**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 2023- 2024)**

**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 | Implement 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** | Biochemical Techniques | 3 | 4 | - | | 25 | 75 | 100 | 4 |
| | **M-II** | Human Cell 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 Computational and Molecular modelling | 3 | - | - | 4 | 25 | 75 | 100 | 4 |
| | **MP-II** | Lab in Quantitative analysis of Biological Compounds | - | - | - | 5 | - | - | - | - |
| | **MP-III** | Lab in Enzymology, Plant Biochemistry and Plant Tissue Culture | 3 | - | - | 5 | - | - | - | - |
| | **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** | Advanced 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 Cancer Biology | 3 | 4 | - | - | 25 | 75 | 100 | 4 |
| | **MP-II** | Lab in Quantitative analysis of Biological Compounds | 6 | - | - | 5 | 25 | 75 | 100 | 4 |
| | **MP-III** | 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** |

**1\1**

| 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. Recombinant DNA technology 2. Bioinformatics
ELECTIVE – II : 1. Internship 2. Mini Project Viva Voce
ELECTIVE – III : Extra Disciplinary Course (EDC)- List enclosed
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.

| **ELECTIVE III COURSES (EL III) : (III-SEMESTER)** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **ELECTIVE –III-EXTRA DISCIPLINARY COURSE:(EDC)** | | | | | | | | |
| **Course** | **CourseName** | **L** | **T** | **P** | **CIA** | **ESE** | **Total** | **Credits** |
| **One Course–From the Group** | | | | | | | | |
| M.A.English | English for Technical Writing | 4 | - | - | 25 | 75 | 100 | 4 |
| M.Sc Maths | Quantitative Aptitude | 4 | - | - | 25 | 75 | 100 | 4 |
| M.Sc Applied Electronics | Mobile Communication | 4 | - | - | 25 | 75 | 100 | 4 |
| M.Sc Food and Nutrition | Food Preservation and Quality Control | 4 | - | - | 25 | 75 | 100 | 4 |
| M.Sc Biochemistry | Hospital Management | 4 | - | - | 25 | 75 | 100 | 4 |
| M.Sc Biotechnology | Forensic Science | 4 | - | - | 25 | 75 | 100 | 4 |
| M.COM(IB) (International Business) | Global Business | 4 | - | - | 25 | 75 | 100 | 4 |
| M.Sc Microbiology | Diagnostic Microbiology | 4 | - | - | 25 | 75 | 100 | 4 |
| **Total** | | | | | | | **100** | **4** |

| | |
|---|---|
| Course Title : **BIOCHEMICAL TECHNQUIES (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)

**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 :**HUMAN CELL 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** | **# - 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 | 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<br>` |
| 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**

**ranscription 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 AND TRANSLATION IN PROKARYOTES AND EUKARYOTES**

**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** | Course Group :**M- III** |
| 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-BIOCHEMISTR** | **#-Semester End Exam** |

| No | Course Outcome(Cos): After completion of this course, the students will be able to | PSOs | Cl.Ses | BLOOM'S TAXONOMYL EVEL |
|---|---|---|---|---|
| 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 | Integrate the mechanisms involved in covalent modification of Glycogen Phosphorylase and Glutamine synthetase | PS03 | 12 | AN |
| CO5 | Illustrate the methods of immobilizations and its applications in pharmaceutical and food industry. | PS04 | 12 | AP |

**UNIT-I (Lecture Hours: 12)**

**ENZYME-INTRODUCTION, NOMENCLATURE AND CLASSIFICATION**

**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)

**ISOLATION AND PURIFICATION OF ENZYMES**

**Methods of homogenization**-(Mammalian tissue, Plant,Fungal and Bacterial cell wall homogenization)

**METHODS OF SEPARATION AND PURIFICATION OF ENZYMES**

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

**Methods based on polarity**- (Ion exchange chromatography,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**

**Types of specificity**-.

Absolute specificity, Stereo specificity, Group specificity or Relative specificity and Reaction specificity 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)

**Lipoic acid** – (Coenzyme in decarboxylation of pyruvate.- Structure and functions)

**TPP-Thiamine Pyrophosphate- (**Structure and

function)

**Pyridoxalphosphate**-(Structure and function)

**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)**

**ENZYME KINETICS:**

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

**Michaelis Menten Derivation**-(Derive the equation and significance of M.Mequation).

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

**MECHANISM OF BISUBSTRATE REACTION:**

**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

nhibition)

**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 Uric acid).

**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 OF ENZYMES:**

**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).

**Carboxy peptidases- (**Mechanism of action of cleavage of carboxy terminal endof protein compounds.Action of Zn in carboxypeptidase).

**Lysozyme- (**Mechanism of action-Digestion process of bacterial cellwall).

**Ribozyme**- (Non protein enzyme– Mechanism)

**Abzyme- Catalytic antibody–(**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, Covalent Bonding, Entrapment and Encapsulation)

**Advantage and application of immobilized enzymes**–(Food industry and pharmaceutical aspects).

**INDUSTRIAL USES OF ENZYMES:**

**Textile and Food industries**-(Baking of bread,brewing industries.Washing powders,immobilized glutamate dehydrogenase linked to alcoholdehydrogenase).

**ROLE OF ENZYME IN DIAGNOSIS AND TREATMENT**

**Serum Marker enzyme– (**ALT,AST,LDH,CPK,ACP)

**ALP,Cancer marker enzymes-**

(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.)

**ANTIOXIDANT ENZYMES:** Role in free radical scavenging activity.

**-SOD,Catalase,and Glutathione peroxidase**

**ROLE OF 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

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|---|---|
| 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 Exam** |

| **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 |

**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 ofdigestion 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 ).
**Buffer system** - Action of oxyhemoglobin (Buffer system Bicarbonate buffer)

**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). **Role of G-proteins in vision** – (Introduction and mechanism,G-protein visual cycle).
**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 | ChatterjeeCC(2003)
**Reference Books :**
R1 Endocrinology | Edition:1 | MJP | Prakash S. Lohar(2005)
R2 Molecular cell biology | Edition:6 | W.H.freeman | LodishHarvey(2007)

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|---|---|
| Course Title : **LAB IN COMPUTATIONAL AND MOLECULAR MODELLING (P)** | Course Code : 13P |
| Semester : **I** | Course Group : **MP - I** |
| 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** | |

**List of Experiments:**

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

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|---|---|---|---|
| Course Title | : **LAB IN QUANTITATIVE ANALYSIS OF BIOLOGICAL COMPOUNDS (P)** | Course Code | : 23P |
| Semester | : **I & II** | Course Group | : MP-**II** |
| 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:**

**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

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

Isolation & Estimation of DNA

Isolation & Estimation of RNA

**Text Books :**

T1. Biochemical Methods | Edition:2 | New Age International Publishers | S. Sadasivam A. Manickam(2005)

**Reference Books :**

R1. Principles and Techniques of Practical Biochemistry | Edition:5 | Cambridge University Press | KeithWilsonJohn M. Walke(2001)

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

**List of Experiments:**

**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:**

T1. BiochemicalMethods|Edition:1|NewAgeInternational|S. SadasivamA. Manickam(1996)

**ReferenceBooks:**

R1. PrinciplesandTechniquesof PracticalBiochemistry|Edition:5|CambridgeUniversity Press|KeithWilsonJohnM.Walker(2001)