RVS COLLEGE OF ARTS AND SCIENCE

Autonomous and Affiliated to Bharathiar University, Approved by AICTE

Re Accredited with 'A+' Grade by NAAC

Sulur, Coimbatore – 641 402.

DEPARTMENT OF BIOCHEMISTRY

M.Sc. BIOCHEMISTRY

(Effective from the Academic Year 2024- 2026)

HOD **PRINCIPAL** **COE**

VISION

Quality Education for Digital Era.

MISSION

To impart a need – based quality education through comprehensive curriculum by adopting apt technologies and progressive teaching, learning and research processes.

ABOUT THE DEPARTMENT

The Department of Biochemistry was established in 1996. The department is functioning with under graduate, Post graduate and Research programs with a team of 11 faculty members.

The Biochemistry focuses on life processes at the molecular level, that emphasis on the biochemistry and molecular biology of cellular metabolism and Bioenergetics.

The curriculum is designed for students seeking preparation for graduate studies, for the health-care professions, or for entry-level positions in science-related industries. The teaching and learning process is well executed properly and reveals with sophisticated instruments.

EXECUTIVE MEMBERS

CHAIRMAN

Dr. K.V. Kupusamy

MANAGING TRUSTEE

Dr. K. Senthil Ganesh

CORRESPONDENT

Mrs. S. Srividyalakshmi Senthil Ganesh

SECRETARY

Prof. Saramma Samuel

PRINCIPAL

Dr. T. Sivakumar

VICE PRINCIPAL

Dr. M.P. Ayyappadas

CONTROLLER OF EXAMIATIONS

Ms. G. Jeyalakshmi

HEAD OF THE DEPARTMENT

Dr. S.Shamina

Department: BIOCHEMISTRY

Programme: M.Sc., BIOCHEMISTRY

Programme code: 1PBC

PROGRAMME OUTCOMES (POs)

PO1	Domain Knowledge
PO2	Communicative Competence
PO3	Digital Strategic Knowledge
PO4	Multi-Cultural Competence
PO5	Critical Thinking and Problem Solving
PO6	Research and Analytical Skills
PO7	Moral, Ethical and Professional Responsibilities
PO8	Leadership and Lifelong Learning

PROGRAMME SPECIFIC OUTCOMES: (PSOs)

Upon completion of Master of Biochemistry, STUDENTS are able to achieve the following outcomes.

PSO1	Assess the fundamental concepts of experimental and theoretical techniques in Molecular Gene expression, Proteomics, Pathology, Clinical research and Nano-sciences.
PSO2	Demonstrate and operate the technologies and thereby gaining insights from clinical data to make cognizant predictions.
PSO3	Research oriented learning to develop methodical and integrative problem-solving approaches in the biochemical industries and to validate effective projects for lifelong learning.
PSO4	Construct and formulate pre-clinical studies to invent innovative ideas to develop their employability and entrepreneurial skills.

RVS COLLEGE OF ARTS AND SCIENCE (Autonomous)
Sulur, Coimbatore – 641 402
SCHEME OF EXAMINATIONS
M.Sc. BIOCHEMISTRY
2023- 2025 BATCH

Semester	Course Opted	Course Name	D	L	T	P	CIA	SEE	Marks	Credits
SEMESTER I	**M-I**	Analytical Biochemistry	3	4	-		25	75	100	4
	M-II	Cell and Molecular Biology	3	4	-		25	75	100	4
	M-III	Enzymes and Enzyme Technology	3	4	-		25	75	100	4
	M-IV	Human physiology, Hormones and signal transduction	3	4	-		25	75	100	4
	MP-I	Lab in Quantitative analysis of Biological Compounds	-	-	-	5	-	-	-	-
	MP-II	Lab in Enzymology, Plant Biochemistry and Plant Tissue Culture	-	-	-	5	-	-	-	-
	MP-III	Lab in Computational and Molecular modeling	3	-		4	25	75	100	4
	ES	Employability skills		2						
	Total			**32**					**500**	**20**

Semester	Course Opted	Course Name	D	L	T	P	CIA	SEE	Marks	Credits
SEMESTER II	**M-V**	Metabolic Regulation	3	4	-	-	25	75	100	4
	M-VI	Nutritional and Clinical Biochemistry	3	4	-	-	25	75	100	4
	M-VII	Plant Biochemistry and phytotherapeutics	3	4	-	-	25	75	100	4
	M-VIII	Stem cells and it's regenerative medicine	3	4	-	-	25	75	100	4
	MP-I	Lab in Quantitative analysis of Biological Compounds	6	-	-	5	25	75	100	4
	MP-II	Lab in Enzymology, Plant Biochemistry and Plant Tissue Culture	6	-	-	5	25	75	100	4
	EL-I	Elective - I	3	4	-	-	25	75	100	4
	ES	Employability skills		2		-				
	Total			**32**					**700**	**28**

Semester	Course Opted	Course Name	D	L	T	P	CIA	SEE	Marks	Credits
SEMESTER III	**M- IX**	Pharmaceutical Biochemistry	3	4	-		25	75	100	4
	M-X	Industrial Biochemistry	3	4	-		25	75	100	4
	M-XI	Immunology and Immuno Techniques	3	4	-		25	75	100	4
	M-XII	Clinical Research and Clinical Data analytics	3	4	-		25	75	100	4
	MP-IV	Lab in Immunology and Recombinant DNA technology	-	-	-	5	-	-	-	-
	MP-V	Lab in Research Techniques in Biochemistry	-	-	-	5	-	-	-	-
	EL-II	Elective II- Internship / Mini Project *Viva Voce*	-	-	-	-	25	75	100	5
	EL-III	Elective III- EDC	3	4	-	-	25	75	100	4
	ES	Employability skills		2					GRADE	2*
	Total			**32**					**600**	**25**

Semester	Course Opted	Course Name	D	L	T		CIA	SEE	Marks	Credits
SEMESTER IV	**M- XIII**	Biostatistics and Research Methodology	3	4	-		25	75	100	4
	MP-IV	Lab in Immunology and Recombinant DNA technology	6	-	-	5	25	75	100	4
	MP-V	Lab in Research Techniques in Biochemistry	6	-	-	5	25	75	100	4
	PV	Major Project Report & Viva Voce	-	-	-		25	75	100	5
	Total			**14**					**400**	**17**
TOTAL									**2200**	**90+2***

M - Major Paper
MP- Major Practical
EL – Elective
EDC - Extra Disciplinary Course
PV- Major Project Report & Viva Voce
ELECTIVE – I : 1. Patent, IPR and Bioethics 2. Bioinformatics
ELECTIVE – II : 1. Internship 2. Mini Project Viva Voce ELECTIVE – III : EDC - Hospital Management
Employability Skills (ES) classes are held in first three semesters.
Exams will be conducted at the end of the III semesters.wc .
Two Extra Credits will be given. This is mandatory to get a degree.

Course Title : **Analytical Biochemistry (T)**	Course Code : 13A
Semester :**I**	Course Group : **M- I**
Teaching Scheme in Hrs (L:T:P) : (**4:0:0)**	Credits : **4 Credits**
Map Code: -	Total Contact Hours: **60**
CIA: **25 Marks**	SEE # : **75 Marks**
Programme: **MSC-BIOCHEMISTRY**	**# - Semester End Exam**

No	Course Outcome (Cos): After completion of this course, the students will be able to	PSOs	CL.ses.	BLOOM'S TAXONOMY LEVEL
CO1	Demonstrate and illustrate working principle and instrumentation of pH meter and centrifugation technique	PS01	12	AP
CO2	Detect and distinguish chromatographic technique and its application.	PS02	12	AN
CO3	Apply and the role of electrophoresis techniques in separation of molecules.	PS03	12	AP
CO4	Assess the spectroscopic techniques and its application.	PS02	12	E
CO5	Categorize the theoretical principles of radioactivity in clinical aspects.	PS04	12	AN

UNIT-I (LECTURE HOURS-12)

BUFFERS

Introduction-(Basics of acidity & basicity)

pH –(Definition,determination of pH using indicators

HendersonsHasselbach equation - Relatioship between pKa& Ph)

pH meter – (Working principle and instrumentation)

Types of electrodes – (Principle & working of calomel,silver/silver chloride, hydrogen electrodes)

Centrifugation

(Introduction - Basic principles of centrifugation-Relative centrifugal force)

Preparative and Analytical centrifugation – (Differential centrifugation, density gradient centrifugation, Basic principlesof sedimentation

Ultracentrifuge - Rotors-types,analytical ultra centrifuge,applications)

Activity

- Differentiate the solutions given based on its pH using pH meter and pH paper .
- Group discussion on different types of centrifugation

UNIT-II (LECTURE HOURS-12)

CHROMATOGRAPHY

Introduction – (Definition, stationary phase, mobile phase, retardation factor)

Paper chromatography. – (Ascending,descending, Circular -Principle, Technique& applications)

Thin layer chromatography – (Adsorbents,solvents used,Principle, Technique& applications

Ion exchange chromatography - Ion exchangers- anion & cation exchange resins. Principle, Technique& applications)

Molecular sieve chromatography – (Types of gels, Principle, technique& applications, Molecular weight determinationof proteins.

Affinity chromatography - Types of ligands, Principle, Technique & applications)

GLC – (Carrier gas, columns, Principle, Technique & applications.

HPLC-Pumping systems, column packing Principle, Technique & applications)

HPTLC- (Principle, Technique & applications)

LCMS – ((Principle, Technique & applications)

Activity

- Packing of column using burette, cotton, sand and silica gel -
- Quiz on Chromatography techniques using Kahoot app

UNIT –III (LECTURE HOURS-12)

ELECTROPHORESIS

Introduction – (Definition, migration of ions in electric field, factors affecting electrophoretic mobility.

Paper electrophoresis - Types (Horizontal, vertical) Principle, Technique& applications.

Gel electrophoresis and Immuno electrophoresis - Types of gel electrophoresis-Agarose, SDS –PAGE)

2D Gel electrophoresis.

Pulse field Gel electrophoresis – (Principle, Technique& applications

Immunoelectrophoresis-Single radial immunodiffusion,Ouchterlony double diffusion, Rocket immune electrophoresis.

Isoelectric focusing - Ampholytes Principle, technique& applications)

Blotting

(Southern blot – Principle, Techniques for DNA detection

Northern and western blot – Principle, Techniques for RNA and protein detection).

Activity

- Chart work to differentiate Horizontal electrophoresis and Vertical electrophoresis.
- Using paper model for blotting techniques- Capillary, electro transfer and semi-dry blotting.

UNIT-IV (LECTURE HOURS-12)

SPECTROMETRY

Introduction - Basic principles,laws of absorption,Beer Lamberts law.
Colorimetry – Principle,Instrumentation & applications
UV-Visible spectrophotometry – Principle,Instrumentation & applications
Flame spectrophotometry - Emission flame & Atomic absorption spectrophotometry
Advanced Techniques – ICP-MS, ICP-OES (Instrumentation & applications.)
Spectrofluorimetry–(Fluorescence, phosphorescence) Techniques, Instrumentation & applications.
FTIR (Fourier Transform Infrared Spectroscopy) – Principle, Instrumentation & applications.

Activity

- Demonstration on principle and working of colorimeter (selection of filter using coloured solution).
- Interpretation on the reports submission of UV- VIS/ FTIR.

UNIT -V (LECTURE HOURS-12)

ISOTOPES

Introduction – (Definition, radioactive decay-negatron, positron, alpha emission, electron capture, gamma rays).
Radioactivity
(Units of radioactivity - Curie,Bequerel,specific activity).
Measurement of radioactivity methods
(Gas ionization - GM counter, proportion counter
Excitation - Scintillation counting)
Photographic method – (Autoradiography)
Clinical applications – (Tracer techniques, Diagnosis, Therapy).

Activity

- Collect related literatures on environmental disasters of radioactive isotopes and methods of disposal of radioactive waste .
- Prepare a chart to categorize the isotopes used for cancer studies.

Text Books :

T1-Analytical Techniques in Biochemistry and Molecular Biology - Authors: Katoch, Rajan, 2011.
T2- Principles and Techniques of Biochemistry and Molecular biology – Edition 7th - Keith Wilson and John Walker, 2016.
T3 - An introduction to Practical Biochemistry- Edition 3rd - David Plummer- 2017.

Reference Books:

R1 –Biophysical chemistry, Avinash Upadhyay and Kakoli Upadhyay,4thEdition 2019.
R2- Introduction to Principles and Techniques of Biochemistry and Molecular Biology , Wilson and Walker's - Edition 8th 2018

Course Title : **CELL AND MOLECULAR BIOLOGY (T)**	Course Code : 13B
Semester :**I**	Course Group :**M- II**
Teaching Scheme in Hrs (L:T:P) : (**4:0:0)**	Credits : **4 Credits**
Map Code: -	Total Contact Hours: **60**
CIA: **25 Marks**	SEE # : **75 Marks**
Programme: **MSC-BIOCHEMISTRY**	**# -**

No	**Course Outcome (Cos): After completion of this course, the students will be able to**	**PSOs**	**Cl.Ses**	**BLOOM'S - TAXONOMY LEVEL**
CO1	Illustrate and compute the structure and function of the cell organelles.	PS01	12	AP
CO2	Demonstrate and illustrate mechanisms of cell-cell interaction.	PS02	12	AP `
CO3	Categorize the concept of DNA replication process.	PS03	12	AN
CO4	Examine and compare prokaryotic and eukaryotic transcription mechanism.	PS04	12	AN
CO5	Validate the concept of translation,and post translation modifications.	PS03	12	E

UNIT-I (Lecture Hours: 12)

STRUCTURE AND FUNCTION OF CELL

Cell –(Structure of a typical cell, Differences between prokaryotic and eukaryotic cells).
Cell Organelles – (Plasma membrane, nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles, chloroplast)
Structure and organization of membrane – (structure of fluid mosaic model, membrane lipids, membrane proteins, and membrane fluidity)
Membrane Transport –(Diffusion (passive and facilitated).Symport, antiport and uniport systems.Active transport – Na^+, K^+ ATPase, Ca^{2+} ATPase, secondary active transport- group translocation of glucose, ions selective channels**)**
Internalization of macromolecules – (Endocytosis, pinocytosis, phagocytosis and exocytosis. Receptor mediated endocytosis)
Activity

1. Make a model on Prokaryotic and Eukaryotic cell
2. Demonstration of membrane transport

UNIT-II (Lecture Hours: 12)

Cell Division & Cell Signalling

Cytoskeleton- (Microtubules, Micro filaments and intermediary filaments - structure and functions.Cell junctions – types, cell adhesion molecules (cadherins and selectins) cell matrix adhesion (integrin's and Desmosome) ECM components – collagen and fibronectin).

Cell Division – (Phases of eukaryotic cell cycle, check points – cyclins, maturation promoting factor (MPF), Cyclin dependent kinases, growth factors, inhibition of cell cycle progression).

Cell Signaling –(Signaling mechanism, signal molecules, signal receptors, forms of inter cellular signaling. Cell surface receptors– G protein coupled receptors, Cyclic AMP, and Cyclic GMP)

Activity

1. Quiz on Cellsignalling by kahoot
2. Group Discussion on cell signaling

UNIT-III (Lecture Hours: 12)

ORGANIZATION OF GENETIC MATERIAL

Introduction – (Central Dogma, Structural organization of prokaryotic and eukaryotic chromosome)

GENOME REPLICATION

Introduction – (Definition and Types. Messelson and Stahl's semi-conservative replication model,Conservative model and dispersive model)

Enzymology of DNA replication – (DNA polymerases, Role of Topoisomerases, DNA ligases, helicases, SSB proteins primase and Telomerase).

REPLICATION IN E.coli- (Origin, initiation, replication fork movement, elongation and termination, uni directional and bidirectional replication)

RNA REPLICATION

Replication of RNA genomes – (RNA replicase and reverse transcriptase)

Activity

1. Animation on central dogma
2. Demonstration of Replication

UNIT-IV(Lecture Hours: 12)

TRANSCRIPTION IN PROKARYOTES

Transcription signals – (In prokaryotes and eukaryotes. RNA polymerases and transcription factors - Structure and function. Process of Transcription in Prokaryotes - Initiation, elongation and termination of transcription in E. coli. Reverse Transcription)

TRANSCRIPTION IN EUKARYOTES

(Classes of RNA - mRNA, rRNA, tRNA, snRNA, hnRNA. RNA Polymerases, Initiation, elongation and termination)

Posttranscriptional modifications.- (Alternative splicing & mRNA processing)

Activity

1. Debate on difference between Prokaryotic and Eukaryotic transcription
2. Preparation of Model of prokaryotic transcription

UNIT-V (Lecture Hours: 12)

Genetic Code – (Salient features, Deciphering the genetic code - Wobble hypothesis)

TRANSLATION IN PROKARYOTES

Process of Translation – (Initiation, chain elongation and termination of polypeptide synthesis in *E. coli*.)

TRANSLATION IN EUKARYOTES

Process of Translation – (Initiation, chain elongation and termination Differences - Binding of aminoacyl t -RNA, Peptide Bond Formation and Translocation)
Post-translational modifications – (Glycosylation of protein,Protein sorting and targeting)
Regulation of gene expression in prokaryotes- (operon concept (lac, tryptophan and arabinose), DNA repair and mutation).

Activity

1. Making a video on Genetic code
2. Making a PowerPoint slides on post translational modifications

REFERENCES

TEXTBOOKS

1. Lehninger Principles of Biochemistry: International Edition – 2017 by David L. Nelson and Michael Cox; Publisher: WH Freeman; 7th ed. 2017 edition
2. Advances in Cell Biology: Volume 2, 2013 by David M. Prescott
3. Cell and Molecular Biology – DeRobertis and Saunders, 8th edition (2017).
4. Molecular Biology | Edition:5 | Mc Graw Hill Higher Education, Moscow. | HEDRICK W PHILIP AND WEAVER F ROBERT,2012

REFERENCE BOOKS

1. Molecular Cell Biology– 2016 by Arnold Berk, Chris A. Kaiser, Harvey Lodish, Angelika Amon, HiddePloegh, Anthony Bretscher, Monty Krieger and Kelsey C. Martin; Publisher: WH Freeman; 8 edition.
2. Molecular Biology of the Cell – 2014 by Bruce Alberts, Alexander D. Johnson, Julian Lewis, David Morgan, Martin Raff, and Keith Roberts; Publisher: W. W. Norton & Company; 6 edition.
3. Molecular Biology of the Gene – 2017 by James D. Watson, A. Baker Tania, P. Bell Stephen, Gann Alexander, Levine Michael and Losick Richard; Publisher: Pearson Education; Seventh edition.
4. Biochemistry – 2015 by Jeremy M. Berg, LubertStryer, John L. Tymoczko and Gregory J. Gatto; Publisher: WH Freeman; 8th ed. edition.
5. Lewin's GENES XII – 2017 by Jocelyn E. Krebs, Elliott S. Goldstein and Stephen T. Kilpatrick; Publisher: Jones and Bartlett Publishers, Inc; 12th Revised edition edition.
6. The Cell: A Molecular Approach -2013 by Geoffrey M. Cooper, and Robert E. Hausman;

CourseTitle: **ENZYMES AND ENZYME TECHNOLOGY(T)**	Course Code :13C
Semester:**I**	CourseGroup :**M- III**
Teaching Scheme in Hrs (L:T:P): (**4:0:0)**	Credits **4**
MapCode: -	TotalContactHours: 60
CIA: **25Marks**	SEE# :**75Marks**
Programme:**MSC-BIOCHEMISTRY**	**#-Semester End Exam**

No	**CourseOutcome(Cos): After completion of this course,the students will be able to**	**PSOs**	**Cl.Ses**	**BLOOM'S TAXONOMYLEVEL**
CO1	Organize classification of enzymes, isolation and purification of enzymes.	PS01	12	AN
CO2	Categorize the structure of coenzymes and their role in various metabolic function.	PS02	12	AN
CO3	Distinguish the mechanism of enzyme kinetics and enzyme inhibition in enzyme catalytic reaction	PS02	12	AN
CO4	Conclude the mechanisms involved in covalent modification of Glycogen Phosphorylase and Glutamine synthetase	PS03	12	E
CO5	Construct the methods of immobilizations and its applications in pharmaceutical and food industry.	PS04	12	C

UNIT-I (Lecture Hours: 12)

ENZYME-INTRODUCTION, NOMENCLATURE AND 2CLASSIFICATION

Introduction–(Definition, properties and history of enzyme)

Nomenclature and classification-(International Union of Biochemistry(IUB)–6 Major Enzymes and subdivision of enzymes with examples).

Intracellular localization of enzymes–(Location of enzymes in cellular and sub cellular organelles)

ISOLATIONANDPURIFICATIONOFENZYMES

Methods of homogenization-(Mammalian tissue, Plant,Fungal and Bacterial material homogenization)

METHODSOFSEPARATIONANDPURIFICATIONOFENZYMES

Methods that depend on size or mass- (Gelfiltration Centrifugation.-Ultracentrifugation and Dialysis –Membrane centrifugation of enzymes).

Methods based on polarity- (Ionexchangechromatography,Electrophoresis and Isoelectric focusing).

UNIT OF ENZYME ACTIVITY:

Turn over number of an enzyme – (Definition and Reaction)

International Unit of enzyme:(Definition and Reaction) –**Katal-(**Definition and Reaction)

SPECIFICITYOFENZYME ACTIVITY

Typesofspecificity-.Absolute specificity,Stereo specificity,Group specificity or Relative specificity and Reactionspecificity with suitable examples.

Activity

1 .Animations illustrating on localization of enzymes in the cell

2 .Group discussion on the topic how"Enzymes Help Us Digest Food"

UNIT-II (Lecture Hours: 12)

COENZYME

Introduction- (Organic compounds-prosthetic groups-Integral part of activesite).

Nicotinamide coenzymes-($NAD^+$and $NADP^+$)

:**Flavin nucleotides**- (Structure and functions FMN and FAD+-

Coenzyme A- (Structure and functions CoA.SH-Structure and functions)

Biotin-(Free biotin,Protein bound biotin.-Structure and functions)

Folate coenzymes–(THF-Structure and functions)

Lipoicacid – (Coenzyme in decarboxylation of pyruvate.- Structure and functions)

TPP-Thiamine Pyrophosphate- (Structure and functions)

Pyridoxalphosphate- (Structure and functions)

ACTIVESITE:

Introduction-(Binding sites and catalytic sites.-Characteristic features of Active sites).

Mode of action – (Lock and Key model and Induced fit theory,)

Determination of active site residues-(Identification of substrate and inhibitors action in enzyme catalytic reaction)

Activity

1 Model presentation for Lock and Key and Induced fit theory

2 Team work for making chart preparation for Coenzymes.

UNIT-III (Lecture Hours: 12)

ENZYMEKINE TICS

Steady state theory – (Definition, Rate of formation of ES, Rate of dissociation and Graph, ,Km - Michaelis constant.andVmax)

MichaelisMentenDerivation-(Derive the equation and significance of M.Mequation).

LBPlot,Eadie Hoftsee and Hanesplot-.(Graph and significance)

MECHANISMOFBISUBSTRATEREACTION:

Single displacement and Double displacement Reaction:

Random- order mechanism- (Ternary complex formation)

Ping-pong mechanism- (Non sequential mechanism)

FACTORS INFLUENCING OR AFFECTING ENZYME CATALYTIC REACTION-(Effect of pH, Temperature
,Enzyme Substrate and Time–Mechanism and Graph).

ALLOSTERIC INHIBITION AND FEEDBACK INHIBITION

Allosteric Inhibition – (Introduction and mechanism- Binding action of enzyme in Allosteric site –Allosteric activator and Allosteric inhibitors).

Feedback Inhibition(-Mechanism of action-CTP and L-Isoleucine act as a feedback inhibitor for feedback inhibition).

REVERSIBLE AND IRREVERSIBLE INHIBITION:

Reversible Inhibition:(Introduction and Types-

Competitive, Non-competitive and Uncompetitive

inhibition)

Competitive Inhibition –(Substrate analogue

mechanism Example- Malonate reaction in TCA

cycle.

Allopurinol reaction in Purine catabolism-Substrate analogue drug for Gout treatment–Reaction for inhibiting the synthesis of Uricacid).

Non competitive inhibition- (Mechanism with suitable examples- Metal ions – Lead, Mercury, Cyanide and Arsenic in Non-competitive inhibition.

Role of Non-competitive inhibitor-Cyanide in Respiratory chain reaction. (ETC))

Uncompetitive Inhibition– (Mechanism with suitable example)

Activity

1. Working model presentation on Ping-Pong mechanism.

2-Making poster presentation on reversible inhibitors in enzyme catalytic reaction.

UNIT-IV (Lecture Hours: 12)

COVALENT MODIFICATION OFENZYMES

Glycogen phosphorylase- (Phosphorylation and Dephosphorylation reaction in animal muscle cells).

Glutamine synthetase- (Covalent modification mechanism in *E.coli* bacteria).

ISOENZYMES- (Introduction and features of Isoenzymes)

Lactate Dehydrogenase- (Introduction,Types- LDH1-5and applications of LDH)

MULTI ENZYME COMPLEX

Pyruvate Dehydrogenase–(Introduction and mechanism of action of PDH–Steps involved in PDH reaction).

PROTEIOLYTICENZYME:

Chymotrypsin-(Mechanism of action of proteolytic enzyme- Cleavage to specific aminoacid residues).

Carboxypeptidases- (Mechanism of action of cleavage of carboxy terminal end of protein compounds.Action

of Zn in carboxypeptidase).

Lysozyme- (Mechanism of action-Digestion process of bacterial cell wall).

Ribozyme- (Non protein enzyme– Mechanism)

Abzyme- Catalyticantibody–(Mechanism of action in immune system)

Activity

1-Quiz-Kahoot on the topic for Proteolytic enzymes.

2. Making clay model presentation for covalent modification of enzymes

UNIT- V (Lecture Hours: 12)

ENZYME
IMMOBILIZATION
Methods of immobilization:Types:
–(Adsorption,Crosslinking,CovalentBonding,Entrapment and Encapsulation)
Advantage sand application of immobilized enzymes–(Food industry and pharmaceutical aspects).

INDUSTRIALUSESOFENZYMES
Textile and Food industries-(Baking of bread,brewing industries.Washing powders,immobilized glutamate dehydrogenase linked to alcoholdehydrogenase).
ROLEOF ENZYME IN DIAGNOSIS AND TREATMENT
Serum Marker enzyme– (ALT,AST,LDH,CPK,ACP)
ALP,Cancer markerenzymes-
(Prostatic acid phosphatase(PAP),
Alkaline phosphatase
And Neuron-specific enolase)
Covid-19 Viral disease-
(Angiotensin Converting Enzyme-2 receptor action-ACE-2)
(Therapeutic enzymes-Asparaginase,Collagenase,Streptokinase,Urokinase,Penicillinase etc.)
ANTIOXIDANTENZYMES: Roleinfreeradicalscavengingactivity.
-SOD,Catalase,and Glutathione peroxidase

ROLEOF ENZYME IN GENETIC ENGINNEERING ASPECTS:
Enzymes in rDNA technology-Future prospects-(Restriction endonucleases,Polymerase,Ligase,Helicase,Topoisomerase for Genetic Engineering aspects).

Activity
1 –Debate on different methods of enzyme immobilization
2 –Making a PPT presentation on industrial application of enzymes.

Text Books:
T1 - Fundamentals of Enzymology | Edition:2 | Oxford Science Publications, Newyork. | Nicholas c. price, Lewisstevens2010
T2-Enzymes- Biochemistry, Biotechnology, Clinicalchemistry.|Edition:3|EastwestPressPvtLtd,NewDelhi.|TREVOR PALMER.and PHILIPBONNER (2014)

Reference Books:

R1–Lehninger Principles of Biochemistry,David.L.Nelson,MichaelM.Cox.Eight edition,2021.

R2-Harper'sIllustrated Biochemistry,Victor Rodwell,David Bender,Kathleen Bothamand Peter Kennelly,Thirt y FirstEdition -May-2018.

R2-Enzyme Chemistry: Impact and Applications,3rdEdition by ColinJSucklingand Gibson Colin.L-2010

Course Title : HUMAN PHYSIOLOGY, HORMONES AND SIGNALTRANSDUCTION	Course Code : 13D
Semester :**I**	Course Group : **M- IV**
Teaching Scheme in Hrs (L:T:P) : (4**:0:0)**	Credits : **4**
Map Code: -	Total Contact Hours: 60
CIA: **25 Marks**	SEE # : **75 Marks**
Programme: **MSC- BIOCHEMISTRY**	**# - Semester End**

No	**Course Outcome (Cos): After completion of this course, the students will be able to**	**PSOs**	**Cl. Ses**	**BLOOM'S TAXONOMY LEVEL**
CO1	Illustrate structure and functions of digestive system and blood compositions.	PS01	12	AP
CO2	Distinguish structure and functions of respiratory, circulatory and excretory system	PS02	12	AN
CO3	Demonstrate the mechanism of nerve impulse conduction and neurotransmitters	PS02	12	AP
CO4	Apply the mechanism, function ofanterior and posterior pituitary hormones	PS03	12	AP
CO5	Examine physical understanding of hormonal signal recognition	PS03	12	AN

HUMAN PHYSIOLOGY, HORMONES AND SIGNALTRANSDUCTION

UNIT-I (LECTURE HOURS: 12)

DIGESTIVE SYSTEM AND BLOOD SYSTEM:

Human physiology- (Homeostasis - Mechanism of homeostasis) –(Maintenance of equilibrium of ions and other body fluids) **Digestive System**- (Introduction and physiological process) Secretion of digestive juices – Mechanism of secretion of pepsinogen and HCl.(Mechanism and action) **Digestion and absorption of Carbohydrates**, Proteins and Fats. (Process of digestion and absorption in carbohydrates, proteins and fats).

Gastro- Intestinal hormones. –

(Introduction, Receptor mechanism of GI hormones)- Action of Cholecystokinin, Disease- Gastric ulcer and Gastritis – (Introduction, etiology. mechanism and treatment) .

Blood- Composition and function- (Introduction and types of blood) - RBC- Hemoglobin- (Introduction and structure) **Disease state**- Polycythemia, Anemia (Definition, symptoms and treatment) Leucocytes- WBC -Disease state - Leukemia, leucopenia, (Definition,symptoms and treatment) **Platelets- (**Introduction, properties Adhesion, aggregation and agglutination)**Blood coagulation** – (Introduction and Mechanism – stages and Factors involved in blood coagulation)

Disease state –(Hemophilia- Introduction, etiology andsymptoms)

Activity

1.Plasma and serum - Blood - Separation of plasma & serum.

2.Microscopic observation- WBC, RBC, Platelets.

UNIT-II (LECTURE HOURS: 9)

RESPIRATORY,CIRCULATORY AND EXCRETORY SYSTEM

Respiratory system: Introduction – (Inspiration and Expiration) Transport and exchange of respiratory gases - Transport of gases -Mechaniam (Transport of oxygen and carbondioxide) and exchange of gases between lungs and blood , between blood and tissue (Partial pressure and Diffusion method).

Circulatory System –

(Introduction, Heart as a pump-(Systolic and diastolic actions) Blood pressure.- Normal value –(Systolic and Diastolic pressure)
ExcretorySystem – (Kidney - Structure of nephron, composition)
Urine formation – (Mechanism of urine formation, Glomerular filteration, Tubular reabsorption and Tubular secretion).
Micturition- (Introduction and Mechanism)
Activity
1.Heart and Kidney - Display the Heart Model.
2. Structure of Nephron - chart preparation.

UNIT-III (LECTURE HOURS: 12)

NERVOUS SYSTEM AND NERVE CELL SIGNALING
Nervous system: (Nerve Cell – Introduction -Neuron – Structure and properties of neuron) **Signal transduction** – (Introduction and Mechanism, Definition, signals, ligands and receptors) **Nerve impulse transmission**- (Introduction and mechanism) (Nerve cells - Synapses, Resting membrane potential, action potential, voltage gated ion-channels, impulse transmission**)**.
Neurotransmitters – (Introduction, properties and types). **Criteria and mode of action of NT Acetyl Choline, Serotonin and Catacholamine** – (Introduction and mechanism of action).
Activity
1.Neurotransmitters - Animation on the Nerve transmission - Mechanism.
2.Chart preparation on Neurotransmitters.

UNIT-IV (LECTURE HOURS: 12)
HORMONES -ANTERIOR AND POSTERIOR LOBE OF PITUTORY HORMONES

Introduction, classification of hormones – (Hormones - Introduction ,Chemical messengers and Classification). **Hormones of the hypothalamus and pituitary** - (chemical nature, Anterior and Posterior lobe of Pitutory Hormone - secretion, release and their biological functions.) **Mechanism of Hormone Action** – (Hormone Receptors, Signal Transduction. Mechanism of Hormone Action - **Steroid hormones and glyco protein hormones** – (General principles concerning nature and mechanism of action of steroid hormones and glyco protein hormones)

Activity
1.Hormones - Chart Preparation - on Hormonal regulation of body mass, eating and drinking.
2.Group discussion onHormones, biological clocks and daily and seasonal rhythms.

UNIT-V (LECTURE HOURS: 12)

RECEPTOR ACTION- NUCLEAR RECEPTOR , STERIOD RECEPTOR , RAS RECEPTOR AND TYROSINE RECEPTOR
Signaling by nuclear receptors: (Ligands, nuclear and orphan receptors – (Structure andfunctions).**Steroid hormone receptor** – (Mechanism of action, Signaling pathway of the steroid hormone receptor). **Signal Transduction** –(Signal Transduction by G proteins, Ras and Receptor Tyrosine Kinases. (Introduction and mechanism). **Disease** – (Signal Transduction in Human Disease- -Introduction, aetiology and mechanism).

Activity
1.Receptor - Animation on Receptor mechanism
2.Model on Receptor ligand binding - signaling action.

Text Books :

T1 Medical Physiology | Edition:5 | JP | Dr.SembulingamL AND SembulingamPrema(2012)
T2 Medical Physiology | Edition:11 | Arun printers | Chatterjee CC(2003)
T3 Guyton and Hall Textbook of Medical Physiology John Edward Hall · 2017

Reference Books :
R1 Endocrinology | Edition:1 | MJP | Prakash S. Lohar(2005)
R2 Molecular cell biology | Edition:6 | W.H.freeman | LodishHarvey(2007)

Course Title	: **LAB IN QUANTITATIVE ANALYSIS OF BIOLOGICAL COMPOUNDS**	Course Code	: 23P
Semester	: **I & II**	Course Group	: MP-**I**
Teaching Scheme in Hrs (L:T:P) : (**0:0:5)**		Credits	: **4 Credits**
Map Code	: **-**	Total Contact Hours	: **150**
CIA	:**25 Marks**	SEE	: **75 Marks**
Programme: M.Sc-**BIOCHEMISTRY**			

List of Experiments:

UNIT I
QUANTITAIVE ANALYSIS

Isolation and Estimation of Starch - Anthrone method

Isolation and Estimation of Glycogen - Colorimetry method

Estimation of Protein - Lowry's method

Estimation of Phenol - Colorimetry method

Estimation of Calcium - Titrimetry method

Estimation of Chloride - Titrimetry method

Estimation of Vitamin - C - Colorimetry method

Estimation of Phosphorous - Fiske - Subbarow method

Estimation of Total Protein, Albumin: Globulin ratio

Estimation of phenol by colorimetry method

Estimation of chloride by titrimetry method

Extractions of lipids from egg

Estimation of Apolipoprotein

Estimation of Thiamine / Riboflavin from cereals by fiuorimetry methods

DETERMINATION OF LIPID PROFILE

Determination of Total Cholesterol

Determination of Phospholipids

Determination of Triglycerides

Determination of HDL Cholesterol

Determination of LDL Cholesterol

SEPERATION TECHNIQUES
CHROMATOGRAPHIC ANALYSIS

Paper chromatography (ascending)

Thin layer chromatography

column chromatography

ELECTROPHORESIS

Agarose gel electrophoresis

SDS gel electrophoresis

UNIT V

Seperation of Sub Cellular organells by differential centrifugation and Density Gradient centrifugation

Isolation & Estimation of DNA

Isolation & Estimation of RNA

Text Books :

Biochemical Methods | Edition:2 | New Age International Publishers | S. Sadasivam A. Manickam(2005)

Reference Books :

Principles and Techniques of Practical Biochemistry | Edition:5 | Cambridge University Press | KeithWilsonJohn M. Walke(2001)

Course Title: **LAB IN ENZYMOLOGY, PLANT BIOCHEMISTRYAND PLANT TISSUE CULTURE**	Course Code : 23Q
Semester : **I& II**	CourseGroup :MP-**II**
Teaching Scheme in Hrs(L:T:P) : **0:0:5**	Credits :**4 Credits**
Map Code : -	TotalContactHours:**150**
CIA : **25Marks**	SEE :**75 Marks**
Programme:M.Sc - **BIOCHEMISTRY**	

DETERMINATIONOFACIDPHOSPHATASEACTIVITY

Effect of pH on Acid Phosphatase activity

Effect of Temperature on Acid Phosphatase activity

Effect of Substrate concentration on Acid Phosphatase activity

ENZYMATICASSAYSINLIVERANDSERUM

Assay of SGPT in Serum

Assay of SGPT in Liver

Assay of SGOT in Serum

Assay of SGOT in Liver–

Determination of Serum Acid Phosphatase activity

Determination of Serum Alkaline Phosphatase activity

Determination of Catalase from plant source – Effect of pH & Temperature

DETERMINATION OF WATER CONTENT IN DIFFERENT PARTS OF PLANTS

a. WholeLeafMethod

b. LeafDiscMethod

SEPARATIONOFCHLOROPHYLLPIGMENTS

a) Separation by Paper chromatography
b) Separation by Thin Layer chromatography

TISSUE CULTURE TECHNIQUES – PLANT TISSUE CULTURE

a. Callus culture for different plants - Bacopa monnieri – Neer Brahmi plant
b. Micropropagation – Protoplast fusion techniques in plants

TextBooks:

BiochemicalMethods|Edition:1|NewAgeInternational|S. SadasivamA. Manickam(1996)

ReferenceBooks:

PrinciplesandTechniquesof PracticalBiochemistry|Edition:5|CambridgeUniversity Press|KeithWilsonJohnM.Walker(2001)

Course Title : **LAB IN COMPUTATIONAL AND MOLECULAR MODELLING**	Course Code : 13P
Semester : **I**	Course Group : MP - III
Teaching Scheme in Hrs (L:T:P) : **0:0:5**	Credits : **4 Credits**
Map Code : -	Total Contact Hours : 60
CIA :**25Marks**	SEE : **75 Marks**
Programme: **MSC-BIOCHEMISTRY**	

1.Understanding PubMed database

2. Analysis of protein sequence from protein database.

3. Analysis of gene sequence from nucleotide database.

4. Getting and analysis of primary protein structure.

5. Secondary structure analysis of protein.

6. Tertiary protein structure analysis using Rasmol.

7. Introduction of various bibliographic databases.

8. Getting the gene sequences by exploring and querying the nucleic acid databases.

9. Identification of Drug Target using pathways- KEGG.

10. Introduction of National Center for Biotechnology Information (NCBI).

11. Introduction of biological search engine- Entrez

12. Introduction to literature database at NCBI and querying the PUBMED central database using the ENTREZ search engine

13. BLAST and Clustal W- NCBI blast via the NCBI web server

14. A brief visit to Ensembl

15. Construction of phylogenetic trees

16. Sequence and Structural Database

17. Gene Prediction using GenMark and GenScan

18. Molecular Docking

19. Molecular binding - Crisper

Course Title :Metabolic Regulation	Course Code : 23A
Semester :**II**	Course Group : M-V
Teaching Scheme in Hrs (L:T:P) : **4:0:0**	Credits : **4 Credits**
Map Code: -	Total Contact Hours: 60
CIA: **25 Marks**	SEE # :**75 Marks**
Programme: **MSC-BIOCHEMISTRY** **Semester End**	**# -**

No	**Course Outcome (Cos)**	**PSOs**	**Cl.Ses**	**BLOOM'S TAXONOMY LEVEL**
CO1	Demonstrate the metabolic pathway of carbohydrates and its regulations.	PS01	12	AP
CO2	Illustrate lipid metabolic pathway and its regulations.	PS01	12	AP
CO3	Categorize metabolic pathway of amino acids and its regulations	PS03	12	AN
CO4	Demonstrate the porphyrin and mineral metabolism	PS02	12	AP
CO5	Apply the metabolism of purine , pyrimidine and its significance.	PS03	12	AP

UNIT - I (LECTURE HOURS: 12)

CARBOHYDRATE METABOLISM

Glycolysis –(Introduction, metabolic Pathway and energetic reactions).

Regulation of glycolysis – (Hexokinase, Phosphofructokinase and pyruvate kinase as regulatory enzymes in glycolysis and hormone regulation)

HMP shunt –(Introduction, metabolic Pathway and energetic reactions).

TCA cycle – (Steps, metabolic pathway and energetic reactions. Regulation at branch points, pyruvate dehydrogenase complex, citrate synthase and alpha - ketoglutarate dehydrogenase).

Gluconeogenesis – (Steps, metabolic pathway and energetic reactions. Regulation by allostericand substrate level control mechanisms)

Glycogen metabolism – (Steps, metabolic pathway and energetic reactions. Regulation ofglycogen phosphorylase, glycogen synthase by effectors, covalent modification and hormones).

Activity :

1. Compare the carbohydrate metabolic pathways by model presentation
2. Make a poster for glycogen metabolism and its regulations

UNIT-II (LECTURE HOURS: 12)

LIPID METABOLISM

Fattyacid biosynthesis – (Lipogenesis pathway and reactions)

Fatty acid degradation- - (Beta oxidation of fatty acid)

Regulation of saturated fatty acid synthesis: - Acetyl COA carboxylase and Fatty acid synthetase complex. Role of hormones, effect of diet on fatty acid synthesis)

Ketone bodies – (Formation and utilization)

Triacylglycerols, Cholesterol and Phospholipids Biosynthesis – (Biosynthesis and regulations)

Biosynthesis of Prostaglandins – (Eicosanoids, Thromboxanes, and Leukotrienes).

Actvity

1. Compare the lipid metabolic pathways
2. Group discussion about inborn errors of metabolism

UNIT - III (LECTURE HOURS: 12)

AMINO ACID METABOLISM

Transamination, and Deaminatin: Reactions with examples

SAM Pathway- Methyl Group Transfer reactions

Urea cycle – (Pathway, reactions & regulation).

Metabolism of Individual Aminoacids – (Glycine ,Phenylalanine, Tyrosine and Methionine) **Conversion of Aminoacids into some specialized products –** Synthesis of Neurotransmitters **An overview of integrated metabolic pathways** –(Major metabolic pathways & control sites.Food intake and starvation induced metabolic change)

Interrelations between Carbohydrate, Protein and Lipid Metabolism

Activity

1. Amino acids – Preparation of chart for the synthesis of specialized products through amino acidmetabolism
2. Group discussion about Interrelations between Carbohydrate, Protein and Lipid Metabolism

UNIT - IV (LECTURE HOURS: 12)

ELECTRON TRANSPORT CHAIN REACTIONS, PORPHYRIN AND MINERAL METABOLISM

ETC: Oxidative phosphorylation, Chemiosmotic theory, Redox potential, ATP synthesis**Porphyrin metabolism-** (Hemoglobin - Biosynthesis, degradation & regulation) **Mineral metabolism**

Calcium – (Sources, absorption, metabolism, biological roles and clinical significance), Phosphate – (Sources, absorption, metabolism, biological roles and clinical significance)

Iron – (Sources, absorption, metabolism, biological roles and clinical significance)

Trace elements

Copper – (Sources, absorption, metabolism, storage and transport) Fluoride **–** (Sources, absorption, metabolism, storage and transport)Iodine - (Sources, absorption, metabolism, storage and transport **Activity**

1. Minerals in diet - Preparing a chart model to illustrate the importance of the minerals metabolism
2. Make a model for Electron Transport chain reaction in mitochondria

UNIT - V (LECTURE HOURS: 12)

NUCLEIC ACID METABOLISM

Purine biosynthesis – (De novo and salvage pathways. Degradation).

Pyrimidine biosynthesis –(De novo and salvage pathways. Degradation)

Regulation of purine biosynthesis – (PRPP aminotransferases regulatory reactions)

Regulation of pyrimidine biosynthesis – (Aspartate carbamoyl transferase. regulatory reactions)**Nucleic acid metabolism** – (Compare the Salvage and Denovo Pathways of Purine and Pyrimidinemetabolism)

Activity

1. Compare the salvage and Denovo pathways of purine and pyrimidine metabolism through posterpresentation.
2. Group discussion about the importance of enzymatic regulatory mechanism in prevention ofclinical disorder in human.

Text Books :

T1 - ROBERT .K MURRAY ,**Harpers illustrated Biochemistry** ,2003 , Edition:26 ,McGraw Hill publication .

T2 – DAVID L NELSON MICHAEL M COX ,**Principles of Biochemistry** ,2021, Edition 8,,W. H. Freeman.

T3 - LUBERT STRYER , JEREMY M BERG, **Biochemistry** | 2003, Edition:5 |W.H.Freeman&company,New York.

T4 – U. SATYANARAYANA and U. CHAKRAPANI , **Biochemistry** –2017, Edition -5,Elsevier RELX India Pvt Ltd .

Reference Books :

R1- DONALD VOET G.JUDITH VOET , Biochemistry ,2021,Edition 4, Wiley Publishers .

R2- PAMELA C. CHAMPE, RICHARD A. HARVEY , **Lippincott's Illustrated Review of Biochemistry,**2009 ,Edition 3 , J.B.Lippincott's Publication.

Course Title	: **CLINICAL BIOCHEMISTRY AND MEDICAL LAB TECHNOLOGY (T)**	Course Code	:
Semester	: **II**	Course Group	:
Teaching Scheme in Hrs (L:T:P) : **4:0:0**		Credits	: **4 Credits**
Map Code	: **C(THEORY CONCEPTS)**	Total Contact Hours: **60**	
CIA	: **25 Marks**	SEE	: **75Marks**
Programme	: **MSC-BIOCHEMISTRY**		

UNIT-1 **Lecture hours: 12**

No.	Course Outcome (Cos): After completion of this course, the students will be able to	PSOs	Cl. Ses	CL
CO1	Analyze glucose metabolism, diabetes mellitus and glycogen storage disorders.	PSO 2	12	AN
CO2	Analyze the deficiencies and disorders associated with amino acid, nucleic acid metabolism and renal function.	PSO 2	12	AN
CO3	Integrate disruptions in lipid metabolism contribute to chronic diseases and liver function.	PSO 3	12	AN
CO4	Exhibit knowledge of hematologic laboratory techniques for diagnosing blood-related diseases.	PSO1	12	AP
CO5	Illustrate normal from abnormal histological patterns examine cellular and tissue samples and assessment of pathology.	PSO 4	12	AP

DISORDERS OF CARBOHYDRATE METABOLISM

Carbohydrate metabolism - - Introduction Hyperglycemia, Hypoglycemia, Glucose Tolerance Test (GTT), Glucosuria, fructosuria, pentosuria Diabetes Mellitus(DM). Types and metabolic abnormalities. - Type I, II and Gestational DM, metabolic abnormalities, diagnosis and management, acute and chronic Glycogen storage diseases (Type I to IX).

UNIT-2 **Lecture hours: 12**

DISORDERS OF AMINO ACID AND NUCLEIC ACID METABOLISM-

Introduction - Inborn errors of amino acid metabolism: Phenylketonuria, Alkaptonuria, Cystinuria, Maple syrup urine disease, and albinism. Disorders of Nucleic acid metabolism

Purine and Pyrimidine metabolism - Hyper uricemia-Gout and its types, Hypo uricemia, Lesch Nyhan syndrome and hereditary Ortotic aciduria. Renal function test: Clearance tests, tests for renal blood flow, concentration and dilution tests. Acute and chronic renal failure, glomerulonephritis, nephrotic syndrome, urinary calculi and dialysis.

UNIT-3 **Lecture hours: 12**

DISORDERS OF LIPID METABOLISM

Clinical disorder of lipid metabolism - Hyperlipoproteinemia, Hypolipoproteinemia- Types

Lipid storage diseases - Taysach and Niemann pick diseases, fatty liver, Hypercholesterolemia, and Hypocholesterolemia. Atherosclerosis - Clinical features and complications. Liver function test, Liver disease - Jaundice, hepatitis, gall stones, cirrhosis and fatty liver, prothrombin time, biochemical diagnosis of diseases by enzymatic assays-AST, ALT, ALP and GGT. Serum Bilirubin test: Van den Berg reaction.

UNIT-4 **Lecture hours: 12**

HEMATOLOGY

Hemopoiesis cell composition of normal adult bone marrow. Anaemias – classification, causes and laboratory investigations for anemias – Iron deficiency anemia, - Megaloblastic anemia, - Hemolytic anemia, haemoglobinemia, blue baby syndrome, methemoglobinemia Leukemias – classification, morphology and cytochemistry of leukemic cells Haemostasis and its investigations. Basic hematologic investigations and their normal values – Hb, TRBC, TLC, DLC, PCV, ESR, Platelet count, Reticulocyte count, Absolute values, BT, CT, APTT, CRT. Preparation of peripheral blood film and bone marrow aspiration, staining of films & stains used in hematology.

UNIT-5 **Lecture hours: 12**

HISTOLOGY

Tissue fixation and processing – Fixatives, tissue processing, microtomy including frozen section, and decalcification of bony tissue. Staining techniques and interpretation**.**

CYTOLOGY

Collection, preservation, fixation, and processing of various cytological specimens.

FNAC – method of aspiration, slide preparation, fixation, and staining of smears

CLINICAL PATHOLOGY

Examination of urine – Physical, Chemical and microscopic examination. Semen examination – Routine and special tests. Examination of CSF (Routine and special tests). Examination of various body fluids – Pleural fluid, Ascitic fluid, pericardial fluid, synovial fluid**.**

Text Books :

T1. Clinical Biochemistry: An Illustrated Colour Text by Michael J. Murphy, Rajeev Srivastava, and Kevin Deans is the 7th edition, published by Elsevier in 2024

T2. Tietz Fundamentals of Clinical Chemistry and Molecular Diagnostics, 8th Edition" by Nader Rifai, Andrea Rita Horvath, and Carl T. Wittwer, also published by Elsevier in 2023

Reference Books :

R1. "Clinical Biochemistry" (7th Edition) by Michael Murphy, Rajeev Srivastava, and Kevin Deans (Elsevier, 2023)

R2. "Medical Biochemistry" by John W. Baynes (Elsevier, 2022)

Course Title : Plant Biochemistry And Phytotherapeutics	Course Code : 23C
Semester :II	Course Group : M - VII
Teaching Scheme in Hrs (L:T:P) : 4:0:0	Credits : 4
Map Code: C(THEORY – CONCEPT)	Total Contact Hours: 60
CIA: 25 Marks	SEE # : 75 Marks
Programme: MSC-BC	# -Semester End Exam

No	Course Outcome (Cos): After completion of this course, the students will be able to	PSOs	Cl. Ses	BLOOM'S TAXONOMY LEVEL
CO1	Demonstrate plant cell membrane proteins and various transport mechanism.	PSO 1	12	AP
CO2	Illustrate photophosphorylation, photorespiration process in plants	PSO 1	12	AP
CO3	Interview on plant growth regulators, secondary plant products and its regulation	PSO 2	12	AP
CO4	Organize the concept of natural medicine for various diseases.	PSO 3	12	AN
CO5	Determining the efficacy of herbal medicine.	PSO 3	12	AN

UNIT I (LECTURE HOURS: 12)

PLANT CELL

Structure. (Composition and functions of plant cell organelles),
cell wall and cell membranes. (Biosynthesis of cell wall and membrane)
Membrane protein systems- Active and passive transport, channels and Sodium- potassium pumps, Calcium pump, Proton pump of cells
Transport mechanisms: (water movement, ascent of sap)
Mechanisms for movement of solutes-(Translocation in xylem and phloem)
Transpiration – types, mechanism and factors affecting transpiration

Activity
Prepare a chart on plant cell organelles
Animation work on xylem and phloem

UNIT II (LECTURE HOURS: 12)

PHOTOSYNTHESIS

Structure and composition (of photosynthetic apparatus - light and dark reactions- Cyclic and Non Cyclic)
Photophosphorylation; (Carbon dioxide fixation - C3, C4 and CAM pathways).

Biosynthesis of sucrose and starch, (Factors affecting the rate of photosynthesis).
Photorespiration- (Photosynthesis and plant productivity),
Carbon cycle, **Nitrogen cycle**, (interrelationship between carbon and nitrogen metabolism),
ATP synthesis (in chloroplast)

Activity
Quiz on Biosynthesis of sucrose and starch
Chart work on carbon and nitrogen cycle

UNIT III (LECTURE HOURS: 12)

GROWTH REGULATORS

Auxins, Gibberellins, cytokinins, ABA- (Ethylene Metabolism, function and mechanism of action)
Plant growth inhibitiors, (Plant Stress, Plant responses to abiotic and biotic stresses),
Phytochemistry: (Plant chemicals and their significance, storage carbohydrates, proteins and fats).
Secondary plant products (and their economic importance – waxes; essential oils, phenolic glycosides, flavoens, anthocyanins and alkaloids).

Activity
Give a structure of Auxins, Gibberellins, cytokinins
Assignment on Secondary plant products and their economic importance
UNIT IV (LECTURE HOURS: 12)

INTRODUCTION TO PHYTOMEDICINE

Natural source of Drugs- (Crude drugs, Classification of Crude drugs, Collection)
system of medicine- Siddha, ayurveda, unani and homeopathy).
Phytoconstituents of therapeutic value –Flavonoids, alkaloids, terpenoids, anthocyanins, Tannins, steroids and lignin
Applications of secondary metabolites in drug development (General methods of phytochemicals and biological screening**),**
Natural sources - (Extraction, isolation and purification of Primary and Secondary metabolites).
Processing of Crude drugs
Study of some herbal formulation techniques (as drug cosmetics).

Activity
1. Drug development from natural products with special emphasis on drugs derived from some of the following Plants: Ashwagandha, Digitalis, Artemesia, Atropa belladonna, Catharanthus roseus, Podophyllum,Taxus species.
2. Selection, identification and authentication of herbal materials, drying and processing of herbal raw material

UNIT V (LECTURE HOURS: 12)

PHYTOTHERAPEUTICS

Herbal Remedies - Toxicity & Regulations: Importance of Herbal Therapies, Herbal versus Conventional drugs, Efficacy of herbal therapies, safety in herbal drugs, toxicity in Herbals and their interaction, Herbal drug regulations in India.

Common CNS Disorders Treated with Phytotherapy- Active Phytotherapeutics for Alzheimer's, Parkinson's disease, Epilepsy and seizures, Insomnia and sleep disturbances. Memory stimulants – Centella asiatica

Phytotherapeutics for Respiratory system - Pulmonary / respiratory disorders – asthma, bronchitis,common cold, allergy and Remedy from plants.

Phytotherapeutics for metaboliic syndrome- diabetes- Herbs with antihyperglycemic effects,- Phytotherapy in Type I Diabetes, Phytotherapy in Type II Diabetes.

Drugs for urinogenital disorders – roots of Withania somnifera –

Drugs for dissolving kidney stones – Musa paradisica (pseudostem)

Analgesic drugs and anti-inflammatory drugs– Cardiospermum

Anticancer drugs – Catharanthus roseus.

Activity

1.Identification of medicinal plants using various macroscopic and microscopic parameters. . And Quantitative separation of phytoconstituents from herbal extracts by
Preparative thin layer chromatography.

2.Discussion on the Determination of moisture content, foreign organic matter, ash values, extractive values, swelling index of plant drug

References:

1. A Textbook Of Fundamentals Of Plant Biochemistry And Biotechnology As Per Icar New Syllabus (Paperback, Bishun D. Prasad, Sangita Sahni,

2. Plant Fundamentals of Plant Physiology by V.K. Jain - 2013

3. Plant Biochemistry and Molecular Biology SK Verma | Mohit Verma · 2008

4. 11. J.B. Harborne, 1998. “Phytochemical methods”, Chapman and Hall.

5. Kumar, N.C., An Introduction to Medical botany and Pharmacognosy. Emkay Publications, New Delhi. 1993 Rao

6. A.P. Herbs that heal. Diamond Pocket Books (P) Ltd., New Delhi, 1999

Textbooks:

1. A Textbook Of Fundamentals Of Plant Biochemistry And Biotechnology As Per Icar New Syllabus (Paperback, Bishun D. Prasad, Sangita Sahni,

2. Plant Fundamentals of Plant Physiology by V.K. Jain - 2013

3. Plant Biochemistry and Molecular Biology SK Verma | Mohit Verma · 2008

4. Quality Control Methods for Medicinal Plant material, 1992, WHO Guidelines.

5. Dr.P.Mukherjee, Quality control herbal drugs, 2005, Business Horizons

Course Title : **STEM CELLS & IT'S REGENERATIVE MEDICINE**	Course Code : 23C
Semester : II	Course Group : **Maj - VII**
Teaching Scheme in Hrs (L:T:P) : **4:0:0**	Credits : **4 Credits**
Map Code : **C(THEORY CONCEPTS)**	Total Contact Hours : 60
CIA : **25 Marks**	SEE : **75 Marks**
Programme: **MSC-BC**	

No	**Course Outcome (Cos): After completion of this course, the students will be able to**	**PSO**	**Cl. Ses**	**BLOOM'S TAXONOMY LEVEL**
CO1	Educate the basics and provide advanced knowledge in stem cell biology, tissue regeneration, biomaterials and Tissue engineering	PS01	12	U
CO2	Impart knowledge on biomaterials and its interaction with various tissues and applying it for biomedical applications	PS01	12	AP
CO3	Interact with clinicians and translational researchers in stem cells and tissue engineering from India and overseas	PS02	12	AP
CO4	Learn the basics of research writing and educate with regulatory aspects of stem cell research	PS02	12	AN
CO5	Provide the basic facts about therapeutic applications and ethics issues about stem cells	PS03	12	AN

UNIT-I **(LECTURE HOURS: 12)**

Introduction : Basics of Stem Cells Introduction to stem cells. Stem cells in vivo and stem cells in vitro. Early development: fertilization, totipotency, and pluripotency. Origin of stem cells - stem cells of the early embryo, the ontogeny of adult stem cells and stem cell niche. Molecular Bases of Pluripotency: signal transduction cascades to the stem cell nucleus.

UNIT-II **(LECTURE HOURS: 12)**

Embryonic Stem Cells Introduction to pluripotent stem cells.Pluripotent stem cells during early embryo. Embryonal carcinoma cells, Derivation of embryonic stem cells. Factors regulating ES Cell Derivation, embryonic germ cells, Genome manipulation in ES cells - Insertional mutagenesis and gene trapping. Maintenance of ES cell pluripotency.

UNIT-III **(LECTURE HOURS: 12)**

Epigenetics Epigenetic Control - DNA - Methylation and histone modifications, genomic imprinting, telomerase regulation,X - chromosome inactivation, reprogramming of cells, induced pluripotent stem cells and their therapeutic applications.

UNIT-IV **(LECTURE HOURS: 12)**

Stem Cells in Tissue Engineering Postnatal stem cells, recent trends in tissue engineering: ex vivo culture of postnatal stem cells, delivery of stem cells; reconstruction of the skeleton - bone and cartilage, skeletal and cardiac muscle regeneration; ex vivo reconstructions - cells, scaffolds, and bioreactors: activation of local and distant endogenous stem cells.

UNIT-V **(LECTURE HOURS: 12)**

Introduction to Regenerative Medicine Introduction to regenerative medicine. Principles of regenerative medicine. Applications of Regenerative Medicine in the nervous system, eye, heart, lung. Large scale manufacturing of cells, tissues and organs. Artificial organs. Genetherapy applications. Engineered Tissues and Regenerative Medicine.

Text Books

1. Stem Cells: From Biology to Therapy, 1st Edition, Wiley-VCH, Robert A. Meyers (2013)
2. Stem Cell Biology and Regenerative Medicine, 1st Edition, Springer, Edited by Nagwa El-Badri(2020)

Reference Books

1. Essentials of Stem Cell Biology, 3rd Edition, Academic Press, Robert Lanza, Anthony Atala(2013)

2. Regenerative Medicine, 1st Edition, Springer, Edited by Gustav Steinhoff (2011)

Course Title : **LAB IN QUANTITATIVE ANALYSIS OF BIOLOGICAL COMPOUNDS**	Course Code : 23P
Semester : **I & II**	Course Group : MP-**I**
Teaching Scheme in Hrs (L:T:P) : (**0:0:5)**	Credits : **4 Credits**
Map Code : -	Total Contact Hours : **150**
CIA :**25 Marks**	SEE : **75 Marks**
Programme: M.Sc-**BIOCHEMISTRY**	

List of Experiments:

I. QUANTITAIVE ANALYSIS

1. Isolation and Estimation of Starch - Anthrone method
2. Isolation and Estimation of Glycogen - Colorimetry method
3. Estimation of Protein – Biuret method
4. Estimation of Phenol - Colorimetry method
5. Estimation of Calcium - Titrimetry method
6. Estimation of Chloride - Titrimetry method
7. Estimation of Vitamin - C - Titrimetry method
8. Estimation of Phosphorous - Fiske - Subbarow method
9. Estimation of Total Protein, Albumin: Globulin ratio
10. Estimation of phenol by colorimetry method
11. Estimation of chloride by titrimetry method
12. Extractions of lipids from egg
13. Estimation of Apolipoprotein
14. Estimation of Thiamine / Riboflavin from cereals by fiuorimetry methods

II. DETERMINATION OF LIPID PROFILE

15. Determination of Total Cholesterol
16. Determination of Phospholipids
17. Determination of Triglycerides
18. Determination of HDL Cholesterol
19. Determination of LDL Cholesterol

III. CHROMATOGRAPHIC ANALYSIS

20. Paper chromatography (ascending)
21. Thin layer chromatography
22. column chromatography

IV. ELECTROPHORESIS

23. Agarose gel electrophoresis
24. SDS gel electrophoresis

V. SEPERATION TECHNIQUES

25. Seperation of Sub Cellular organells by differential centrifugation and Density Gradient centrifugation
26. Isolation & Estimation of DNA
27. Isolation & Estimation of RNA

Text Books :

Biochemical Methods | Edition:2 | New Age International Publishers | S. Sadasivam A. Manickam(2005)

Reference Books :

Principles and Techniques of Practical Biochemistry | Edition:5 | Cambridge University Press | KeithWilsonJohn M. Walke(2001)

Course Title: **LAB IN ENZYMOLOGY, PLANT BIOCHEMISTRYAND PLANT TISSUE CULTURE**	Course Code : 23Q
Semester : **I& II**	CourseGroup :MP-**II**
Teaching Scheme in Hrs(L:T:P) : **0:0:5**	Credits :**4 Credits**
Map Code : **-**	TotalContactHours:**150**
CIA : **25Marks**	SEE :**75 Marks**
Programme:M.Sc **- BIOCHEMISTRY**	

I. DETERMINATIONOFACIDPHOSPHATASEACTIVITY

1. Effect of pH on Acid Phosphatase activity
2. Effect of Temperature on Acid Phosphatase activity
3. Effect of Substrate concentration on Acid Phosphatase activity

II. ENZYMATICASSAYSINLIVERANDSERUM

4. Assay of SGPT in Serum
5. Assay of SGPT in Liver
6. Assay of SGOT in Serum
7. Assay of SGOT in Liver–
8. Determination of Serum Acid Phosphatase activity
9. Determination of Serum Alkaline Phosphatase activity
10. Determination of Catalase from plant source – Effect of pH & Temperature

III. DETERMINATION OF WATER CONTENT IN DIFFERENT PARTS OF PLANTS

11. WholeLeafMethod
12. LeafDiscMethod

IV. SEPARATIONOFCHLOROPHYLLPIGMENTS

13. Separation by Paper chromatography
14. Separation by Thin Layer chromatography

V. TISSUE CULTURE TECHNIQUES – PLANT TISSUE CULTURE

15. Callus culture for different plants - Bacopa monnieri – Neer Brahmi plant
16. Micropropagation – Protoplast fusion techniques in plants

TextBooks:

BiochemicalMethods|Edition:1|NewAgeInternational|S. SadasivamA. Manickam(1996)

ReferenceBooks:

PrinciplesandTechniquesof PracticalBiochemistry|Edition:5|CambridgeUniversity Press|KeithWilsonJohnM.Walker(2001)