RATHNAVEL SUBRAMANIAM COLLEGE OF ARTS & SCIENCE (AUTONOMOUS)
SULUR, COIMBATORE-641402

DEPARTMENT OF BIOCHEMISTRY

M.Sc.,BIOCHEMISTRY

Syllabus effective for the students admitted during the academic Year 2021 Batch & onwards

(2021 - 2023)

HOD	PRINCIPAL	COE

RATHNAVEL SUBRAMANIAM COLLEGE OF ARTS AND SCIENCE

DEPARTMENT OF BIOCHEMISTRY

M.Sc. BIOCHEMISTRY (2021 BATCH)

PROGRAMME OUTCOMES (POs):

PO1	To provide outcome-based education in the respective disciplines and to impart skills which will enable the students secure job in their core disciplines in this digitally transforming era.
PO2	To develop the art of critical thinking, creativity and to imbibe emerging trends thereby to excel in their interested domains of specializations.
PO3	To inculcate and develop research competence systematically besides the capacity to analyze the viability of new ideas, entrepreneurship and professionalism based on the students' choice and aptitude.
PO4	To instill a culture of life-long learning and the ability to understand the socio-economic issues.

PROGRAMME SPECIFIC OUTCOMES: (PSOs)

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

PSO1	To understand the fundamental concepts and master the pertinent experimental and theoretical techniques in Cell and Molecular biology, Clinical Biochemistry, Plant Biochemistry and Drug Biochemistry to inflate the understanding of the Biochemistry field.
PSO2	To transform the way by using sophisticated technologies like immune techniques and thereby gaining insights from clinical data to make cognitive decisions, predictions and to reveal the proficiency in quantitative reasoning and analytical skill within a student.
PSO3	Understanding the research-oriented learning that develops methodical and integrative problem-solving approaches in enabling them to write effective project reports in a multidisciplinary environment.
PSO4	To augment the students in pre-clinical studies, Clinical Research, Bioinformatics and Industrial Biochemistry enabling them to invent new ideas to develop their entrepreneurial skills, decisive thinking and self-governance.

RATHNAVEL SUBRAMANIAM COLLEGE OF ARS AND SCIENCE

SCHEME OF EXAMINATIONS-M. Sc. BIOCHEMISTRY
2021 BATCH BASED ON CBCS PATTERN

Semester	Type	Title of the Paperp	Hours Of Instructions / Week		Credits	Duration Of Examination in hours	Marks		
			Lecture hours	Tutorial hours			CIA	EOS	Total
I	M-I	Research Techniques	4	-	4	3	25	75	100
	M-II	Cell and Molecular Biology	4	-	4	3	25	75	100
	M-III	Enzymes and Enzyme Technology	4	-	4	3	25	75	100
	M-IV	Stem cells and Cancer Biology	4	-	4	3	25	75	100
	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	4	-	4*	3	40	60	100 *
II	M-V	Metabolic Regulation	4	-	4	3	25	75	100
	M-VI	Advanced Clinical Biochemistry	4	-	4	3	25	75	100
	M-VII	Plant Biochemistry	4	-	4	3	25	75	100
	M-VIII	Human physiology, Hormones and signal transduction	4	-	4	3	25	75	100
	MP-I	Lab in Quantitative analysis of Biological Compounds	5	-	4	6	40	60	100
	MP-II	Lab in Enzymology, Plant Biochemistry and Plant Tissue Culture	5	-	4	6	40	60	100
	EL-I	ELECTIVE I	4	-	4*	3	25	75	100 *
III	M-IX	Drug Biochemistry	4	-	4	3	25	75	100
	M-X	Industrial Biochemistry	4	-	4	3	25	75	100
	M-XI	Immunology and Immuno Techniques	4	-	4	3	25	75	100

	M - XII	Clinical Research and Clinical Data analytics	4	-	4	3	25	75	100
	MP-IV	Lab in Immunology and Recombinant DNA technology	5	-	-	-	-	-	-
	MP-V	Lab in Research Techniques in Biochemistry	5	-	-	-	-	-	-
	EL-II	Elective II- Internship and *Viva Voce***	-		4*	-	40	60	100 *
	EL-III	Elective III- EDC# - Hospital Management	4	-	4*	3	25	75	100
IV	M-XIII	Biostatistics and Research Methodology	4	-	4	3	25	75	100
	MP-III	Lab in Immunology and Recombinant DNA technology	5	-	4	6	40	60	100
	MP-IV	Lab in Research Techniques in Biochemistry	5	-	4	6	40	60	100
	Pro - I	Project Report and *Viva voce*** / Internship	-		4	-	40	60	100
I - III	ES	Employability skills	-	-	2*	-	-	-	GRADE
		TOTAL	**106**						**2200**

M - Major Paper;
MP- Major Practical;
EL – Elective;
Pro – I- Major Project and *Viva voce*;
EDC - Extra Disciplinary Course – Hospital Management
**** Project *Viva Voce*Marks 80:20 respectively will jointly be assessed based on 40:60 ratio application.**
"Employability Skills (ES) classes are held in first three semesters. Exams will be conducted in their II and III semesters.
Two Extra Credits will be given. This is 'Mandatory' to get a degree."
ELECTIVE – I : 1a. Recombinant DNA technology
1b. Bioinformatics

ACADEMIC YEAR 2021-2022

Course Title : **RESEARCH TECHNQUIES**	Course Code : 13A
Semester :**I**	Course Group : **DSC I**
Teaching Scheme in Hrs (L:T) : **3:1**	Credits : **4 Credits**
Map Code: C(THEORY – APPLICATION)	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	Pos &PSOs	Cl.Ses	BLOOM'S TAXONOMY LEVEL
CO1	Explain the terms like pH, pOH, acidic, basic, neutral solutions and pH meter to acquire the practical skill.	PO1& PS01	12	U
CO2	Outline the importance of suitable chromatographic technique for actual analytical purposes.	PO1& PS01	12	U
CO3	Apply the applications of centrifugation and chromatography in biological investigation.	PO1& PS01	12	Ap
CO4	Illustrating the use of electrophoresis techniques and its analysis of biomolecule separations.	PO1& PS01	10	U
CO5	List out various spectroscopic techniques and its instrumentation methods.	PO1& PS01	10	R
CO6	Explain the theoretical principles of radioactivity and appreciate the uses of radioisotopes.	PO1& PS01	4	U
CO7	Motivating the students in handling the basic experimental techniques.	PO1& PS01	4	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 - ICPMS, ICPOS
Spectrofluorimetry–(Fluorescence, phosphorescence) Techniques, Instrumentation & applications.
FTIR (Fourier Transform Infrared Spectroscopy) – Principle, Instrumentation & applications.

Molecular characterization studies

NMR – Principle, Instrumentation &applications.
X-Ray diffraction - Bragg's equation, Reciprocal lattice concept, Molecular structure of crystal.
Mass spectrometry- (GCMS & LCMS) Principle, Technique & applications.
SEM , TEM - Principle, Technique & 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

- Article collection on environmental disasters of radioactive isotopes and methods of disposal of radioactivewaste .
- Diagrammatic representation using different 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**	Course Code : 13B
Semester :**I**	Course Group : **DSC II**
Teaching Scheme in Hrs (L:T) : **3:1**	Credits : **4**
Map Code: C(THEORY – APPLICATION)	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	Pos &PSOs	Cl.Ses	BLOOM'S TAXONOMY LEVEL
CO1	Understand the structure and function of the cell and cell membrane	PO1& PS01	12	U
CO2	Explain membrane physiology to include transport mechanisms, membrane potentials and action potentials	PO1& PS01	12	U
CO3	Utilize the knowledge on the cellular components underlying cell division	PO1& PS01	12	Ap
CO4	Assess the mechanisms underlying cell differentiation, cell-cell communication, cell recognition, cell Adherence.	PO1& PS01	12	E
CO5	Explain the concept of DNA replication and study the enzymes involved in the replication process	PO1& PS01	5	U
CO6	Learn about the eukaryotic and prokaryotic promoters, RNA polymerase, mechanism of transcription	PO1& PS01	4	R
CO7	Outline the concept of translation, mechanism of protein synthesis, post translation modifications in eukaryotes, protein processing and targeting.	PO1& PS01	3	U

UNIT-I (Lecture Hours: 12)

Structure and Function of Cell

Prokaryotes and eukaryotes- Structure of a typical cell, Differences between prokaryotic and eukaryotic cells, .differences between animal and plant 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). Active transport – symport, antiport, Na+ K+ ATPase. Ion gradients, ion selective channels, group translocations.

Internalization of macromolecules - Endocytosis, pinocytosis, phagocytosis and exocytosis. Receptor mediated endocytosis

Cytoskeleton- Structure and function,role in motility and cell division: amitosis mitosis; meiosis and genetic recombination

Activity

1. **Make a chart on Prokaryotic and Eukaryotic cell**
2. **Group Discussion on mitosis and meiosis**

UNIT-II (Lecture Hours: 12)

Cell Division & Cell Signalling

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

Regulation of cell cycle - Overview of cell cycle. Cell cycle Control in mammalian cells, Checkpoints in cell -cycle regulation, factors and genes regulating cell cycle.

Cell Signaling molecules, receptors and their functions – G protein coupled receptors, Cyclic AMP, and Cyclic GMP

Types of cell signalling

Activity

1. **Quiz on Cell division**
2. **Group Discussion on cell signalling**

UNIT-III (Lecture Hours: 12)

ORGANIZATION OF GENETIC MATERIAL

Introduction - Cell, Central Dogma, Gene, DNA & RNA, Nucleotides and Nucleosides

GENOME REPLICATION

Introduction - Definition and Types. Messelson and Stahl's semi-conservative replication model - E-coli cultures, CsCl gradient, DNA Composition, Replication Cycles. Continuous and discontinuous synthesis - Consevative model and dispersive model

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

Replication of linear & circular DNA - Initiation , Elongation and Termination. Multiple initiation sites and bidirectional replication - Replication forks and rotation around the axis

RNA REPLICATION
Replication of RNA genomes - RNA replicase and reverse transcriptase.
Activity

1. **Animation on central dogma**
2. **Article collection on DNA 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. Posttranscriptional modifications.

TRANSCRIPTION IN EUKARYOTES

Process of Transcription in Eukaryotes - Classes of RNA - mRNA, rRNA, tRNA, snRNA, hnRNA. RNA Polymerases, Initiation, elongation and termination

Reverse transcription

Activity

1. Making a model on Transcription in prokaryotes
2. **Group Discussion on** Transcription in prokaryotes

UNIT-V (Lecture Hours: 12)

TRANSLATION IN PROKARYOTES

Genetic Code - Salient features, Deciphering the genetic code - Wobble hypothesis Translational Initiation - Aminoacyl-tRNA synthetases. Organization of mRNA, activation of amino acids, ribosomes and translation factors.

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, Translocation

Post-translational modifications - Protein sorting and targeting , Phosphorylation

Regulation of gene expression in prokaryotes- operon concept (lac, tryptophan, and arabinose)

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;

Course Title :**ENZYMES AND ENZYME TECHNOLOGY TTTECHNOLOGY**	Course Code : 13C
Semester :**I**	Course Group : **DSC III**
Teaching Scheme in Hrs (L:T) : **3:1**	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	Pos &PSOs	Cl.Ses	BLOOM'S TAXONOMY LEVEL
CO1	Explainthe classification of enzymes according to IUB, isolation and purification of enzymes from different sources through various biochemical techniques.	PO1& PS01	10	U
CO2	Summarize the structure of coenzymes and their role in various metabolic function.	PO1& PS01	5	U
CO3	Illustrate the mechanism of enzyme kinetics and enzyme inhibition in enzyme catalytic reaction	PO1& PS01	10	U
CO4	Describe the mechanisms involved in covalent modification of Glycogen Phosphorylase in animal and Glutamine synthetase in *E. coli* organism.	PO1& PS01	10	An
CO5	List out the mechanism of action of isoenzymes and proteolytic enzymes	PO1& PS01	10	An
CO6	Apply the methods of immobilizations and its applications in pharmaceutical and food industry.	PO1& PS01	10	Ap
CO7	Identify the role of enzyme in diagnosis and treatment of various diseases.	PO1& PS01	5	An

UNIT -I- (12 Hours)

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 subcellular organelles

ISOLATION AND PURIFICATION OF ENZYMES

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

METHODS OF SEPARATION AND PURIFICATION OF ENZYMES

Methods that depend on size or mass - Gel filtration. Centrifugation. - Ultra centrifugation 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

SPECIFICITY OF ENZYME 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 -(12 Hours)

COENZYMES

Introduction - Organic compounds - prosthetic groups - Integral part of active site.

Nicotinamide coenzymes - NAD+ and NADP+- Structure and functions

Flavin nucleotides - FMN and FAD+- Structure and functions

Coenzyme A - 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 functions

Pyridoxal phosphate - Structure and functions

ACTIVE SITE:

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 --(12 Hours)

ENZYME KINETICS

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

Michaelis Menten Derivation- Derive the equation and significance of M.M equation.

LB Plot , Eadie Hoftsee and Hanes plot - .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 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 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)

Un competitive 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- --(12 Hours)

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 - LDH 1-5 and applications of LDH

MULTIENZYME COMPLEX

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

PROTEIOLYTIC ENZYME:

Chymotrypsin- Mechanism of action of proteolytic enzyme- Cleavage to specific amino acid residues.

Carboxy peptidases- Mechanism of action of cleavage of carboxy terminal end of protein compounds. Action of Zn in carboxy peptidase.

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

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- --(12 Hours)

ENZYME IMMOBILIZATION

Methods of immobilization: Types:

– Adsorption, Cross linking, Covalent Bonding, Entrapment and Encapsulation

Advantages 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 glutamatedehydrogenase linked to alcohol dehydrogenase.

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 endo nucleases, 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, Lewis stevens 2010

T2 - Enzymes - Biochemistry, Biotechnology, Clinical chemistry. | Edition:3 | East west Press Pvt Ltd, New Delhi. | TREVOR PALMER. And PHILIP BONNER (2014)

Reference Books :

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

R2- Harper's Illustrated Biochemistry, Victor Rodwell, David Bender, Kathleen Botham and Peter Kennelly, Thirty First Edition -May-2018.

R2- Enzyme Chemistry: Impact and Applications, 3rd Edition by Colin J Suckling and Gibson Colin .L -2010

Course Title :**STEM CELL AND CANCER BIOLOGY**	Course Code : 13D
Semester :**I**	Course Group : **DSC IV**
Teaching Scheme in Hrs (L:T) : **3:1**	Credits : **4**
Map Code: C(THEORY – APPLICATION)	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	Pos &PSOs	Cl.Ses	BLOOM'S TAXONOMY LEVEL
CO1	Understand the key features of the origin the basics, properties and types with their derivatives of stem cells	PO1& PS01	12	U
CO2	Determine the causes of cancer cells, neurodegenerative disease and the fate mapping of stem cells.	PO1& PS01	12	U
CO3	Infer the future challenges associated with stem cell applications.	PO1& PS01	12	An
CO4	Illustrating the interruption of carcinogens and mutagens in the normal cell cycle.	PO1& PS01	12	U
CO5	Explain the types of cancer and its treatment through stem cell therapy	PO1& PS01	12	R

UNIT-1 (LECTURE HOURS: 10)

Stem cells

Introduction - Definition, Undifferentiated biological cells, Inner cell mass

History of stem cells - Potential in the field of medicine, ethics

Concept of stem cells - Symmetric stem cell division, asymmetric stem cell division and progenitor division

Properties - Unipotent, oligopotent, totipotent, pluripotent

Adult stem cells &haematopoietic stem cells

Adult stem cells - Generation and culturing

Haematopoietic stem cells - Generation and culturing

Isolation - Production and Culture of stem cells , Preparing medium, Monolayer culture

Advantage and disadvantage of stem cell - Attributes, Limitations and Oppostion

ACTIVITY

- Making clay models of different stem cells -
- Exhibiting cartoon way of representing a stem cell -

UNIT-2 (LECTURE HOURS: 10)

Types of stem cells- primal, embryonic and adult stem cells

Primal cells - Introduction, Types of stem cells, Cord blood

Embryonic stem cells - Embryo, Inner cells mass, Invirto fertilization

Adult stem cells - Pluripotent, Haemotopoietc stem cells

Neural and derived stem cells

Neural stem cell - Introduction, multipotent cells

Derived stem cells - Ectoderm derived stem cell and Endoderm derived stem, Development

Neurodegenerative diseases - Introduction Implications and causes

Stem cell in aging

Aging - Introduction, Aging, Decline in stem cell function

ACTIVITY

- To download animations illustrating working of neural cells -
- To label images on a worksheet in differentiating Stem Cells for Research -

UNIT-3 (LECTURE HOURS: 10)

Stem cell therapies

Skin replacement - Introduction, Skin replacement, Grafting, Complications and therapy using stem cells

Brain cell Transplantation - Repairing damaged cells of CNS, Brain injury and therapy

Diabetes - Types, Replacement of Pancreatic cells and therapy

Heart failure - Heart attacks and potential stem cell-based therapies

Future challenges and ethical issues

Issues related to stem cells - Ethical and legal issues, Challenges in stem cell usage

ACTIVITY

- Debate on the merits and demerits of stem cell therapies and its ethical issues -
- Article collection of recent stem cell research from journals -

UNIT-4 (LECTURE HOURS: 9)

Cell cycle and cancer

Introduction of cell phases - Mitotic phase, Interphase, Centromere, Chromatids

Cancer - Tumor, Metastasis, Neoplasmas

Apoptosis - Introduction, Engulfment, Necrosis, Dendrites

Cancer symptoms - Early symptoms, APC, tumor suppressor cells

Leukemia

Introduction - Definition, Reciprocal translocation

History and causes - Genetics, origin of cancer

Cancer cells

Cancer stem cells - Introduction and its nature

ACTIVITY

- Debate on life after cancer -
- To download animations illustrating Apoptosis -

UNIT-5 (LECTURE HOURS: 9)

Causes and types of cancer

Causes of cancer - Physical and Biological factors, Carcinogen, Radiation exposure, Tumour promoters

Types of cancer - Tumour, Benign tumour, malignant tumour, Metastasis

Properties of cancer cells

Properties - Transformation of normal cells, Apoptosis failure

Treatment and therapies of cancer

Types - Biological therapy, Radiation therapy, Targeted cancer therapy , Immunotherapy

ACTIVITY

- To make a Group discussion on causes, control measures of Cancer cells.
- Prepare a chart differentiating normal and a cancer cell

Text Books :

Mary Clarke and Jonathan Frampton, **Stem Cells Biology and Application;**2020, 1st Edition; Garland Science

Mehmet R. Topcul, Idil Cetin, **Stem Cells in Cell Therapy and Regenerative Medicine,** 2018, 2nd Edition;Published by OMICS International

Reference Books :

Robert Lanza, Anthony Atala; **Essentials of Stem Cell Biology;** 2014, Third Edition, Academic Press

Pezzella, **Oxford Textbook Of Cancer Biology,** 2020; Oxford UP

Paperback, Ruddon Raymond W. **Cancer Biology,** 2007, Oxford University Press Inc

Course Title	: **LAB IN QUANTITATIVE ANALYSIS OF BIOLOGICAL COMPOUNDS**	Course Code	:
Semester	: **I & II**	Course Group	: MP-**I**
Teaching Scheme in Hrs (L:T:P) : **0:0:5**		Credits	: **3 Credits**
Map Code	:**H**	Total Contact Hours	: **150**
CIA	:**60 Marks**	SEE	: **60 Marks**
Programme: M.Sc-**BC**			

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 BIOCHEMISTRY AND PLANT TISSUE CULTURE**	Course Code :
Semester : **I & II**	Course Group : MP-**II**
Teaching Scheme in Hrs (L:T:P) : **0:0:5**	Credits : **4 Credits**
Map Code :**H**	Total Contact Hours: **150**
CIA :**60 Marks**	SEE : **60**

	Marks
Programme: M.Sc-**BC**	

DETERMINATION OF ACID PHOSPHATASE ACTIVITY

Effect of pH on Acid Phosphatase activity

Effect of Temperature on Acid Phosphatase activity

Effect of Substrate concentration on Acid Phosphatase activity

ENZYMATIC ASSAYS IN LIVER AND SERUM

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 WATER CONTENT IN DIFFERENT PARTS OF PLANTS

a.Whole Leaf Method

b. Leaf Disc Method

SEPARATION OF CHLOROPHYLL PIGMENTS

1. Separation by Paper Chromatography
2. Separation by Thin Layer Chromatography

Text Books :

Biochemical Methods | Edition:1 | New Age International | S. Sadasivam A. Manickam(1996)

Reference Books :

Principles and Techniques of Practical Biochemistry | Edition:5 | Cambridge University Press | Keith Wilson John M. Walker(2001)

Course Title	: **BIOINFORMATICS**	Course Code	:
Semester	: **I**	Course Group	: MP 3
Teaching Scheme in Hrs (L:T:P) : **0:0:5**		Credits	: **4 Credits**
Map Code	:**H**	Total Contact Hours	: 60
CIA	:**60 Marks**	SEE	: **60 Marks**
Programme: **MSC-BC**			

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

Course Title : RECOMBINANT DNA TECHNOLOGY	Course Code : 23B
Semester :II	Course Group : DSC VI
Teaching Scheme in Hrs (L:T) : 3:1	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	Learn the basic techniques involved in recombinant DNA manipulations including DNA restriction, ligation, transformation and selection of recombinant plasmid.	PSOs	10	U
CO2	Understand the functions of several vectors used in cloning and Devise their own cloning strategies for DNA	PSOs	5	U
CO3	Illustrate creative use of modern tools and techniques for manipulation and analysis of genomic sequences.	PSOs	10	U
CO4	To describe the application of recombinant DNA technology in biotechnological research and Construct cDNA and genomic DNA libraries	PSOs	10	AN
CO5	To understand the strategizing research techniques employing in rDNA technology	PSOs	10	AN
CO6	Learn the preparation of insert and vectors for the cloning	PSOs	10	AP

UNIT I (LECTURE HOURS: 12)
Introduction to Recombinant DNA
Definition, Recombinant DNA and evolution - Host controlled restriction modification
The range of manipulative enzymes
DNA polymerase, Polynuceotide kinase - Functions
T4 DNA ligase - Joining DNA molecules
Terminal deoxynucleotidyl I transferase - Functions

Reverse transcriptase and Topoisomerase - Functions
Restriction endonucleases Type I, II & III - Characteristics of Type II Restriction endonuclease, nomenclature, restriction sites
Activity
DNA manipulating enzymes - 1. Group discussion on various DNA manipulating enzymes
DNA Polymerase - 2. Download animation of mechanism of DNA Polymerase
UNIT II (LECTURE HOURS: 12)
Vectors- Definition, Properties and its types
Vectors - Definition, Properties of good vectors
Plasmids and Cosmids - Plasmids- Types, Structural and Functional Organization of Plasmids, Cosmids- Principle and cloning
Bacteriophage vector - Lambda phage, M13 single strand phage vector
yeast cloning vectors - YAC, YEP
Animal viral vector - SV 40
Plant viral vector - Cauliflower mosaic virus vector (CaMV)
Activity
E.coli vector EcoRI - 1.Use paper models to simulate the process of inserting insulin gene of interest into your E.coli vector EcoRI
Vectors - 2.Display the images of different vectors and make a comparison chart mentioning the difference in vector size and gene holding capacity
UNIT III (LECTURE HOURS: 12)
Introduction of the vector into suitable host- Gene transfer techniques
Introduction of the vector into suitable host: - Properties of good host, preparation of competent cells
Transformation of DNA to bacterial, plant and animal cells - Transformation -Calcium mediated transformation
Microinjection - Gene transfer to animal cell, plant cell
Lipofection - Gene transfer to Animal cell
Electroporation - Gene transfer to animal cell, plant cell and bacterial cell
Nuclear transplantation - Transgenic sheep

Homologous recombination - Recombinant virus
Natural genetic engineering by Agrobacterium - Ti plasmid, binary vector strategy
Activity
microinjection - 1.Demonstration of microinjection method using models.
Gene transfer methods - 2. Animation depicting the various methods used for introducing vector into suitable host
UNIT IV (LECTURE HOURS: 12)
Screening of Recombinants

Reporter genes and selectable marker genes - Neomycin , hygromycin, green fluorescence protein

Selection of clones having specific DNA insert - colony hybridization, hybrid arrested translation, nucleic acid hybridization, complementation
Immunochemical methods for screening - colony/plaque screening with antibodies
Gene library and Functional genomics
Gene library - Construction cDNA library and genomic library
Functional genomics - DNA chips and microarray gene screen technology; site directed mutagenesis

Activity
Microarray - 1.Demonstrate the mechanism of microarray gene screen technology by powerpoint presentation
Screening methods - 2.Group discussion on screening methods for Recombinants
UNIT V (LECTURE HOURS: 12)
Techniques in Recombinant DNA technology
Blotting Techniques - Southern, Northern, Western blotting
immunological techniques - Enzyme linked Immunoabsorbant Assay
PCR - Making multiple copies of DNA
DNA Finger printing using RFLP - Digesting the DNA and mapping, Applications
RAPD - Randomly Amplified Polymorphic DNA

Chromosome walking and jumping - Identification of neighboring sequences
DNA sequencing - Chemical and enzymatic method
Hazards of Recombinant DNA technology and regulations
Hazards of rDNA technology and regulations. - Rules and regulation to control the hazards of genetically modified organisms.
Activity
ELISA - 1.Animation depicting the antigen and antibody reaction in ELISA
DNA Fingerprinting - 2.Case study: A person was murdered by an unknown person. How will you find the accused using DNA finger printing
Text Books :
T1-Gene Cloning by T.A.Brown | Edition:5 | BlackWell Publishers, London | T.A.Brown(2006)
T2-Principles of Gene ManipulationEdition | Edition:3 | Blackwell Scientific Publication | S.B.Primrose AND R.W.Old (2006)
T3-Biotechnology | Edition:3 | Book and Allied Kolkata | U Sathyanarayan (2005)
T4-From Genes to Clones | Edition:2 | Panima Publishers | E.L.Winnecker(2003)
T5-Genes VI | Edition:3 | Oxford University Press | B.Lewin(2000)
T6-Recombinant DNA technology and molecular cloning | Edition:2 | Scientific American Publication Black well publica | Kary B. Mullis (1996)
T7-Immunology | Edition:5 | WH Freeman andcompany NY | Richard AGold boy AND Thomas JKindt(2003)
Reference Books :
R1-Molecular Cloning | Edition:3 | Cold Spring Harbour laboratory | Kaaren AJanssen AND NinaIrwin(2001)