



PSGR Krishnammal College for Women



DEPARTMENT OF BIOTECHNOLOGY (UG)

**CHOICE BASED CREDIT SYSTEM (CBCS) & LEARNING OUTCOMES-
BASED CURRICULAR FRAMEWORK (LOCF)**

(Semester – I)

BACHELOR OF SCIENCE - BIOTECHNOLOGY

2022 – 2025 BATCH

B.Sc BIOTECHNOLOGY

PROGRAMME LEARNING OUTCOME (PLO):

After completion of this programme, the student will be able to

PLO1: Achieve successful technical and professional career which will turn the student into an effective researcher or as an entrepreneur.

PLO2: Acquire sound knowledge in basic sciences and applied sciences and thereby applying the principles in dealing problems in a scientific way.

PLO3: Acquire knowledge in the fields of molecular biology, genome biology, gene engineering, protein engineering, immuno-technology, tissue engineering and bioinformatics.

PLO4: Have a life-long learning to follow novel developments in the field which will inspire high ethical values and technical standards.

PLO5: Be equipped to transfer this knowledge to the consumer by applying biotechnological principles in producing a research-oriented product.

PROGRAMME SPECIFIC OUTCOME:

At the end of the programme the student will

PSO1: Ability to understand the structure and function of cells.

PSO2: Skill to make biosafe cloning host cells, design new proteins, develops new diagnostic tools, drug discovery through virtual analysis.

PSO3: Acquire skills to higher levels of learning and/or for the development of new products.

PSO4: Initiate new start-ups in areas of biotechnology.

PSO5: Comprehend current trends to meet the future challenges in biotech industry.



DEPARTMENT OF BIOTECHNOLOGY-UG
CHOICE BASED CREDIT SYSTEM & OUTCOME BASED EDUCATION
BACHELOR OF SCIENCE (B.Sc.) – 2022-2025 BATCH
SYLLABUS & SCHEME OF EXAMINATION

Applicable to students admitted during the academic year 2022-2023 onwards (I & II Sem)

SEM	Part	Subject Code	Title of the Paper		Instruction hours/week	Contact hours	Tutorial	Duration of Examination	Examination Marks			Credits
									CA	ESE	TOTAL	
I	I	TAM2201/ HIN2201/ FRE2201	Language Tamil I/ Hindi I/ French Paper I	Language	6	86	4	3	50	50	100	3
	II	ENG2101	English paper I	English	6	86	4	3	50	50	100	3
	III A	BT22C01	Core Paper I – Cell and Molecular biology	CC	5	71	4	3	50	50	100	4
		BT22CP1	Core Practical I – Lab in Cell and Molecular biology	CC	3	45	-	-	-	-	-	-
	III A	BT22A01/ CE22A01/ PS22A01	Allied I –Paper I Biochemistry/ Allied Chemistry for Biologist Paper I/ Allied Physics Paper –I	GE	5	71	4	3	30	45	75	4
	III A	BT22AP1/ CE21AP1/ PS21AP1	Allied Practical I Lab in Biochemistry/ Allied Chemistry Practical for Biologist / Allied Physics practical	GE	3	45	-	-	-	-	-	-
	IV	NME22B1/ NME22A1/ NME21ES	Basic Tamil I/ Advanced Tamil I/WS/AS/GS/ Introduction to Entrepreneurship	AEC	2	28	2	2	50	50	100	2
		NME12GA W	Foundation Course I (General Awareness)	AEC	Self-Study Online			100	-	100	Grade	

CC – Core Courses
 GE – Generic Elective
 AEC – Ability Enhancing Course

CA – Continuous Assessment
 ESE - End Semester Examination

#Allied theory papers with practicals will be evaluated for 50/50 and converted into 30/45; Theory and practical converted to 20/30

CIA PATTERN

1. Theory

INTERNAL COMPONENT	50 Marks
CIA I	7
CIA II	7
MODEL EXAM	10
ASSIGNMENT	4
SEMINAR	5
QUIZ	4
CLASS PARTICIPATION	5
APPLICATION OF KNOWLEDGE, INNOVATION AND CREATIVITY	5
ATTENDENCE	3
TOTAL	50 Marks

2. Practical - 50 : 50 = 100 Marks

Internal Component(Practical)	50 marks
Lab Performance (Practical + Interaction) (12+12)	24
Regularity in record submission	8
Model Examination	15
Attendance	3
Total	50 Marks

3. SBS 25/75 pattern:

INTERNAL COMPONENT	25 / 75 = 100 Marks
THEORY	
CIA I	5
CIA II	5
Model exam	15
Total	25 Marks

4. CIA Question Paper Pattern:

2 x 25 = 50 Marks

One question from each unit with each question comprising of

- Two questions with a weightage of 2 marks (no choice)
- Two questions with a weightage of 6 marks (no choice)
- One question with weightage of 9 marks (Internal Choice at the same CLO level)

5. ESE Question Paper Pattern:

5 x 20 = 100 Marks

One question from each unit with each question comprising of

- One question with a weightage of 2 marks (no choice)
- One question with a weightage of 6 marks (Internal Choice at the same CLO level)
- One question with weightage of 12 marks (Internal Choice at the same CLO level)

COURSE NUMBER	COURSE NAME	CATEGORY	L	T	P	CREDIT
BT22C01	Core paper I-Cell and Molecular Biology	CORE	71	4	-	4

Preamble

To facilitate the students to

- Familiarize various aspects of cellular organization and their role in DNA replication, transcription and translation.
- Develop comprehensive understanding on the complete cellular and molecular function of cell organelles in terms of cell to cell interaction, gene regulation, cellular signaling.
- Impart the skills of molecular biology and their applications in various disciplines

Course Outcomes

On the successful completion of the course, students will be able to

CLO Number	CLO Statement	Knowledge Level
CLO 1	Classify the cells based on their structural and genetic makeup of the organism.	K1
CLO 2	Examining the basic concepts of cell cycle and regulators involved in it.	K2
CLO 3	Implementing the concepts of cell signalling and communication in research fields.	K3
CLO 4	Exploration of the genetic mechanisms involved in studying the cellular activity of an organism.	K4

Mapping with Programme Outcomes

CLOS	PLO1	PLO2	PLO3	PLO4	PLO 5
CLO 1	S	S	S	S	S
CLO 2	S	M	S	M	M
CLO 3	S	S	M	S	S
CLO 4	S	M	S	S	M

S- Strong; M-Medium

Syllabus

UNIT I: Basics of Cells

14 hrs

Cell as a basic unit: discovery of the cells, classification of cell types, development of cell theory, early chemical investigation in cell biology. Prokaryotic and Eukaryotic cell organization. Cytoplasmic compartments of the cell. Structure and Functions of organelles.

UNIT II: Mechanisms of Cell Transport

14 hrs

Chemical composition and fluidity of membranes; dynamic nature of membranes; transportation across cell membrane; membrane potentials; extracellular matrices– structure and function; cytoskeleton– structure and function

UNIT III: Cell Division, Cell cycle Regulation and Cell Signaling

14 hrs

Eukaryotic cell cycle, Cyclin, CDKs, Check points, Cell cycle inhibitors, DNA content, FACS, Regulation of cell cycle- factors and genes regulating cell cycle. Mitosis and Meiosis; Cell signaling – types of cell signaling - G protein mediated, Tyrosine kinase mediated signaling. Transposable elements-prokaryotes.

UNIT IV: Organization and functions of DNA

14 hrs

Chromosomes-structure, function and specialized structure. DNA-Structure, types, DNA replication in prokaryotes and eukaryotes. DNA damage-types of DNA damage and factors affecting, Mutation, types and DNA Repair mechanism-types, Base Excision repair, SOS repair, NHEJ.

UNIT V: Gene Regulation and Expression

15 hrs

Transcription, Prokaryotes and Eukaryotes. mRNA processing Translation –Prokaryotes and Eukaryotes. Gene regulation: prokaryotic gene regulation- Operon concept; Lac operon and Trp operon. Post translational modifications- phosphorylation, glycosylation, ubiquitination and methylation.

TEXT BOOKS

S.No	Authors	Year	Title of the book	Publishers
1.	S C Rastogi	2020	Cell and Molecular Biology	New age International Publishers
2.	Samantha Granger	2018	Textbook of Cell Biology	Callisto reference
3.	Thomas D.Pollard, William C.Earnshaw, Jennifer Lippincott-Schwartz, Graham Johnson	2016	Cell Biology	Elsevier; 3rd edition
4.	Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, and Peter Walter	2014	Molecular Biology of Cell 6 th Edition	W. W. Norton & Company
5.	Harvey Lodish; Arnold Berk; Chris A. Kaiser; Monty Krieger; Anthony Bretscher; Hidde Ploegh; Kelsey C. Martin; Michael Yaffe; Angelika Amon	2021	Molecular Cell Biology Ninth Edition	Macmillan's Publishers

REFERENCE BOOKS

S.No	Authors	Year	Title of the book	Publishers
1	Bruce Alberts, Karen Hopkin, Alexander D. Johnson, David Morgan; Martin Raff, Keith Roberts; Peter Walter	2018	Essential Cell Biology 5 th Edition	W.W.Norton & Company
2	D.Freifelder	2015	Freifelders Essentials of Molecular Biology	Jones & Bartlett Publishers
3	Harvey Lodish; Arnold Berk; Chris A. Kaiser; Monty Krieger; Anthony Bretscher; Hidde Ploegh; Kelsey C. Martin; Michael Yaffe; Angelika Amon	2021	Molecular Cell Biology 9 th Edition	Macmillan's Publishers

Course Designer:

Dr.R.Nirmal Kumar

Dr.A.Dhivya

BT22C01-Cell and Molecular Biology				
Module No.	Topic	No. of periods	Content delivery methods	CLO'S
UNIT I				
1	Cell as a basic unit: discovery of the cells,	3	Lecture	CLO1
2	classification of cell types, development of cell theory, early chemical investigation in cell biology.	3	Discussion	CLO1, CLO2
3	Prokaryotic and Eukaryotic cell organization.	4	Lecture	CLO1, CLO2
4	Cytoplasmic compartments of the cell. Structure and Functions of organelles	4	Lecture	CLO1, CLO2, CLO3
UNIT II				
5	Chemical composition and fluidity of membranes	3	Lecture	CLO1, CLO2
6	Dynamic nature of membranes; transportation across cell membrane;	3	Lecture	CLO2, CLO3
7	Membrane potentials; extracellular matrices– structure and function;	4	Lecture	CLO2, CLO3. CLO4
8	Cytoskeleton– structure and function	4	Discussion	CLO2, CLO3. CLO4
UNIT III				
9	Eukaryotic cell cycle, Cyclin, CDKs, Check points, Cell cycle inhibitors,	3	Discussion	CLO2, CLO3. CLO4
10	DNA content, FACS, Regulation of cell cycle- factors and genes regulating cell cycle.	3	Lecture	CLO2, CLO3. CLO4
11	Mitosis and Meiosis; Cell signaling – types of cell signaling - G protein mediated,	4	Lecture	CLO2, CLO3. CLO4
12	Tyrosine kinase mediated signaling. Transposable elements-prokaryotes.	4	Demonstration	CLO2, CLO3. CLO4
UNIT IV				
12	Chromosomes-structure, function and specialized structure.	3	Lecture	CLO2, CLO3. CLO4
13	DNA-Structure, types, DNA replication in prokaryotes and eukaryotes.	3	Lecture	CLO2, CLO3. CLO4
14	DNA damage-types of DNA damage and factors affecting,	4	Lecture	CLO2, CLO3. CLO4
15	Mutation, types and DNA Repair mechanism-types, Base Excision repair, SOS repair, NHEJ.	4	Discussion	CLO2, CLO3. CLO4
UNIT V				
16	Transcription, Prokaryotes and Eukaryotes. mRNA processing.	3	Lecture	CLO3, CLO4,
17	Translation –Prokaryotes and Eukaryotes. Gene regulation: prokaryotic gene regulation- Operon concept;	3	Lecture	CLO3. CLO4,
18	Lac operon and Trp operon.	4	Lecture	CLO3. CLO4,
19	Post translational modifications- phosphorylation, glycosylation, ubiquitination and methylation	5	Discussion	CLO3. CLO4,

COURSE NUMBER	COURSE NAME	CATEGORY	L	T	P	CREDIT
BT22CP1	Core Practical I (Lab in Cell and Molecular Biology & Microbiology)	CORE	-	-	90	4

Objectives

- To develop the knowledge on different microbiological techniques and isolate microorganisms from the various sources and to establish pure cultures
- To isolate and differentiate different cell organelles and utilize staining techniques to visualize them
- To understand molecular techniques in separating the genetic material from the organism
- To analyze the methodology of isolating proteins from the organisms.

Course Outcomes

On the successful completion of the course, students will be able to

CLO Number	CLO Statement	Knowledge Level
CLO1	Understand and identify techniques in isolating different microorganisms.	K1
CLO2	Acquire the skills in interpreting the specimens and inferring the results.	K2
CLO3	Demonstrate basic molecular techniques in isolating the genetic material from both prokaryotic and eukaryotic organisms	K3
CLO4	Will be capable of determining the isolation and separation of proteins from the samples given.	K3

Mapping with Programme Outcomes

CLOs	PLO1	PLO2	PLO3	PLO4	PLO 5
CLO1	S	S	M	M	S
CLO2	S	M	S	S	M
CLO3	S	S	M	M	S
CLO4	S	M	S	S	M

S- Strong; M-Medium

Lab in Cell and molecular biology**(Semester I Practicals)**

1. Use of simple compound microscope and Micrometry
2. Different types of cells–parenchyma, collenchymas, sclerenchyma, epithelium
3. Permanent slide preparation
4. Osmosis and tonicity
5. Cell division –Mitotic stages –Preparation of Onion Root Tip
6. Cell division –Meiotic stages –Preparation of *Tradescantia* Flower bud
7. Isolation of Genomic DNA from bacterial cells
8. Isolation of RNA
9. Quantification of DNA

Course Designer:**Dr. R. Nirmal Kumar**

COURSE NUMBER	COURSE NAME	CATEGORY	L	T	P	CREDIT
BT22A01	Allied paper I-Biochemistry	Allied	71	4	-	4

Objectives

- To facilitate the students to
- To understand the structure of simple sugars
 - To elucidate the role played by different Biomolecules
 - To analyze the structure of different sugars, lipids, amino acids and proteins.
 - To analyze the various pathways involved in sugar utilization

Course Outcomes

On the successful completion of the course, students will be able to

CLO Number	CLO Statement	Knowledge Level
CLO 1	Classify the biomolecules based on structure and function	K1
CLO 2	Comprehend the basics of enzymes and their role in different metabolic processes.	K2
CLO 3	Acquire knowledge about the Importance of lipids and their biosynthesis	K3
CLO 4	Analyze the significance of metabolic pathways and their role in cellular function	K3

Mapping with Programme Outcomes

CLOs	PLO1	PLO2	PLO3	PLO4	PLO 5
CLO 1	S	S	M	S	S
CLO 2	S	M	S	M	M
CLO 3	S	S	M	S	S
CLO 4	S	M	S	M	S

S- Strong; M-Medium

SYLLABUS

UNIT I: Structure and Function of Carbohydrates

14 hrs

Carbohydrates: Definition, classification, structure and biological functions of mono, di, oligo and polysaccharides (starch, glycogen, cellulose, dextrin, hyaluronic acid, keratin sulphate, heparin and chondroitin sulphate).

UNIT II: Enzymes

14 hrs

Enzymes – properties, classes of enzymes, enzyme reaction, theories of enzyme reaction, MM equation, LB plot, factors affecting enzyme reaction, enzyme units, enzyme assay, coenzyme, Co-factors.

UNIT III: Lipids

14 hrs

Biological significance, nomenclature and classification. Simple lipids; Fatty acids and their properties, triglycerides, waxes, steroids and prostaglandins. Compound lipids: Phospholipids, sphingolipids and glycolipids. Lipoproteins. β -oxidation of lipids, Biosynthesis of lipids.

UNIT IV: Vitamins & Proteins

14 hrs

Vitamins – water soluble and fat soluble, importance of vitamins in life. Amino acids: structure, classification, physical and chemical properties. Proteins: Biological importance, classification, general properties. Primary structure- Human Insulin, Secondary structure - keratin tertiary structure- myoglobin and quaternary structure- Hemoglobin.

UNIT V: Metabolism of Biomolecules

15 hrs

Metabolism: Catabolism & Anabolism. Energy metabolic pathways – Glycolysis, Krebs's cycle, Oxidative phosphorylation. Substrate level phosphorylation, Gluconeogenesis, pentose phosphate pathway (HMP shunt).

TEXT BOOKS

S.No	Authors	Year	Title of the book	Publishers
1	Nelson,D.L.and Cox,.M. Lehninger	2021	Principles of Biochemistry 8 th Edition	Macmillan Higher Education
2	U. Satyanarayana, U.Chakrapani	2020	Biochemistry, Fifth edition revised	Elsevier
3.	Roger L. Miesfeld, Megan M. McEvoy	2016	Biochemistry	W.W. Norton
4.	Donald Voet, Charlotte W. Pratt, Judith G. Voet	2012	Principles of Biochemistry	Wiley; 4th Edition International Student Version
5	Jain, J.L, Sunjay Jain and Nitin Jain	2010	Biochemistry	Chand and Company, New Delhi

REFERENCE BOOKS

S.No	Authors	Year	Title of the book	Publishers
1	Victor Rodwell , David Bender , Kathleen Botham, Peter Kennelly, P.	2018	Harper's Biochemistry 31 st edition	McGraw Hill
2	Jeremy M.Berg, John L.Tymoczko and Lubertstryer	2002	Biochemistry	W H Freeman & Co. , Objectives

Course Designer:

Dr.R.Nirmal Kumar

Dr.A.Dhivya

BT22A01-Biochemistry				
Module No.	Topic	No. of periods	Content delivery methods	CLO'S
UNIT I				
1	Carbohydrates: Definition, classification	3	Lecture	CLO1
2	Structure and biological functions of mono, di, oligo and polysaccharides	3	Discussion	CLO1, CLO2
3	Starch, glycogen, cellulose, dextrin, hyaluronic acid	4	Discussion	CLO1, CLO2
4	Keratin sulphate, heparin and chondroitin sulphate	4	Lecture	CLO1, CLO2
UNIT II				
5	Enzymes – properties, classes of enzymes.	3	Lecture	CLO2
6	Enzyme reaction, theories of enzyme reaction, MM equation,	3	Lecture	CLO2, CLO3
7	LB plot, factors affecting enzyme reaction	4	Lecture	CLO2, CLO3. CLO4
8	Enzyme units, enzyme assay, coenzyme, Co-factors	4	Lecture & Assignment	CLO2, CLO3. CLO4
UNIT III				
9	Biological significance, nomenclature and classification.	3	Discussion	CLO2, CLO3. CLO4
10	Simple lipids; Fatty acids and their properties, triglycerides, waxes, steroids and prostaglandins.	3	Lecture	CLO2, CLO3. CLO4
11	Compound lipids: Phospholipids, sphingolipids and glycolipids. Lipoproteins.	4	Lecture & Seminar	CLO2, CLO3
12	β -oxidation of lipids, Biosynthesis of lipids	4	Demonstration	CLO2, CLO3. CLO4
UNIT IV				
12	Vitamins – water soluble and fat soluble, importance of vitamins in life.	3	Lecture	CLO2, CLO3. CLO4
13	Amino acids: structure, classification, physical and chemical properties.	3	Lecture	CLO2, CLO3. CLO4
14	Proteins: Biological importance, classification, general properties.	4	Lecture	CLO2, CLO3. CLO4
15	Primary structure- Human Insulin, Secondary structure - keratin tertiary structure- myoglobin and quaternary structure- Hemoglobin	4	Demonstration & Discussion	CLO2, CLO3. CLO4
UNIT V				
16	Metabolism: Catabolism & Anabolism.	3	Lecture	CLO2,CLO3, CLO4,
17	Energy metabolic pathways – Glycolysis, Kreb's cycle,	3	Discussion	CLO2,CLO3. CLO4
18	Oxidative phosphorylation. Substrate level phosphorylation,	4	Lecture	CLO3. CLO4
19	Gluconeogenesis, pentose phosphate pathway (HMP shunt).	5	Lecture	CLO4

COURSE NUMBER	COURSE NAME	CATEGORY	L	T	P	CREDIT
BT22AP1	Allied Practical–I (Lab in Biochemistry and Instrumentation and Analysis)	Allied	-	-	90	2

Objectives

To facilitate the students to

- Evaluate methods of biomolecule estimations, separation techniques and methods for biochemical analysis
- To enable the students to Learn to make standard solutions
- Gain knowledge in usage of separation techniques
- Apply the knowledge of understanding volumetric, colorimetric and spectrophotometric analysis

Course Outcomes

On the successful completion of the course, students will be able to

CLO Number	CLO Statement	Knowledge Level
CLO1	Remember and differentiate the different techniques employed in estimating Biomolecules	K1
CLO2	Categorizing the method to quantify proteins and sugars	K2
CLO3	Examining the enzymatic assays and their calculations	K3
CLO4	Comprehend the basics of chromatography techniques	K4

Mapping with Programme Outcomes

CLOs	PLO1	PLO2	PLO3	PLO4	PLO 5
CLO1	S	S	M	M	M
CLO2	S	S	M	M	S
CLO3	S	S	M	S	S
CLO4	S	M	S	M	M

S- Strong; M-Medium

Lab in Biochemistry (Semester I Practicals)

1. Preparation of standard solutions
2. Qualitative Analysis of Carbohydrates – Glucose, Fructose, Sucrose, Starch
3. Qualitative Analysis of Amino acid – Tyrosine, Cysteine, Tryptophan
4. Estimation of proteins-Lowry's methods
5. Estimation of total free amino acids – Ninhydrin Method
6. Estimation of Glucose (Dinitrosalicylic acid method)
7. Quantification of Vitamin C
8. Analysis of Oils- Saponification Value, Acid Number