ERA UNIVERSITY, LUCKNOW
STUDY & EVALUATION SCHEME (Effective from Session 2024-25)
M.Sc. BIOTECHNOLOGY
YEAR I, SEMESTER – I

S. No.	Course category	Course code	Course title	Hours/week			EVALUATION SCHEME				CT	C	Attributes						
				L	T	P	Mid Sem Exam	TA	Total	End Sem Exam			Employability	Entrepreneurship	Skill Development	Gender	Environment Sustainability	Human values	Professional Ethics
THEORY																			
1.	Major Own Faculty	MBT0101T	Biochemistry & Metabolism	3	1	0	20	20	40	60	100	4	√						
2.	Major Own Faculty	MBT0102T	Biophysical Techniques	3	1	0	20	20	40	60	100	4	√	√	√		√		
3.	Major Own Faculty	MBT0103T	Cell Biology	3	1	0	20	20	40	60	100	4	√						
4.	Major Own Faculty	MBT0104T	Molecular Biology	3	1	0	20	20	40	60	100	4	√		√		√		
5.	Major Own Faculty	MBT0105T	Microbiology	3	1	0	20	20	40	60	100	4	√				√		
PRACTICALS																			
6.	Major Own Faculty	MBT0106P	Laboratory Course I (Biochemistry + Cell Biology + Molecular Biology + Microbiology)	0	0	8	20	20	40	60	100	4	√	√	√		√		
Total											**600**	**24**							

L- Lecture T- Tutorial P- Practical C- Credit TA- Teacher Assessment

CT- Course Total

Era University
Department of Biotechnology
Course Outline
Academic Year: 2024-2025

Course Name: Biochemistry & Metabolism	**Course Code:** MBT0101T	**Year:** I	**Semester:** I
Core Course			
Credits: 4	**Total No. of Lectures: 60** **Lecture-Tutorial-Practical (In hours/week) L-T-P:** 3-1-0		
Evaluation Spread	**Internal Continuous** 40	**End Term Exam**	60
Course Objective	• The objective of the paper is to gain fundamental knowledge about catabolism, anabolism, regulation of metabolism and pathway analysis. • Obtain knowledge and understanding of how enzymes and metabolites in living system work to generate energy and synthesize different biomolecules. • The interrelation of each of these metabolic pathways and their contribution in various metabolic disorders. • The application of the knowledge generated in the practical aspects of Biotechnology.		
Course Outcome	CO1: Students will be gaining in-depth knowledge about the structure and properties of various biomolecules including carbohydrates, amino acids, proteins, lipids and nucleic acids. CO2: Students will be exploring the different aspects of biochemical reactions including Bioenergetics, coupling of reactions, different kinds of biochemical reactions, various classes of enzymes, regulatory steps, enzyme regulation etc. CO3: Students will be able to understand major metabolic pathways of biomolecules, their energetic and regulatory aspects and associated metabolic disorders.		
Pedagogy	Interactive, Discussion Based Sessions, Presentations, Seminars		
Internal Evaluation Mode	Sessional Test: 20 Quiz: 5 Assignments: 5 Attendance: 5 Presentations: 5		

Unit	**Topic**	**No. of Lectures Total = 60**
I	Classification, characteristics and functions of simple carbohydrates; Structure and properties of mono, oligo and polysaccharides; Structure and functions of mucopolysaccharides, peptidoglycans, Hyaluronic acid, and heparin. Carbohydrate catabolism: Glycolytic pathway, Tricarboxylic acid cycle, Gluconeogenesis, Hexose monophosphate pathway, glycogenesis and glycogenolysis, Krebs- Kornberg pathway. Energy production by aerobic and anaerobic respiration: organization of respiratory electron transport system, mechanism of oxidative phosphorylation, CO_2 assimilation.	**12**
II	Amino acids-Physicochemical properties of amino acids; proteins-classification, structures size, shape, structural organization proteins-primary, secondary, tertiary and quaternary (myoglobin, hemoglobin model) structure of proteins, protein folding. Transamination, deamination and decarboxylation reactions; Metabolism of aromatic amino acids; formation of ammonia and urea; nitrogen fixation by bacteria; inborn errors of metabolism-phenylketonuria, alcaptonuria, Maple syrup urine disease, sickle cell anemia, galactosuria, glutaricaciduria type 1, Gaucher's and Krabbe's disease.	**12**
III	Fatty acids: general formula, nomenclature and physicochemical properties; lipid classification: simple, complex; general structure and function of	**12**

	major lipid sub-classes - acyl glycerols, phosphoglycerides, phospholipids, sphingolipids, and steroids. Waxes, circulating lipids- chylomicrons, HDL, LDL and VLDL. Biosynthesis, degradation and regulation of saturated fatty acid, oxidation of unsaturated fatty acid and synthesis of UFA by enzymatic (prostaglandin and leukotrines) and non-enzymatic (free radicals and lipid peroxidation) mechanisms, cholesterol and ketone body metabolism and regulation, synthesis of triacylglycerol, phospholipids and sphingolipids.	
IV	Structure of purines, pyrimidines, nucleosides and nucleotides; Physical & biochemical properties of DNA; Types of DNA: A, B and Z DNA, their structure and significance; Physical & biochemical properties of RNA: tRNA, rRNA, mRNA and hnRNA; Primary, secondary, and tertiary structures of RNA. Metabolism of purines and pyrimidines; Disorders of purines and pyrimidines	**12**
V	Secondary metabolism: Terpenes (sesquiterpenes, carotenoids), alkaloids, flavonoids, phenolic compounds, shikimic acid pathway, importance of secondary metabolites. Bioenergetics-free energy change in biological transformation, thermodynamic principles in biology, redox potential, high energy compounds.	**12**

Suggested Readings

1. Principles of Biochemistry, Lehninger. A. L. 1993. C.B.S., India.
2. Biochemistry, Voet D. & J. Voet. 1995. 2nd Edn. 1995. John Wiley and Sons, USA.
3. Biochemistry, Berg, J. M., L. J. Tymcozco and Stryer 2002. 5th Edn. W. H. Freeman and Company, New York.
4. Biochemistry, Garrett and Girisham, 2010, Cengage Learning.
5. Harper's Biochemistry, Murray, R.K., D.K. Granner, P.A. Mayes and V.W. Rodwell. 2002. McGraw Hill Publishing Company, New Delhi.
6. Text Book of Biochemistry-West, Todd, Mason, Bruggen-Amerind Publishing Co. Pvt., Ltd.

UNIT	MAPPED CO
I	CO1, CO2
II	CO1, CO2, CO3
III	CO1, CO2, CO3
IV	CO1, CO2, CO3
V	CO1, CO2

MAPPED CO's WITH PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
CO1	√	√	√			√	√	√	
CO2	√	√	√			√	√	√	
CO3	√	√	√			√	√	√	

Course Created by: **Approved by:**

Era University
Department of Biotechnology
Course Outline
Academic Year: 2024-2025

Course Name: Biophysical Techniques	**Course Code:** MBT0102T	**Year:** I	**Semester:** I
Core Course			

Credits: 4	**Total No. of Lectures: 60** **Lecture-Tutorial-Practical (In hours/week) L-T-P:** 3-1-0			
Evaluation Spread	**Internal Continuous**	40	**End Term Exam**	60

Course Objective	• Students will demonstrate a core knowledge base in the theory and practice of modern biophysical techniques to make the students conversant about the various tools & techniques used in research laboratories, industries and diagnostics. • To gain knowledge about operative procedures, and applications of the various techniques.
Course Outcome	CO1: Enable the student to get sufficient knowledge in principles and applications of bio-instruments. CO2: Student would be able to understand the different types of spectroscopic techniques. CO3: Student would be able to describe the basic principle, technique and applications of different type of chromatographic techniques like paper, ion exchange and affinity chromatography. CO4: Student would gain knowledge regarding fundamental principles behind centrifugation and electrophoresis. CO5: Student would be able to get thorough knowledge of ESR, NMR and various principles and instrumentation. CO6: Student would understand the principles and applications of different types of microscopy.
Pedagogy	Interactive, Discussion Based Sessions, Presentations, Seminars
Internal Evaluation Mode	Sessional Test: 20 Quiz: 5 Assignments: 5 Attendance: 5 Presentations: 5

Unit	**Topic**	**No. of Lectures Total = 60**
I	**Microscopy** Principles and application of light, dark and bright field microscopy, phase contrast, fluorescence Electron Microscopy (scanning and transmission electron microscopy), staining and fixation and flow cytometry.	**12**
II	**Centrifugation Techniques** Basic principles of sedimentation, types of centrifuges and rotors, Preparative ultracentrifugation-differential centrifugation, Density-gradient, analytical ultracentrifugation.	**12**
III	**Spectroscopy** Simple theory of absorption of light molecules, Beer-Lambert law, absorbance, transmittance, extinction coefficient, light sources, monochromatic, visible spectrophotometer, infrared spectroscopy, flame photometer, atomic absorption, plasma emission, ESR and NMR spectrometry, Mass, MALDI – TOF, ESI MS and X-ray Crystallography.	**12**
IV	**Chromatographic methods** General principles, TLC and Paper chromatography, Ion exchange, gel filtration, Affinity, High-performance liquid chromatography: Principle,	**12**

	instrumentation, practical procedure and applications of gas chromatography techniques. **Radioisotope techniques**- Basic concepts, GM and scintillation counter, autoradiography, RIA, applications in biological science.	
V	**Electrophoresis** General principles, horizontal & vertical gel electrophoresis, Agarose, native PAGE, SDS PAGE, capillary electrophoresis, isoelectric focusing, 2D gel, Pulse-field gel electrophoresis: principle, methodology and applications in separation of large DNA fragments. **Blotting Techniques**: Southern Blotting, Northern Blotting and Western Blotting.	**12**

Suggested Readings

1 Keith Wilson John Walker John M. Walker "Principles and Techniques of Practical Biochemistry"
2 Joseph Sambrook David W. Russell Joe Sambrook "Molecular Cloning: A Laboratory Manual"
3 William M., Ph, D. O'Leary Robert Dony Wu" Practical Handbook of Microbiology"
4 Brown, TA "Gene cloning: An introduction" Biochemistry, 2nd ed. Edward Arnold.
5 W.W Umbrit and R.H. Burris. Manometer and biochemical techniques.

UNIT	MAPPED CO
I	CO1 & CO6
II	CO1 & CO4
III	CO1, CO2 & CO5
IV	CO1 & CO3
V	CO1 & CO4

MAPPED CO's WITH PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
CO1		√	√			√			
CO2		√	√			√			
CO3		√	√			√			
CO4		√	√			√			
CO5		√	√			√			
CO6		√	√			√			

Course Created by:

Approved by:

Era University
Department of Biotechnology
Course Outline
Academic Year: 2024-2025

Course Name: Cell Biology	**Course Code:** MBT0103T	**Year:** I	**Semester:** I
Core Course			
Credits: 4	**Total No. of Lectures: 60** **Lecture-Tutorial-Practical (In hours/week) L-T-P:** 3-1-0		
Evaluation Spread	**Internal Continuous** 40	**End Term Exam**	60
Course Objective	This course covers the structure, functions, and processes of cells, as well as the signaling pathways involved in growth and development. The course also combines cellular function with the application of technology and molecular genetics, allowing students to investigate and develop new research opportunities for the greatest benefit of humanity.		
Course Outcome	CO1: Student will understand nature of bio-membrane and function. CO2: Students will understand molecular localization of protein from translation modification to translocation. CO3: Students will understand the cell signaling pathway involve in cellular mechanisms. CO4: Students will understand cytoskeleton structure, function and cellular communication of different cell junction. CO5: Students will understand cell cycle mechanism and Molecular basis of cancer, its regulation and key events.		
Pedagogy	Interactive, Discussion Based Sessions, Presentations, Seminars		
Internal Evaluation Mode	Sessional Test: 20 Quiz: 5 Assignments: 5 Attendance: 5 Presentations: 5		

Unit	**Topic**	**No. of Lectures Total = 60**
I	Discovery of cell, cell theory, prokaryotes and eukaryotes, evolution of eukaryotic cell. Structural organization of virus, bacteria and eukaryotic cell; ultra-structure of animal and plant cell. Structural organization and function of cell wall, cell membrane, lysosome, peroxysome; Nucleus: components, nuclear pore complex, organization of chromatin nucleosomes, chromosomes, export and import of proteins. Mitochondria: structure & functions. Endoplasmic reticulum: signal peptide hypothesis, insertion of membrane proteins and glycosylation. Golgi complex: secretory and lysosomal proteins. Plastids; vacuoles; chloroplast. Glycosylation of proteins.	**10**
II	Membrane Transport mechanisms: Principles of membrane transport; Types of carrier proteins and active membrane transport (Na^+ and K^+ pump, Ca^{++} pump, H^+ pump); Ion channels - Family of membrane transport proteins. Protein sorting: Transport of molecules between nucleus and cytosol; Transport of proteins to cellular organelles (ER, Mitochondria, Chloroplast et c). Intra-vesicular traffic: Transport vehicles, SNAREs, Clathrin coat assembly; Transport from ER to Golgi and then to lysosomes; Molecular basis of endocytosis and exocytosis.	**12**
III	Cellular Communication: Types of extra cellular signal molecules and their binding mechanisms. Intracellular signaling. Types of signaling pathways: G-protein linked cell surface receptor mediated system, Enzyme-linked cell surface receptors; Signaling in plants.	**14**

	Molecular Motors: Molecular motor protein super family; Movement of myosin along actin filaments; Movement of Kinesin and Dynein along microtubules. Cell Junctions: Types, molecular basis and functions. Cell-Cell adhesion - Cadherins, Selectins, their mechanisms and functions. ECM: Glycosaminoglycans (GAG), Collagens, Elastin, Fibronectin, Basal- lamina, their structure and functions.	
IV	Phases of cell cycle. Regulation of cell cycle: Discovery of MPF, cyclins and cyclin dependent kinases, Check points- role of Rb and p53. Apoptosis: Neurotrophic factors, caspases, Pathways of apoptosis, Regulation of Programmed Cell Death. Therapeutic interventions of uncontrolled cell growth.	**12**
V	Cancer: Types and stages. Oncogene, tumor suppressor gene, oncogenic mutation. Molecular basis of cancer, virus induced cancer, metastasis, and interaction of cancer cells with normal cells. Cell senescence.	**12**

Suggested Readings

1. Molecular Biology of the Cell-Alberts *et al*
2. Molecular Cell Biology-Lodish*et al*
3. Cooper, G. M., &Hausman, R. E. (2013). The Cell: A Molecular Approach.
4. Baltimore "Molecular Cell Biology".

UNIT	MAPPED CO
I	CO1
II	CO2
III	CO3
IV	CO4
V	CO5

MAPPED CO's WITH PO's & PSO'

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
CO1	√	√	√			√			
CO2	√	√	√			√			
CO3	√	√	√			√			
CO4	√	√	√			√			
CO5	√	√	√			√			

Course Created by:

Approved by:

Era University
Department of Biotechnology
Course Outline
Academic Year: 2024-2025

Course Name: Molecular Biology	**Course Code:** MBT0104T	**Year:** I	**Semester:** I
Core Course			

Credits: 4	**Total No. of Lectures: 60**	**Lecture-Tutorial-Practical (In hours/week) L-T-P:** 3-1-0		
Evaluation Spread	**Internal Continuous**	40	**End Term Exam**	60

Course Objective	At the end of this course, students should be able to demonstrate a clear understanding of the facts and basic concepts of molecular biology. They should be capable of displaying a good knowledge base in biological concepts and be able to integrate knowledge with critical thinking skills to become problem solvers.
Course Outcome	CO1: Layering a problem-oriented approach to learning CO2: Lead to independent learning of advanced molecular biology concepts CO3: Students wouldgain higher level thinking skills that is necessary for research.
Pedagogy	Interactive, Discussion Based Sessions, Presentations, Seminars
Internal Evaluation Mode	Sessional Test: 20 Quiz: 5 Assignments: 5 Attendance: 5 Presentations: 5

Unit	**Topic**	**No. of Lectures Total = 60**
I	**Genomic organization and DNA replication** Genomic organization of prokaryotes & eukaryotes, Chromatin–histone and non-histone proteins. Levels of DNA supercoiling. DNA replication: prokaryotic and eukaryotic DNA replication, Mechanisms of DNA replication in prokaryotes and eukaryotes. Enzymes and proteins involved in DNA replication.	**12**
II	**Transcription and Post Transcriptional Modifications** Mechanism of Transcription in prokaryotes & eukaryotes, Enzymes and proteins involved in transcription, Post Transcriptional modifications: 5’ cap formation, 3’-end processing, Splicing, RNA Editing**.**	**12**
III	**Protein Synthesis and Regulation of gene expression** Mechanism of Translation in prokaryotes & eukaryotes, regulation of translation, co &post translational modification.	**12**
IV	**Molecular Markers** Molecular markers in genome analysis: RFLP, RAPD ISSR and AFLP analysis; genomic /cDNA libraries, Application of molecular markers. Protein targeting	**12**
V	**DNA Damage and Repair** Types of DNA damages: Simple Mutations, deamination, missing bases, Chemical Modification of Bases, pyrimidine dimers, strand breaks DNA Repair Mechanisms: Direct Repair, Excision Repair, Recombination Repair, Mismatch Base Repair, SOS Repair.	**12**

Suggested Readings

1. Alberts B., Bray D., Lewis J., Raff M., Roberts K., Watson J., Molecular Biology of the Cell, 5th edition, 2008, Garland science publication
2. Robertis &Robertis, Cell & Molecular Biology, 8th edn, 2001, WottersKlwer–
3. Brown T.A., Genomes 3, 2007, Garland science.
4. Lodish, H.F., Lodish, B., Berk, A., Darnell, J.E., Zipursky, S.L., Baltimore, D., Matsudaira, P., Molecular Cell biology, 6th edn, 2007, WH Freeman
5. J. D. Watson, T. A. Baker, S. P. Bell, A. Gann, M. Levine, R. Losick, Molecular Biology of the Gene, 5th edn. (2004), Pearson Education Inc.
6. Karp, G. 1999 Cells and Molecular Biology; Concepts and Experiments. John Wiley & Sons, Inc., USA.
7. Wolf, S. L. 1993. Molecular and Cellular Biology, Wadsworth Publishing Co., California, USA.

UNIT	MAPPED CO
I	CO1, CO2, CO3
II	CO1, CO2, CO3
III	CO1, CO2, CO3
IV	CO1, CO2, CO3
V	CO1, CO2, CO3

MAPPED CO's WITH PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
CO1	√	√	√			√			
CO2	√	√	√			√			
CO3	√	√	√			√			

Course Created by:

Approved by:

Era University
Department of Biotechnology
Course Outline
Academic Year: 2024-2025

Course Name: Microbiology		**Course Code:** MBT0105T	**Year:** I	**Semester:** I
Core Course				
Credits: 4	**Total No. of Lectures: 60**	**Lecture-Tutorial-Practical (In hours/week) L-T-P:** 3-1-0		
Evaluation Spread	**Internal Continuous**	40	**End Term Exam**	60
Course Objective	This paper provides deeper insight into microbiology which includes the study of all small living organisms which are not visible to naked eyes such as bacteria, virus, fungi which are collectively known as microorganisms. This paper also consists knowledge of techniques which will used for microbial identification such as staining, culture, sterilization, their genetics and applications.			
Course Outcome	CO1: The course will provide knowledge to understand the basic microbial structure and function. CO2: Students will be able to describe the importance of microorganisms. CO3: Students will gain knowledge about microbiology and its role in the field of medical, environmental, and agriculture industries. CO4: The student will be able to identify common infectious agents and the diseases that they cause. CO5: The course will provide knowledge to understand the methods used to identify infectious agents in the clinical microbiology laboratory.			
Pedagogy	Interactive, Discussion Based Sessions, Presentations, Seminars			
Internal Evaluation Mode	Sessional Test: 20 Quiz: 5 Assignments: 5 Attendance: 5 Presentations: 5			
Unit	**Topic**			**No. of Lectures Total = 60**
I	**Unit I: History and Scope of Microbiology** Introduction, history and developments of microbiology, general characteristics of prokaryotes and eukaryotes. Spontaneous Generation, Germ theory of disease, Koch's postulates, Microorganisms and their types- morphology and classification (Bacteria, viruses, fungi, algae, and protozoans). Archaebacteria, Mycoplasma. Microbes in extreme environments (thermophiles, alkalophiles, acidophiles, Psychrophiles, Halophiles, and Piezophiles); Methanogens**.**			**12**
II	**Control of microorganisms and microbial interactions:** Concept of sterilization and disinfection; Types of physical and chemical methods of sterilization. M**ode of action of antibiotics**: Narrow and broad spectrum (Penicillin, ampicillin), antifungals (clotrimazole), antiretroviral (tenofovi). **Microbial interactions:** Mutualism, symbiosis, commensalisms, predation, parasitism and amensalism. Symbiosis and antibiosis among microbial population. Microflora of soil and its role in N_2fixation.			**12**
III	**Microbial genetics** Basics of microbial genetics; Molecular classification of microbes, Plasmid DNA and its types, Prokaryotic replication, transcription and translation; Recombination in Prokaryotes: Transformation, Conjugation			**12**

	and Transduction; Bacteriophage (Lytic and lysogenic cycle).	
IV	**Clinical microbiology** Introduction of medical microbiology, Diseases caused by pathogenic microorganisms; bacteria, mycoplasma, fungi, and virus. Emerging and resurgent infectious diseases. Antimicrobial resistance and Superbugs. Biotechnological methods in management of microbial diseases. The normal microflora of the Skin, Oral cavity, and Gastrointestinal tract of the human body.	**12**
V	**Technological advances in microbiology** Cleaning oil spills, Bioleaching, Bioremediation, Biodegradable plastics, Biofuels/Biodiesel, Biopesticides, Biofertilizers and Vermitechnology. Bacterial Quorum Sensing, Microbial fuel cells. Prebiotics and Probiotics.	**12**

Suggested Readings

1. Microbiology, M.J. Pelczar, E.C.S. Chan and N.R. Kreig, Tata McGraw Hill.
2. General Microbiology, R.Y. Stanier, J.L. Ingraham, M. L. Wheelis and P.R. Painter, Macmillian.
3. Industrial Microbiology Prescott and Dunn's; G Reed; CBS Publishers.
4. The microbes – An Introduction to their Nature and Importance, P.V. Vandenmark and B.L. Batzing Benjamin Cummings.
5. The Microbial World, Roger Y. Stanier, Prentice Hall.
6. Microbiology, Tortora, Funke and Chase, Benzamin & Cummings.

UNIT	MAPPED CO
I	CO1, CO3
II	CO1, CO3
III	CO1, CO3
IV	CO1, CO2, CO3, CO4
V	CO1, CO4, CO5

MAPPED CO's WITH PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
CO1	√								
CO2		√					√		
CO3	√	√	√				√	√	
CO4	√	√	√						
CO5			√		√				

Course Created by:

Approved by:

Era University
Department of Biotechnology
Course Outline
Academic Year: 2024-2025

Course Name: Laboratory Course I (Biochemistry + Cell Biology + Molecular Biology + Microbiology)	**Course Code:** MBT0106P	**Year:** I	**Semester:** I

Core Course				
Credits: 4	**Total No. of Lectures:** NIL **Lecture-Tutorial-Practical (in hours/week) L-T-P:** 0-0-8			
Evaluation Spread	**Internal Continuous**	40	**End Term Exam**	60
Course Objective	The objective of this laboratory course is to introduce students to experiments in Biochemistry, cell & molecular biology and microbiology. The course is designed to teach students the utility of set of experimental methods in biotechnology in a problem-oriented manner.			
Course Outcome	CO1: Student should be able to understand the fundamental aspects of these techniques in biological phenomenon CO2: Ability to apply these practical knowledge and experience in biotech industries. CO3: Ability to conduct fundamental and applied research in the field of biology			
Pedagogy	Interactive, Discussion Based Sessions, Practical's			
Internal Evaluation Mode	Sessional Test: 20 Viva: 10 Attendance: 5 Lab Record: 5			

Topic

1. **BIOCHEMISTRY: (30HRS)**
2. Qualitative tests of carbohydrates: Molisch's test, Fehling's test; Benedict's test; Barfoed's test; Seliwanoff's test; Iodine test.
3. Qualitative tests of proteins: Proteins & amino acids: Millon's test, Xanthoproteic test, Biuret test.
4. Estimation of carbohydrate by Anthrone method.
5. Estimation of protein by Lowry's method.
6. Chromatography-Separation of amino acids by paper chromatography and thin layer chromatography (TLC).

2.CELL BIOLOGY: (30HRS)

1. To study the structure of any prokaryotic and eukaryotic cell.
2. Study of meiosis
3. Study of mitosis.
4. To Staining of Sex chromatin (Barr body).
5. Vital Staining of Mitochondria with Janus green B.

3. MOLECULAR BIOLOGY: (30HRS)

1. Estimation of DNA by DPA method.
2. Estimation of RNA by resorcinol method.
3. Electrophoresis Techniques: Agarose gel electrophoresis, SDS page.
4. Isolation, separation and visualization of native DNA from blood
5. Isolation, separation and visualization of RNA from blood
6. Amplification of gene using Polymerase chain Reaction

4. MICROBIOLOGY: (30HRS)

1. To isolate the mitochondria from the given sample.
2. Isolation of bacteria from water/soil samples, colony purification.
3. Inoculation, Purification techniques: Serial dilution, pour plate and streak plate method.
4. Identification of isolated bacteria: Gram staining other staining methods, metabolic

characterization.

5. Sensitivity of various microorganisms (bacteria and fungus) towards Antibiotic/Antifungal agents.
6. Growth curve of microorganisms.

MAPPED CO's WITH PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
CO1	√	√	√		√	√	√		
CO2		√	√		√	√	√	√	
CO3		√	√		√	√	√	√	

Course Created by:

Approved by: