PERIYAR UNIVERSITY

Periyarpalkalai Nagar, Salem-636011
(Reaccredited with 'A' grade by the NAAC

DEPARTMENT OF BIOCHEMISTRY

M.Sc. DEGREE

[Choice based credit system (CBCS)]

OBE REGULATIONS AND SYLLABUS

(Effective from the academic year 2026-2027 and thereafter)

1. Preamble

The Department of Biochemistry was established in the year 2005. The department comprises of one Assistant Professor, one Associate Professor and two professors. The main objective of the department is to inculcate the basic concepts and applications of Biochemistry and thrive in the field of research and development. The department is known for its commitment to the self development of students into well-molded individuals who can take on leadership role in Industry/ Academic/ Government organization. The Department aims in developing human resources in Biochemistry and to expand and transfer knowledge in particular to the rural community residing in and around Salem district of Tamil Nadu, India. There is a greater demand globally, for trained manpower in the areas of Biochemistry for Research and Development in multinational companies, public sectors, quality control labs, biopharmaceutical companies, food industries as well as in universities. The Department is inbuilt and established with numerous research facilities such as high speed Ultra centrifuges, Spectrophotometers, Semi Autoanalyser, colorimeter, Deep freezers, Cold room, sonicator, Gel documentation system, orbital shakers, PCR machines, CO_2 incubators, ELISA Reader, centrifuges, incubators, laminar flow, electronic balance, etc.

2. General Graduate Attributes

The graduate attributes reflect both disciplinary knowledge and understanding, skills, competencies, that students should acquire/attain and demonstrate while studying Biochemistry program. Some of the characteristic attributes that a graduate should demonstrate are as follows:

1. **Disciplinary knowledge:** Capable of demonstrating comprehensive knowledge and understanding of Biochemistry
2. **Communication Skills:** express thoughts and ideas effectively in orally and writing
3. **Critical thinking:** Capability of analyzing, interpreting, discussion by following scientific approach to knowledge enrichment.
4. **Problem solving:** apply one's learning skills to imply on real life situations.
5. **Analytical reasoning**: ability to analyze and solve problems quickly and effectively
6. **Research-related skills:** Ability to define problems, analyse, interpret and draw conclusions from data and report the results of an experiment or investigation.
7. **Cooperation/Team work**: Ability to work effectively as a member of a team rather than individually.

8. **Scientific reasoning:** Ability to evaluate ideas and evidence of a particular problem and reason them based on scientific approach.
9. **Reflective thinking:** ability to learn from experience
10. **Information/digital literacy:** Capability to use ICT in a variety of learning situations.
11. **Self-directed learning:** Ability to work independently with efficiency based on the knowledge acquired while learning.
12. **Moral and ethical awareness/reasoning:** Ability to follow moral/ethical values in all aspects of work.
13. **Leadership readiness/qualities:** Capability to guide people to the right destination, in a smooth and efficient way.
14. **Lifelong learning:** Ability to acquire knowledge and skills through self-directed learning aimed at personal development

3. Program specific qualification Attributes

The cognitive domain involves knowledge and the development of intellectual skills (Bloom, 1956). This includes concepts that serve in the development of intellectual abilities and skills. There are six major categories of cognitive processes, starting from the simplest to the most complex

- Knowledge and understanding level (K1 and K2)
-
- Application level (K3)
- Analytical level (K4)
- Evaluation capability level (K5)
- Scientific or synthesis level (K6)

4. Vision

To achieve academic excellence in Biochemistry by imparting in-depth knowledge to the students and producing quality students trained in the various facets of Biochemistry, facilitating research activities and cater to the academic, industrial & societal demands. To make university a centre of excellence in the discipline of Biochemistry.

5. Program objectives and outcomes

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

The career perspectives of the Master's program in Biochemistry are

PEO 1: To prepare students for the future careers in the concerned/various relevant fields in which a core understanding of the chemistry of life is important.

PEO 2: To enable the graduates to exhibit leadership, make life long learners with professional and social ethics and make them communicate effectively.

PEO 3: To add highly skilled scientific workforce in the area of biomedical research sectors, academic, industry as well as for research laboratories across the country and the globe by following best practices for improving the professionalization and employability of students.

PEO 4: The practical and technical skills with laboratory-based work and the final year research project prepare the students for a research or technical position by defining specific and transferable skills.

PEO 5: To sensitize and train the students towards research with typical employers include pharmaceutical, biotechnology, food, water and agricultural companies and specialist services, such as toxicological studies.

PEO 6: To train the students in generic and competency skills so as to be able to work in potential places including scientific and medical publishers and the Intellectual Property Office

PROGRAMME SPECIFIC OBJECTIVES (PSOs)

The Overall objective of the Program is to promote education and research in biochemistry and provide academic and professional excellence for immediate productivity in industrial, or clinical settings for an ultimate benefit of society and environment.

PSO1:	To acquire necessary knowledge and skills in core themes, principles and components of basic Biochemistry
PSO2:	To demonstrate the knowledge of biochemical processes from the cellular and molecular aspects
PSO3:	To Integrate and apply the techniques studied and to compare and contrast the depth of scientific knowledge in the broad range of fields
PSO4:	to be able to understand, analyze and apply the studied basic and concepts in wide variety of applications including diagnostics, biochemical pathway regulation and drug development and use this knowledge and apply the same for multitude of laboratory applications.
PSO5:	To provide students with the knowledge and skill base that would enable them to go for self-employment and entrepreneurship

PROGRAMME OBJECTIVES (POs)

PO1: To demonstrate comprehensive knowledge on various areas of Biochemistry.

PO2: To acquire skills in areas related to the current and emerging developments.

PO3: To communicate the concepts, constructs and techniques of the subject learnt in a clear, concise and lucid manner.

PO4: To plan and execute the experiments to the relevant theories of Biochemistry.

PO5: To apply critical thinking, scientific reasoning and mathematical skills in studied areas of Biochemistry.

PO6: To train the students to acquire various relevant generic and competency skills in various aspects of biochemistry so as to be able to work independently in a group or individually

PO7: To make a student life long learner with moral and ethical values

PROGRAMME OUTCOME (PO'S):-

M.Sc programme in Biochemistry will provide students with the necessary knowledge and skills to undertake a career in research, either in industry or in an academic setting. The training provided will give students the breadth and depth of scientific knowledge in Biochemistry. On completion of the programme, students will be qualified to apply for a PhD or to gain employment in the pharmaceutical or biotechnology industries, which are among the strongest growth sectors. The programme will be based on a combination of taught modules, independent learning and an extended research project to be carried out either in the University departments or industry or in association with industry at the University. The programme incorporates a substantial element of hands-on research experience, with enhanced experimental skills being gained alongside experienced research workers.

It is intended that, on successful completion of the M.Sc degree programme, students will :

1. **be capable of demonstrating comprehensive knowledge** and have a fundamental/systematic or coherent understanding of major concepts, theoretical principles and experimental findings in biochemistry.
2. **acquire skills in areas related to the current and emerging developments** in the field of Biochemistry.
3. **be identifying and applying appropriate biochemical principles** and methodologies to solve a wide range of problems associated with Biochemistry.
4. **communicate the results of studies undertaken** in Biochemistry accurately in a range of different contexts using the main concepts, constructs and techniques of the subject learnt in a clear and concise manner in writing and oral skills.

5. **Plan and execute the experiments**, investigate, analyze and interpret data collected using appropriate experimental methods, and report the findings of the experiment and relate the interpretations and conclusions to relevant theories of Biochemistry.
6. They will have the **ability to employ critical thinking, scientific reasoning and efficient problem** solving skills in the basic areas of biochemistry.
7. Be able to **demonstrate relevant generic skills and competencies** such as (i) problem solving skills, (ii) investigative skills, (iii) communication skills (iv) analytical skills, (v) ICT skills, (vi) skills such as the ability to work both independently and in a group.
8. **demonstrate professional behaviour** such as (i) unbiased and truthful in all aspects of work (ii) follow moral and ethical practices (iii) Life long learners aimed at personal development and for improving knowledge/skill development (iv) focusing on issues related to social cause.

6. Candidate eligibility for admission

Graduates in Biochemistry, Chemistry, Pharmacy, Bachelors of medical lab technology, Microbiology and Life Sciences as principle subject or Biochemistry as subsidiary subject are eligible for admission to the course.

7. Duration of the course: Two year degree programme

8. Curriculum structure for each semester

M.Sc. Biochemistry curriculum structure for each semester 2026-2027

Sem	Course Code	Title of the Course	Marks			Hrs	Credits	Total Credit
			CIA	EA	Total			
I	26UPBIC1C01	Core I - Biological Molecules	25	75	100	6	5	23
	26UPBIC1C02	Core II- Advanced Enzymology	25	75	100	5	5	
	26UPBIC1E01	Elective I - Cellular Biochemistry	25	75	100	4	4	
	26UPBIC1E02	Elective II- IPR and Biosafety	25	75	100	4	4	
	26UPBIC1P01	Core Practical I - (Biological molecules, Enzymology and Bioanalytical Techniques)	40	60	100	5	5	
II	26UPBIC1C03	Core III - Intermediary Metabolism and Energetics	25	75	100	5	5	25
	26UPBIC1C04	Core IV - Molecular Biology	25	75	100	5	5	
	26UPBIC1E03	Elective III - BioAnalytical Techniques	25	75	100	4	4	
	26UPBIC1E04	Elective IV - Endocrinology and Hormonal Regulation	25	75	100	4	3	
	26UPBIC1P02	Core Practical II (Molecular Biology and Cell Biology)	40	60	100	5	5	
	26UPSOC2H01	Fundamentals of Human Rights	25	75	100	2	1	
	26UPBIC1N01	Swayam	25	75	100	2	2	
III	26UPBIC1C05	Core V-Clinical and Diagnostic Biochemistry	25	75	100	5	5	26
	26UPBIC1C06	Core VI - Immunology and Immunotechnology	25	75	100	6	5	
	26UPBIC1E05	Elective V– Genetic Engineering and Gene Technology	25	75	100	6	4	
	26UPBIC1E06	Elective VI- Oncology	25	75	100	4	4	
	26UPBIC1P03	Core Practical III (Genetic Engineering, Immunology and Immuno Techniques)	40	60	100	6	5	
	26UPBIC1N02	NME- Medical Lab Technology(Supportive)	25	75	100	3	2	
	26UPBIC1I01	Internship (Review)	25	75	100	-	1	
IV	26UPBIC1C07	Core VII– Pharmacology and Clinical Toxicolgy	25	75	100	5	5	18
	26UPBIC1P04	Core Practical IV (Clinical &Diagnostic Biochemistry and Toxicology)	40	60	100	6	5	
	26UPBIC1X01	Extension Activity	-	-	-	-	1	
	26UPBIC1PR01	Project and Viva-voce	50	150	200	-	7	
		TOTAL			**2300**		**92**	**92**

SUPPORTIVE COURSES FOR OTHER DEPARTMENTS

1. 26UPBIC1N 02 - Medical Lab Technology
2. 26UPBIC1 N03 - Tools and Techniques in Bioscience
3. 26UPBIC1N 04 - Clinical diagnosis in health and diseases
4. 26UPBIC1N 05 – Biochemistry-The molecules of life

VALUE ADDED COURSE

1. PLANT THERAPEUTICS : 26UPBICVA01
2. DOWN STREAM PROCESSING OF ENZYMES : 26UPBICVA02
3. RT PCR APPLICATION IN CANCER BIOLOGY : 26UPBICVA03
4. CLINICAL DIAGNOSIS : 26UPBICVA04

8. Credit calculation

Method of teaching	Hours	Credits
Lecture	1	1
Tutorial/demonstration	1	1
Practical/Internship/ Self-Learning	2	1

CBCS – Scheme of examinations semester wise structure

Teaching methodologies

The classroom teaching would be through conventional lectures and use of OHP and Power point presentations. The lecture would be such that the students should participate actively in the discussion, student's seminars would be conducted and scientific discussions would be arranged to improve their communicative skill.

In the laboratory, instructions will be given for the experiments followed by demonstration and finally the students have to do the experiments individually. Periodic tests will be conducted for the students. Slow learners will be given special attention

9. Examinations

There shall be four semester examinations. Two in the first year and two in the second year. Candidates failing in any subject will be permitted to appear for such failed subjects at subsequent examination. The syllabus has been divided into 4 semesters. The examination for the Semester I & III will be held in November/December and that for the Semester II and IV will be in the month of April/May. The Practical examination will be conducted at the end of each semester. Candidates failing in any of the practical examination will be permitted to appear for such failed practical examination at subsequent practical examination.

10. Scheme for evaluation and Attainment Rubrics

Theory	External	: 75 Marks
	Internal	: 25 Marks
	Three test	: 10 Marks
	Seminar	: 5 Marks
	Assignment	: 5 Marks
	Attendance	: 5 Marks
Practical	External	: 60 Marks
	Internal	: 40 Marks
	Practical test	: 30 Marks
	Record	: 5 Marks
	Attendance	: 5 Marks

SCHEME FOR PRACTICAL EXAM

Time – 5 hours	**Max. Marks = 60**
I Major	
Experiment - I	25
Experiment - II	25
II Viva	5
III Record	5
Procedure	5
Table	4
Graph	4
Calculation	6
Result	6
The Experiments carried out by using Kits	
Procedure	5
Observation	10
Result	10

QUESTION PAPER PATTERN (THEORY)

Part A : Answer All questions (MCQ) 20 x 1 = 20 marks
Part B : Answer any three questions (Analytical reasoning) 3 x 5 = 15 marks
Part C : Answer All questions (either or type) 5 x 8 = 40 marks

Duration of the examination - 3 hours Maximum marks – 75

FOR RESEARCH

S.No.	**Particulars**	**Marks**	**Examiners**
1	Dissertation	30%	Internal Examiner
		30%	External Examiner
2	Viva-voce	20%	Internal Examiner
		20%	External examiner

11. Grading system

Evaluation of performance of students is based on ten-point scale grading system as given below

Ten Point Scale			
Grade of Marks	Grade Points	Letter Grade	Description
90-100	9.0-10.0	O	Outstanding
80-89	8.0-8.9	D+	Excellent
75-79	7.5-7.9	D	Distinction
70-74	7.0-7.4	A+	Very Good
60-69	6.0-6.9	A	Good
50-59	5.0-5.9	B	Average
00-49	0.0	U	Re-appear
ABSENT	0.0	AAA	Absent

BIOLOGICAL MOLECULES

COURSECODE : **26UPBIC1C01**

MARKS : 100

Hours	L	T	P	C
	5	1	0	5

COURSE OBJECTIVES: To understand which will enable to

Demonstrate foundational knowledge about important biomolecules in cells and living organism, essential to life processes.

COURSE OUTCOMES (CO) basis of biomolecules

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

CO1	Understand and demonstrate how the structure of carbohydrates determines their Chemical properties and reactivity.Various functional groups involved in bond formation/linkage and also encourages the student to draw and recognize key structures of carbohydrates.
CO2	Understand the structure,functional groups, draw and recognize key structuresof Aminoacids and function of aminoacids, their interactions,various structural aspects Of proteins involved in biology.
CO3	Understand the structure and function of import and biological macromolecules like lipids,its types,composition,its role in biological function.Various functional groups bond formation /linkage.
CO4	Have knowledge of the structure/conformational freedom of DNA/RNA various Functional groups in bond formation/linkage, functional difference help students to Draw and recognize key structures of nucleicacids,know their functions in biology.
CO5	Know about the structure,types of minerals and vitamins in biological reactions, And its relationship with disease.

SYLLABUS

Unit	Unit title	Intended Learning chapters	Knowledge domain	Hours of Instruction
I	Carbohydrates	Classification of Carbohydrate-structure,occurrence, properties and biological functions. Homoglycans-structure and biological functions. Heteroglycans and complex carbohydrates: Structure, and biological function. Mucopolysaccharides – bacterial cell wall polysaccharides and sialic acid. Lectins –characteristics and uses, Blood group antigens, Major classes of glycoproteins:O-linked and N-Linked oligosaccharides.	K1,K2,K3	12
II	Proteins	Amino acid 1 and 3 letter abbreviation, classification,biologically important peptides.	K1,K2,K3	14

		peptide bond, peptides. Physical interactions that determine the properties of proteins – shot range repulsions, electrostatic forces, van der waals interaction, hydrogen bond and hydrophobic interactions. Primary structure and its determination.The Ramachandran plot and cross links. Secondarystructure:Theα-helix, β-sheets andCorey model for fibrous proteins,supersecondary structures - Zinc motifs, Leucine zipper motif. Tertiarystructure-Collagen and quaternary structure - Hemoglobin.		
III	Lipids	Classificationoflipids.Saturatedandunsaturated fattyacids.Derivedlipids:Phospholipids,glycolipids, structure and function. Eicosanoids-structure and biological actions of prostaglandins, prosracyclins, thromboxanes, leukotrienes andlipoxins.Lipoproteins-Classificationand composition. Amphipathic lipids – membranes, micelles,emulsionsandliposomes.	K1,K2, K3	12
IV	NucleicAcids	Structure of nucleic acids, Structure of dsDNA – Watson and Crick model of DNA, properties of dsDNA,DNAsequencingprocedures-Maxam Gilbert method andSanger's dideoxy methods. PropertiesofDNA–denaturation,renaturation, Cotcurves,CrucifromDNA,Triplestranded DNA.TriplexandduplexRNA,MajorandMinorclassesof RNA-mRNA,tRNA,rRNA,hnRNA.	K1,K2, K3	14
V	Vitaminsand Porphyrins	Watersolublevitamins-thiamine,riboflavin,niacin,pyridoxine,folicacid,ascorbic acid sources, structure, biochemical functions, deficiency diseases, daily requirements.Fat soluble - vitamin A, vitamin D2, vitamin E and vitaminK-sources, structure, biochemical functions, deficiency diseases, daily requirements and hypervitaminosis. Porphyrins the porphyrin ring system.	K3,K4	13

Program specific attributes

Knowledge and understanding level (K1 and K2)

Application level (K3)

Analytical level (K4)

Evaluation capability level (K5)

Scientific or Synthesis level(K6)

TextBooks

1. Nelson,D.L.andCox,M.M.2013.Lehninger Principles of Biochemistry,6th Edition,W.H.Freeman & Co.
2. Berg,J.M. *etal*., 2012.Biochemistry,7thEdition,W.H.Freeman&Co.
3. Voet,D.*etal.,*2012. Fundamentals of Biochemistry: Life at the Molecular level, 4thEdition, John Wiley and Sons.

ReferenceBooks

1. Zubay, G.L.1998. Biochemistry, Wm.C.Brown Publishers.
2. Sinden, S.R. DNA structure and function, First Edition, Academic Press, 1994.
3. Carl Branden and John Tooze, Introduction to Protein Structure, Second Edition, Garland Publishing,1999.
4. Garrett,R.and Grisham,C.2010. Biochemistry,4thEdition,Saunders College Publishing.

MAPPING

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	H	M	M	L	L	M	M	L
CO2	H	M	L	L	L	M	M	L
CO3	H	M	L	L	L	M	M	L
CO4	H	L	L	L	L	M	M	L
CO5	H	M	M	L	L	M	M	L

H-High;M-Medium;L-Low

ADVANCED ENZYMOLOGY

Hours	L	T	P	C
	5	1	0	5

COURSE CODE : **26UPBIC1C02**

MARKS :**100**

COURSE OBJECTIVES : To understand the classification, kinetics, mechanism of action, regulation and applications of enzymes.

COURSE OUTCOMES (CO)

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

CO1	Characterize the enzymes in each enzymatic class, examples of such enzymes. Role of coenzymes in the activity of enzymes will be thoroughly understood by the students.
CO2	Understand the concepts of Purification of enzymes with known examples
CO3	To understand enzyme active site concepts and its various mechanism of action.
CO4	Assess the relationship between properties and structure of the enzymes, kinetics of enzymatic reactions and their inhibition with specific examples
CO5	Relate the regulatory mechanisms of enzyme activity which involve in the maintenance of body's homeostasis

SYLLABUS

Unit	Unit title	Intended Learning chapters	Knowledge domain	Hours of Instruction
I	Classification and Coenzymes	Enzyme–Nomenclature and classification of enzymes. Effect of pH, temperature and substrate concentrations on enzyme catalyzed reactions. Co-enzymes and Co-factors mechanism of action in enzyme catalyzed reactions: NAD, FAD and TPP.	K1,K2,K3, K4 & K5	13
II	Enzyme Purification	Enzyme purifications methods: Strategy of enzyme purification, Methods of separation (principle only), Purification table, Intracellular enzyme – Glutathione reductase from *E.coli.,*- Extracellular enzymes – amylase.	K1,K2,K3, K4 & K5	12

III	Enzyme active site and catalysis	Active site –Enzyme active site and its concepts- modification using chemical procedures and site-directed mutagenesis. Types of catalysis - Acid base catalysis, covalent catalysis - Mechanism of reaction catalyzed by enzymes - lysozyme. Role of metal ions in enzyme activity – carbonic anhydrase- nonprotein enzymes – ribozymes.	K1,K2,K3, K4 & K5	13
IV	Enzyme Kinetics and inhibition	Enzyme Kinetics: steady state kinetics, MichaelisMenten kinetics, importance of Vmax, Km, - Lineweaver- Burk plot, Bisubstrate reactions: ordered, random- Enzyme inhibition – Reversible - competitive, non-competitive, mixed inhibition, irreversible inhibition.	K1,K2,K3, K4 & K5	14
V	Enzyme Regulation and applications of enzymes	Enzyme regulation: Allosteric control, Symmetric and sequential modes for action of allosteric enzymes. Mechanism of action and regulation of pyruvate dehydrogenase- Enzyme Immobilization methods. Enzymes in therapy: Enzymes as anti-inflammatory agents, digestive aids. Therapeutic use of streptokinase.	K1,K2,K3, K4 & K5	15

Program specific attributes

Knowledge and understanding level (K1 and K2)

Application level (K3)

Analytical level (K4)

Evaluation capability level (K5)

Scientific or synthesis level (K6)

REFERENCES:

Text Books

1. Palmer,T. 1995.Understanding enzymes, 4 th Edition, Prentise Hall.
2. Allan Svendsen. 2016. Understanding Enzymes: Function, Design, Engineering and Analysis. Pan Standford.
3. Price,N.C. and Stevens,L. 1999. Fundamentals of Enzymology, 3rd Edition, Oxford University Press.
4. Berg,J.M. *et al*., 2012. Biochemistry, 7th Edition, W. H. Freeman & Co.

Reference Books

1. Walsh,G. 2014. Protein Biochemistry and Biotechnology, 2nd Edition, John Wiley and Sons Ltd.
2. Chapline,M.F. and Buke,C. 1990. Enzyme technology, 1st Edition, Cambridge University Press.

Weblink

1. https://nptel.ac.in/courses/102/102/102102033/
2. https://nptel.ac.in/content/storage2/courses/102101007/downloads/PPT/LEC-07-PPT.pdf
3. https://nptel.ac.in/content/storage2/courses/103105054/assignments/Q_&_A_Set_8.pdf

MAPPING

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO1	H	L	M	L	L	L	L	L
CO2	H	L	L	L	L	M	M	L
CO3	H	L	M	L	M	M	L	L
CO4	H	L	M	L	M	M	M	L
CO5	H	L	M	L	L	L	M	L

H-High; M-Medium; L-L

ELECTIVE I-CELLULAR BIOCHEMISTRY

Hours	L	T	P	C
	3	1	0	4

COURSE CODE : 26UPBICIE01

MARKS : 100

COURSE OBJECTIVES : At the end of the course, learners will be able to understand the structure of the cell membrane, mechanisms of membrane transport, types of cell junctions, cell adhesion molecules, cell signaling pathways, processes of cell division and differentiation, regulation of the cell cycle, and mechanisms of cell death.

COURSE OUTCOMES (CO)

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

CO1	To explain the cell theory and evolution of cells and describe the molecular organization of prokaryotic and eukaryotic cells, including the structure and functions of cellular organelles, cytoskeleton, cell junctions and cell adhesion molecules.
CO2	To understand the structure and functional properties of biological membranes and explain the various mechanisms of membrane transport including passive and active transport processes.
CO3	To describe different types of cells signaling, signaling molecules and receptors, intracellular signal transduction mechanisms, second messengers and major signaling pathways involved in cellular communication.
CO4	To explain the phases of the cell cycle, regulatory mechanisms involving cyclins and CDKs, and describe the molecular events involved in mitosis and meiosis
CO5	To understand the types and potency of stem cells, their isolation, differentiation and applications in regenerative medicine, and explain the mechanisms and significance of programmed and non-programmed cell death including apoptosis, necrosis and autophagy.

SYLLABUS

Unit	Unit title	Intended Learning chapters	Knowledge domain	Hours of Instruction
I	Cell and Tissue Organization	Cell theory and evolution of cells. Molecular organization of prokaryotic and eukaryotic cells. Structure and functions of cellular organelles including nucleus, mitochondria, endoplasmic reticulum, Golgi apparatus, lysosomes and peroxisomes. The cytoskeleton: Structure and functions of microtubules, microfilaments and intermediate filaments. Cell junctions: Tight junctions, adherens junctions, desmosomes and gap junctions. Cell adhesion molecules (CAMs): Cadherins, integrins, selectins and members of the immunoglobulin superfamily.	K2	12

II	Membrane Transport	Structure and properties of biological membranes. Diffusion: Passive diffusion and facilitated diffusion. Osmosis and membrane permeability. Transport systems: Uniport, symport and antiport mechanisms. Active transport: Primary and secondary active transport. Transport proteins and pumps: P-type ATPases (Na^+/K^+-ATPase), F-type ATPases (ATP synthase), ABC transporters.Ion channels: Ligand-gated and voltage-gated ion channels. Other transport systems: Aquaporins and ionophores. Vesicular transport: Endocytosis (phagocytosis, pinocytosis and receptor-mediated endocytosis) and exocytosis.	K2	12
III	Cell Signaling	Types of cell signalling: Endocrine, paracrine, autocrine and juxtacrine signalling. Signalling molecules and their receptors. Functions of cell surface receptors. Intracellular signal transduction pathways and signal amplification. Second messengers: cAMP, cGMP, IP_3, DAG and Ca^{2+}. Major signalling pathways: G-protein coupled receptors (GPCRs), receptor tyrosine kinases (RTKs) and Ras–MAP kinase pathway.Regulation and termination of signalling.	K3	14
IV	Cell Cycle and Cell Division	Phases of the cell cycle: G_1, S, G_2 and M phases. Regulation of the cell cycle: Cyclins, cyclin-dependent kinases (CDKs) and cell cycle checkpoints. Molecular events during mitosis and meiosis: Chromosome segregation, spindle formation and regulation of cell division.	K3	13
V	Stem Cells and Cell Death	Stem cells: Types of stem cells (embryonic, adult and induced pluripotent stem cells). Stem cell potency: Totipotent, pluripotent and multipotent stem cells. Isolation, identification, expansion and differentiation of stem cells. Applications of stem cells in regenerative medicine and therapeutic research. Ethical issues in stem cell engineering. Cell death mechanism: Types of cell death,Necrosis: Causes and mechanism.Apoptosis: Morphology and molecular pathways (mitochondrial/intrinsic pathway and death receptor/extrinsic pathway).Autophagy: Basic mechanisms and cellular significance.	K4	14

Program specific attributes

- ✓ Knowledge and understanding level (K1 and K2)
- ✓ Application level (K3)
- ✓ Analytical level (K4)
- ✓ Evaluation capability level (K5)
- ✓ Scientific or synthesis level (K6)

REFERENCES:

Text Books

1. Alberts, B. *et al*., 2014. Molecular Biology of the Cell, 6th Edition, Garland Publishing Co.
2. Lodish *et al*. 2016. Molecular Cell Biology, 8th Edition, W.H. Freeman and Co.
3. Cooper, G.M. and Hausman, R.E. 2013. The Cell: A Molecular Approach, 6th Edition, Sinauer Associates, Inc.
4. Text book of Biochemistry with Clinical Correlations, 7th edition, Thomas M. Devlin, a 2010.

Reference Books

1. Karp Cell & Molecular Biology, Wiley. 8th ed. 2016.
2. De Robertis and De Robertis. Cell and Molecular Biology. Lippincott Williams and Williams. 8th ed. 2017.

Web link

1. https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/cell-biology
2. https://www.microscopemaster.com/cell-biology.html

MAPPING

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	H	L	M	M	L	L	M	L
CO2	H	L	M	M	L	M	M	L
CO3	H	L	M	M	L	L	M	L
CO4	H	L	M	M	L	M	M	L
CO5	H	L	M	M	L	L	M	L

H-High; M-Medium; L-Low

ELECTIVE II-BIOSAFETY,LAB SAFETY AND IPR

COURSECODE :26UPBICIE02
MARKS :100
COURSE OBJECTIVES : The main objective of this course is to understand the importance of biosafety, laboratory safety, and the scope of patenting in biological research.

Hours	L	T	P	C
	3	1	0	4

COURSE OUTCOMES (CO)

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

CO1	To understand and implement various aspects of biosafety and carry out risk assessment of products in biological research.
CO2	Understand the basic concepts of ethics and safety that are essential for different disciplines of science and procedures involved and protection of intellectual property and related rights.
CO3	To appreciate the intellectual property rights and its implementation of on the invention related to biological research.
CO4	To understand the statutory bodies that regulate the property rights and its validity in various countries.
CO5	Critique the ethical concerns associated with modern biotechnology processes and plan accordingly.

SYLLABUS

Unit	Unit title	Intended Learning chapters	Knowledge domain	Hours of Instruction
I	**Biosafety**	Historical background; introduction to biological safety cabinets; primary containment for biohazards; biosafety levels; recommended biosafety levels for infectious agents and infected animals; biosafety guidelines – government of India, roles of IBSC, RCGM, GEAC etc. for GMO applications in food and agriculture; environmental release of GMOs; risk assessment; risk management and communication; national regulations and international agreements.	K1, K2, K3	12
II	**Laboratory safety**	Chemical, electrical and fire hazards; handling and manipulating human or animal cells and tissues, toxic, corrosive or mutagenic solvents and reagents; mouth pipetting, and inhalation exposures to infectious aerosols, Safe handling of syringe needles or other contaminated sharps, spills and splashes onto skin and mucous membranes. History of biosafety microbiology and molecular biology, Risk assessment, Personal protective equipment, Laboratory facilities and safety equipment, Disinfection, decontamination and sterilization, Regulatory compliance, Laboratory security and emergency response and administrative controls.	K1,K2, K3, K4	12

III	**Intellectual Property Rights (IPR)**	Introduction to patents, types of patents, process involved in patenting in India, trademarks, copyright, industrial design, trade secrets, traditional knowledge, geographical indications, history of national and international treaties and conventions on patents, WTO, GATT, WIPO, Budapest Treaty, Patent Cooperation Treaty (PCT) and TRIPS.	K1, K2 K3, K4	14
IV	**Patent filing and infringement**	Objectives, Rights, Patent Acts 1970 and its amendments. Procedure of obtaining patents, working of patent, Infringement, Industrial Application: Non-Patentable Subject Matter, Registration Procedure, Rights and duties of Patentees.	K1, K2, K3, K4	13
V	**Bioethics**	Introduction to bioethics, human genome project and its ethical issues, genetic manipulations and their ethical issues, ethical issues in GMOs, foods and crops in developed and developing countries, ethical issues involved in stem cell research, use of animals in research experiments, animal cloning, human cloning and their ethical aspects.	K1, K2, K3, K4	14

Program specific attributes

- ✓ Knowledge and understanding level (K1 and K2)
- ✓ Application level (K3)
- ✓ Analytical level (K4)
- ✓ Evaluation capability level(K5)
- ✓ Scientific or synthesis level (K6)

REFERENCES:

Text Books

1. V. Shree Krishna, (2007). Bioethics and Biosafety in Biotechnology, New Age International Pvt. Ltd. Publishers.
2. Deepa Goel, Shomini Parashar, (2013). IPR, Biosafety and Bioethics, Pearson. R. Ian Freshney, 2016.
3. Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications, 6th Ed, John Wiley & Blackwell.
4. BAREACT, Indian Patent Act 1970 Acts & Rules, Universal Law Publishing Co. Pvt. Ltd., 2007.

Reference Books

1. Biosafety in Microbiological and Biomedical Laboratories, (2020) 6th Ed.
2. Kankanala C., (2007), Genetic Patent Law & Strategy, 1st Edition, Manupatra Information Solution Pvt. Ltd.,

Web link…

1. https://www.cdc.gov/labs/pdf/SF 19_308133-A_BMBL6_00-BOOK-WEB- final3.pdf

MAPPING

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	H	M	L	M	L	M	M	L
CO2	H	H	M	M	L	M	M	L
CO3	H	M	M	M	L	M	M	L
CO4	H	H	H	M	L	M	M	L
CO5	H	M	M	M	L	M	M	L

H-High; M-Medium; L-Low

Hours	L	T	P	C
	-	-	5	5

CORE PRACTICAL I
BIOLOGICAL MOLECULES, ENZYMOLOGY AND TECHNIQUES

COURSE CODE : 26UPBIC1P01

MARKS :100

COURSE OBJECTIVES: At the end of the course learners will be able to qualitatively and Quantitatively identify the biological molecules, enzymes present in the given sample

1. Preparation of normal, molar and percentage solution
2. Estimation of reducing sugars
3. Estimation of protein
4. Estimation of β-carotene from carrot
5. Estimation of ascorbic acid from citrus friuts
6. Determination of Substrate concentration using MM Plot.
7. Identification of types of reversible inhibition by LB Plot
8. Isolation, purification and characterization of peroxidase enzyme
9. Separation of Aminoacids by paper chromatography.

OUTCOMES

The students will be acquainted with hands-on knowledge in the qualitative and quantitative analysis of biological molecules, enzymes in the given samples.

CORE-III-INTERMEDIARY METABOLISM AND ENERGETICS

Hours	L	T	P	C
	5	1	0	5

COURSECODE : 26UPBIC1C03

MARKS : 100

COURSE OBJECTIVES : To understand the various metabolic pathways operating in living cells with special emphasis on carbohydrate, lipid, amino acid, nucleic acid metabolism and the electron transport chain.

COURSEOUTCOMES(CO)

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

CO1	To demonstrate and understanding of the metabolic pathways-the energy-Yielding and energy requiring reactions in life
CO2	To demonstrate an understanding of the diversity of metabolic regulation.
CO3	To emphasis the unique role in metabolism for life existence
CO4	To provide conceptual theoretical knowledge
CO5	To relatevarious metabolic connectivity and its control

SYLLABUS

Unit	Unit title	Intended learning chapters	Knowledge domain	Hours of instruction
I.	Energetics & Bio-oxidation	Free energy and entropy & enthalpy. Enzymes involved in redox reactions. The electron transport chain - Oxidative phosphorylation and mechanism of action. The chemiosmotic theory. Uncouplers and ionophores.Regulation of oxidative phosphorylation-Inhibitors.	K1,K2,K3	13
II.	Carbohydrate Metabolism	Glycolysis/citric acid cycle and itsregulation. The pentose phosphate pathway. Metabolism ofglycogenandregulation-Coricycle.Futile cycles.	K1 &K2	14
III.	Metabolism of fats	Biosynthesis of fattyacids-fattyacid synthase complex, Oxidation of fatty acids (β). Role of carnitine in fattyacid transport, Metabolism of triglycerides, Cholesterol - Biosynthesis, regulation, transport and excretion.	K1,K2,K3	13

IV.	Protein metabolism	Branched Amino acids (BCAAs)- Aromatic amino acids-AliphaticAminoAcid- Catabolism of aminoacid nitrogen- transamination, deamination, ammonia formation and the urea cycle. Catabolism of carbon skeletons of aminoacids.	K2& K3	13
V.	Nucleic acid Metabolism & Porphyrins	Metabolism of purines - De novo and salvage pathways for biosynthesis. Purine catabolism. Biosynthesis and catabolism of pyrimidines. Biosynthesis and degradation of porphyrins and heme.	K1 &K2	12

Program specific attributes

Knowledgeandunderstandinglevel(K1andK2)
Application level (K3)
Analytical level(K4)
Evaluation capability
level(K5)
Scientificorsynthesislevel(
K6)

REFERENCE

Text Books

1. S.Melmedetal., 2015. WilliamsText BookofEndocrinology, 13th Edition, Saun
2. ThomasMDevlin.2006.TextbookofBiochemistry withClinicalCorrelation2ndedWiley &Sons.

ReferenceBooks

1. Fundamentalsof Biochemistry: LifeattheMolecularLevel,5thEdition
2. DonaldVoet,JudithG. Voet,CharlotteW.Pratt, 2016
3. Zubey,G.L.1998.Biochemistry,Wm.C.Brown Publishers
4. Garrett,R.andGrisham,C.2010.Biochemistry,4thEdition,SaundersCollege Publishing.

WebLink

1. https://archive.nptel.ac.in/courses/104/105/102105034/
2. https://nios.ac.in/media/documents/dmlt/Biochemistry/Lesson-03.pd
3. https://www.osmosis.org/notes/Protein_Metabolism

MAPPING

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	H	L	M	M	L	L	M	L
CO2	H	L	L	L	L	M	M	L
CO3	H	M	M	L	L	L	M	L
CO4	H	M	M	M	L	M	M	L
CO5	H	L	M	M	L	L	M	L

H-High;M-Medium;L-Low

CORE IV-MOLECULAR BIOLOGY

COURSE CODE: 26UPBIC1C04

Hours	L	T	P	C
	5	1	0	5

MARKS : 100

COURSE OBJECTIVES : To understand the basic structure and functioning of the genetic material, knowledge on the activity of genes and genomes, molecular mechanisms of DNA replication, repair, recombination, transcription, protein synthesis and gene regulation.

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COURSE OUTCOMES (CO)

CO1	Molecular biology gives an in-depth knowledge of biological processes through the investigation of the underlying molecular mechanisms.
CO2	Describe the processes of replication, repair and recombination
CO3	Understanding the underlying process of prokaryotic transcription and regulation
CO4	Explain the mechanism of eukaryotic transcription and regulation
CO5	Provides the basics of genetic code, translation and targeting

SYLLABUS

Unit	Unit title	Intended Learning chapters	Knowledge domain	Hours of Instruction
I	Chromatin and Genome	Central dogma of Molecular biology. Structure of the bacterial nucleoid, Role of Nucleoid Associated proteins. Eukaryotic chromatin organization. Genome complexity- genome size, C- value paradox, coding and non coding DNA, Introns and exons and repetitive DNA (SINES, LINES, simple sequence repeats - satellite, minisatellite and microsatellite).	K1,K2	13
II	Replication, Repairing mechanism and Recombination	DNA replication in prokaryotes and eukaryotes. Proteins responsible for replication. Inhibitors of replication. DNA repair mechanisms – Excision repair, double-strand break repair, recombination repair and SOS response. Recombination – Homologous recombination, site specific recombination.	K1,K2	12

III	Transcription	Prokaryotic Transcription-Structure of E.coli RNA polymerase, Steps involved in transcription. Transcription inhibitors. Post-transcriptional processing of rRNA and tRNA. Eukaryotic transcription- Structure of RNA polymerase I, II and III. General transcription factors. Steps involved in transcription. Post transcriptional processing of mRNA.	K1, K2	13
IV	Transcriptional Regulation	Regulation of transcription in prokaryotes – lac operon and trytophan operon. Regulation of transcription in eukaryotes- Transcriptional factors, Activators and repressors. Steroid hormone receptors. DNA binding motifs- Helix turn helix, zinc fingers, leucine zippers, helix loop helix motifs.	K1, K2,	12
V	Genetic Code, and Translation	Genetic code - salient features. Mutations– definition, Types of mutation. Mechanism of protein synthesis in bacteria and eukaryotes- amino acid activation, initiation, elongation and termination. Inhibitors of protein synthesis. Co and post-translational modifications.	K1,k2, K3	15

Program specific attributes

Knowledge and understanding level (K1 and K2)
Application level (K3)
Analytical level (K4)
Evaluation capability level(K5)
Scientific or synthesis level (K6)

REFERENCES:

Text Books

1.Lodish*et al*. 2012. Molecular Cell Biology, 7th Edition, W.H. Freeman and Co.
2. Weaver,R.F. 2011. Molecular Biology, 5th Edition, WCB McGraw Hill, Higher Education.
3. Karp,G. 2009.Cell and Molecular Biology, 6th Edition, John Wiley & Sons, Inc.

Reference Books

1. Alberts,B.*et al*., 2008. Molecular Biology of the Cell, 5th Edition, Garland Publishing Co.
2. Watson,J.D.*et al*., 2013. Molecular Biology of the Gene, 7th Edition, Pearson Education.
3. Lewin,B. 2007. Genes IX, 9th Edition, Jones and Bartlett Publishers.

Web Link

1. https://ocw.mit.edu/courses/7-03-genetics-fall-2004/pages/lecture-notes/
2. https://www.ncbi.nlm.nih.gov/books/NBK9846/
3. https://www.ncbi.nlm.nih.gov/books/NBK26879/
4. https://www.ncbi.nlm.nih.gov/books/NBK26879/

MAPPING

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO1	H	L	L	M	L	L	M	L
CO2	H	L	L	M	L	L	M	L
CO3	H	L	L	L	L	L	M	L
CO4	H	L	L	M	L	L	M	L
CO5	H	L	L	L	L	L	M	L

H-High; M-Medium; L-Low

ELECTIVE-III-BIOANALYTICAL TECHNIQUES

COURSE CODE : 26UPBIC1E03

MARKS : 100

Hours	L	T	P	C
	5	1	0	5

COURSE OBJECTIVES : The objective of this course is to understand the working principles, instrumentation and applications of the instruments in various disciplines of biological sciences

COURSE OUTCOMES (CO)

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

CO1	To explore the basic concepts of pH, buffers and the types of various electrochemical cells and its application. The students will also be able to identify and understand the principle components of a light and electron microscope with biological applications.
CO2	To explain the principles of the liquid and gas chromatography as well as electro-migration techniques and evaluate strengths and limitations of the most important chromatographic separation and detection methods.
CO3	To understand how *electrophoresis* facilitates the separation of molecules based on various principles of electrophoresis.
CO4	To understand the principles of spectroscopy and to analyse and interpret spectroscopic data collected by the methods discussed in the course.
CO5	To assimilate the principles and applications of centrifuge. Employ the knowledge for the separation of bimolecular/cells/organelles by selecting appropriate Centrifugation techniques.

SYLLABUS

Unit	Unit title	Intended Learning chapters	Knowledge domain	Hours of Instruction
I	Electrochemistry and Microscopy	Electrochemistry: Electrochemical cells- Henderson - Hasselbalch equation, buffer, pH measurement-glass electrode. Microscopy - fluorescence and phase contrast microscope. Electron microscopy and its types (SEM and TEM), Confocal Laser Scanning Microscopy.	K1,K2, K3,K4	14
II	Chromatographic methods	Chromatography- Principle, instrumentation and applications:- Thin layer, HPLC, RF-HPLC, Gas Chromatography, Supercritical Fluid Chromatography- Chromatofocusing	K1,K2, K3,K4	12

III	Electrophoresis	General principle, migration of charged particle in an applied electric field, factors affecting mobility. SDS-PAGE, 2D-PAGE, isoelectric focusing gels, agarose gel electrophoresis, capillary electrophoresis &Zymography.	K1, K2, K3,K4	12
IV	Spectroscopy	Principle, Instrumentation and applications -UV-Visible spectroscopy, Raman spectroscopy- FTIR, ESR, NMR, Mass Spectrophotometry – MS & MALDI and circular dichroism spectroscopy. Fluorimetry, X ray photoelectron spectroscopy.	K1, K2, K3,K4	13
V	Centrifugation & Radioactivity	Basic principles of sedimentation; types of rotor; preparative and analytical centrifugation - types and its applications, CsCl density gradient-centrifugation. Radioactivity– solid and liquid scintillation counter-Autoradiography, applications of radioisotopes in biology, radiation hazards and safe disposal of radioactivity waste.	K1, K2, K3,K4	14

Program specific attributes

Knowledge and understanding level (K1 and K2)
Application level (K3)
Analytical level (K4)
Evaluation capability level (K5)
Scientific or synthesis level (K6)

REFERENCES:

Text Books

1. Wilson,K. and Walker,J. 2010. Principles and Techniques of Biochemistry and Molecular Biology, 7thEdition , Cambridge University. Press.
2. Upadhyay,A. Upadhyay,K. and Nath,N. 2016. Biophysical Chemistry: Principles and Techniques, 4th Edition, Himalaya Publishing. 11th Edition
3. Sharma,B.K. 2014. Instrumental Methods of Chemical analysis, Krishna Prakashan Ltd.

Reference Books

1. Skoog.D, Holler F and Crouch S. 2016. Principles of Instrumental Analysis, 7th Edition, Cengage Learning custom publishing.
2. Boyer,R. 2009. Modern Experimental Biochemistry, 3rd Edition, Pearson India.

Weblink

1. https://nptel.ac.in/courses/102/103/102103044/
2. https://nptel.ac.in/courses/102/107/102107028/
3. https://nptel.ac.in/courses/103/108/103108100/

MAPPING

P O / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO1	H	L	M	L	L	L	M	L
CO2	H	L	L	L	L	M	L	L
CO3	H	M	M	L	M	M	L	L
CO4	H	L	M	L	M	M	L	L
CO5	H	L	M	L	L	L	M	L

H-High; M-Medium; L-Low

ELECTIVE IV- ENDOCRINOLOGY AND HORMONAL REGULATION

COURSECODE : 26UPBIC1E04

Hours	L	T	P	C
	4	1	0	3

MARKS : 100

COURSE OBJECTIVES : To obtain sound knowledge in Hormonal Biochemistry.

COURSE OUT COMES(CO)

CO1	To provide core principle and concepts of molecular endocrinology to unable to Students under standard acquire knowledge.
CO2	To provide clear understanding and critical interpretations of clinical manifestation.
CO3	To impact the basis theoretical knowledge in molecular endocrine
CO4	Educating and familiarizing the terms and concepts of molecular endocrinology
CO5	To impact complete idea and knowledge in hormones.

SYLLABUS

Unit	Unit title	Intended learning chapters(K1,K2)	Knowledge domain	Hours of instruction
I.	History and anatomy of Mammalian endocrine system.	Classification of hormones. Hypothalamic hormones. Pituitary hormones (i)Anterior pituitary hormones : biological actions and regulation of growth hormone, ACTH, gonadotropins and prolactin, Leptin. (ii)Posterior pituitary hormones-biological actions of vasopressin- ADH secretion (SIADH) Oxytocin. Hypopituitarism.	K1 &K2	13
II.	Thyroid and Parathyroid hormones	Thyroid hormones- synthesis, secretion, regulation, transport, metabolism and physiological functions. Hyper and hypothyroidism. Hormonal regulation of calcium and phosphate metabolism. Secretion and biological actions of PTH, Calcitonin and calcitriol.	K1, K2	12

III.	Adrenal Hormones	Adrenal cortical hormones: Synthesis, regulation and biological effects of glucocorticoids and mineralocorticoids. Cushing's syndrome, aldosteronism, CAH, aderenal cortical insufficiency, Addison's disease. Adrenal medullaryhormones: Synthesis, regulation and physiological effects of catecholamines- Phaeochromocytoma.	K1, K2	15
IV.	Gonadal, Pancreaticand Gastro intestinal hormones:	Gonadal hormones: Biosynthesis, regulation and biological functions of androgens. Hypogonadism. Pancreatic Hormones: insulin- glucagon and somatostatin. Gastrointestinal hormones-synthesis and physiological function.	K1, K2	15
V.	Signal transduction and Neuro transmitter:	Basic concepts, general features of cell signalling. Endocrine, paracrine and autocrine signaling. Receptors-Classification-Nuclear and cytosolic receptors. G-protein-coupled receptors. Second messengers: c-AMP- Neurotransmitter –general features, mechanism and biological function. Neurotransmitter receptor- Cholingeric and adrenergic.	K1 &K2	15

Program specific attributes

Knowledge and understanding level(K1andK2) Application level (K3)
Analytical level (K4)
Evaluation capability level (K5)
Scientific or synthesis level(K6)

REFERENCE:

Text Books:

1. Hadely,M.andLevine,J.E.2006.Endocrinology,6 thEdition,BenjaminCummings.
2. Smith,E.*etal*.,1983.PrinciplesofBiochemistry,7thEdition,McGrawHillInternational Book
3. Harper'sIllustratedBiochemistryThirty-FirstEditionMcGraw-HillEducation– Illustrated, 2018.
4. HaroldVarleyetal,Varley'spracticalclinicalbiochemistry,6thedition,London:HeinemannMedical Books ; New Delhi (India) : CBS, 2006, 1988.
5. Dr.M.Suriyavathana, IntermediaryMetabolism–AStudentsCompanion,SaraPublication,2018.

ReferenceBooks:

1. Guyton,A.C.andHall,J.E.2010. Textbook of MedicalPhysiology, 12thEdition, Saunders Publishers.
2. S.Melmedet al.,2015. WilliamsTextBook ofEndocrinology, 13thEdition, Saun
3. Biochemistry-DonaldVoet,J.G.Voet, JohnWiley, JO HNWIVP &PublisherKayePace
4. Biochemistry4thed- Campbell andFarrell,Brooks/ColePub Co.

MAPPING

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	H	L	M	M	L	M	L	L
CO2	H	L	M	M	L	M	L	L
CO3	H	M	M	M	L	M	L	L
CO4	H	L	M	M	L	M	L	L
CO5	H	L	M	M	L	L	L	L

H-High;M-Medium; L-Low

CORE PRACTICAL II

MOLECULAR BIOLOGY AND CELL BIOLOGY

Hours	L	T	P	C
	-	-	5	5

COURSE CODE : 26UPBICP02

MARKS : 100

COURSE OBJECTIVES : This course is designed to provide hands-on training in molecular and microbial techniques.

1. Isolation and estimation of DNA
2. Isolation and estimation of RNA
3. Estimation of phosphorus
4. Estimation of chlorophyll in leaves
5. Separation of lipids by TLC
6. Separation of aminoacids by TLC
7. Agarose gel electrophoresis of DNA
8. Isolation of pure culture - Serial dilution, pour plate, spread plate, streak plate

OUTCOMES

After the completion of this course the students will be able to understand and gain practical experience in molecular and microbial techniques

CORE-V - CLINICAL AND DIAGNOSTIC BIOCHEMISTRY

COURSE CODE :26UPBIC1C05

Hours	L	T	P	C
	5	1	0	5

MARKS :100

COURSE OBJECTIVES : To impart knowledge about the biochemical basis of various Diseases and disorders, and to study various diagnostic and Therapeutic methodologies available for diseases and disorders.

COURSEOUTCOMES(CO)

CO1	To have a basic knowledge on collection of samples,role of preservatives, time of its additions, need of its addition, and also various procedures involved in collection of clinical samples like blood,urine,stool,CSF,amniotic fluid as well as purpose of collection, biochemical test that could be carried out in the samples.
CO2	To have a critical understanding on Inbornerrors of metabolism. And its causative Factors like genetic defect in specific key metabolic enzymes induced specific Diseases of carbohydrate,lipid, protein,purine and pyrimidine metabolism.
CO3	Enzymatic assay protocols that could help one to diagnose the specific illness like Hepatobiliary diseases by comparing with the normal values and by knowing Cusative factors.
CO4	Understand the test available for gastric,liver,pancreas function inorder to assess The laboratory results obtained as well as to interpret them.
CO5	Tohaveabetterin-depth knowledge on diagnosis using biochemical parameters, complications, management of diseases like Diabetesmellitus,Atherosclerosis, Obesity.

SYLLABUS

Unit	Unit title	Intended learning chapters	Knowledge domain	Hours of instruction
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.CSF– composition and collection, chemical examination and infections and spinal cord infections. Amniotic fluid:Origin, collection, composition and analysis of amnioticfluid Automation in the clinical biochemistry: Precision, reliability, reproducibility and other Factors in quality control.	K1,K2,K3	15

II.	**Inborn metabolism**	Disorders of carbohydrate metabolism – Intolerance and fructosuria. Disorders of lipid metabolism- Lipid storage diseases, fatty liver And lipoproteinemias. Disorders of aminoacid metabolism– Aminoaciduria, phenylketonuria, Hartnup disease, alkaptonuria, albinism, cystinuria, cystinosis, homocystinuria and maple syrup urine disease. Disorders of purine, pyrimidine and porphyrin metabolism- Hyperuricemia, Hyporuricemia and gout, orotic aciduria, porphyrias–Erythropoietic and hepatic.	K1,K2,K3	15
III.	**Clinical enzymology**	Serum enzyme activities in diseases- Principle and assay of transaminases, phosphatases, isocitrate dehydrogenase, 5' nucleotidase, ά-Hydroxybutyrate dehydrogenase, ceruloplasmin, γ-glutamyl transpeptidase, creatine kinase. lactatedehydrogenase, amylase, lipase, choline esterase. Enzyme patterns in disease – Hepatobiliary disease, myocardial infarction	K1, K2, K3	11
IV.	**Hepatic, pancreatic andrenal functional tests**	Normal structure and functions of liver, diseases of the liver, hepatitis types, cirrhosis, liver functiontests, disorders of bilirubin metabolism. Pancreatic and gastric function tests–peptic Ulcer Renal function tests- Biochemical findings In glomerulo nephritis, acute and chronic renal failure, nephritic syndrome, nephrolithiasis. Normal and abnormal constituents of urine.	K1, K2, K3	12
V.	**Diabetes, Atherosclero Sis and obesity**	Blood glucose homeostasis-Role of tissues and hormones. Diabetes mellitus–classification, metabolic abnormalities, diagnosis and management, acute and long-term complications. Atherosclerosis – risk factors, biochemical Findings and management. Obesity- definition, classification, causes, mechanism, factors modulating it.	K3, K4, K5	12

Program specific attributes

Knowledge and understanding level (K1andK2)
Application level (K3)
Analytical level (K4)
Evaluation capability level(K5)
Scientific or synthesis level(K6)

REFERENCES:

Text Books

1. Burtis,C. and Bruns,D.20.Teitz Fundamentals of Clinical Chemistry,7th Edition, W.B. Saunders Company.
2. Devlin,T.M. 2010. Text book of Biochemistry with Clinical Correlation,7th Edition, John Wiley and Sons.
3. Varley,H.1980. Practical Clinical Biochemistry, Volume I and II, 5th Edition,CBS Publishers.

Reference Books

1. Mayne, P.D.1994. Clinical Chemistry in Diagnosis and Treatment, 6th Edition, Hodder Arnold Publication.
2. Marshall,W.J. and Bangeit,S.K. 1995.Clinical Biochemistry-Metabolic concepts and Clinical aspects, Churchill Livingstone.
3. Guyton,A.C. and Hall,J.E.2015. Text Book of Medical Physiology,13thEdition, Saunders

MAPPING

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	H	M	M	M	H	H	M	L
CO2	H	M	M	M	M	H	M	L
CO3	H	M	M	M	H	H	M	L
CO4	H	M	M	M	H	H	M	L
CO5	H	M	M	M	M	H	M	L

H-High; M-Medium; L-Low

CORE-VI IMMUNOLOGY AND IMMUNOTECHNOLOGY

COURSE CODE :**26UPBICIC06**

Hours	L	T	P	C
	4	1	0	5

MARKS : **100**

COURSE OBJECTIVES : The candidate will gain knowledge of the cells of the immune system, antigens, antibodies, the complement system, hypersensitivity reactions, transplantation immunology, vaccines, and immunological techniques.

COURSE OUTCOMES (CO)

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

CO1	Explain the basic concepts of immunology, properties of the immune system, and the structure and functions of various immune cells and lymphoid organs.
CO2	Describe the characteristics of antigens and antigen–antibody interactions, and explain the components and activation pathways of the complement system.
CO3	Illustrate the structure, classification, and functions of immunoglobulins and explain the different types and mechanisms of hypersensitivity reactions.
CO4	Understand the principles of transplantation immunology, including graft rejection and HLA antigens, and describe the types and applications of vaccines.
CO5	Demonstrate knowledge of various immunological techniques such as agglutination, precipitation, immunoelectrophoresis, ELISA, ELISPOT, immunofluorescence, and fluorescence-activated cell sorting (FACS).

SYLLABUS

Unit	Unit title	Intended Learning chapters	Knowledge domain	Hours of Instruction
I	Introduction to Immunology	Immune system- definition and properties. Cells of the immune system - neutrophils, eosinophils, basophils, mast cells, monocytes, macrophages, dendritic cells, natural killer cells, and lymphocytes (B cells and T cells).Lymphoid organs- Primary and Secondary; structure and functions.	K1, K2	13
II	Antigens and Complement System	Antigens - definition, properties- antigenicity and immunogenicity, antigenic determinants and haptens. Types of antigens. Antigen - antibody interactions. Affinity, avidity, valency, cross reactivity and multivalent binding. Complement system - components of complement activation and its biological consequences- classical, alternative and lectin pathways.	K1, K2	13
III	Immunoglobulins and Hypersensitivity	Immunoglobulins - Structure, classification and functions. Factors influencing immunogenicity. Hypersensitivity - types and mechanisms.	K1, K2	13

IV	Transplantation immunology and vaccines	Transplantation immunology- graft rejection and HLA antigen. Role of MHC and T cell. Prevention of graft rejection. Vaccines - Types and uses. Attenuated vaccines, preventive vaccines, DNA vaccines, mRNA vaccines and subunit vaccines.	K1, K2,K3, K4	13
V	Immunotechniques	Agglutination and precipitation technique. Immunoelectrophoresis, RIA, Immunoblotting. Avidine-biotin mediated immune assay. Immunohistochemistry- Immunofluorescence, Immune ferritin technique,fluorescent immunoassay, Fluorescence cell sorting (FACS), Cytokines assay: ELISA and ELISPOT.	K1, K2, K3, K4,K5	13

Program specific attributes

- ✓ Knowledge and understanding level (K1 and K2)
- ✓ Application level (K3)
- ✓ Analytical level (K4)
- ✓ Evaluation capability level(K5)
- ✓ Scientific or synthesis level (K6)

REFERENCES:

Text Books

1. Jenni Punt, Sharon Stranford et al. Kuby Immunology. WH Freeman & Co. 8th ed. 2018.

2. Abbas et al. Cellular and Molecular Immunology. Elsevier. 9th ed. 2018.

3. Janeway, C. (Ed), Travers. Immunobiology. Garland Publ. 8th ed. 2016.

4. Coico and Sunshine. Immunology: A short Course. Wiley-Liss. 7th ed. 2015.

Reference Books

1. Roitt et al. Roitt's Essential Immunology. Wiley - Blackwell Sci. 13th ed. 2017.

2. Abbas,A.K.*et al*., 2012. Cellular and Molecular Immunology, Fourth Edition, Elsevier SaundersCompany.

Web Link

1. www.whfreemen.com/kuby
2. www.immunologylink.com

MAPPING

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	H	M	M	L	L	L	M	L
CO2	H	M	M	M	L	L	M	L
CO3	H	M	M	M	L	L	M	L
CO4	H	M	M	M	L	M	M	L
CO5	H	M	M	H	M	M	M	L

H-High; M-Medium; L-Low

Hours	L	T	P	C
	5	1	0	5

ELECTIVE- V-GENETIC ENGINEERING AND GENE THERAPY

COURSE CODE :26UPBIC1E05

MARKS : 100

COURSE OBJECTIVES : To familiarize the students with the recent knowledge in gene technology; the completion of this course the students will have be able to comprehension the versatile tools and techniques employed in genetic engineering; and to appraise them about applications of genetic engineering.

COURSE OUTCOMES (CO)

CO1	The student will have knowledge of tools and strategies used in genetic engineering.
CO2	Understanding the application of genetic engineering techniques in basic and applied research.
CO3	To understand the concept of the gene expression systems used in genetic engineering.
CO4	To impact knowledge latest updation and application of genetic engineering
CO5	To motivate and create interest to uptake genetic engineering for research

SYLLABUS

Unit	Unit title	Intended learning chapters (K1,K2)	Knowledge domain	Hours of instruction
I	Restriction endonucleases, cloning vectors, and ligation	Type II Restriction Endonucleases nomenclature and types of cleavage. Cloning vectors: plasmids (pBR322 and pUC), phage vectors (λ), cosmids, YACs. Methods of ligation of insert and vector DNA molecules: cohesive end method, homopolymeric tailing, blunt-end ligation, linkers and adapters	K1, K2,K3	18

II.	Gene cloning methods & screening strategies:	Gene transfer methods: Electroporation, lipofection, microinjection. Choice of host organisms for cloning. Construction of genomic and cDNAlibraries - genomic cloning, cDNA cloning. Differences between genomic and cDNA libraries. Screening of recombinants: marker inactivation (antibiotic resistance, blue-white selection), colony hybridization.	K2,K3	16
III.	Gene Expression systems:	Factors affecting expression of cloned genes. Expression of eukaryotic genes in bacterial expression vector. Fusion proteins, strategies to enhance protein stability, secretion and metabolic load. Expression in eukaryotic cells: Expression in yeast- yeast vectors, GAL system. Reporter genes- types and uses.	K1&K2	16
IV.	Gene Manipulation Tools	Blotting techniques: Southern, northern, and western. Principle and applications of DNA fingerprinting, DNA footprinting in situ hybridization, PCR and its types- DNA Sequencing: Automated sequencing. Nextgeneration sequencing. Site-directed mutagenesis (SDM): cassette and oligonucleotide-directed mutagenesis. Protein engineering by directed evolution and DNA shuffling. Hazards and safety aspects of genetic engineering.	K1,K3, K4	16
V.	Transgenesis & Gene therapy	Transformation, co-transformation, selectable markers, reporter genes. Transgenic animals - methods of production gene knock out in transgenic mice. Transgenic animals as models of human disease. Application of transgenic mice, animal bioreactors (Pharm animals).Antisense RNA technique. Transgenic plant technology-development and applications. Invivo&Exvivo gene therapy.	K1 & K2	16

Program specific attributes

Knowledge and understanding level (K1 and K2)
Application level (K3)
Analytical level (K4)
Evaluation capability level(K5)
Scientific or synthesis level (K6)

REFERENCE:

Text Books

1. Brown,T.A. 2010. Gene cloning and DNA analysis: An introduction, 6 th Edition, Wiley-Blackwell Publishers.
2. Primrose,S.B. and Twyman,R. 200661 Principles of Gene Manipulation and

Genomics,
7th Edition, Oxford University Press.
3. Glick,B.R. and Pasternak,J.J. 2009. Molecular Biotechnology - Principles and Applications of Recombinant DNA, 4th Edition, ASM Publishers.

Reference Books

1. Strachan,T. and Read,A.P. 2003. Human Molecular Genetics, 3rd Edition, Garland Science Publishers.
2. Watson,J.D.*et al*., 2007. Recombinant DNA-Genes and Genomes: A short course, 3rd Edition, Cold Spring Harbor Laboratory Press.
3. Winnacker,E.L. 1987. From Genes to clones, 1st Edition, Wiley-Blackwell Publishers.
4. Nicholl,D.S.T. 2008. An introduction to Genetic Engineering. 3 rd Edition, Cambridge University Press

Weblink

1. http://www.aun.edu.eg/molecular_biology/Procedure1/1%20Gene%20cloning%20an%20overview.pdf
2. https://archive.nptel.ac.in/courses/102/103/102103074/
3. https://nptel.ac.in/courses/102103013
4. https://nptel.ac.in/courses/102103074

MAPPING

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO1	H	M	M	M	M	L	M	L
CO2	H	M	M	M	M	M	M	L
CO3	H	M	M	M	M	L	M	L
CO4	H	M	M	M	M	M	M	L
CO5	H	M	M	M	M	L	M	L

H-High; M-Medium; L-Low

ELECTIVE- VI ONCOLOGY

COURSE CODE: 26UPBICE06

Hours	L	T	P	C
	4	1	0	3

MARKS 100

COURSE OBJECTIVES : To understand the epidemiology of cancer, mechanism of Oncogenesis and apoptosis, and currently available therapeutic treatments.

COURSE OUTCOMES (CO)

CO1	To have an understanding, basic knowledge on various cancer growth and Morphology of cancer, terminologies used, types and prevalence of cancer, to Have a further indepth knowledge in the continuing units
CO2	Develop an understanding of how a cancer cell develops into a malignant tumor, the Mechanisms of DNA damage through various agents and how this process is linked To cellular transformation and cancer risk.
CO3	Understand the common cellular and molecular mechanisms that are underegulated in Cancer cells and there as on for their deregulation. And also the relationship between Diet and cancer,free radicals and antioxidants balance/role in cancer development.
CO4	To have abetter understanding on the impact of apoptosis, its types on oncogenesis,cancer diagnosis via several different methods,cytotoxicity assays,which will enable the student to be aware on current diagnostic tools and the principles behind it.
CO5	Having basic knowledge on novel therapeutic approaches available for cancer and its assessment/identification by different cancer markers.

SYLLABUS

Unit	Unittitle	IntendedLearningchapters	Knowled ge domain	Hours of Instruct ion
I	Introduction	Cancercell-morphologyandgrowthcharacteristics. Types of growth-hyperplasia, dysplasia,anaplasia and neoplasia.Types and prevalence of cancer. Nomenclature of neoplasms, classification based on origin/organ.	K1,K2	11
II	Epidemiology of cancer	Epidemology of cancer, Agents causing cancer-radiation,viruses, chemicals. Multistep carcinogenesis : Initiation, Promotion, Progression. Paraneoplastic syndromes	K1,K2	11

III	Molecular mechanism	protooncogenesis, oncogene, oncoproteins, tumour suppressor genes involved in cancer. Free radicals and antioxidants in cancer. Diet and cancer. Cell cycle and cancer: Control of the cell cycle-cyclins and CDKs	K1, K2,K4	11
IV	Apoptosis and cancer	Intrinsic and extrinsic pathways- Mechanism of apoptosis, signaling pathways. Types and their impact on apoptosis and oncogenesis. Principles and methods of cancer diagnosis-Biochemical, genetic, cytotoxic, cellgrowth and viability tests.	K1,K2,K 3,K4	11
V	Cancer therapy	Different forms of therapy, chemotherapy, radiation therapy, gene therapy, immune therapy, surgical therapy and biologic therapy. Principles Of cancer biomarkers and their applications.	K1, K2,K3,K 4	10

Programspecificattributes

Knowledge and understanding level(K1andK2)
Application level (K3)
Analytical level (K4)
Evaluation capability level(K5)
Scientific or synthesis level(K6)

REFERENCES:

Text Books

1. Franks,L.M.andTeich,N.M.1991.An introduction to Cellular and Molecular Biology of cancer, 2nd Edition, Oxford University Press.
2. Vincent,T.*etal*.,2011.Principles and Practice of Oncology: Primer of the Molecular Biology of Cancer, 1stEdition, Lippincott Williams and Wilkins.
3. Weinberg,R.A.2013. The Biology of Cancer,2ndEdition,Garland Science.
4. Hesketh,R.2013. Introduction to Cancer Biology, Cambridge University Press.

ReferenceBooks

1. McKinnell, R.G.*etal*., 2006. The Biological Basis of Cancer, 2nd Edition, Cambridge University Press.
2. Pelengaris,S. and Khan, M.2002.The Molecular Biology of Cancer,2ndEdition, Wiley Blackwell.

MAPPING

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	H	L	L	M	L	M	L	L
CO2	H	L	M	M	L	M	L	L
CO3	H	L	M	M	L	M	L	L
CO4	H	L	M	M	L	M	L	L
CO5	H	L	L	M	L	M	L	L

H-High;M-Medium;L-Low

CORE PRACTICAL III
GENETIC ENGINEERING, IMMUNOLOGY AND IMMUNO TECHNIQUES

Hours	L	T	P	C
	-	-	6	5

COURSE CODE :26UPBIC1P03

MARKS : 100

COURSE OBJECTIVES : This course is designed to provide hands-on training in clinical Biochemistry and recombinant DNA techniques.

1. Isolation of genomic DNA from liver/plant/ bacterial source
2. Isolation of plasmid DNA from bacteria
3. Restriction digestion of DNA
4. Transformation in *E.coli*
5. PCR demonstration
6. Immuno diffusion – Single radial and double diffusion
7. Immunoelectrophoresis
8. Rocket immunoelectrophoresis
9. Agglutination tests
10. Serial dilution of ASO titre,VDRLtitre

OUTCOMES

The students will have a clear understanding and hands-on experience on the most practical aspect of genetic engineering, immunology and immuno techniques.

CORE-VII-PHARMACOLOGY AND CLINICAL TOXICOLOGY

COURSECODE : 26UPBICIC07
MARKS : 100
COURSE OBJECTIVES : The main objectives of the course are to understand the various aspects of pharmacology and to gain knowledge about the therapeutic uses of different drugs.

Hours	L	T	P	C
	4	1	0	5

COURSE OUTCOMES (CO)

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

CO1	Explain the basic principles of pharmacology, including classification of drugs, dosage forms, routes of drug administration, mechanisms of drug action, factors modifying drug action, and interpretation of dose–response relationships such as ED_{50} and LD_{50}.
CO2	Describe the principles of pharmacokinetics, including drug absorption, distribution, metabolism (Phase I and Phase II reactions), elimination, and the role of drug-metabolizing enzymes.
CO3	Understand the principles of drug screening and evaluation using in vitro, in vivo, and ex vivo methods, and explain the different phases and design of preclinical and clinical trials.
CO4	Discuss the principles of chemotherapy and their applications in treating parasitic, fungal, and viral infections, and explain the regulatory guidelines and ethical considerations involved in new drug discovery.
CO5	Explain the concepts of clinical toxicology, including classification of toxicity and adverse drug reactions such as tolerance, intolerance, addiction, allergy, hypersensitivity, antagonism, and synergism.

SYLLABUS

Unit	Unit title	Intended Learning chapters	Knowledge domain	Hours of Instruction
I	General Pharmacology	Introduction to pharmacology; classification of drugs based on their sources; dosage forms; routes of drug administration; sites of action of drugs. Mechanisms of drug action; factors modifying drug action. Combined effects of drugs and analysis of dose–response curves, including ED_{50} and LD_{50}.	K1, K2, K3	12
II	Pharmacokinetics	Absorption, distribution, metabolism, and elimination of drugs; general pathways of drug metabolism (Phase I and Phase II reactions); drug-metabolizing enzymes.	K1,K2, K3, K4	12
III	Drug Delivery & Trials	General principles of screening; correlation between various animal models and human situations; correlation between *in vitro* and *in vivo* screening methods, with special emphasis on cell-based assays, biochemical assays, radioligand binding assays, and pharmacological assays. *In vitro*, *in vivo*, and *ex vivo* experiments. Preclinical and clinical trials (Phase I, Phase II, Phase III, and Phase IV). Main features of clinical trials, including methodological and organizational considerations, and principles of trial conduct and reporting. Key aspects of clinical trial design, including sample size, delivery, and assessment of clinical trials.	K1, K2 K3, K4	14

IV	Therapeutics	General principles of chemotherapy and its applications against parasitic infections, fungal infections, and viral diseases. Application in new drug discovery (NDD) according to Indian regulatory authority and USFDA guidelines. Ethical considerations and protocols for the use of human subjects in the drug discovery process.	K1, K2, K3, K4	13
V	Clinical Toxicology	Definition; classification of toxicity, including occupational, environmental, and pharmaceutical factors. Adverse drug reactions: drug tolerance, intolerance, addiction, allergy, hypersensitivity, antagonism, and synergism.	K1, K2, K3, K4	14

Program specific attributes

- ✓ Knowledge and understanding level (K1 and K2)
- ✓ Application level (K3)
- ✓ Analytical level (K4)
- ✓ Evaluation capability level(K5)
- ✓ Scientific or synthesis level (K6)

REFERENCES:

Text Books

1. The pharmacology, Volumes I and II – Goodman, Gilman, 2013; 13th edition.
2. Pharmacology– Rang and Dales, 2018 9th edition.
3. Pharmacology and Pharmacotherapeutics – Satoskar et al., 25edition Popular Prakashar, Mumbai.
4. Burger's medicinal chemistry and drug discovery: principles and practice – Wolf, John Wiley 1995; 5th edition.

Reference Books

1. Shargel, L.et al., 2012. Applied Biopharmaceutics and Pharmacokinetics, 6thEdition, Mc Graw-Hill Medical.
2. Foreman, J.C. and Johansen, T.J. 1996. Text Book of Receptor Pharmacology,2nd Edition, CRC Press.
3. Goodman, L.S. et al., Goodman and Gillman's the pharmacological basis oftherapeutics, 6th Edition, McGraw Hill, 1996.

Web link…

1. https://www.mooc-list.com/tags/pharmaceutical
2. https://www.mooc-list.com/tags/medicinal-chemistry

MAPPING

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	H	L	M	M	L	L	M	L
CO2	H	M	M	M	L	L	M	L
CO3	H	M	M	H	M	L	M	L
CO4	H	L	M	M	L	M	M	M
CO5	H	M	M	M	L	M	M	L

H-High; M-Medium; L-Low

CORE PRACTICAL IV

CLINICAL DIAGNOSTIC BIOCHEMISTRY AND TOXICOLOGY

Hours	L	T	P	C
	--	-	6	5

COURSE CODE : **26UPBIC1P04**

MARKS **:** 100

COURSE OBJECTIVES: This course is designed to provide hands-on training in clinical Biochemistry and toxicology.

1. Estimation of Reducing sugar
2. Estimation of Cholesterol
3. Estimation of Iron
4. Estimation of Vitamin C
5. Detection of Food Adulterants : Detection of Rhodamine B, Detection of TOCP in oil,Detection of foreign resin in Asafoetida, Detection of Iodised salt , Test for coal tar and Iron filings in Tea,Detection of exhausted cloves in cloves

6. Detection of food adulterants in milk : Detection of detergents,Ammonium salts in milk by Methylene blue test , Nesslers test, Detection of Maltodextrin by Iodine Test, Detection of hydrogen peroxide by Iodine test .

7.Detection of Artificial colours: in chili , Turmeric , coffee powder, in green peas.

8.Identification ofadulterats in foods: Detection of clay and chicory in coffee powder, Detection of common salt and Iodised salt, Detection of exhausted tea in tea leaves.

OUTCOMES

The students will have a clear understanding and hands-on experience on the most Practical aspect of clinical biochemistry and toxicology.

SUPPORTIVE COURSES FOR OTHER DEPARTMENTS

[NON-MAJOR ELECTIVE]

NME I-MEDICAL LAB TECHNOLOGY

COURSE CODE : **26UPBIC1N02**

Hours	L	T	P	C
	3	1	0	4

MARKS : **100**

COURSE OBJECTIVES : This syllabus has been formulated to impart basic knowledge of biochemistry, analytical techniques and to perform clinical laboratory tests accurately and efficiently.

COURSE OUTCOMES (CO)

CO1	To gain knowledge in the general laboratory instruments and equipment and to know about the specimen processing for biochemical analysis.
CO2	To understand the principles and applications in the analytical techniques.
CO3	To understand the principles and applications of biochemical tests.
CO4	To understand the principles and applications of automation of the analytical processes in clinical laboratory.
CO5	To understand the laboratory information systems.

SYLLABUS

Unit	Unit title	Intended Learning chapters	Knowledg e domain	Hours of Instructi on
I	General approach to medical laboratory sciences	Safety aspects in the clinical laboratory. Basic Chemistry and laboratory calculations. Specimen collection and processing for Biochemical analyses - Blood, urine, sputum, Bone marrow, CSF.	K1,K2,K3	13
II	Principles of Analytical techniques	Principles of Colorimeter, Spectrophotometry and AAS. Chromatography (Principle) Partition, adsorption and HPLC. Electrophoresis (Principle only) – Agarose gel, SDS PAGE. Immunochemistry – ELISA and PCR technique – RT PCR	K1,K2,K3	12
III	Clinical Chemistry	Biochemical tests – glucose- OGTT and HbA1c, protein, albumin, urea, creatinine, uric acid and cholesterol. Urinary parameters. Electrolytes and blood gases analysis.	K1,K2,K3 ,K4	15
IV	Function Test	Liver function test, renal function test, gastric function test, pancreatic function test – serum amylase, trypsin and lipase. Thyroid function test.	K1,K2,K3	13

V	**Automation and Laboratory management and Quality assurance**	Automation of the analytical processes, Types of autoanalyzers - Steps in the automated systems, Total quality management of clinical laboratory. Laboratory information systems.	K1,K2,K3 ,K4	13

Program specific attributes

Knowledge and understanding level (K1 and K2)
Application level (K3)
Analytical level (K4)
Evaluation capability level (K5)
Scientific or synthesis level (K6)

REFERENCES

Text Books

1. Mukherjee,K.L. 1988. Medical Laboratory Technology – A procedure manual for routine diagnostic tests, Vol I , II, III. Tata McGraw Hill Publishing Company Limited.
2. Burtis,C.A. and Ashwood,E.R. 2007. Teitz Textbook Clinical Chemistry., Third Edition, W.B.Saunders Company.
3. Varley,S. 1988. Practical Clinical Biochemistry, Gowenlock *et al*., Sixth Edition, CBS Publishers & Distributors. 1988

Reference Books

1. Henry,J.B. 1988. Clinical Diagnosis and Management by Laboratory Methods. 17th Edition, W.B.Saunders Company.
2. Chatterjee,M.N. and Shinde,R. Text book of Medical Biochemistry, 5th Edition, Jaypee Brothers Medical Publishers, 2002.
3. Devlin,T.M. 1998. Text book of Biochemistry with Clinical Correlation, 4th Edition, John Wiley and Sons.

Web link

1. https://nios.ac.in/media/documents/dmlt/Biochemistry/Lesson-23.pdf
2. https://nios.ac.in/media/documents/dmlt/Biochemistry/Lesson-25.pdf
3. https://nios.ac.in/media/documents/dmlt/Biochemistry/Lesson-26.pdf
4. https://nios.ac.in/media/documents/dmlt/Biochemistry/Lesson-27.pdf

MAPPING

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	H	M	M	M	L	L	M	L
CO2	H	M	M	M	L	L	M	L
CO3	H	M	M	M	L	L	M	L
CO4	H	M	M	M	L	L	M	L
CO5	H	M	M	M	L	L	M	L

H-High; M-Medium; L-Low

NME III-TOOLS AND TECHNIQUES IN BIOSCIENCE

COURSE CODE : 26UPBIC1N03

Hours	L	T	P	C
	3	1	0	4

MARKS : 100

COURSE OBJECTIVES : To understand the principles, instrumentation and applications of major analytical techniques used in biosciences.

COURSE OUTCOMES (CO)

CO1	To understand the techniques in cell fractionation. To understand the techniques and applications of radioisotopes in biology.
CO2	To understand the principles and applications of centrifugation and microscopy
CO3	To understand the principles and applications of chromatography.
CO4	To understand the principles and applications of electrophoretic techniques.
CO5	To understand the principles and applications of spectroscopy.

SYLLABUS

Unit	Unit title	Intended Learning chapters	Knowledge domain	Hours of Instruction
I	Cell-fractionation technique, Radioisotopes in Biology	**Cell separation methods:** Cell lysis, homogenization, extraction, salting in, salting out, dialysis and ultra filtration. **Radioisotopes in Biology:** Types of radioactive decay, **D**etection and quantitation - GM counter and solid and liquid scintillation counter. Autoradiography and their applications. Applications of radioisotopes.	K1,K2, K3	13
II	Centrifugation, Microscopy	**Centrifugation:** Principles of sedimentation**,** Svedberg's constant, Types of rotors**.** Differential and density gradient centrifugation. **Microscopy:** Principles and application of light, fluorescence, scanning and transmission electron microscopy	K1,K2, K3	13
III	Chromatographic techniques	**Chromatographic techniques:** General principles of chromatography**.** Principles and applications of paper, TLC, ion exchange, Affinity, FPLC and HPLC.	K1, K2, K3	13

IV	Electrophoretic techniques	**Electrophoretic techniques:** General principles and factors affecting electrophoresis**.** Polyacrylamide gel electrophoresis- SDS-PAGE, 2D-electrophoresis, agarose gel electrophoresis, capillary electrophoresis, isoelectric focusing, high voltage electrophoresis,	K1, K2, K3	13
V	Spectroscopic techniques	**Spectroscopic techniques:** Principles of spectrophotometer, Types - Atomic absorption spectroscopy, fluorimeter, UV-Visible, NMR, ESR, X ray photoelectron spectroscopy.	K1, K2,K3	13

Program specific attributes

Knowledge and understanding level (K1 and K2)
Application level (K3)
Analytical level (K4)
Evaluation capability level (K5)
Scientific or synthesis level (K6)

REFERENCES

Text Books

1. Wilson,K. and Walker,J. 2005. Principles and Techniques of Practical Biochemistry, 6th Edition , Cambridge University. Press .
2. Upadhyay,A. Upadhyay,K. and Nath,N. 2009. Biophysical Chemistry: Principles and Techniques, Third Edition, Himalaya Publishing. 11th Edition

Reference Books

2. Sharma,B.K. 1981. Instrumental Methods of Chemical analysis, 5 th Edition Goel Publications.
3. Homie,D.J. and Peck,H. Analytical Biochemistry, Third Edition, Longman

Web link

1. https://archive.nptel.ac.in/courses/102/107/102107028/
2. https://nios.ac.in/media/documents/dmlt/Biochemistry/Lesson-18.pdf
3. https://nios.ac.in/media/documents/dmlt/Biochemistry/Lesson-22.pdf
4. https://nios.ac.in/media/documents/dmlt/Biochemistry/Lesson-21.pdf

MAPPING

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	H	M	M	M	L	L	M	L
CO2	H	M	M	M	L	L	M	L
CO3	H	M	M	M	L	L	M	L
CO4	H	M	M	M	L	L	M	L
CO5	H	M	M	M	L	L	M	L

H-High; M-Medium; L-Low

NME IV-CLINICAL DIAGNOSIS IN HEALTH AND DISEASES

Hours	L	T	P	C
	3	1	0	4

COURSE CODE :26UPBIC1N04

MARKS :100

COURSE OBJECTIVES : The aim of the course is to understand the diagnostic procedures adopted in various disease conditions and its management.

COURSE OUTCOMES (CO)

CO1	To know about general health, syndrome and common diseases that affects mankind
CO2	To understand the importance of liver and kidney function test
CO3	To understand the basics and importance of heart, lung and brain test
CO4	To know the basic mechanisms of communicable diseases
CO5	To imbibe and understand the mechanism of non- communicable diseases and their clinical significance

SYLLABUS

Unit	Unit title	Intended Learning chapters	Knowledg e domain	Hours of Instructi on
I	Introduction	Introduction: General health, syndrome and common diseases – communicable and non-communicable diseases. Samples for analysis: Blood, urine, pleural fluid, synovial fluid, cerebrospinal fluid and tissues and histology. General check up: Blood group, Hb, height and weight, waist to hip ratio, electro cardio gram, X-ray, abdomen scan and appearance of scars, urine analysis – routine analysis (protein, sugar, pigments and cells).	K1,K2,K3	13
II	Liver and kidney function test	Significance of function test. Tests for liver function: Enzyme assay (SGOT, SGPT, Alkaline phosphatase, GGT), Total protein, albumin /globulin ratio and their significance. Test for kidney function: Urea and creatinine estimation and their significance.	K1,K2,K3	12
III	Heart, lung and brain test	Test for heart function: Blood pressure (cystolic and diastolic), lipid profile (cholesterol, triglycerides, HDL, LDL estimation) and their importance. Test for lung function: Chest X-ray, Spirometry. Test for Brain function: EEG, MRI, CT. Test for Surgery: Bleeding time, clotting time. Special test: X-ray, CT, MRI, Doppler, TMT, angioplasty.	K1,K2,K3	15

IV	Diagnosis of microbial infections	Infection: Bacterial, viral, fungal and protozoans. Blood: Total cell count, differential count, erythrocyte sedimentation rate. Infectious diseases: Tuberculosis, Leprosy, Malaria, Hepatitis, Cholera, Dengue, HIV, Chikun gunya and H1N1. TORCH – Panel (infertility profile), Infection in pregnancy,	K1,K2,K3	13
V	Non communicable diseases	Non communicable diseases: Diabetes: Blood sugar, urine sugar, glucose tolerance test, HbA1c. Hyper tension: Lipid profile, electrolyte (sodium, potassium, chloride and biocarbonate) investigation. Cancer markers: ELISA.	K1,K2,K3	13

Program specific attributes

Knowledge and understanding level (K1 and K2)
Application level (K3)
Analytical level (K4)
Evaluation capability level (K5)
Scientific or synthesis level (K6)

REFERENCES

Text Books

1. Burtis,C. and Bruns,D. 2007. Teitz Fundamentals of Clinical chemistry Chemistry, 3rd Edition W.B.Saunders Company.
2. Devlin,T.M. 1998. Text book of Biochemistry with Clinical Correlation, 4th Edition.
3. Varley,H. 1980.Practical Clinical Biochemistry, Volume I and II, 5th Edition, CBS Publishers.

Reference Books

1. Mayne,P.D. 1994. Clinical Chemistry in Diagnosis and Treatment, 6 th Edition, Hodder Arnold Publication.
2. Marshall,W.J. and Bangeit, S.K. 1995. Clinical Biochemistry - Metabolic concepts and Clinical aspects, Churchill Livingstone.
3. Guyton,A.C. and Hall,J.E. 2010. Text Book of Medical Physiology, 12th Edition, Saunders.

Web link

1. https://nios.ac.in/media/documents/dmlt/Biochemistry/Lesson-07.pdf
2. https://nios.ac.in/media/documents/dmlt/HC/Lesson-29.pdf
3. https://nios.ac.in/media/documents/dmlt/Biochemistry/Lesson-16.pdf
4. https://nios.ac.in/media/documents/dmlt/Biochemistry/Lesson-17.pdf

MAPPING

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	H	M	M	M	L	L	M	L
CO2	H	M	M	M	L	L	M	L
CO3	H	M	M	M	L	L	M	L
CO4	H	M	M	M	L	L	M	L
CO5	H	M	M	M	L	L	M	L

H-High; M-Medium; L-Low

NME V-INTRODUCTION TO BIOCHEMISTRY

COURSE CODE : 26UPBIC1N05

Hours	L	T	P	C
	3	1	0	4

MARKS : 100

COURSE OBJECTIVES : This course is an introduction to biochemistry and covers the structure and functions of biological molecules.

COURSE OUTCOMES (CO)

CO1	Understand the basics involved in the structure of carbohydrates like anomerism,stereoisomerism, epimer formation and their types, chemical properties, and functions.
CO2	Understand the basics in the structure of lipids, classifications like simple and complex lipid including lipopotein and lipo polysaccharides and teir biological functions.
CO3	Understand the basic structure- types, classification, properties- coagulation, denaturation, function of protein, amino acids and its sequencing.
CO4	Have a basic knowledge on the structure of DNA, experiments that proved it as a genetic material, as well as to know their properties, functions in biology.
CO5	Know about the structure, types of vitamins in biological reactions, and its relationship with disease, daily requirement.

SYLLABUS

Unit	Unit title	Intended Learning chapters	Knowledg e domain	Hours of Instructi on
I	Carbohydrates	Classification-monosaccharides, disaccharides, polysaccharides basic chemical structure, aldoses and ketoses, Structural characteristics -cyclic structure of mo nosaccharides, steroisomerism, anomers and epimers. General reaction and properties. Structure and biological functions of homo- and heteropolysaccharides.	K1,K2,K3	13
II	Lipids	Classification, structure, properties and functions of fatty acids, essential fatty acids, fats, phospholipids, sphingolipids, cerebrocides, steroids, bile acids, prostaglandins, lipoamino acids, lipoproteins, phosphatidopeptides, lipopolysaccharides.	K1,K2,K3	12
III	Proteins	Classification, structure and properties of amino acids, biologically active peptides, classification and properties of proteins, sequencing of proteins, conformation and structure of proteins -primary, secondary, tertiary and quaternary structure, coagulation and denaturation of proteins.81	K1,K2,K3	15

IV	Nucleic acids	Nucleic acids as genetic information carriers, experimental evidence e.g., genetic transformation, Hershey-Chase experiments, action spectrum, etc. Structure and function of nucleotides. Primary, secondary and tertiary structure of nucleic acids, DNA forms and conformations, Denaturation of DNA. Cot curve analysis	K1,K2,K3	13
V	Vitamins	Structure, biochemical functions, deficiency diseases, daily requirements of water soluble and fat soluble vitamins and their coenzyme activity. Hyper vitaminosis.	K1,K2,K3	13

Program specific attributes

Knowledge and understanding level (K1
and K2) Application level (K3)
Analytical level (K4)
Evaluation capability
level (K5)
Scientific or synthesis level (K6)

REFERENCES

Text Books

1. Nelson,D.L and Cox,M.M.2013. Lehninger Principles of Biochemistry, 6 th Edition, W.H. Freeman
2. Garrett,R. and Grisham,C. 2010. Biochemistry, 4th Edition, Saunders College Publishing

Reference Books

1. Berg,J.M. *et al*. 2012. Biochemistry, 7th Edition, W. H. Freeman & Company, 2012.
2. Voet,D. *et al.,* 2012. Fundamentals of Biochemistry: Life at the Molecular level, 4th Edition, John Wiley and Sons.

Web link

1. https://archive.nptel.ac.in/courses/104/102/104102016/
2. https://archive.nptel.ac.in/courses/102/103/102103074/

MAPPING

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8

CO1	H	M	M	M	L	L	M	L
CO2	H	M	M	M	L	L	M	L
CO3	H	M	M	M	L	L	M	L
CO4	H	M	M	M	L	L	M	L
CO5	H	M	M	M	L	L	M	L

H-High; M-Medium; L-Low