STEM CELL TECHNOLOGY	SEMESTER - III

Total Credits: 4
4 Hours / Week

PREAMBLE:

- To study the types of Stem cells
- To learn about the applications of Tissue Engineering

COURSE OUTCOMES

On successful completion of the course, students will be able to:

CO Number	CO Statement	Knowledge Level
CO1	Know the process of stem cell and storage	K3
CO2	Understand the stem cell importance in plants	K3, K4
CO3	Imparts knowledge on the stem cells in animals	K3, K4, K5
CO4	In depth understanding of haemopoietic stem cell	K4, K5
CO5	Focus on stem cell therapies and its application	K4, K5

Mapping with Programme Outcomes

COs/Pos	PO1	PO2	PO3	PO4	PO5
CO1	S	M	S	S	S
CO2	S	S	S	S	S
CO3	S	M	S	S	S
CO4	S	S	M	M	M
CO5	S	S	S	S	S

S-Strong: M-Medium; L-Low

18PBT3EA	ELECTIVE-III: STEM CELL TECHNOLOGY	SEMESTER – III

Total Credits: 4
Hours / Week: 4

CONTENTS

UNIT - I

Stem Cells and Cellular Pedigrees

Scope of stem cells – definition of stem cells – concepts of stem cells – differentiation, maturation, proliferation, pluripolericy, self – maintainance and self – renewal – problems in measuring stem cells – preservation protocols.

UNIT - II

Stem Cell Concept in Plants

Stem cell and founder zones in plants – particulary their roots – stem cells of shoot meristems of higher plants.

UNIT - III

Stem Cell Concept in Animals

Skeletal muscle stem cell – Mammary stem cells – intestinal stem cells – keratinocyte stem cells of cornea – skin and hair follicles –Tumour stem cells, Embryonic stem cell biology - factors influencing proliferation and differentiation of stem cells – hormone role in differentiation.

UNIT - IV

Haemopoietic Stem Cell

Biology – growth factors and the regulation of haemopoietic stem cells. Hematopoietic stem cell niche, Embryonic stem cell-derived Hematopoietic stem cells. Cord blood hematopoietic stem cells- Cord

blood transplantation Characteristics of cord blood stem cells Genomics and proteomics of cord blood stem cells

UNIT - V

Potential Uses of Stem Cells

Cellular therapies – vaccines – gene therapy – immunotherapy – tissue engineering – blood and bone marrow – Fc cells. Stem cells for the treatment of muscular dystrophy- Cellular environment of a dystrophic muscle, Myogenic stem cells from embryonic stem cells and inducible pluripotent stem cells.

TEXT BOOKS:

1. *CS Potten , 1997.* **Stem cells.** Elsevier.
2. *Robert Paul Lanza, 2006.* **Essentials of stem cell biology.** 2nd edition. Academic Press;

REFERENCE BOOKS:

1. *Song Li, Nicolas L'Heureux, Jennifer Elisseeff.* 2011. **Stem Cell and Tissue Engineering.** 1st edition. World Scientific Publishers.
2. *Robert Lanza, John Gearhart, Brigid Hogan.* 2006. **Essentials of Stem Cell Biology**. 2nd edition. Macmillan Publishing Solutions.

17PMB3EA	ELECTIVE III- FOOD MICROBIOLOGY AND FOOD QUALITY CONTROL	SEMESTER- III

PREAMBLE:

This course has been designed for students to learn and understand the relation between food and microbes, fermented food, food borne diseases and food quality control.

COURSE OUTCOMES

On successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge level
CO1	• To understand the relation between the food and microbes and types of microorganisms in related to food. • To acquaint the knowledge on spoilage of various types of food by microbes • To Understand the principles of food preservation and some preservation methods	K2, K3
CO2	• To describe the characteristics food infections and poisoning and various food borne microorganisms. • To understand the role of microbes and the process involved in the production of various fermented food products.	K3
CO3	• To acquaint the knowledge on indicator organisms and examination of food for the identification of spoilage causing microorganisms.	K3, K4
CO4	• To become equipped with in house quality assurance in food industry and, GMP, SSOP and HACCP Principles	K3, K4
CO5	• To describe about the food laws and regulations. • To understand the GHP and waste disposal	K3

	in food industry	

MAPPING WITH PROGRAMME OUTCOMES

CO5/PO5	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	M	M
CO2	M	S	M	S	S
CO3	S	M	S	M	M
CO4	S	S	M	S	S
CO5	S	S	S	M	S

S-Strong,M-Medium,L-Low

17PMB3EA	ELECTIVE III- FOOD MICROBIOLOGY AND FOOD QUALITY CONTROL	SEMESTER- III

Total credits: 4
Hours per week: 4

CONTENTS

UNIT - I

Food as a substrate – Incidence and types of microorganisms in food – Contamination and Spoilage of Meat, Poultry, Sea foods, Vegetables, Fruits. Principles of food preservations: Asepsis, Preservation by use of High temperature, Low temperature, Canning, Drying, Radiation and Food additives.

UNIT - II

Food poisoning – Food borne diseases- Bacterial and Non- Bacterial. Fermented foods - Meat and fishery products – Country cured hams, Dry sausages, Katsuobushi. Fermented milk products –, Yoghurt and Cheese.

UNIT - III

Indicator organisms – Direct examination – culture techniques – enumeration methods – plate – Viable & Total Count; Alternative methods – Dye reduction tests , electrical methods , ATP determination: Rapid methods, immunological methods – DNA / RNA methodology – Laboratory accreditation.

UNIT - IV

In house Committee for quality assurance, Persons involved, Internal Microbial Quality control Policy, Quality Check at every step from

collection of raw materials till it reaches the customer, GMP, SSOP, HACCP- Principles & Applications.

UNIT - V

Food laws and regulations

A. National – PFA Essential Commodités Act (FPO, MPO etc.)

B. International – Codex Alimentarius, ISO – 9000 series, ISO 22000 & BS 5750.

C. Regulatory Agencies – WTO, FSSAI.

Hygiene and sanitation in food sector General Principles of Food Hygiene, GHP for commodities, equipment, work area and personnel, cleaning and disinfect ion (Methods and agents commonly used in the hospitality industry), Safety aspects of processing water (uses & standards) and Waste Water & Waste disposal.

TEXT BOOKS:

1. *Frazier. W.C and D.C Westhoff*. 2008. **Food Microbiology.** 5th ed. Tata McGraw Hill publishing Co., New Delhi.
2. *Jay, J.M* .2007. **Modern Food Microbiology** 7th edition, Van Nostra and Rainhokdd Co.

REFERENCE BOOKS:

1. *Adams. M. R and M. D Moss*.2008. **Food Microbiology,** 3rd edition. Panama Publishers.
2. Food safety and standards regulations, 2010.
3. The ministry of health and family welfare, The Gazette of India : Extraordinary, Part - III, section
4. D Kumar Bhatt, Priyanka Tomar, 2010**.An Introduction to Food Science Technology and Quality Management** 1st Edition, Kalyani Publishers.
5. Chris Bell, Paul Neavas and Anthony P. Williams, 2006. Food Microbiology and Laboratory Practices, Blackwell Publishing.

18PBC3EA	ELECTIVE – III: NUTRITION AND CLINICAL NUTRITION	SEMESTER –III

PREAMBLE:

- This course offers an overview of food science and human nutrition knowledge help in achieving and maintaining good health
- Students can gain an in-depth knowledge and understanding on appropriate nutritional care for prevention/and treatment of the various diseases.

COURSE OUTCOMES:

On successful completion of the course, students will be able to

CO number	CO Statement	Knowledge Level
CO1.	Inspect the composition of fiber and nutritional changes in inborn errors. Asses the nutritional status and Understand the nutritional changes due to preservation of food process.	K_4 & K_5
CO2.	Examine the clinical test for Cardiovascular diseases. Explain the importance of nutritional support during treatment of diseases.	K_4 & K_5
CO3.	Test for liver function. Relationship with food habits during treatment of livers diseases such as Hepatitis, Cirrhosis and Hepatic coma.	K_4 & K_5
CO4.	Examine the clinical test for renal functions. Compare the nutritional care- acid and alkaline ash diet and also diet modification with minerals for treatment of renal calculi.	K_4 & K_5
CO5.	Understand the dietary management during treatment of infectious diseases and cancer.	K_4 & K_5

MAPPING WITH PROGRAMME OUTCOMES:

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	M	M
CO2	S	S	S	M	M
CO3	S	S	S	M	M
CO4	S	S	M	M	M
CO5	S	S	M	M	M

L-Low; M-Medium and S-Strong

18PBC3EA	ELECTIVE – III: NUTRITION AND CLINICAL NUTRITION	SEMESTER –III

Total Credit: 4
Hours per week: 4

CONTENTS

UNIT I

Concept of Balanced diet, Calories requirement – sedentary, moderate & heavy worker, Fast foods, Additives in the diet, Dietary allergies. Lactose intolerance. Quality of protein – animal versus plant protein, Parenteral nutrition, Types of diets – Paleo diet, keto diet, Prebiotics and Probiotics. Chemical composition of dietary fiber and its importance - Physiological effects and metabolic adaptation during exercise - Nutritional management of inborn errors of metabolism

Diet and nutrition in India

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

UNIT II

Dietary management of Cardio Vascular Diseases

Clinical diagnostic tests and nutrition management for - Dyslipidemias, Atherosclerosis, Angina Pectoris and Myocardial Infarction (MI) and Congestive Cardiac Failure (CCF), Prevention through life style modifications.

Dietary management of Hypertension

Dietary management - Diet related factors influencing hypertension, DASH diet

UNIT III

Dietary management of Liver disease

Types, Etiology, Symptoms and Complications, Physiology, functions of the liver and liver function tests. Metabolic consequences of alcohol consumption, Dietary management for - Hepatitis, Cirrhosis and Hepatic coma.

UNIT IV

Dietary management of Kidney Diseases

Kidney function tests; Types of kidney diseases:- Glomerulonephritis, Nephrotic Syndrome, Acute Renal Failure (ARF), Chronic Renal Failure (CRF), End Stage Renal Disease (ESRD)-Dialysis and Kidney Transplant. Nephrolithiasis/Renal Calculi : Etiology, Types of stones and nutritional care- acid and alkaline ash diet. Use of sodium, potassium and phosphorous exchange lists in diet planning of kidney diseases patient.

UNIT V

Dietary management in Febrile condition: Metabolic changes during infection and dietary treatment for - Typhoid, Influenza, Malaria, Tuberculosis and HIV & AIDS

Dietary management of cancer:

Dietary management to cancer patients.

TEXT BOOKS

1. Swaminathan S,(1985): Advanced Textbook on Food & Nutrition Vol. 1 & N (2nd Ed. Revised _ Enlarged) Bapp Co..
2. Mahan L.K., Sylvia Escott-Stump (2000): Krause‟s Food Nutrition and Diet Therapy ,10th Edition, W.B. Saunders Company London.

3. B. Srilakshmi, (2007): Dietetics, published by K.K. Gupta For New age International Pvt. Ltd. New Delhi.
4. Swaminathan, M. 1974. Essentials of food and nutrition Vol. II, Applied aspects, Ganesh Pubishers, Madras

REFERENCE BOOKS

1. James Orten and Otto Neuhaus, 2003. Human biochemistry, 10th edition, CV Mosby Company, London.
2. Antia F.P. And Philip Abraham (2001) Clinical Nutrition and Dietetics, Oxford Publishing Company.
3. Passmore P. And M.A. East Wood: Human Nutrition And Dietetics, Churchill Living Stone.
4. WohlShils and Goodheart: Modern Nutrition In Health And Disease, McLAren And Ubrman, Philadelphia.
5. Robinson Ch., M.B. Lawlea, W.L., Chenoweth, and A.E., Carwick: Normal and Therapeutic Nutrition, Macmillan Publishing Company.
6. NIN books Nutritional values of Indian food.

17PBCSS1	SELF STUDY: INHERITANCE BIOLOGY	SEMESTER-III

PREAMBLE:

- The course gives an understanding of inheritance patterns
- Students can gain basic knowledge about inheritance of species.

COURSE OUTCOMES:

On successful completion of the course, students will be able to

CO number	CO Statement	Knowledge Level
CO1.	Explain the Mendelian principles	**K_2**
CO2.	Illustrate the concepts of extensions of Mendelian principles	**K_2**
CO3.	Evaluate the various types of gene mapping methods and extra chromosomal inheritance	**K_5**
CO4.	Illustrate the Microbial genetics	**K_3 & K_4**
CO5.	Demonstrate and Analyze concepts of Quantitative genetics.	**K_3 & K_4**

MAPPING WITH PROGRAMME OUTCOMES:

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	**S**	**M**	**M**	**M**	**S**
CO2	**S**	**S**	**M**	**M**	**S**
CO3	**S**	**M**	**M**	**M**	**S**
CO4	**S**	**S**	**S**	**M**	**S**
CO5	**M**	**M**	**S**	**S**	**S**

L-Low; M-Medium and S-Strong

17PBCSS1	INHERITANCE BIOLOGY	SEMESTER III

Total Credits: 1

UNIT I

Mendelian principles: Dominance, segregation, independent assortment. Concept of gene : Allele, multiple alleles, pseudoallele, complementation tests

UNIT II

Extensions of Mendelian principles: Codominance, incomplete dominance, gene interactions, pleiotropy, genomic imprinting, penetrance and expressivity, phenocopy, linkage and crossing over, sex linkage, sex limited and sex influenced characters.

UNIT III

Gene mapping methods: Linkage maps, tetrad analysis, mapping with molecular markers, mapping by using somatic cell hybrids, development of mapping population in plants. Extra chromosomal inheritance: Inheritance of Mitochondrial and chloroplast genes, maternal inheritance.

UNIT IV

Microbial genetics: Methods of genetic transfers – transformation, conjugation, transduction. Mapping genes by interrupted mating, fine structure analysis of genes. Human genetics: Pedigree analysis, lod score for linkage testing, karyotypes, genetic disorders.

UNIT V

Quantitative genetics: Polygenic inheritance, heritability and its measurements, QTL mapping Structural and numerical alterations of chromosomes: Deletion, duplication, inversion, translocation, ploidy and their genetic implications.

REFERENCE

1. Gardner, Eldon J, Michael J. Simmons, and D P. Snustad. Principles of Genetics. New York: J. Wiley, 1991. Print.

2. Pierce, Benjamin A. Genetics: A Conceptual Approach. New York: W.H. Freeman, 2012. Print.

3. Stansfield, William D. Schaum's Outline of Theory and Problems of Genetics. New York: McGraw-Hill, 1969. Print.

17PBCSS2	SELF STUDY: EVOLUTION AND BEHAVIOUR	SEMESTER-III

PREAMBLE:

- The course gives an understanding of Evolutionary concepts
- Students can gain basic knowledge about origin and evolution cells and population genetics concepts.

COURSE OUTCOMES:

On successful completion of the course, students will be able to

CO number	CO Statement	Knowledge Level
CO1.	Distinguish and explain the Darwin concepts	**K_4 & K_5**
CO2.	Explain the origin and evolution cells	**K_4 & K_5**
CO3.	Examine the palaentiology principles.	**K_4**
CO4.	Explain the concepts of population genetics.	**K_4 &K_5**
CO5.	Analyze the correlation among Brain, Behavior and Evolution	**K_2 & K_3**

MAPPING WITH PROGRAMME OUTCOMES:

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	**S**	**M**	**M**	**M**	**S**
CO2	**S**	**S**	**M**	**M**	**S**
CO3	**S**	**M**	**M**	**M**	**S**
CO4	**S**	**S**	**S**	**M**	**S**
CO5	**M**	**M**	**S**	**S**	**S**

L-Low; M-Medium and S-Strong

17PBCSS2	EVOLUTION AND BEHAVIOUR	SEMESTER III

Total credits: 1

CONTENTS

UNIT I

Emergence of evolutionary thoughts Lamarck; Darwin–concepts of variation, adaptation, struggle, fitness and natural selection; Mendelism; Spontaneity of mutations; The evolutionary synthesis.

UNIT II

Origin of cells and unicellular evolution: Origin of basic biological molecules; Abiotic synthesis of organic monomers and polymers; Concept of Oparin and Haldane; Experiement of Miller (1953); The first cell; Evolution of prokaryotes; Origin of eukaryotic cells; Evolution of unicellular eukaryotes; Anaerobic metabolism, photosynthesis and aerobic metabolism.

UNIT III

Paleontology and Evolutionary History: The evolutionary time scale; Eras, periods and epoch; Major events in the evolutionary time scale; Origins of unicellular and multi cellular organisms; Major groups of plants and animals; Stages in primate evolution including Homo. Molecular Evolution: Concepts of neutral evolution, molecular divergence and molecular clocks; Molecular tools in phylogeny, classification and identification; Protein and nucleotide sequence analysis; origin of new genes and proteins; Gene duplication and divergence.

UNIT IV

The Mechanisms: Population genetics – Populations, Gene pool, Gene frequency; Hardy-Weinberg Law; concepts and rate of change in gene frequency through natural selection, migration and random genetic drift; Adaptive radiation; Isolating mechanisms; Speciation; Allopatricity and Sympatricity; Convergent evolution; Sexual selection; Co-evolution.

UNIT V

Brain, Behavior and Evolution: Approaches and methods in study of behavior; Proximate and ultimate causation; Altruism and evolution- Group selection, Kin selection, Reciprocal altruism; Neural basis of learning, memory, cognition, sleep and arousal; Biological clocks; Development of behavior; Social communication; Social dominance; Use of space and territoriality; Mating systems, Parental investment and Reproductive success; Parental care; Aggressive behavior; Habitat selection and optimality in foraging; Migration, orientation and navigation; Domestication and behavioral changes.

REFERENCES

1.Smith, John Maynard. The Theory of Evolution. Cambridge: Cambridge UP, 1993. Print.

2.Strickberger, Monroe W. *Evolution*. Boston: Jones and Bartlett,

1990. Print.

3.Veer Bala Rastogi .Organic evolution.MEDTEC.2014.Print.

18PBC43A	BIO-ETHICS, BIO-SAFETY AND IPR	SEMESTER-IV

PREAMBLE:

To make the students to:

- Understand the basic concepts of patent rights and follow the regulatory framework important for the product safety and benefit for the society.
- Will creates awareness on the patenting of biotechnological processes and products and makes students aware about the regulation of bioethics and the biosafety rules and understands the laws governing biotechnology and related field at national and international level.
- To gain knowledge about precautions (for example basic and Good Laboratory Practices (GLP), Standard Operating Procedures (SOP) necessary during biotechnological work and to understand the ethical perspective of handling potentially harmful biomaterials.

COURSE OUTCOMES:

On successful completion of the course, students will be able to

CO number	CO Statement	Knowledge Level
CO1.	Understand the concepts, criteria, and importance of IPR and analyze the basic principles and legal framework of intellectual property rights and its application to biotechnology	K_2 &K_4
CO2.	Understand the basic issues of IPR, Biosafety and Bioethics and expected to practice and	K_2 & K_3

	implement all these policies in their future endeavor.	
CO3.	Create awareness on the Biosafety, Bioethics and patenting of biotechnological processes and products**.**	K_6
CO4.	Explain biosafety and bioethics in the context of modern biotechnology, demonstrate good laboratory procedures and practices and apply the standard operating procedures for biotechnology research	K_2 & K_3
CO5.	Apply Biosafety practices in appropriate Biosafety labs	K_3

MAPPING WITH PROGRAMME OUTCOMES:

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	**S**	**S**	**S**	**M**	**S**
CO2	**S**	**S**	**S**	**M**	**S**
CO3	**S**	**S**	**S**	**S**	**S**
CO4	**S**	**S**	**M**	**M**	**S**
CO5	**S**	**S**	**S**	**S**	**S**

L-Low; M-Medium and S-Strong.

18PBC43A	BIOETHICS, BIOSAFETY AND IPR	SEMESTER-IV

TotalCredits: 4
Hours per week: 4

CONTENTS

UNIT–I introduction toIntellectual property rights (IPR)

Introduction. Definitions. General Agreement on Trade and Tariff (GATT) and World Trade Organizations. Establishment and functions of GATT, WTO and WIPO. WTO Guidelines and Summits. Physical and Intellectual Property. Tangible and Intangible property. Roles of IBSC, RCGM and GEAC

UNIT-II Intellectual property rights (IPR)practices

TRIPS. Different types of intellectual property rights (IPR) - Patents, Trade mark, Trade secret, Copy right and Geographical Indications. Requirement of patentability. Compulsory licences. Biotechnological examples of patent, trademark, trade secret, copy right. Traditional Knowledge.

UNIT-III Patents processes and examples

Patent application. Rules governing patents. Patent related cases. Licensing - FlavrSavr™ tomato as a model case. Biopiracy and case studies on patents (Basmati rice, Turmeric, and Neem). Indian Patent Act, 1970 and recent amendments.

UNIT-IV Biosafety guidelines

Biosafety-Introduction. Different levels of Biosafety. Guidelines for rDNA

research activities. General guidelines for research in transgenic plants, Good Laboratory Practices (GLP) and Good Manufacturing Practices (GMP). Containments- Types. Basic Laboratory and Maximum Containment Laboratory. Biological weapons. The Cartagena Biosafety protocol (CAB).Assessment of risks associated with GMO.

UNIT-V Bioethics principles and practices

Bioethics-Introduction. Animal Rights. General issues related to environmental release of transgenic plants, animals and microorganisms.Ethical issues related to research in embryonic stem cell cloning. Ethical,Legal and Social Implications (ELSI) of Human Genome Project

Text Books:

1. Subbaram N. 2003. **Patents**, Pharma Book Syndicate, Hyderabad.

2. Sree Krishna V.2007. **Bioethics and Biosafety in Biotechnology**, New Age International (P) Limited Publishers. ISBN (13): 978-81-224-2248-1

3. Glick, B.R., and Pasternack, J.J. 2010. **Molecular Biotechnology: Principles and Applications of Recombinant DNA**, 4th Edition, ASM Press, Washington, DC.

Reference Books:

1. Chawla H.S. 2001. **Introduction to Plant Biotechnology**, 3rd Edition , Oxford & IBH Publishing Co. Pvt. Ltd.

2. M.K.Sateesh. 2008. **Bioethics and Biosafety** , I.K.International Pvt. Ltd, New Delhi, India.

3. PrabuddhaGanguly. 2008. **Intellectual Property Rights**, Tata McGraw Hill Publishing Company, India. ISBN: 9780070077171 .

17PBC43P	CORE PRACTICAL-IV BIOCHEMISTRY-IV	SEMESTER-IV

Total Credit: 3
Hours per week: 6

PREAMBLE:

- This course provides an overview of experimental aspects involving cancer biology, biochemical toxicology and clinical nutrition.

CONTENTS

BIOINFORMATICS:

1. Retrieval of sequences from online sequence databases (Plant, bacterial & animal databases)
2. Perform pair wise alignment of sequences using BLAST program.
3. Design primers for the given gene sequences.
4. Perform multiple sequence alignment and generate phylogenetic tree.
5. Retrieve and visualize the three dimensional structures of proteins.
6. Retrieve metagenomic sequences and primer designing to develop STS marker.

CANCER BIOLOGY:

1. Study of abnormal human karyotype and pedigrees (dry lab)
2. Isolation of lymphocytes from blood
3. Study of cell viability/ death assay by use of trypan blue and MTT assay
4. Study of apoptosis through analysis of DNA fragmentation patterns.

BIOCHEMICAL TOXICOLOGY:

1. Determination of Kow (octonal-water coefficient) for a xenobiotic

2. Kinetics of activity loss of an enzyme in the presence of trace amounts of metals
3. Determination of adulterant (toxicant) in household food samples including spices, oil and milk.
4. Determination of LD50 value of a toxicant.

NUTRITION:

1. Estimation of haemoglobin
2. Determination of total iron binding capacity
3. Bioassay for vitamin B12/B1
4. Homocysteine estimation
5. Serum/urine MMA estimation
6. Vitamin A/E estimation in serum

REFERENCE BOOK

1. Swaminathan, M, 1974. **Essentials of food and nutrition**, Vol. II, Applied aspects, Ganesh Pubishers, Madras.
2. *Srivastava S,* 2010. **Molecular Techniques in Biochemistry and Biotechnology**, 1st edition, New Central Book Publishers.
3. *Sadasivam S and Manickam*, 1996. **Biochemical Methods**, 2nd Edition, New Age International Publishers Pvt Ltd.

18PBT4EP	ELECTIVE IV - PRACTICAL - APPLIED BIOTECHNOLGY	SEMESTER IV

Total Credits: 2
4 Hours/Week

CONTENTS

1. Morphology and anatomy of any 5 food crops.
2. Plant fibers - Morphology microscopic study anatomy of whole fibers, using staining methods.
3. Medicinal plants: At least 5 medicinal plants and their morphology, anatomy, phyto-chemistry.
4. Case study – On environmental Management (air and soil)
5. Preparation of Compost/ Vermicompost for agricultural development.
6. Production of spawn for mushroom cultivation.
7. Water quality assessment (acidity and alkalinity tests)
8. Estimation of minerals in soil
9. Agarose Gel Electrophoresis.
10. SDS PAGE
11. Restriction Digestion
12. Ligation

REFERENCES:

1. *Arora, R.K. and Nayar, E.R.* 1984. **Wild relatives of crop plants in India.** NBPGR Science, Monograph No.7.
2. *Thakur, R.S., Puri, H.S. and Husain, A.* 1969. **Major medicinal plants of India, Central Institute of medicinal and aromatic plants.** Lucknow.

3. *Walters, Michele, Scholes, Robert J. (Eds.)*. **The GEO Handbook on Biodiversity Observation Networks.** 2017. 1st Edition. Springer International Publishing.
4. *Paterson, Russell, Lima, Nelson (Eds.).* **Bioprospecting.** 2017. 1st Edition. Springer International Publishing.
5. *Joseph Sambrook*, *Michael R. Green*.2012**. Molecular Cloning: A Laboratory Manual.** 4th edition. Cold Spring Harbor.

18PMB4EP	ELECTIVE IV - PRACTICAL - MICROBIOLOGICAL LABORATORY TECHNIQUES	SEMESTER - IV

Total Credits: 2
Hours per week: 4

CONTENTS

1. Staining Techniques (Grams and LPCB)–Food samples- vegetables and packed foods.
2. Sterility tests for Instruments – Autoclave & Hot Air Oven
3. Air quality checking by settle plate method.
4. Sterility testing of Microbiological media
5. Sterility testing of Pharmaceutical products –Antibiotics, Vaccines & fluids
6. Enumeration of microbes from industrial effluents.
7. Evaluation of Drug potency by MIC.
8. Isolation & characterization of Bacteria from Wood.
9. Isolation & characterization of Bacteria from Paints.
10. Water quality analysis – MPN.
11. Estimation of BOD
12. Estimation of COD.
13. Isolation of microorganisms from spoiled foods – Meat, milk, Cereals and Bread.
14. Milk quality – Dye reduction test.
15. Determination of Thermal death point and thermal death time.

LABORATORY MANUALS:

1. *Cappuccino & Sherman,* **Microbiology - A laboratory manual**, 6th Ed, Pearson Education.
2. *Dr.B.J.Wadher & Dr.G.L.Bhoosreddy,* **Manual of diagnostic microbiology**, Ist Ed., Himalaya publishing house, Nagpur.
3. *George.A.Wistreich & Max.D.Lechtman,* Laboratory **Exercises in Microbiology**, 3rd Ed, Glencoe press, London.

18PBC4EP	ELECTIVE IV - PRACTICAL - NUTRITIONAL SCIENCE	SEMESTER-IV

Total Credits: 2
Hours per week: 4

PREAMBLE:

- This course provides an overview of experimental aspects involving Nutritional science

CONTENTS

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

REFERENCE BOOK

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

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