



**PSGR
Krishnammal College for Women**



**PSGR KRISHNAMMAL COLLEGE FOR WOMEN
COIMBATORE-641004
(College of Excellence)
Autonomous and Affiliated to Bharathiar University
(Accredited with 'A+' Grade by NAAC with CGPA 3.71 (IV Cycle)
(Ranked 7th in NIRF 2024)**

**DEPARTMENT OF BIOTECHNOLOGY
CHOICE BASED CREDIT SYSTEM (CBCS) & LEARNING OUTCOMES- BASED
CURRICULAR FRAMEWORK (LOCF)
B.Sc. BIOTECHNOLOGY**

SEMESTER I - IV

2024 – 2027 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
CHOICE BASED CREDIT SYSTEM (CBCS) & LEARNING OUTCOME BASED
CURRICULAR FRAMEWORK (LOCF)
BACHELOR OF SCIENCE (B.Sc.) BIOTECHNOLOGY – 2024-2027 BATCH
SYLLABUS & SCHEME OF EXAMINATION
Applicable to students admitted during the academic year 2024-2025 and onwards

SEMESTER	Part	Course Code	Title of the Course	Course Type	Instruction hours/week	Contact hours	Tutorial hours	Duration of Examination	Examination Marks			Credits	
									CA	ESE	TOTAL		
I	I	TAM2301/ HIN2301/ FRE2301	Language I – T / H / F	L	6	88	2	3	25	75	100	3	
	II	ENG2301	English Paper I	E	6	88	2	3	25	75	100	3	
	III	BT24C01	Cell and Molecular Developmental Biology	CC	4	58	2	3	25	75	100	4	
	III	BT24CP1	Core Practical I –Cell and Molecular Developmental Biology and Microbiology Practical	CC	4	60	-	-	-	-	-	-	
	III	BT24A01/ CE23A01/ PS23A01	Allied Paper I Biochemistry/ IDC-Allied Chemistry For Biologist -I /Allied Physics Paper–I	GE	5	73	2	3	20	55	75 ^e	4	
	III	BT24AP1/ CE23AP1/ PS23AP1	Allied Practical I Biochemistry and Bioinstrumentation Practical / Allied Chemistry Practical for Biologist / Allied Physics Practical	GE	3	45	-	-	-	-	-	-	
	IV	Non-Tamil Students											2
		NME23B1/ NME23A1	Basic Tamil I/ Advanced Tamil I	AEC	2	28	2	-	100	-	100		
		Students with Tamil as Language											
			NME23ES	Introduction to Entrepreneurship	AEC	2	30	-	-	100	-	100	
I-V	VI	COM15SER	Community Services	GC	30 hrs outside class hours					Completed or not			
I-V	VI	24BONL1 24BONL2 24BONL3	Online Course 1 Online Course 2 Online Course 3	ACC	-	-	-	-	-	-	-	-	

L : Language

E : English

GE : Generic Elective

CA – Continuous Assessment

€ : CA conducted for 25 and converted into 20, ESE conducted for 75 and converted into 55

CC : Core Courses

ACC : Additional Credit Courses

AEC : Ability Enhancement Courses GC : General Courses

ESE - End Semester Examination

QUESTION PAPER PATTERN

CA Pattern

Section A	:	$3 \times 2 = 6$
Section B	:	$3 \times 5 = 15$ (either or – same CLO Level)
Section C	:	$3 \times 8 = 24$ (either or – same CLO Level)
Total		45 marks

ESE Pattern

Section A	:	$5 \times 2 = 10$
Section B	:	$5 \times 5 = 25$ (either or – same CLO Level)
Section C	:	$5 \times 8 = 40$ (either or – same CLO Level)
Total		75 marks

Internal Components for theory (for 25 Marks)

CA Test	:	5 Conducted for 45 marks after 50 days
Model Exam	:	7 Conducted for 75 marks after 85 days (Q.P. Pattern (2,5,8) Each Unit 15 Marks)
Seminar/Assignment/Quiz	:	5
Class Participation	:	5
Attendance	:	3

25 marks + ESE 75 Marks

From the academic year 2024-25 and onwards marks allotted for attendance component in CA is modified as

91-100% attendance : 3 Marks

81-90% attendance : 2 Marks

75-80% attendance : 1 Mark

CA Question Paper Pattern: 1 x 45=45 Marks (Each unit carries 15 marks)

One question from each unit with each question comprising of

- One questions with a weightage of 2 marks (no choice)
- One questions with a weightage of 5 marks (Internal Choice at the same CLO level)
- One question with weightage of 8marks (Internal Choice at the same CLO level)

Model Question Paper Pattern: 1 x 75 =75 Marks (Each unit carries 15 marks)

- One question with a weightage of 2 marks (no choice)
- One question with a weightage of 5 marks (Internal Choice at the same CLO level)
- One question with weightage of 8 marks (Internal Choice at the same CLO level)

Internal component for Practical's (for 25 Marks)

Lab Performance	-	7 marks
Regularity	-	5 marks
Model Exam	-	10 marks
Attendance	-	3 marks
Total	-	25 marks

ESE Practical's Pattern

The End Semester Examination will be conducted for a maximum of 75 marks with a maximum 15 marks for the record and other submissions if any.

COURSE CODE	TITLE OF THE COURSE	CATEGORY	L	T	P	CREDITS
BT24C01	CELL AND MOLECULAR DEVELOPMENTAL BIOLOGY	THEORY	58	2	-	4

Objectives:

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
- Understand the principles and molecular mechanisms involved in cellular differentiation, morphogenesis, growth and Potency of the cell.

Course Learning Outcomes

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

CLO Number	CLO Statement	Knowledge Level
CLO1	Classify the cells based on their structural and genetic makeup of the organism.	K1
CLO2	Examining the basic concepts of cell cycle and regulators involved in it.	K2
CLO3	Implementing the concepts of cell signaling and communication in research fields.	K3
CLO4	Exploration of the genetic mechanisms involved in studying the cellular activity of an organism.	K4

Mapping with Programme Learning Outcomes

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

S- Strong; M-Medium

BT24C01-CELL AND MOLECULAR DEVELOPMENTAL BIOLOGY

Unit I: Basics of Cells (11 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 (12 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, Protein Sorting - Protein degradation.

Unit III: Cell Division, Cell cycle Regulation and Cell Signaling (12 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. Apoptosis-Mitochondrial pathway.

Unit IV: Gene Regulation and Expression (12 hrs)

Central Dogma of the cell. DNA-Structure, types, ***DNA replication in prokaryotes** - Transcription in Prokaryotes and Eukaryotes - RNA Processing - Genetic code- Translation - ***Similarities and differences in prokaryotic and eukaryotic translation - Post Translational Modifications**. ***DNA damage-types of DNA damage and factors affecting**, Mutation, types and DNA Repair mechanism-types, Base Excision repair, SOS repair, NHEJ.

Unit V: Embryology (11 hrs)

Gametogenesis - ***Spermatogenesis** and Oogenesis in mammals. ***Fertilization- Types of cleavage, blastula formation**, embryonic fields, gastrulation and formation of germ layers in animals- Organogenesis.

***Link Provided for the Highlighted Content Offered in Blended Mode**

S.No	Topics	Video Link
Unit I: Basics of Cells		
1	Development of cell theory, prokaryotic and Eukaryotic cell organization	https://youtu.be/Pxujitlv8wc?si=VUbhZk0_nCHoq-DJ https://youtu.be/URUJD5NEXC8?si=FQUxOFpsfMkacM9f
Unit II: Mechanisms of Cell Transport		
2	dynamic nature of membranes; transportation across cell membrane; membrane potentials	https://youtu.be/qBCVVszQQNs?si=iK0tnvN8sRpCvtlg https://youtu.be/RPAZvs4hvGA?si=GKW1uLOJJVVijuxo
Unit III: Cell Division, Cell cycle Regulation and Cell Signaling		
3	Eukaryotic cell cycle, Cyclin, CDKs, Check points, Mitosis and Meiosis; Cell signaling – types of cell signaling - G protein mediated	https://youtu.be/0BqJ58ZiWwA?si=8Azil9Zg45Gtyzby https://youtu.be/DwAFZb8juMQ?si=5eyGXuPGaXqCLeRU https://youtu.be/9sF_h-bAnIE?si=rgAtHdwb8XAYJ-gy https://youtu.be/kLOWGKEvZF0?si=mRGStR-lda_2QtvR
Unit IV: Gene Regulation and Expression		
4	DNA replication in prokaryotes, Similarities and differences in prokaryotic and eukaryotic translation - Post Translational Modifications. DNA damage-types of DNA damage and factors affecting	https://youtu.be/IjVLhoyfGAM?si=a4jjdPTy89urWGp4 https://youtu.be/_br9ahJX4Bc?si=-1AFrYmNkrp6u2cl https://youtu.be/gG7uCskUOrA?si=bW5DxQgEc7Q4C83x https://youtu.be/2yI_SoOWFMU?si=81vKbeuUjknZQjkl https://youtu.be/ceFr0xTMV5k?si=6icNHEf_U0RNjd0j https://youtu.be/NXT3cMTTLEI?si=XhSfRr9kOaQGe-9e
Unit V: Embryology		
5	Spermatogenesis, Fertilization- Types of cleavage, blastula formation	https://youtu.be/ZFLb19nC2bs?si=cCc_dhrN83xj2V5f https://youtu.be/HuWCwyRiaUI?si=WfCKnOrc2vu2kWKp https://youtu.be/VQoVOrA6dXo?si=xxa1VVtpfby5RzZK

TEXT BOOKS

S. No.	Authors	Title of the book	Publishers	Year & Edition
1.	S C Rastogi	Cell and Molecular Biology	New Age International Private Limited	2020
2.	Sastry KV, Shukla V	Developmental Biology	Rastogi Publications	2018
3.	Thomas D. Pollard, William C. Earnshaw, Jennifer Lippincott-Schwartz, Graham Johnson	Cell Biology	Saunders	2016
4.	Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, and Peter Walter	Molecular Biology of Cell	Garland Science	2014 & 6 th Edition

REFERENCE BOOKS

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

Course Designer:

Dr. R. Nirmal Kumar

Module No.	Topic	CLO level	No. of periods	Content delivery method	Student engagement	Participatory Learning / Experiential Learning / Problem based Learning
Unit I Basics of Cells						
1.	Cell as a basic unit	CLO1	1	Lecture – Chalk and Talk / Group reading	Word cloud/ Mind map / Think Write and Share	Participatory Learning
2.	Discovery of the cells,	CLO1	1	Displays	Gallery walk, Post it parade	Experiential Learning
3.	Classification of cell types	CLO1	1	OER	Debate, Quescussion, Pro-con grid	Problem-based Learning
4.	Development of cell theory	CLO1, CLO2	1	PPT / OER	Quiz (Quizalize/ Socrative)	Participatory Learning
5.	Early chemical investigation in cell biology	CLO1, CLO2	1	Chalk and talk/ Picture	Debate, Quescussion, Pro-con grid	Problem-based Learning
6.	Prokaryotic and Eukaryotic cell organization	CLO1, CLO2	1	PPT / OER	Gallery walk, Post it parade	Experiential Learning
7.	Cytoplasmic compartments of the cell.	CLO1, CLO2, CLO3	1	Virtual lab	Presentation	Problem-based Learning
8.	Cytoplasmic compartments of the cell.	CLO1, CLO2, CLO3	1	Lecture – Chalk and Talk / Group reading	Word cloud/ Mind map / Think Write and Share	Participatory Learning
9.	Structure and Functions of organelles	CLO1, CLO2, CLO3	1	OER	Debate, Quescussion, Pro-con grid	Problem-based Learning
10.	Structure and Functions of organelles	CLO1, CLO2, CLO3	1	Lecture – Chalk and Talk / Group reading	Word cloud/ Mind map / Think Write and Share	Participatory Learning
11.	Structure and Functions of organelles	CLO1, CLO2, CLO3	1	Lecture – Chalk and Talk / Group reading	Word cloud/ Mind map / Think Write and Share	Participatory Learning

Unit – II Mechanisms of Cell Transport						
12.	Chemical composition and fluidity of membranes;	CLO1, CLO2	1	Lecture / Seminar	Diagrams, Sketchboard	Participatory Learning
13.	dynamic nature of membranes	CLO1, CLO2	1	PPT	Group reading and discussion	Experiential Learning
14.	dynamic nature of membranes	CLO1, CLO2	1	Lecture / Seminar	Diagrams, Sketchboard	Participatory Learning
15.	transportation across cell membrane;	CLO1, CLO2, CLO3	1	PPT	Word cloud/ Mind map / Think Write and Share	Participatory Learning
16.	membrane potentials	CLO1, CLO2, CLO3	1	PPT	Review collection, Case study	Problem-based Learning
17.	membrane potentials	CLO1, CLO2, CLO3	1	Lecture / Seminar	Diagrams, Sketchboard	Participatory Learning
18.	extracellular matrices– structure and function;	CLO1, CLO2, CLO3	1	OER	Flipped classroom, Presentation	Participatory Learning
19.	cytoskeleton– structure and function	CLO1, CLO2, CLO3	1	Lecture / OER	Simulation	Experiential Learning
20.	cytoskeleton– structure and function	CLO1, CLO2, CLO3	1	Lecture / OER	Simulation	Experiential Learning
21.	Protein Sorting -	CLO1, CLO2, CLO3	1	Lecture / OER	Simulation	Experiential Learning
22.	Protein degradation	CLO1, CLO2, CLO3	1	Lecture/ Virtual lab	Simulation	Experiential Learning
23.	Protein degradation	CLO1, CLO2, CLO3	1	Lecture/ Virtual lab	Simulation	Experiential Learning
Unit – III Cell Division, Cell cycle Regulation and Cell Signaling						
24.	Eukaryotic cell cycle,	CLO2, CLO3	1	ORE / PPT	Flipped classroom, Assignment	Participatory Learning
25.	Cyclin, CDKs, Check points,	CLO2, CLO3	1	Lecture PPT	Peer teaching	Participatory Learning

26.	Cell cycle inhibitors, DNA content, FACS,	CLO2, CLO3	1	Video / Observation	Group discussion	Experiential Learning
27.	Regulation of cell cycle-	CLO2, CLO3	1	Video / Observation	Student seminar	Experiential Learning
28.	factors and genes regulating cell cycle.	CLO2, CLO3	1	Lecture PPT	Student seminar	Participatory Learning
29.	Mitosis	CLO2, CLO3	1	Lecture PPT	Student seminar	Participatory Learning
30.	Meiosis	CLO2, CLO3	1	Seminar / PPT	Flipped classroom	Participatory Learning
31.	Cell signaling –	CLO2, CLO3	1	Video / Observation	Discussion	Experiential Learning
32.	types of cell signaling - G protein mediated	CLO2, CLO3	1	Lecture PPT	Quiz	Participatory Learning
33.	Tyrosine kinase mediated signaling	CLO2, CLO3	1	Video / Observation	Discussion	Experiential Learning
34.	Transposable elements- prokaryotes.	CLO2, CLO3	1	Lecture PPT	Pro/con grid	Experiential Learning
35.	Apoptosis- Mitochondrial pathway	CLO2, CLO3	1	Virtual lab, Chalk and talk/ Picture	Group reading and discussion	Problem-based Learning
Unit – IV Gene Regulation and Expression						
36.	Central Dogma of the cell	CLO4	1	Lecture	Design thinking	Problem-based Learning
37.	DNA-Structure, types	CLO4	1	Seminar / PPT	Word cloud/ Mind map / Think Write and Share	Participatory Learning
38.	DNA replication in prokaryotes	CLO4	1	PPT	Word cloud/ Mind map / Think Write and Share	Participatory Learning
39.	Transcription in Prokaryotes and Eukaryotes	CLO4	1	PPT	Review collection	Participatory Learning
40.	RNA Processing - Genetic code	CLO4	1	Demonstration	Discussion	Experiential Learning
41.	Translation	CLO4	1	Brainstorming	Flipped classroom, Discussion	Experiential Learning
42.	Similarities and differences in	CLO4	1	PPT	Word cloud/ Mind map /	Participatory Learning

	prokaryotic and eukaryotic translation				Think Write and Share	
43.	Similarities and differences in prokaryotic and eukaryotic translation	CLO4	1	PPT	Discussion	Experiential Learning
44.	Post Translational Modifications	CLO4	1	PPT	Case study	Problem-based Learning
45.	DNA damage and types of DNA damage and factors affecting	CLO4	1	PPT	Word cloud/ Mind map / Think Write and Share	Participatory Learning
46.	Mutation, types and DNA Repair mechanism-types	CLO4	1	Research article reading	Group reading and discussion	Experiential Learning
47.	Base Excision repair, SOS repair, NHEJ	CLO4	1	PPT	Review collection, Case study	Problem-based Learning
Unit –V Embryology						
48.	Gametogenesis -	CLO3, CLO4	1	Research article reading	Group reading and discussion	Experiential Learning
49.	Spermatogenesis	CLO3, CLO4	1	PPT	Word cloud/ Mind map / Think Write and Share	Participatory Learning
50.	Oogenesis in mammals	CLO3, CLO4	1	Video / Observation	Group discussion	Experiential Learning
51.	Fertilization	CLO3, CLO4	1	Video / Observation	Group discussion	Experiential Learning
52.	Types of cleavage	CLO3, CLO4	1	PPT, Socratic	Group reading and discussion	Experiential Learning
53.	Types of cleavage	CLO3, CLO4	1	PPT, Socratic	Case study	Problem-based Learning
54.	blastula formation	CLO3, CLO4	1	PPT	Word cloud/ Mind map / Think Write and Share	Participatory Learning
55.	embryonic fields	CLO3, CLO4	1	Lecture	Flipped classroom	Problem-based Learning

56.	Gastrulation and formation of germ layers in animals	CLO3, CLO4	1	Lecture	Group reading and discussion	Experiential Learning
57.	Gastrulation and formation of germ layers in animals	CLO3, CLO4	1	Lecture	Group reading and discussion	Experiential Learning
58.	Organogenesis.	CLO3, CLO4	1	Research article reading	Group reading and discussion	Problem-based Learning

Name of the course	BT24C01-Cell and Molecular Developmental Biology
Name of the Faculty	Dr. G. Archana
Participatory Learning	40 %
Experiential Learning	40 %
Problem-based Learning	20 %

COURSE CODE	TITLE OF THE COURSE	CATEGORY	L	T	P	CREDITS
BT24CP1	CORE PRACTICAL I - CELL AND MOLECULAR DEVELOPMENTAL BIOLOGY AND MICROBIOLOGY PRACTICAL	PRACTICALS	-	-	120	4

Objectives:

To facilitate the students to

- 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 the molecular techniques in separating the genetic material from the organism
- To identify the components of blood cells and summarizes the concept of gametes.

Course Learning 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 components of blood cells and determine the concept of gametes	K3

Mapping with Programme Learning Outcomes

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5
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

**BT24CP1 - CELL AND MOLECULAR DEVELOPMENTAL BIOLOGY AND
MICROBIOLOGY PRACTICAL**

CELL AND MOLECULAR DEVELOPMENTAL BIOLOGY

(60 hrs)

1. Use of simple compound microscope and Micrometry
2. Blood smear preparation and Identification of Blood cells
3. Plant cell sectioning (CS)- Dicot and monocot sections of stem and root
4. Preparations of onion peel and observations of cells
5. Osmosis and tonicity
6. Isolation of Genomic DNA
7. Quantification of DNA using UV Spectroscopy/ Nano Drop
8. Observation of sperm & Egg
9. Mounting of chick Embryo - 24 h, 48 h, 72 h, 96 h.

MICROBIOLOGY

(60 hrs)

1. Microbiological techniques–Sterilization techniques, Media preparation
2. Isolation and enumeration of microbes (bacteria & fungi) from soil.
3. Pure culture methods-pour plate, spread plate, streak plate method.
4. Identification of Bacteria: Staining methods–simple and Gram's staining.
5. Motility test: Hanging drop technique.
6. Biochemical Identification–IMViC–test.
7. Hydrolysis test -Starch and Casein.
8. Growth curve of bacteria
9. Anti-microbial sensitivity test–Disc diffusion test.
10. Fungal identification: Lactophenol cotton blue staining and KOH mounting (morphology)

TEXT BOOKS:

S.No	Authors	Title of the book	Publishers	Year & Edition
1.	A K Roy & M.M. Prasad	Laboratory Manual of Microbiology: Practical Manual Series: 05	New India Publishing Agency	2010
2.	Cappuccino	Microbiology: A Laboratory Manual	Pearson Education India	2014
3.	Chaitanya K. V.	Cell and Molecular Biology - A Lab Manual	PHI Learning	2013

REFERENCE BOOKS:

S.No	Authors	Title of the book	Publishers	Year & Edition
1.	Dr. H. Abdul Jaffer Ali	Microbiology Laboratory Manual	Vijay Nicole Imprints	2017
2.	R. Saravanan, D., Dhachinamoorthi, CH. M M. Prasada Rao	A Handbook of Practical Microbiology	LAP LAMBERT Academic Publishing.	2019 & 1 st Edition
3.	Cappuccino, J. G., & Welsh, C.	Current Protocols in Cell Biology	Wiley Publication.	2019 & 1 st Edition

Course Designer:

Dr. G. Anbarasi

Dr. G. Archana

COURSE CODE	TITLE OF THE COURSE	CATEGORY	L	T	P	CREDITS
BT24A01	ALLIED PAPER I- BIOCHEMISTRY	THEORY	73	2	-	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 Learning Outcome

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

CLO Number	CLO Statement	Knowledge Level
CLO1	Classify the biomolecules based on structure and function	K1
CLO2	Comprehend the basics of enzymes and their role in different metabolic processes.	K2
CLO3	Acquire knowledge about the Importance of lipids and their biosynthesis	K3
CLO4	Analyze the significance of metabolic pathways and their role in cellular function	K3

Mapping with Programme Learning Outcomes

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

S- Strong; M-Medium

BT24A01-BIOCHEMISTRY

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

(15 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, apo- and holo-enzymes. Co-factors, and prosthetic group, Isoenzymes. Enzyme inhibition-Reversible (competitive, uncompetitive, non-competitive) and irreversible inhibition. ***Mechanism based inhibitors**.

Unit III: Lipids

(15 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 saturated fatty acids**.

Unit IV: Vitamins & Proteins

(15 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

(14 hrs)

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

***Link Provided for the Highlighted Content Offerefd in Blended Mode**

S.No	Topics	Video Link
Unit I: Structure and Function of Carbohydrates		
1	Structure and Function of Carbohydrates-cellulose, dextrin, chondroitin sulphate	https://www.youtube.com/watch?v=8UyHLl0jc-A https://www.youtube.com/watch?v=Yd3-AR_hDgk
Unit II: Enzymes		
2	UNIT II- MM equation, LB plot, Mechanism based inhibitors	https://www.youtube.com/watch?v=y43pIHUtjeM https://www.youtube.com/watch?v=jJUoQMLMV2E
Unit III : Lipids		
3	Unit III- Lipids- triglycerides, Lipoproteins. β -oxidation of lipids, Biosynthesis of saturated fatty acids.	https://www.youtube.com/watch?v=BVxeeiR7JB0 https://www.youtube.com/watch?v=J6z77QGsyQc https://www.youtube.com/watch?v=vxDSl9XKB1A
Unit IV : Vitamins & Proteins		
4	Unit IV- importance of vitamins in life.Biological importance, classification, general properties.	https://www.youtube.com/watch?v=rhwk3-uuUis https://www.youtube.com/watch?v=OOXLym4XD0
Unit V : Metabolism of Biomolecules		
5	Unit V- Metabolism: Catabolism & Anabolism	https://www.youtube.com/watch?v=HrYRMknYHrk https://www.youtube.com/watch?v=wTrmGhCogRk https://www.youtube.com/watch?v=XwJ-mCp-TZ0 https://www.youtube.com/watch?v=Lf4irlyN1eE

TEXT BOOKS

S.No	Authors	Title of the book	Publishers	Year & Edition
1	Nelson,D.L.andCox, .M. Lehninger	Principles of Biochemistry	Macmillan Higher Education	2021& 8 th Edition
2	U. Satyanarayana, U.Chakrapani	Biochemistry,	Elsevier	2021& 6 th Edition
3	A.C. Deb	Fundamentals of Biochemistry	New central book agency	2001
4	Donald Voet, Charlotte W. Pratt, Judith G. Voet	Principles of Biochemistry	Wiley; International Student Version	2012 & 4 th Edition
5	Jain, J.L, Sunjay Jain and Nitin Jain	Biochemistry	Chand and Company, New Delhi	2010

REFERENCE BOOKS

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

Course Designer:

Dr. V. Bhuvaneshwari

Module No.	Topic	CLO level	No. of periods	Content delivery method	Student engagement	Participatory Learning / Experiential Learning / Problem based Learning
Unit I - Structure and Function of Carbohydrates						
1.	Carbohydrates: Definition	CLO1	1	Lecture – Chalk and Talk / Group reading	Word cloud/ Mind map / Think Write and Share	Participatory Learning
2.	Carbohydrates: Classifications	CLO1	1	Displays	Gallery walks, Post it parade	Experiential Learning
3.	Structure	CLO1 CLO2	1	OER	Debate, Quescussion, Pro-con grid	Problem-based Learning
4.	biological functions	CLO1 CLO2	1	Lecture – Chalk and Talk / Group reading	Word cloud/ Mind map / Think Write and Share	Participatory Learning
5.	Monosaccharides	CLO1 CLO2	1	Displays	Gallery walks, Post it parade	Experiential Learning
6.	Disaccharides	CLO1 CLO2	1	PPT / OER	Quiz (Quizalize/ Socrative)	Participatory Learning
7.	Oligosaccharides	CLO1 CLO2	1	Chalk and talk/ Picture	Debate, Quescussion, Pro-con grid	Problem-based Learning
8.	Polysaccharides	CLO1 CLO2	1	Lecture – Chalk and Talk / Group reading	Word cloud/ Mind map / Think Write and Share	Participatory Learning
9.	Starch	CLO1 CLO2	1	Spotters/ Chalk and talk	Flipped classroom, Poster	Experiential Learning
10.	Glycogen	CLO1 CLO2	1	PPT / OER	Gallery walks, Post it parade	Experiential Learning
11.	cellulose, dextrin,	CLO1 CLO2	1	Virtual lab	Presentation	Problem-based Learning

12.	hyaluronic acid	CLO1 CLO2	1	Lecture – Chalk and Talk / Group reading	Word cloud/ Mind map / Think Write and Share	Participatory Learning
13.	keratin sulphate,	CLO1 CLO2 CLO3	1	OER	Debate, Quescussion, Pro-con grid	Problem-based Learning
14.	Heparin	CLO1 CLO2 CLO3	1	PPT / OER	Gallery walks, Post it parade	Experiential Learning
15.	chondroitin sulphate).	CLO1 CLO2 CLO3	1	Video / Observation	Group discussion	Experiential Learning
Unit – II: Enzymes						
16.	Enzymes – properties,	CLO1 CLO2	1	PPT / OER	Quiz (Quizalize/ Socrative)	Participatory Learning
17.	classes of enzymes, enzyme reaction,	CLO1 CLO2	1	Lecture / Seminar	Diagrams, Sketchboard	Participatory Learning
18.	theories of enzyme reaction	CLO1 CLO2	1	PPT	Review collection, Case study	Problem-based Learning
19.	MM equation, LB plot,	CLO1 CLO2	1	Video / Observation	Group discussion	Experiential Learning
20.	factors affecting enzyme reaction,	CLO2 CLO3	1	PPT	Review collection, Case study	Problem-based Learning
21.	enzyme units, enzyme assay	CLO2 CLO3	1	Lecture / Seminar	Diagrams, Sketchboard	Participatory Learning
22.	Coenzyme	CLO2 CLO3 CLO4	1	PPT	Review collection, Case study	Problem-based Learning
23.	apo- and holo- enzymes.	CLO2 CLO3 CLO4	1	Lecture / Seminar	Diagrams, Sketchboard	Participatory Learning
24.	Cofactors, and prosthetic group,	CLO2 CLO3 CLO4	1	Spotters / Lecture	Post it parade	Experiential Learning
25.	Isoenzymes	CLO2 CLO3 CLO4	1	OER	Flipped classroom, Presentation	Participatory Learning
26.	Enzyme inhibition-	CLO2 CLO3 CLO4	1	Lecture / OER	Simulation	Experiential Learning
27.	(competitive, uncompetitive, non-competitive)	CLO2 CLO3 CLO4	1	Lecture / OER	Simulation	Experiential Learning
28.	and irreversible inhibition.	CLO2 CLO3	1	Lecture / OER	Simulation	Experiential Learning

		CLO4				
29.	Mechanism based inhibitors	CLO2 CLO3 CLO4	1	Lecture/ Virtual lab	Simulation	Experiential Learning
Unit – III: Lipids						
30.	Biological significance, nomenclature	CLO2 CLO3 CLO4	1	ORE / PPT	Flipped classroom, Assignment	Participatory Learning
31.	and classification. Simple lipids	CLO2 CLO3 CLO4	1	Lecture PPT	Peer teaching	Participatory Learning
32.	Fatty acids and their properties	CLO2 CLO3 CLO4	1	Video / Observation	Group discussion	Experiential Learning
33.	Triglycerides	CLO2 CLO3 CLO4	1	Video / Observation	Student seminar	Experiential Learning
34.	waxes.	CLO2 CLO3 CLO4	1	Lecture PPT	Student seminar	Participatory Learning
35.	steroids	CLO2 CLO3 CLO4	1	Lecture PPT	Student seminar	Participatory Learning
36.	prostaglandins.	CLO2 CLO3 CLO4	1	Seminar / PPT	Flipped classroom	Participatory Learning
37.	Compound lipids:	CLO2 CLO3	1	Demonstration	Discussion	Experiential Learning
38.	Phospholipids,	CLO2 CLO3	1	Lecture PPT	Quiz	Participatory Learning
39.	sphingolipids	CLO4 CLO5	1	Demonstration	Discussion	Experiential Learning
40.	Glycolipids	CLO2 CLO3 CLO4	1	Lecture PPT	Pro/con grid	Participatory Learning
41.	Lipoproteins.	CLO2 CLO3 CLO4	1	Video	Quesdiscussion	Participatory Learning
42.	β -oxidation of lipids,	CLO2 CLO3 CLO4	1	Video / Observation	Group discussion	Experiential Learning
43.	Biosynthesis of saturated fatty acids	CLO2 CLO3 CLO4	1	Video / Observation	Group discussion	Experiential Learning
44.	Biosynthesis of saturated fatty acids	CLO2 CLO3 CLO4	1	Video / Observation	Group discussion	Experiential Learning
Unit – IV: Vitamins & Proteins						
45.	Vitamins –	CLO2 CLO3	1	Lecture	Design thinking	Problem-based Learning

		CLO4				
46.	water soluble	CLO2 CLO3 CLO4	1	Research article reading	Group reading and discussion	Problem-based Learning
47.	fat soluble	CLO2 CLO3 CLO4	1	Research article reading	Group reading and discussion	Problem-based Learning
48.	importance of vitamins in life.	CLO2 CLO3 CLO4	1	Video / Observation	Group discussion	Experiential Learning
49.	Amino acids:	CLO2 CLO3 CLO4	1	Interaction on topics and Assignment	Review collection	Participatory Learning
50.	structure, classification,	CLO2 CLO3 CLO4	1	PPT	Review collection	Participatory Learning
51.	physical and chemical properties	CLO2 CLO3 CLO4	1	Demonstration	Discussion	Experiential Learning
52.	physical and chemical properties	CLO2 CLO3 CLO4	1	Brainstorming	Flipped classroom, Discussion	Participatory Learning
53.	Proteins: Biological importance,	CLO2 CLO3 CLO4	1	PPTFlipped Classroom	Review collection, Case study	Problem-based Learning
54.	classification,	CLO2 CLO3 CLO4	1	PPT	Case study	Problem-based Learning
55.	general properties.	CLO2 CLO3 CLO4	1	Video / Observation	Group discussion	Experiential Learning
56.	Primary structure-Human Insulin,	CLO2 CLO3 CLO4	1	Research article reading	Group reading and discussion	Experiential Learning
57.	Secondary structure - keratin	CLO2 CLO3 CLO4	1	PPT	Review collection	Participatory Learning
58.	tertiary structure-myoglobin	CLO2 CLO3 CLO4	1	Research article reading	Group reading and discussion	Experiential Learning
59.	quaternary structure-Hemoglobin	CLO2 CLO3 CLO4	1	PPT	Review collection, Case study	Problem-based Learning
Unit –V Metabolism of Biomolecules						
60.	Metabolism:	CLO3 CLO4	1	Research article reading	Group reading and discussion	Experiential Learning

61.	Catabolism	CLO3 CLO4	1	PPT	Review collection	Participatory Learning
62.	Anabolism.	CLO3 CLO4	1	Video / Observation	Group discussion	Experiential Learning
63.	Anabolism.	CLO3 CLO4	1	Video / Observation	Group discussion	Experiential Learning
64.	Energy metabolic pathways	CLO3 CLO4	1	Video / Observation	Group discussion	Participatory Learning
65.	Energy metabolic pathways	CLO3 CLO4	1	PPT, Socratic	Case study	Problem-based Learning
66.	Glycolysis	CLO3 CLO4	1	PPT	Review collection	Participatory Learning
67.	Glycolysis	CLO3 CLO4	1	PPT	Case study	Problem-based Learning
68.	Kreb's cycle,	CLO3 CLO4	1	Video / Observation	Group discussion	Experiential Learning
69.	Oxidative phosphorylation	CLO3 CLO4	1	PPT	Review collection	Participatory Learning
70.	Oxidative phosphorylation	CLO3 CLO4	1	Video / Observation	Group discussion	Experiential Learning
71.	Substrate level phosphorylation,	CLO3 CLO4	1	PPT	Review collection	Participatory Learning
72.	Gluconeogenesis	CLO3 CLO4	1	PPT	Review collection	Participatory Learning
73.	pentose phosphate pathway	CLO3 CLO4	1	Research article reading	Group reading and discussion	Participatory Learning

Name of the course	BT24A01-BIOCHEMISTRY
Name of the Faculty	Dr Rachana Sharma
Participatory Learning	40 %
Experiential Learning	40 %
Problem-based Learning	20 %

COURSE CODE	TITLE OF THE COURSE	CATEGORY	L	T	P	CREDITS
BT24AP1	ALLIED PRACTICAL I- BIOCHEMISTRY AND BIOINSTRUMENTATION PRACTICAL	PRACTICALS	-	-	90	2

Objectives:

- To facilitate the students to evaluate the methods of biomolecules estimations, separation techniques and 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 Learning Outcomes

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

CLO	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 Learning Outcomes

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5
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

BT24AP1- BIOCHEMISTRY AND BIOINSTRUMENTATION PRACTICAL

BIOCHEMISTRY

(45 hrs)

1. Preparation and standardization of solutions
2. Qualitative Analysis of Carbohydrates – Glucose, Fructose, Sucrose, Starch
3. Qualitative Analysis of Amino acid – Glycine, Tyrosine, Cysteine, Tryptophan, Proline, glutamic acid
4. Estimation of proteins-Lowry's method
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 - Acid Number

BIOINSTRUMENTATION

45 hrs)

1. Laboratory rules and regulations –Safety principles and Handling
2. pH measurement of samples using pH meter
3. Preparation of buffer-Phosphate Buffer
4. Centrifugation-Separation of organelles using Centrifugation
5. Paper Chromatography- Separation of plant pigments
6. Spectrophotometric method -Estimation of chlorophyll content
7. Thin Layer Chromatography for separation of amino acids
8. Analysis of Phytochemicals using HPLC (demo)

TEXT BOOKS:

S.No	Authors	Title of the book	Publishers	Year & Edition
1.	Geethalakshmi, Sundararama, Anitha Arumugam	Lab in Cell Biology, Microbiology and Bioinstrumentation: Laboratory Manual	Amazon Asia-Pacific Holdings Private Limited	2017
2.	Deepak Shrivastava	Practical Handbook of Biochemistry: Lab Manual	Notion Press	2020
3.	Sadasivam, S. and Manickam, A.	Biochemical methods	New Age International Publishers.	2018 & 3 rd Edition
4.	Veerakumari. L	Bioinstrumentation	MJP Publishers, New Delhi, India	2009

REFERENCE BOOKS:

S.No	Authors	Title of the book	Publishers	Year & Edition
1.	N.A. Khan & K.N.Singh	Laboratory Manual of Biochemistry	Daya Publishing House	2014
2.	Abhijit Paintal, Chinmoy Goswami, Rabindra Narain	Handbook of Bioinstrumentation	Dominant Publishers & Distributors	2011
3.	Pingoud, A and Urbanke, C.	Biochemical Methods: A Concise Guide for Students and Researchers	Wiley-VCH.	2010 & 1 st Edition

Course Designers:

Dr. R. Nirmal Kumar

Dr. V. Bhuvaneshwari



DEPARTMENT OF BIOTECHNOLOGY
CHOICE BASED CREDIT SYSTEM (CBCS) & LEARNING OUTCOME BASED
CURRICULAR FRAMEWORK (LOCF)
BACHELOR OF SCIENCE (B.Sc.) BIOTECHNOLOGY – 2024-2027 BATCH
SYLLABUS & SCHEME OF EXAMINATION

SEM	Part	Course Code	Title of the Course	Course Type	Instruction hours/week	Contact hours	Tutorial Hours	Duration of Examination	Examination Marks			Credits
									CA	ESE	TOTAL	
II	I	TAM2302/ HIN2302/ FRE2302	Tamil Paper II Hindi Paper II French Paper II	L	6	88	2	3	25	75	100	3
	II	ENG2302	English paper II	E	5	73	2	3	25	75	100	3
	III	BT24C02	Microbiology	CC	5	73	2	3	25	75	100	4
		BT24CP1	Cell and Molecular Developmental Biology and Microbiology Practical	CC	4	60	-	5	25	75	100	4
	III	BT24A02/ CE24A02/ PS24A02	Bioinstrumentation/ Chemistry for Biologists -II/ Physics Paper-II	GE	5	73	2	3	20	55	75 [€]	4
		BT24AP1/ CE23AP1/ PS23AP1	Biochemistry and Bioinstrumentation Practical / Chemistry Practical for Biologists / Physics Practical	GE	3	45	-	4/3/3	15	35	50 [§]	2
	IV	NM24UHR	Universal Human Values and Human Rights	AECC	2	30	-	-	100	-	100	2
		NME23B2/ NME23A2*	Basic Tamil II / Advanced Tamil II	AEC	-	-	-	-	100	-	100	Gr.
I-II	VI	NM23GAW	General Awareness	AEC	SS	-	-	-	100	-	100	Gr.
I-V	VI	COM15SER	Community Services 30 Hours	GC	-	-	-	-	-	-	-	-
I-V	VI	24BONL1 24BONL2 24BONL3	Online Course 1 Online Course 2 Online Course 3	ACC	-	-	-	-	-	-	-	-

L : Language

E : English

AEC : Ability Enhancing Course

Gr. : Grade

€ : CA conducted for 25 and converted into 20, ESE conducted for 75 and converted into 55

§ : CA conducted for 25 and converted into 15, ESE conducted for 75 and converted into 35

***After class hours**

CC : Core Courses

AECC : Ability Enhancement Compulsory Courses

GC : General Courses

CA – Continuous Assessment

GE : Generic Elective

ACC : Additional Credit Courses

ESE - End Semester Examination

QUESTION PAPER PATTERN

CA Pattern

Section A	–	$3 \times 2 = 6$
Section B	–	$3 \times 5 = 15$ (either or – same CLO Level)
Section C	–	$3 \times 8 = 24$ (either or – same CLO Level)
Total		45 marks

ESE Pattern

Section A	-	$5 \times 2 = 10$
Section B	-	$5 \times 5 = 25$ (either or – same CLO Level)
Section C	-	$5 \times 8 = 40$ (either or – same CLO Level)
Total		75 marks

Internal component for Theory

CIA Test	-	5	Conducted for 45 marks after 50 days
Model Exam	-	7	Conducted for 75 marks
			(Q.P. Pattern (2,5,8) Each Unit 15 Marks)
Seminar/Assignment/Quiz	-	5	
Class Participation	-	5	
Attendance	-	3	

25 + ESE 75 Marks = 100 Marks

From the academic year 2024-25 and onwards marks allotted for attendance component in CA is modified as

91-100% attendance: 3 Marks

81-90% attendance: 2 Marks

75-80% attendance: 1 Mark

CA Question Paper Pattern: 1 x 45=45 Marks (Each unit carries 15 marks)

One question from each unit with each question comprising of

- One questions with a weightage of 2 marks (no choice)
- One questions with a weightage of 5 marks (Internal Choice at the same CLO level)
- One question with weightage of 8marks (Internal Choice at the same CLO level)

Model Question Paper Pattern: 1 x 75 =75 Marks (Each unit carries 15 marks)

- One question with a weightage of 2 marks (no choice)
- One question with a weightage of 5 marks (Internal Choice at the same CLO level)
- One question with weightage of 8 marks (Internal Choice at the same CLO level)

Internal component for Practicals (for 25 Marks)

Lab Performance	-	7 marks
Regularity	-	5 marks
Model Exam	-	10 marks
Attendance	-	3 marks
Total	-	25 marks

ESE Practicals Pattern

The End Semester Examination will be conducted for a maximum of 75 marks with a maximum 15 marks for the record and other submissions if any.

Evaluation pattern for Part IV: Universal Human Values and Human Rights

Quiz	: 50 marks
Assignment	: 25 marks
Project/ Case study	: 25 marks
Total	: 100 marks

COURSE CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
BT24C02	MICROBIOLOGY	CORE THEORY	73	2	-	4

Learning Objectives:

To facilitate the students

- To study the structure and function of microbial cells
- To enumerate different types of microbes
- To analyze the physiology of microbes
- To evaluate microbial growth
- To evaluate the use of microbes in different industries

Course Learning Outcomes

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

CLO Number	CLO Statement	Knowledge Level
CLO 1	Acquire knowledge about the discovery of microbes and techniques utilized for their discovery	K1
CLO 2	Understand and gain knowledge about different types of Microorganism and their nutritive requirements for their growth	K2
CLO 3	Comprehend the ideology to culture and enumerate the microorganisms and its association with nature	K3
CLO 4	Inculcate knowledge on Industrial microbiology for digital transformation	K4

Mapping with Programme Learning Outcomes

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5
CLO 1	S	M	S	S	M
CLO 2	S	M	L	M	M
CLO 3	M	L	M	L	M
CLO 4	S	M	L	M	M

S- Strong; M-Medium; L-Low

BT24C02- MICROBIOLOGY

Unit I: Introduction to Microscopy

(14 hrs)

Historical developments in microbiology History of Rishi Charak and microorganisms. **Definition and scope of microbiology, Microscopy: Light Microscope: Simple; Compound Microscopes–Dark field, light field, phase contrast, Fluorescent Microscopes**, Electron microscope and Confocal Microscope.

Unit II: Media and Culture Techniques

(14 hrs)

Microbiological Media: Types, preparation, methods of sterilization; enumeration of microorganisms in soil, water and air; isolation of microorganisms from environment; **pure culture techniques, maintenance and Preservation; Staining: stains and types of staining–Lactophenol Cotton Blue Staining, Calcoflour staining Staining, Leishmann Staining, Gram staining, Capsule staining.**

Unit III: Microbial nutrition, growth and control

(15 hrs)

Structure of bacterial cell, Growth and reproduction of bacteria. Nutrients, nutritional types of microorganisms, Autotrophic microbes, Chemotrophic microbes, Photosynthetic microbes, aerobic microbes, anaerobic microbes, **Bacterial Growth, Measurement –Direct and Indirect. Bacterial growth- bacterial growth curve asynchronous growth, synchronous growth, limitation of microbial growth, Fermentative microbes.**

Unit IV: Biology and Economic importance of Microbes

(15 hrs)

Biology and economic importance of **Soil borne bacteria- *Rhizobium*sp, *Azospirillum*. Algae:*Spirulina*, *Cyanobacteria* Food borne- *Staphylococcus aureus*, *Clostridium* sp, *Escherichia coli*, *Pseudomonas* sp. Fungal Species: *Aspergillus* sp, *Candida* sp, *Fusarium* sp, *Pleurotus* sp. Plant viruses: NPV. Mammalian viruses: SARS-CoV-2 virus (COVID-19). Ayurvedic view of the cause of diseases.**

Unit V: Industrial Microbiology

(15 hrs)

Introduction to microbes-based enzyme production; **Enzymes used in detergents, textile and leather industries.** Production of amylase and protease. **Impact on Society, Business, Government and People - Introduction to 5.0.** Development of microbial sensors for environmental monitoring and biomedical applications. Microalgae based technologies for waste water treatment.

*** Link Provided for the Highlighted Content Offered in Blended Mode**

S.No	Topics	Video Link
Unit I: Introduction to Microscopy		
1	Definition and scope of microbiology, Microscopy: Light Microscope: Simple, Compound Microscopes–Dark field, light field, phase contrast, Fluorescent Microscopes.	https://www.youtube.com/watch?v=GgTlAtsW1KM https://www.youtube.com/watch?v=b2PCJ5s-iyk
Unit II: Media and Culture Techniques		
2	Techniques of pure culture, maintenance and Preservation, Staining: stains and types of staining.	https://www.youtube.com/watch?v=1tOVnZ438Fk https://www.youtube.com/watch?v=AZS2wb7pMo4
Unit III: Microbial nutrition, growth, and control		
3	Bacterial Growth, Measurement – Direct and Indirect. Bacterial growth-bacterial growth curve asynchronous growth, synchronous growth, limitation of microbial growth. Fermentative microbes.	https://www.youtube.com/watch?v=xfYoz-PEIwk https://www.youtube.com/watch?v=hWubgAZBRmY
Unit IV: Biology and Economic Importance of Microbes		
4	Food borne- <i>Staphylococcus aureus</i> , <i>Salmonella</i> sp. <i>Clostridium</i> sp, <i>Escherichia coli</i> , <i>Bacillus subtilis</i> , <i>Pseudomonas</i> sp. Fungal Species: <i>Aspergillus</i> sp, <i>Agaricus</i> sp, <i>Candida</i> sp, <i>Fusarium</i> sp, <i>ycoplasma</i> sp Baculovirus; Viruses: TMV. Mammalian viruses: retroviruses, SARS-CoV-2 virus (COVID-19). Protozoa	https://www.youtube.com/watch?v=-iIDNskrf-k https://www.youtube.com/watch?v=iHSSF7I--OA https://www.youtube.com/watch?v=RPn7YVNQKag https://www.youtube.com/watch?v=7aWm4kYLpwU https://www.youtube.com/watch?v=R05wRflewJ8 https://www.pearson.com/channels/biology/asset/d4686bee/viral-replication-of-the-sars-cov-2-virus-nanobiology-course-2020-monday-group
Unit V: Industrial Microbiology		
5	Enzymes used in detergents, textile and leather industries. Impact on Society, Business, Government and People-Introduction to 5.0.	https://www.youtube.com/watch?v=M76joBn16rk https://www.youtube.com/watch?v=eGrK5vRKKWU

TEXT BOOKS

S.No.	Authors	Title of the book	Publishers	Year & Edition
1.	Michael J. Pelczar.Jr, E.C.S Chan, Noel R.Krieg	Pelczar Microbiology	McGraw Hill	2020, 7th Edition
2.	Madigan Michael T. Martinko John M. Bender Kelly S.Buckley Daniel H. Stahl DavidA.	Brock's Biology of Microorganisms	Pearson	2017, 14th Edition
3.	Joanne Willey and Kathleen Sandman and Dorothy Wood	Prescott's Microbiology,	McGraw Hill	2020, 11 th Edition
4.	Simon Baker, Jane Nicklin, Caroline Griffiths	BIOS Instant Notes in Microbiology	Taylor & Francis	2011, 7th Edition
5.	P. Kaliraj and T. Devi. Higher Education for Industry 4.0 and Transformation to Education 5.0			

REFERENCE BOOKS

S.No	Authors	Title of the book	Publishers	Year & Edition
1.	M.T.Madigan,J.M.Martinko ,J.Parker.	Brock's Biology of Microorganisms	Prentice Hall	2019, 15 th Edition
2.	Moat Albert. G, Foster. John.W, Speetor, Michel P	Microbial Physiology	Wiley Liss Publishers.	2011, 4 th Edition
3.	Das,H.K.	TextBook of Biotechnology	Wiley Dreamtech India Pvt. Ltd	2017, 5 th Edition

Course Designer:

Dr. P.Suganya

Dr. G. Archana

Module No.	Topic	CLO level	No. of hours	Content delivery method	Learning Methods
Unit – I-Introduction to Microscopy					
1.	Historical developments in microbiology	CLO1, CLO2	2	Lecture – Chalk and Talk / Group reading.	Participatory Learning, Experiential Learning
2.	Important Microbial Products invented	CLO1, CLO2, CLO3	1	Chalk and talk/ Picture	Participatory Learning
3.	Definition and scope of microbiology	CLO2, CLO3	2	Chalk and talk/ Picture	Participatory Learning, Experiential Learning
4.	Introduction to Microscopy	CLO2, CLO3, CLO4	1	Virtual lab	Problem-based Learning, Participatory Learning
5.	Light Microscope	CLO3, CLO4	1	Virtual lab, Demonstration	Problem-based Learning
6.	Compound Microscopes- Dark field	CLO3, CLO4	1	Virtual lab	Experiential Learning
7.	light field, phase contrast	CLO3, CLO4	2	Demonstration	Experiential Learning
8.	Fluorescent Microscopes,	CLO3, CLO4	2	Field observations and observation of renewable organic material	Problem-based Learning, Participatory Learning
9.	Electron microscope	CLO2, CLO3, CLO4	1	Demonstration	Experiential Learning
10.	Confocal Microscope.	CLO3	1	Practical session demonstration	Experiential Learning
Unit – II-Media and Culture Techniques					
11.	Microbiological Media: Introduction.	CLO1, CLO2	1	Demonstration	Experiential Learning

12.	Microbiological Media-Types	CLO1, CLO2, CLO3	1	PPT / OER	Participatory Learning
13.	Preparation of media and methods of sterilization	CLO1, CLO2, CLO3	1	Chalk and talk/ Picture	Participatory Learning
14.	Enumeration of microorganisms in soil	CLO2, CLO3	1	Chalk and talk/ Picture	Participatory Learning
15.	water	CLO2, CLO4	1	Demonstration	Experiential Learning
16.	air	CLO2, CLO3, CLO4	1	Virtual lab	Problem-based Learning
17.	Isolation of microorganisms from environment	CLO2, CLO3	1	OER/PPT	Experiential Learning
18.	pure culture techniques, maintenance and Preservation	CLO3, CLO4	2	Virtual lab, Demonstration	Problem-based Learning, Experiential Learning
19.	Staining: stains and types of staining	CLO3, CLO4	1	Lecture	Participatory Learning
20.	Lactophenol Cotton Blue Staining.	CLO3, CLO4	2	Demonstration	Participatory Learning
21.	Calcoflour staining Staining, Gram staining	CLO2, CLO3, CLO4	1	Demonstration	Experiential Learning
22.	Leishmann Staining, Capsule Staining	CLO3	1	Demonstration	Experiential Learning
Unit – III-Microbial nutrition, growth and control					
23.	Structure of bacterial cell- Introduction	CLO1, CLO2	1	Lecture – Chalk and Talk / Group reading	Participatory Learning
24.	Growth and reproduction of bacteria.	CLO1, CLO2, CLO3	2	PPT / OER	Experiential Learning
25.	Nutrients, nutritional types of microorganisms	CLO2, CLO3	2	Video Lecture and Discussion https://www.youtube.com/watch?v=3A9w_PUGd8Q	Participatory Learning, Problem-based Learning

26.	Autotrophic microbes	CLO2, CLO3, CLO4	1	Book/ Article review	Experiential Learning
27.	Chemotrophic microbes	CLO2, CLO3	1	OER	Problem-based Learning
28.	Photosynthetic microbes	CLO3, CLO4	1	Lecture – Chalk and Talk / Group reading	Problem-based Learning
29.	Aerobic microbes	CLO3, CLO4	1	PPT	Experiential Learning
30.	Anaerobic microbes	CLO3, CLO4	1	Lecture	Participatory Learning
31.	Bacterial Growth	CLO3, CLO4	1	Peer teaching	Participatory Learning
32.	Measurement – Direct and Indirect	CLO4	1	Lecture	Experiential Learning
33.	Bacterial growth-bacterial growth curve asynchronous growth	CLO2, CLO3, CLO4	1	Peer teaching	Participatory Learning
34.	synchronous growth	CLO2, CLO3, CLO4	1	Peer teaching	Participatory Learning
35.	Limitation of microbial growth, Fermentative microbes.	CLO2, CLO3, CLO4	1	Peer teaching	Participatory Learning
Unit – IV-Biology and Economic importance of Microbes					
36.	Biology of Soil borne bacteria	CLO1, CLO2	1	Lecture – Chalk and Talk / Group reading	Participatory Learning
37.	Economic importance of Soil borne bacteria	CLO1, CLO2, CLO3	1	Flipped classroom /PPT / OER	Experiential Learning
38.	Soil borne bacteria- <i>Rhizobium</i> sp	CLO1, CLO2, CLO3	1	Chalk and talk/ Picture	Participatory Learning
39.	<i>Azospirillum</i>	CLO2, CLO3	1	Video Lecture and Discussion https://www.youtube.com/watch?v=VnxVFgWK64U	Experiential Learning

40.	Biology of Algae	CLO2, CLO4	1	Lecture – Chalk and Talk / Group reading	Experiential Learning
41.	Economic importance of Algae	CLO2, CLO3, CLO4	1	Virtual lab	Problem-based Learning
42.	<i>Spirulina and Cyanobacteria</i>	CLO2, CLO3	1	Student seminar	Participatory Learning
43.	Biology and Economic Importance of Food borne- <i>Staphylococcus aureus</i>	CLO3, CLO4	1	One-minute presentation	Participatory Learning
44.	<i>Clostridium sp, Escherichia coli, Pseudomonas sp</i>	CLO1, CLO3	1	Virtual lab	Experiential Learning
45.	Fungal Species: <i>Aspergillus sp, Candida sp</i>	CLO3, CLO4	1	Lecture	Experiential Learning
46.	<i>Fusariumsp, Pleurotussp</i>	CLO3, CLO4	1	Field observations	Problem-based Learning
47.	Plant viruses: NPV	CLO4	2	Lecture	Participatory Learning, Problem-based Learning
48.	Mammalian viruses: SARS-CoV-2 virus (COVID-19).	CLO3, CLO4	1	Simulation	Experiential Learning
49.	Ayurvedic view of the cause of diseases	CLO2, CLO3	1	Demonstration	Experiential Learning
Unit – V-Industrial Microbiology					
50.	Introduction to microbes-based enzyme production	CLO1, CLO2	2	Lecture – Chalk and Talk / Group reading	Participatory Learning
51.	Enzymes used in detergents	CLO1, CLO2, CLO3	2	Chalk and talk/ Picture	Participatory Learning
52.	Textiles	CLO2, CLO4	1	Demonstration	Experiential Learning

53.	leather industries	CLO2, CLO3, CLO4	1	Demonstration	Experiential Learning
54.	Production of amylase	CLO2, CLO3	1	Flipped Class room	Experiential Learning
55.	protease.	CLO3, CLO4	1	Virtual lab, Demonstration	Problem-based Learning
56.	Impact on Society, Business, Government and People - Introduction to 5.0.	CLO3, CLO4	2	Virtual lab	Experiential Learning, Participatory Learning
57.	Development of microbial sensors for environmental monitoring	CLO3, CLO4	3	Field observations and observation of renewable organic material	Problem-based Learning, Participatory Learning
58.	biomedical applications	CLO2, CLO3, CLO4	1	Book/ Article review	Experiential Learning
59.	Microalgae based technologies for waste water treatment.	CLO2, CLO3	1	Lecture	Problem-based Learning

Name of the course	BT23C02-Microbiology
Name of the Faculty	Dr. P.Suganya
Participatory Learning	40 %
Experiential Learning	40 %
Problem-based Learning	20 %

COURSE CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
BT24A02	BIOINSTRUMENTATION	ALLIED THEORY	73	2	-	4

Learning Objectives:

To facilitate the students to

- To understand the basics of bioinstrumentation
- To explore the working principles of bioanalytical instruments
- To learn applications of bioinstrumentation in biotechnology
- To understand safety protocols in instrumentation use
- To gain knowledge of modern bioinstrumentation trends

Course Learning Outcomes

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

CLO Number	CLO Statement	Knowledge Level
CLO1	Discuss the principle and methodology of various instruments and their process	K1
CLO2	Understand the applications in various fields of bioscience	K2
CLO3	Demonstrate knowledge and practical skills using instruments in biology and medical field	K3
CLO4	Analyze and interpret the techniques and results involved in research	K4

Mapping with Programme Learning Outcomes

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	S	S	M	M	M
CLO2	M	M	M	L	S
CLO3	S	M	M	M	S
CLO4	M	M	S	S	S

S- Strong; M-Medium; L-Low

BT24A02- BIOINSTRUMENTATION

Unit I: Laboratory techniques

(14 hrs)

Biosafety in laboratories: - General safety measures, Chemical and Biological hazards. Theory, Principle, **Working and Applications of - pH meter**, Weighing balance Centrifuge- Preparative, Analytical and Ultra, Laminar Air Flow, Autoclave, Hot Air Oven and Incubator. Buffers for biological experiments.

Unit II: Chromatography Techniques

(15 hrs)

Theory, Principle, Apparatus, Methods and Applications of Paper Chromatography, TLC, **HPTLC**, Gel Filtration Chromatography, **Ion Exchange Chromatography**, Affinity Chromatography, Gas Chromatography and HPLC.

Unit III: Electrophoretic techniques

(14hrs)

Theory, Principle, Apparatus, Methods and Applications of Paper Electrophoresis, Agarose Gel electrophoresis, PAGE-Native and SDS. Blotting- Principles, types, Steps involved **Southern**, **Western** and Northern Blotting.

Unit IV: Colorimetric analysis and Spectroscopy

(15 hrs)

Colorimetric Analysis: Lambert's law, Beer's law, **basic principles and working of Colorimeter**. Principle, working, instrumentation and applications of UV/Vis spectroscopy, **IR spectroscopy**, Atomic Absorption Spectroscopy, NMR spectroscopy and Mass spectroscopy.

Unit V: Radio-isotopic Techniques Image analysis

(15 hrs)

Introduction, basic principles, types, **procedure and applications of Geiger Muller Counter**; Scintillation counting - solid, liquid, gas; Gamma counter and Image analysis; MRI Scan.

*** Link Provided for the Highlighted Content Offered in Blended Mode**

S.No.	Topics	Video Link
Unit I: Laboratory techniques		
1	Biosafety in laboratories	https://www.youtube.com/watch?v=Wyn4WpxS90
	Working and Applications of - pH meter	https://www.youtube.com/watch?v=zJTQLce-WC8
Unit II: Chromatography Techniques		
2	HPTLC	https://www.youtube.com/watch?v=KO16ndWHcpk
	Ion Exchange Chromatography	https://www.youtube.com/watch?v=wFpLgDceBhk
Unit III: Electrophoretic techniques		
3	Western blotting	https://www.youtube.com/watch?v=Ll_7z4YS2Ak
	Southern blotting	https://www.youtube.com/watch?v=qsy5t0y7Zl4
Unit IV: Colorimetric analysis and Spectroscopy		
4	Basic principles and working of Colorimeter	https://www.youtube.com/watch?v=2MW-qc1ABss
	IR spectroscopy	https://www.youtube.com/watch?v=WTmj_9VT5oE
Unit V: Radio-isotopic Techniques Image analysis		
5	Procedure and applications of Geiger Muller Counter	https://www.youtube.com/watch?v=TnvAQ9ZHDyE https://www.youtube.com/watch?v=ieEeFKrFBIg

TEXT BOOKS:

S.No	Authors	Title of the book	Publishers	Year & Edition
1.	MJ Reilly	Bioinstrumentation	CBS Publishers & Distributors	2018, 1 st Edition
2.	Dr. Priyanka Pandey	Text Book on Bioinstrumentation	Walnut Publication	2023, 1 st Edition
4	Rana, S.V.S	Bio Techniques. Theory and Practices	Rastogi Publications, Meerut	2012, 3rd Edition

REFERENCE BOOKS:

S.No	Authors	Title of the book	Publishers	Year & Edition
1.	RS Khandpur Sabari	Handbook Of Analytical Instruments	McGraw Hill	2015, 3 rd Edition
2.	Dinesh Kumar Chatanta, Prahlad Singh Mehra	Instrumental Methods of Analysis in Biotechnology	I K International Publishing House Pvt. Ltd; First Edition	2012, 1 st Edition
3.	Nelu Grinberg and Sonia Rodriguez	Ewings Analytical Instrumentation Handbook	CRC Press	2019, 4 th Edition

Course Designer:**Dr. RK Selvakesavan****Dr. G. Shalini**

Module No.	Topic	CLO level	No. of hours	Content delivery method	Learning Methods
Unit – I- Laboratory techniques					
1	Biosafety in laboratories	CLO1	1	Lecture	Participatory Learning
2	General safety measures	CLO1	1	PPT	Participatory Learning
3	Chemical hazards	CLO1	1	Lecture	Participatory Learning
4	Biological hazards	CLO1	1	PPT	Experiential Learning
5	Theory and Principle, of - pH meter	CLO1	1	PPT	Participatory Learning
6	Working and Applications of - pH meter	CLO1	1	Virtual lab	Problem-based Learning
7	Weighing balance	CLO1	1	PPT	Participatory Learning
8	Centrifuge- Preparative and Analytical	CLO1	1	Lecture and PPT	Experiential Learning
9	Centrifuge- Ultra	CLO1	1	PPT	Participatory Learning
10	Laminar Air Flow	CLO1	1	Lecture	Experiential Learning
11	Autoclave	CLO1	1	PPT and discussion	Experiential Learning
12	Hot Air Oven	CLO1	1	PPT	Problem-based Learning
13	Incubator	CLO1	1	Lecture	Experiential Learning
14	Buffers for biological experiments.	CLO1	1	Lecture	Experiential Learning
Unit – II- Chromatography Techniques					
15	Theory and Principle of Paper Chromatography		1	Discussion	Problem-based Learning
16	Apparatus and Methods of Paper Chromatography	CLO2	1	PPT	Problem-based Learning
17	Applications of Paper Chromatography	CLO2	1	Lecture and PPT	Participatory Learning

18	Theory and Principle of TLC	CLO2	1	Lecture and PPT	Participatory Learning
19	Apparatus, Methods and Applications of TLC	CLO2	1	PPT	Experiential Learning
20	Theory and Principle of HPTLC	CLO2	1	Virtual lab	Experiential Learning
21	Apparatus, Methods and Applications of HPTLC	CLO2	1	PPT and Discussion	Experiential Learning
22	Theory and Principle of Gel Filtration Chromatography	CLO2	1	Lecture	Participatory Learning
23	Apparatus, Methods and Applications of Gel Filtration Chromatography	CLO2	1	Discussion	Problem-based Learning
24	Theory and Principle of Ion Exchange Chromatography	CLO2	1	Virtual lab	Participatory Learning
25	Apparatus, Methods and Applications of Ion Exchange Chromatography	CLO2	1	Lecture and Discussion	Experiential Learning
26	Affinity Chromatography	CLO2	1	Virtual lab	Problem-based Learning
27	Gas Chromatography	CLO2	1	Lecture and PPT	Participatory Learning
28	Theory and Principle of HPLC	CLO2	1	Discussion	Experiential Learning
29	Apparatus, Methods and Applications of HPLC	CLO2	1	Lecture	Participatory Learning
Unit – III- Electrophoretic techniques					
30	Theory and Principle of Paper Electrophoresis	CLO2	1	Demonstration	Experiential Learning
31	Apparatus, Methods and Applications of Paper Electrophoresis	CLO3	1	Lecture	Problem-based Learning
32	Theory and Principle of Agarose Gel electrophoresis	CLO3	1	Lecture	Participatory Learning
33	Apparatus and Methods of Agarose Gel electrophoresis	CLO3	1	Discussion	Participatory Learning
34	Applications of Agarose Gel electrophoresis	CLO3	1	PPT	Experiential Learning
35	PAGE-Native	CLO3	1	Demonstration	Experiential Learning

36	PAGE-SDS	CLO3	1	PPT	Participatory Learning
37	Blotting	CLO3	1	Lecture	Experiential Learning
38	Principles and types of Southern Blotting	CLO3	1	Seminar	Participatory Learning
39	Steps involved Southern Blotting	CLO3	1	Lecture and PPT	Experiential Learning
40	Principles and types of Western Blotting	CLO3	1	PPT	Experiential Learning
41	Steps involved Western Blotting	CLO3	1	Review collection	Problem-based Learning
42	Principles and types of Northern Blotting	CLO3	1	Research article reading	Experiential Learning
43	Steps involved in Northern Blotting	CLO3	1	PPT	Problem-based Learning
Unit – IV- Colorimetric analysis and Spectroscopy					
44	Colorimetric Analysis	CLO3	1	PPT, Socratic	Participatory Learning
45	Lambert's law	CLO3	1	PPT	Experiential Learning
46	Beer's law	CLO4	1	Lecture	Participatory Learning
47	Basic principles of Colorimeter.	CLO4	1	Lecture	Problem-based Learning
48	Working of Colorimeter.	CLO4	1	Discussion	Participatory Learning
49	Principle and working of UV/Vis spectroscopy	CLO4	1	Research article reading	Experiential Learning
50	Instrumentation and applications of UV/Vis spectroscopy	CLO4	1	Brainstorming	Participatory Learning
51	Principle and working of IR spectroscopy	CLO4	1	Observation	Experiential Learning
52	Instrumentation and applications of IR spectroscopy	CLO4	1	Talk and Chalk	Participatory Learning
53	Principle and working of Atomic Absorption Spectroscopy	CLO4	1	PPT	Experiential Learning
54	Instrumentation and applications of Atomic Absorption Spectroscopy	CLO4	1	OER	Participatory Learning
55	Principle and working of NMR spectroscopy	CLO4	1	PPT	Problem-based Learning

56	Instrumentation and applications of NMR spectroscopy	CLO4	1	Research article reading	Experiential Learning
57	Principle and working of Mass spectroscopy	CLO4	1	Lecture	Participatory Learning
58	Instrumentation and applications of Mass spectroscopy	CLO4	1	OER	Problem-based Learning
Unit –V- Radio-isotopic Techniques and Image analysis					
59	Introduction of Geiger Muller Counter	CLO4	1	PPT	Problem-based Learning
60	Basic principles and types of Geiger Muller Counter	CLO4	1	Lecture	Participatory Learning
61	Procedure and applications of Geiger Muller Counter	CLO4	1	OER	Experiential Learning
62	Introduction, basic principles and types of Scintillation counting - solid	CLO4	1	Seminar	Participatory Learning
63	Procedure and applications of Scintillation counting - solid	CLO4	1	Lecture	Experiential Learning
64	Introduction, basic principles and types of Scintillation counting - liquid	CLO4	1	OER	Experiential Learning
65	Procedure and applications of Scintillation counting - liquid	CLO4	1	Virtual lab	Experiential Learning
66	Introduction, basic principles and types of Scintillation counting - gas	CLO4	1	Virtual lab	Experiential Learning
67	Procedure and applications of Scintillation counting - gas	CLO4	1	PPT	Participatory Learning
68	Introduction, basic principles and types of Gamma counter	CLO4	1	Lecture	Participatory Learning
69	Procedure and applications of Gamma counter	CLO4	1	PPT	Experiential Learning

70	Introduction, basic principles and types of Image analysis	CLO4	1	Discussion	Participatory Learning
71	Procedure and applications of Image analysis	CLO4	1	Research article reading	Problem-based Learning
72	Introduction, basic principles and types of MRI Scan	CLO4	1	Discussion	Participatory Learning
73	Procedure and applications of MRI Scan	CLO4	1	PPT	Problem-based Learning

Name of the course	BT24A02-BIOINSTRUMENTATION
Name of the Faculty	Dr. RK Selvakesavan
Participatory Learning	40 %
Experiential Learning	40 %
Problem-based Learning	20 %

COURSE CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
BT24CP1	CELL AND MOLECULAR DEVELOPMENTAL BIOLOGY AND MICROBIOLOGY PRACTICAL	PRACTICALS	-	-	120	4

Learning Objectives

To facilitate the students

- 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 the molecular techniques in separating the genetic material from the organism.
- To identify the components of blood cells and summarize the concept of gametes.

Course Learning 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 components of blood cells and determine the concept of gametes	K3

Mapping with Programme Learning Outcomes

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

S- Strong; M-Medium; L-Low

**BT24CP1 - CELL AND MOLECULAR DEVELOPMENTAL BIOLOGY AND
MICROBIOLOGY PRACTICAL**

CELL AND MOLECULAR DEVELOPMENTAL BIOLOGY

(60 hrs)

1. Use of simple compound microscope and Micrometry
2. Blood smear preparation and Identification of Blood cells
3. Plant cell sectioning (CS)- Dicot and monocot sections of stem and root
4. Preparations of onion peel and observations of cells
5. Osmosis and tonicity
6. Isolation of Genomic DNA
7. Quantification of DNA using UV Spectroscopy/ Nano Drop
8. Observation of sperm & Egg
9. Mounting of chick Embryo - 24 h, 48 h, 72 h, 96 h.

MICROBIOLOGY

(60 hrs)

1. Microbiological techniques–Sterilization techniques, Media preparation
2. Isolation and enumeration of microbes (bacteria & fungi) from soil.
3. Pure culture methods-pour plate, spread plate, streak plate method.
4. Identification of Bacteria: Staining methods–simple and Gram's staining.
5. Motility test: Hanging drop technique.
6. Biochemical Identification–IMViC–test.
7. Hydrolysis test -Starch and Casein.
8. Growth curve of bacteria
9. Anti-microbial sensitivity test–Disc diffusion test.
10. Fungal identification: Lactophenol cotton blue staining and KOH mounting (morphology)

TEXT BOOKS:

S.No	Authors	Title of the book	Publishers	Year & Edition
1.	A K Roy & M.M.Pras ad	Laboratory Manual of Microbiology: Practical ManualSeries: 05	New India PublishingAgency	2010, 1 st edition
2.	Cappuccino	Microbiology: A Laboratory Manual	Pearson Education India	2014, 3 rd Edition
3.	Chaitanya K. V.	Cell and Molecular Biology - A LabManual	PHI Learning	2013, 3 rd Edition

REFERENCE BOOKS:

S.No	Authors	Title of the book	Publishers	Year & Edition
1.	Dr.H.AbdulJaffer Ali	Microbiology Laboratory Manual	Vijay Nicole Imprints	2017, 1 st Edition
2.	R. Saravanan , D., Dhachinamoorthi ,CH. M M. PrasadaRao	A Handbook of Practical Microbiology	Lap Lambert Academic Publishing .	2019& 1 st Edition
3.	Cappuccino, J. G.,& Welsh, C.	Current Protocols in CellBiology	Wiley Publicatio n.	2019&1 st Edition

Course Designer:**Dr.G.Archana****Dr.P Suganya**

COURSE CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
BT24AP1	BIOCHEMISTRY AND BIOINSTRUMENTATION PRACTICAL	PRACTICALS	-	-	90	2

Learning Objectives

- To enable the students to learn to make standard solutions
- To evaluate the methods of biomolecule estimations and biochemical analysis
- To gain knowledge in usage of separation techniques
- To facilitate the students to apply the knowledge of understanding volumetric, colorimetric and spectrophotometric analysis

Course Learning 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 Learning 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; L-Low

BT24AP1- BIOCHEMISTRY AND BIOINSTRUMENTATION PRACTICAL

BIOCHEMISTRY

(45 hrs)

1. Preparation and standardization of solutions
2. Qualitative Analysis of Carbohydrates – Glucose, Fructose, Sucrose, Starch
3. Qualitative Analysis of Amino acid – Glycine, Tyrosine, Cysteine, Tryptophan, Proline, glutamic acid
4. Estimation of proteins-Lowry's method
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 - Acid Number

BIOINSTRUMENTATION

(45 hrs)

1. Laboratory rules and regulations –Safety principles and Handling
2. pH measurement of samples using pH meter
3. Preparation of buffer-Phosphate Buffer
4. Centrifugation-Separation of organelles using Centrifugation
5. Paper Chromatography- Separation of plant pigments
6. Spectrophotometric method -Estimation of chlorophyll content
7. Thin Layer Chromatography for separation of amino acids
8. Analysis of Phytochemicals using HPLC (demo)

TEXT BOOKS:

S.No	Authors	Title of the book	Publishers	Year & Edition
1.	Geethalakshmi Sundararama , Anitha Arumugam	Lab in Cell Biology, Microbiology and Bioinstrumentation: Laboratory Manual	Amazon Asia-Pacific Holdings Private Limited	2017, 1 st Edition
2.	Deepak Shrivastava	Practical Handbook of Biochemistry: Lab Manual	Notion Press	2020, 2 nd Edition
3.	Sadasivam, S. and Manickam, A.	Biochemical methods	New Age International Publishers.	2018 & 3rd Edition
4.	Veerakumari. L	Bioinstrumentation	MJP Publishers, New Delhi, India	2009, 1 st Edition

REFERENCE BOOKS:

S.No	Authors	Title of the book	Publishers	Year & Edition
1.	N.A. Khan & K.N.Singh	Laboratory Manual of Biochemistry	Daya Publishing House	2014, 1 st Edition
2.	Abhijit Paintal, Chinmoy Goswami, Rabindra Narain	Handbook of Bioinstrumentation	Dominant Publishers & Distributors	2011, 1 st Edition
3.	Pingoud, A and Urbanke, C.	Biochemical Methods: A Concise Guide for Students and Researchers	Wiley-VCH.	2010, 1 st Edition

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



BACHELOR OF SCIENCE IN BIOTECHNOLOGY
CHOICE BASED CREDIT SYSTEM (CBCS) &
LEARNING OUTCOME BASED CURRICULAR FRAMEWORK (LOCF)
SYLLABUS & SCHEME OF EXAMINATION
BACHELOR OF SCIENCE IN BIOTECHNOLOGY- 2024-2027 BATCH

Semester	Part	Course Code	Title of the course	Course Type	Instruction hours/ Week	Contact hours	Tutorial hours	Duration of Examination	Examination Marks			Credits
									CA	ESE	Total	
III	I	TAM2303/ HIN2303/ FRE2303	Tamil Paper III/ Hindi Paper III/ French Paper III	L	6	88	2	3	25	75	100	3
	II	ENG2403	English Paper-III	E	5	73	2	3	25	75	100	3
	III	BT24C03	Immunology	CC	4	58	2	3	25	75	100	4
	III	BT24CP2	Immunology Practical	CC	4	60	-	5	15*	35*	50	2
	III	TH24A22/	Statistics for Biotechnology/	GE	4	58	2	3	25	75	100	4
		BT24A03	Basics of Computer application	GE	4	58	2	3	20	55	75	3
	III	TH23AP1/ BT23AP2	Statistics for Biotechnology Practical/	GE	2	30	-	-	-	-	-	-
			Basics of Computer Application Practical	GE	2	30	-	3	15*	35*	50	2
	III	BT24SB01	Basics of Bioinformatics	SEC	3	43	2	-	100	-	100	3
III	IV	NM23DTG	Design Thinking	AEC	2	30	-	-	100	-	100	2
I-III	VI	COM15SER	Community Services 30 hrs	GC	-	-	-	-	-	-	-	-
I-V	VI	24BONL 1 24BONL 2 24BONL 3	Online course I Online course II Online course III	ACC	-	-	-	-	-	-	-	-

L- Language; E- English; CC- Core Courses ; AEC -Ability Enhancement Course; GE-Generic Elective, GC -General Courses; SEC: Skill Based Course; ACC: Additional Credit Courses, CA -Continuous Assessment, ESE - End Semester Examination

***For Practical CA conducted for 25 and converted into 15. ESE conducted for 75 and converted into 35 by COE.**

COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CREDITS
BT24C03	IMMUNOLOGY	THEORY	58	2	-	4

Preamble

- To understand the basic concepts of immunological processes and immune system functions.
- To gain in-depth knowledge of antigens, antibodies, immune cells, and their roles in immune regulation
- To comprehend the genetic basis for immunological diversity and analyze the principles behind immunodeficiency disorders
- To apply the concept of antigen–antibody reactions in various immunodiagnostic and therapeutic techniques.

Course Learning Outcomes

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

CLO Number	CLO Statement	Knowledge Level
CLO1	Understand the basic concepts of immunological processes	K1
CLO2	Interpret the genetic basis for immunological diversity and the generation of adaptive immune responses	K2
CLO3	Acquire the ideology of antigen –antibody reactions in various immune techniques and its potential therapeutic applications	K3
CLO4	Analyze the principle behind the Immunodeficiency disorders and screen the suitable drug utilizing advanced molecular techniques	K4

Mapping with Programme Learning Outcomes

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	M	S	M	M	M
CLO2	S	M	S	S	S
CLO3	S	S	S	S	M
CLO4	M	M	S	M	S

S- Strong; M-Medium

Unit I: Basics of Immunology and Immune System

(12 hrs)

Introduction- Historical Development in Immunology. ***Biological aspects of Immunology**, Self and non-self-recognition, specificity, memory of the immune system. Cells of the immune system- lymphocytes, mononuclear phagocytes- dendritic cells, granulocytes, NK cells and mast cells, cytokines. Primary and Secondary lymphoid organs – Thymus, Bone marrow, Lymph nodes and Spleen. ***Hematopoiesis: Development, maturation, activation, regulation, differentiation**, and classification of T-cells and B-cells.

Unit II: Immune Response Mechanisms

(11 hrs)

Immunity: Types: Active and passive immunity. ***Cell-mediated immunity**, humoral immunity, immune response, primary and secondary response. Phagocytosis, mechanism of phagocytosis. Interferon: Types of Interferons. ***Complement system: Nature, components of complement**. Pathways: Classical and alternative pathways.

Unit III: Antigens and Antibodies

(12 hrs)

Antigens: Essential features of Ag, haptens, Carrier molecule, Immunological valence, Antigenic determinants. Antibodies: Nature, ***Primary structure of immunoglobulins**, light chain, heavy chain, variable region, constant region, Hinge region; Domain structure of Ig and significance; ***Classification of Immunoglobulins**: Types –IgG (G1, G2, G3 & G4), IgM, IgA, IgD and IgE (Origin, structural functions).

Unit IV: Immune Tolerance and Hypersensitivity

(11 hrs)

Immune tolerance, Immunodeficiencies; Immunosuppression, Transplantation – ***Immunological basis of transplantation reactions, laws of transplantation**. Allergy and hypersensitivity – Types of hypersensitivity. Immune response to infectious diseases, Immunodeficiency diseases – SCID, ***AIDS**.

Unit V: Applied Immunology

(12 hrs)

Monoclonal Antibodies - Hybridoma Technology vs. Polyclonal. Classification of Vaccines - Attenuated, sub-unit vaccine -***COVID vaccines**, DNA and RNA vaccines and anti-idiotypic vaccines. Immunodiagnostic methods-Immunodiffusion, agglutination, precipitation, ***complement fixation**, Immunofluorescence, Immunoblotting. ***ELISA-Principle, Methodology and applications**. Immunotherapy- Check point inhibitors.

TEXT BOOKS

S.No	Authors	Title of the book	Publishers	Year & Edition
1.	Jenni Punt, Sharon Stranford, Patricia Jones and Judith A Owen	Immunology	WH Freeman	2018 & 8 th Edn.
2.	Peter J. Delves, Seamus J Martin, Dennis R Burton and Ivan Roitt, M	Roitt's Essential Immunology	Wiley Blackwell	2017 & 13 th Edn.
3.	Peter lydyard, Alex Whelan and Michael Fanger	Instant notes in Immunology	Taylor & Francis	2011 & 3 rd Edn.

REFERENCE BOOKS

S.No	Authors	Title of the book	Publishers	Year & Edition
1.	Kenneth M. Murphy, Paul Travers and Mark Walport	Janeway Immunologic	Springer Spektrum	2014 & 9 th Edn.
2.	Brown, TA.	Genomes 3	Garland Science Publishing, New York	2007 & 3 th Edn.
3.	Dunham, I	Genome Mapping and sequencing	Horizon Scientific.	2003 & 1 st Edn.

Course designers:

Dr. R. Nirmal Kumar

Dr. G. Anbarasi

***Link Provided for the Highlighted Content Offered in Blended Mode**

S.No	Topics	Video Link
Unit I: Basics of Immunology and Immune System		
1	Biological aspects of Immunology, Hematopoiesis: Development, maturation, activation, regulation, differentiation	https://www.youtube.com/watch?v=_jBpv9fYSU4&t=35s https://www.youtube.com/watch?v=XVWOIKdpF_I
Unit II: Immune Response Mechanisms		
2	Cell-mediated immunity, Complement system: Nature, components of complement	https://www.youtube.com/watch?v=2vh24StylNo https://www.youtube.com/watch?v=d6qFPegEYV0
Unit III: Antigens and Antibodies		
3	Primary structure of immunoglobulins, Classification of Immunoglobulins	https://www.youtube.com/watch?v=vxWf-66lymg https://www.youtube.com/watch?v=EcuY1uXgvqU
Unit IV: Immune Tolerance and Hypersensitivity		
4	Immunological basis of transplantation reactions, laws of transplantation, AIDS	https://www.youtube.com/watch?v=_MccnQRaIdQ https://www.youtube.com/watch?v=GWWBIBS9hwM https://www.youtube.com/watch?v=bjdqw9rXXd8
Unit V: Applied Immunology		
5	COVID vaccines, ELISA- Principle, Methodology and applications	https://www.youtube.com/watch?v=bjdqw9rXXd8 https://www.youtube.com/watch?v=bjdqw9rXXd8

Module No.	Topic	CLO level	No. of periods	Content delivery method	Learning methods
Unit I: Basics of Immunology and Immune System					
1.	Introduction- Historical Development in Immunology.	CLO1	1	PPT / OER	Participatory Learning
2.	Biological aspects of Immunology,	CLO1	1	Lecture	Experiential Learning
3.	Self and non-self-recognition,	CLO1	1	Lecture – Chalk and Talk / Group reading	Participatory Learning
4.	specificity, memory of the immune system.	CLO1	1	OER	Problem-based Learning
5.	Cells of the immune system- lymphocytes, mononuclear phagocytes-	CLO1	1	Spotters/ Chalk and talk	Experiential Learning
6.	dendritic cells, granulocytes,	CLO1	1	Virtual lab	Experiential Learning
7.	NK cells and mast cells, cytokines.	CLO1	1	Lecture	Participatory Learning
8.	Primary and Secondary lymphoid organs – Thymus, Bone marrow,	CLO1	1	Lecture/ Virtual lab	Experiential Learning
9.	Lymph nodes and Spleen.	CLO1	1	Spotters/ Chalk and talk	Experiential Learning
10.	Hematopoiesis: Development, maturation,	CLO1	1	Lecture and video	Participatory Learning
11.	activation, regulation, differentiation, and	CLO1	1	Chalk and talk/ Picture	Problem-based Learning
12.	classification of T-cells and B-cells.	CLO1	1	Lecture / OER	Experiential Learning
Unit II: Components of Immune Cells					
13	Immunity: Types: Active and passive immunity.	CLO1	1	Pathogen observation and video	Experiential Learning
14	Cell-mediated immunity,	CLO1	1	OER and video	Problem-based Learning
15	humoral immunity,	CLO1	1	PPT and video	Problem-based Learning
16	immune response, primary and secondary response.	CLO2	1	PPT and video	Problem-based Learning
17	Phagocytosis,	CLO2	1	PPT and video	Problem-based Learning

18	mechanism of phagocytosis.	CLO2	1	ORE / PPT	Participatory Learning
19	Interferon: Types of Interferons.	CLO2	1	Lecture / Seminar	Participatory Learning
20	Complement system:	CLO2	1	Lecture / OER	Experiential Learning
21	Nature, components of complement.	CLO2	1	Lecture and video	Experiential Learning
22	Pathways: Classical and	CLO2	1	Research article reading	Problem-based Learning
23	alternative pathways.	CLO2	1	OER	Problem-based Learning
Unit III: Cellular and Humoral Immunity					
24	Antigens: Essential features of Ag,	CLO2	1	Lecture PPT and Video	Participatory Learning
25	haptens, Carrier molecule,	CLO2	1	Lecture and Video	Participatory Learning
26	Immunological valence, Antigenic determinants.	CLO2	1	Demonstration and Video	Experiential Learning
27	Antibodies: Nature,	CLO2	1	Virtual lab and Video	Problem-based Learning
28	Primary structure of immunoglobulins,	CLO2	1	Lecture PPT	Participatory Learning
29	light chain, heavy chain, variable region, constant region, Hinge region;	CLO2	1	Lecture PPT	Participatory Learning
30	Domain structure of Ig and significance;	CLO3	1	Seminar / PPT	Participatory Learning
31	Classification of Immunoglobulins:	CLO3	1	Video /Observation	Participatory Learning
32	Types –IgG (G1, G2, G3 & G4),	CLO1	1	Video / Observation	Experiential Learning
33	IgM,	CLO3	1	PPT Flipped Classroom	Problem-based Learning
34	IgA, IgD and	CLO3	1	Video / Observation	Experiential Learning
35	IgE (Origin, structural functions).	CLO3	1	Video / Observation	Experiential Learning
Unit IV: Immune Tolerance and Hypersensitivity					
36	Immune tolerance,	CLO4	1	PPT Flipped Classroom	Problem-based Learning
37	Immunodeficiencies;	CLO4	1	Research article reading	Experiential Learning
38	Immunosuppression,	CLO4	1	Research article reading	Experiential Learning
39	Transplantation –	CLO4	1	PPT and video	Problem-based Learning

40	Immunological basis of transplantation reactions,	CLO4	1	PPT and video	Problem-based Learning
41	laws of transplantation.	CLO4	1	PPT, Socratic	Problem-based Learning
42	Allergy and hypersensitivity –	CLO4	1	Brainstorming	Participatory Learning
43	Types of hypersensitivity.	CLO4	1	PPT, Socratic	Problem-based Learning
44	Immune response to infectious diseases,	CLO4	1	PPT	Problem-based Learning
45	Immunodeficiency diseases – SCID,	CLO4	1	Socratic	Problem-based Learning
46	AIDS.	CLO4	1	Video /Observation	Participatory Learning
Unit V: Applied Immunology					
47	Monoclonal Antibodies -	CLO3 CLO4	1	Research article reading	Problem-based Learning
48	Hybridoma Technology vs. Polyclonal.	CLO3 CLO4	1	Discussion	Participatory Learning
49	Classification of Vaccines -	CLO3 CLO4	1	Research article reading and video	Problem-based Learning
50	Attenuated, sub-unit vaccine - COVID vaccines,	CLO3 CLO4	1	Research article reading and video	Experiential Learning
51	DNA and RNA vaccines and anti-idiotypic vaccines.	CLO3 CLO4	1	Research article reading and video	Experiential Learning
52	Immunodiagnostic methods- Immunodiffusion,	CLO3 CLO4	1	PPT, Socratic	Problem-based Learning
53	agglutination, precipitation,	CLO3 CLO4	1	PPT	Problem-based Learning
54	complement fixation, Immunofluorescence,	CLO3 CLO4	1	Demonstration and video	Participatory Learning
55	Immunoblotting.	CLO3 CLO4	1	Interaction on topics and Assignment	Participatory Learning
57	ELISA-Principle, Methodology and applications.	CLO3 CLO4	1	PPT	Problem-based Learning
58	Immunotherapy- Check point inhibitors	CLO3 CLO4	1	Lecture and video	Problem-based Learning

Name of the Course	BT24C03 - Immunology
Name of the Faculty	Dr. P. Suganya
Participatory Learning	29.3%
Experiential Learning	29.3%
Problem-based Learning	41.4%

COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CREDITS
BT24CP2	IMMUNOLOGY PRACTICAL	PRACTICAL	-	-	60	2

Preamble

- To learn basic techniques used to detect and analyze blood components, antigens, and antibodies.
- To understand how antigens and antibodies interact in lab tests.
- To practice diagnostic tests for detecting infections and immune disorders.
- To collect and analyze blood samples for grouping, cell counts, and serum/plasma separation.

Course Learning Outcomes

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

CLO Number	CLO Statement	Knowledge Level
CLO1	Perform fundamental immunological and hematological techniques in the laboratory	K1
CLO2	Demonstrate the principles of antigen-antibody interactions through diagnostic and analytical techniques	K2
CLO3	Analyze, interpret, and report experimental data from immunological and haematological tests.	K2
CLO4	Correlate laboratory findings with clinical conditions and immune system functions	K4

Mapping with Programme Learning Outcomes

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	S	S	S	S	S
CLO2	S	M	S	M	M
CLO3	S	S	M	S	S
CLO4	S	M	S	S	M

S- Strong; M-Medium

BT24CP2 - IMMUNOLOGY PRACTICAL (60 hrs)

1. Separation of Serum and plasma from Blood
2. Identification of WBC counting, RBC counting and differential blood count
3. Identification of blood group and Rh typing
4. Testing for typhoid antigens by Widal test
5. Testing for Anti streptolysin – O
6. Single Radial Immunodiffusion
7. Immunodiffusion – Ouchterlony Double Diffusion
8. Immuno-electrophoresis – Rocket immuno-electrophoresis
9. Enzyme Linked Immuno Sorbent Assay (ELISA) (Demo)

TEXT BOOKS

S.No	Authors	Title of the book	Publishers	Year& Edition
1.	Talwar G P, Gupta S K	A Handbook of Practical and Clinical Immunology	CBS Publishers & Distributors Pvt. Ltd.	2017 & 2 nd Edn.
2.	Frank C Hay, Olwyn M R.	Practical Immunology	Wiley- Blackwell	2008 & 4 th Edn.

REFERENCE BOOKS

S.No	Authors	Title of the book	Publishers	Year& Edition
1.	David Male, Jonathan Brost, David Roth, Ivan Roitt	Immunology	Elsevier	2012 & 8 th Edn.
2.	Dr. Yogesh Kumar	A Handbook of Immunology and Immunological Techniques	I I P Iterative International Publishers	2024 & 1 st Edn.

Course Designers:

Dr. G. Anbarasi

Dr. V. Bhuvaneshwari

COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CREDITS
BT24A03	BASICS OF COMPUTER APPLICATION	THEORY	58	2	-	3

Preamble

- To develop their skills, the necessary for office automation industry-oriented applications
- To develop the basic skills required to write network ports.

Course Learning Outcomes

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

CLO	CLO Statement	Knowledge Level
CLO1	Understand basics of computer hardware, software and internet tools	K1
CLO2	Apply the basic skills for computer and Internet.	K2
CLO3	Demonstrate the knowledge on computer skills and create personal, academic and business documents and databases	K3
CLO4	Apply their knowledge MS office and Internet of things in creating research related applications	K4

Mapping with Programme Learning Outcomes

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	S	S	S	M	S
CLO2	S	S	S	M	S
CLO3	S	S	M	M	M
CLO4	S	S	M	M	M

S- Strong; M-Medium

BT24A03 - BASICS OF COMPUTER APPLICATION (58 hrs)

Unit I: Basics of Computers

(12 hrs)

Definition of a Computer - Characteristics of computers, Applications of Computers. Block Diagram of a Digital Computer. Input devices and Output devices. Devices, hardware, software human ware, application software, system software, Memories - Primary, Auxiliary and Cache Memory. MS Windows – Desktop, Recycle bin, My Computer, Documents, Pictures, Music, Videos, Task Bar, Control Panel

Unit II: MS Word

(12 hrs)

Microsoft Word – Components of MS Word - Creating, Editing, Formatting and Printing of word. Documents, Insert Headers and Footers, Draw Tables, Table Auto format. Page layout. Margins, Orientation, Page Borders and Shading. Inserting Bookmark, Shapes, Word Art, Page Numbers, Mail Merge.

Unit III: MS-Excel

(11 hrs)

Overview of Excel features – Create new worksheet, Selecting cells, Entering and editing Text, Numbers, Inserting Rows/Columns –Changing column widths and row heights, Insert formulas- Statistical mathematical and basic Formulae, Insert graphs, graph types and Interpreting the Data. Change font size, Colouring and shading the texts.

Unit IV: PowerPoint

(11 hrs)

PowerPoint: Basic of power point, creating and editing slides, formatting slides, Master slides, Templates, coloring text and objects, Transitions, heading slides, using clip art gallery, chart creations, managing files.

Unit V: Internet of Things and Development of India in IOT

(12 hrs)

Internet of Things: Introduction, Definition & characteristics of IOT, IOT in everyday life, Internet of everything. IOT Applications: Intelligent Traffic systems, Smart Parking, Smart cities and location sharing, Smart Agriculture, IOT in education. Development of India in IOT: Solar Plant System, ATM chip card system, IOT in health care industry, IOT in rural empowerment. Challenges in IOT: Big Data Management, Connectivity challenges. Cloud Computing- Amazon Web Services and Google Cloud Platform.

TEXT BOOKS

S.No	Authors	Title of the book	Publishers	Year & Edition
1.	N. Krishnan	Computer fundamentals and windows with internet technology	SCITECH Publications	2001 & 1 st Edn.

REFERENCE BOOKS

S.No	Authors	Title of the book	Publishers	Year & Edition
1.	Srinivasa K.G., Siddesh G.M., Hanumantha Raju R	Internet of Things	Cengage Learning India Pvt. Ltd	2018 & 1 st Edn.
2.	R.K. Taxali	Pc Software For Windows 98 Made Simple	McGraw-Hill Education (India) Pvt Limited	2002 & 1 st Edn.

Course Designers:

Dr. R. Nirmal Kumar

COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CREDITS
BT24AP2	BASICS OF COMPUTER APPLICATION PRACTICAL	PRACTICALS		-	30	2

Preamble

- To apply the knowledge of Computer skills and the role of MS- WORD
- To get a clear idea about the process of MS-POWER POINT and its importance
- To understand about MS-EXCEL and the preparation of worksheet

Course Learning Outcomes

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

CLO	CLO Statement	Knowledge Level
CLO1	Understand the basics of Microsoft office and its various applications	K1
CLO2	Comprehend the power point usage in creating presentations for seminar	K2
CLO3	Apply the knowledge of MS excel in drawing graphs and interpreting the data	K2
CLO4	Analyze the usage of MS access in creating databases	K4

Mapping with Programme Learning Outcomes

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

S- Strong; M-Medium

BT24AP2 - BASICS OF COMPUTER APPLICATION PRACTICAL (30 hrs)

1. MS word- New page, font size, spacing, Paragraph writing and spacing
2. MS word- Underline, Tabulation, insert picture
3. MS powerpoint-Prepare presentations, slide design, tabulation, inserting clip arts, animations
4. MS power point –seminar presentation
5. MS excel-make charts, edit x-axis, y –axis, change graph style, insert data and interpret
6. MS excel-Perform basic mathematical and statistical tools-add, subtract, mean, average, Standard deviation
7. MS Access- Sort on name, place, pincode-create students data base
8. MS Access- Data base making with S.No, date,pincode, prod-id and prod-name
9. MS Access- Create employee database

TEXT BOOKS

S.No	Authors	Title of the book	Publishers	Year& Edition
1.	N. Krishnan	Computer fundamentals and windows with internet technology	SCITECH Publications	2001 & 1 st Edn.

REFERENCE BOOKS

S.No	Authors	Title of the book	Publishers	Year & Edition
1.	Srinivasa K.G., Siddesh G.M., HanumanthaRaju R	Internet of Things	Cengage Learning India pvt. Ltd	2018 & 1 st Edn.
2.	R.K. Taxali	Pc Software For Windows 98 Made Simple	McGraw-Hill Education (India) Pvt Limited	2002 & 1 st Edn.

Course Designer:

Dr. R. Nirmal Kumar

COURSE NUMBER	COURSE TITLE	CATEGORY	L	T	P	CREDITS
BT24SB01	Basics of Bioinformatics	THEORY	43	2	-	3

Preamble

- To familiarize students how to use bioinformatics tools to analyze biological data
- To develop the skills, they need to analyse protein structures
- To screen large datasets of compounds for potential drug candidates and ADME studies

Course Learning Outcomes

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

CLO	CLO statement	Knowledge Level
CLO1	Understand the principle and application of various search tools/ methods to store and retrieve data.	K1
CLO2	Acquire the concepts and application of Sequence alignment and Phylogenetic analysis.	K2
CLO3	Apply various analysis methods for structure prediction, validation and drug-receptor interactions and waste cleanup	K3
CLO4	Analyze nucleotide sequences for various organisms.	K4

Mapping with Programme Learning Outcomes

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

* S-Strong, M-Medium

BT24SB01-BASICS OF BIOINFORMATICS (43 hrs)

Unit I- Biological Databases

(8 hrs)

Introduction to bioinformatics, National Center for Biotechnology Information (NCBI)- Tools and Databases of NCBI, Nucleotide Database, Protein Database, ***Gene Expression Database**. EMBL Nucleotide Sequence Database (EMBL-Bank)- Introduction, Sequence Retrieval, ***Sequence Submission to EMBL**, Sequence analysis tools. DNA Data Bank of Japan (DDBJ): Introduction, Resources at DDBJ, Data Submission at DDBJ. Swiss-Prot- Introduction and Salient Features.

Unit II- Sequence alignment and Phylogenetic analysis

(8 hrs)

Introduction to Sequence analysis (Proteins and Nucleic acids) – FASTA formatting, ***Sequence alignment methods- Pairwise alignment (Local and Global) – BLAST, Multiple alignment – CLUSTAL W**. Phylogenetic Basics- Molecular evolution and Phylogeny, Terminology, forms of tree representation. ***Phylogenetic tree construction methods and programs-** Distance-Based methods, Character-Based methods.

Unit III- Nucleotide sequence analysis

(8 hrs)

Analyze nucleotide sequences – detecting ORFs, finding genes, constructing restriction maps, designing primers and probes. Plant genomic databases-Ensembl Plants and TAIR, Animal genomic databases - ***Mouse Genome Informatics** and FlyAtlas. Specialized Genome databases- SGD, TIGR, and ACeDB.

Unit VI- Structural Bioinformatics

(8 hrs)

Protein structure basics, structure databases- PDB, CATH, SCOP, and PDBsum. Methods for protein structure prediction- Secondary structure predictions - Chou-Fasman and Garnier-Osguthorpe- Robson (GOR) method, Tertiary structure predictions – Homology Modelling and threading. ***Modelled Structure visualization and validation**.

Unit V- Artificial Intelligence mediated Computer aided drug discovery

(11 hrs)

***AI mediated Computer aided drug design** - Introduction to docking, types, protein and ligand preparation, virtual screening, ADMET prediction- SWISS ADME, docking- Auto dock, drug-receptor interaction-Pymol & Rasmol.

TEXT BOOKS

S.No	Name of the Authors	Title of the Book	Publishers	Year & Edition
1.	R. Amjesh, S.S. Vinodchandra	Bioinformatics for beginners	LAP Lambert Academic Publishing	2019 & 1 st Edn.
2.	Arthur M. Lesk	Introduction to Bioinformatics	Oxford University Press;	2019 & 5 th Edn.
3.	S. C. Rastogi, N. Mendiratta and P. Rastogi	Bioinformatics: Methods And Applications: Genomics, Proteomics and Drug Discovery	Phi Learning	2022 & 5 th Revised Edn.
4.	Pevsner J.	Bioinformatics and Functional Genomics	Wiley-Blackwell	2009 & 3 rd Edn.

REFERENCE BOOKS

S.No	Name of the Authors	Title of the Book	Publishers	Year & Edition
1	Campbell A. M., Heyer L. J.	Discovering Genomics, Proteomics and Bioinformatics.	Benjamin Cummings.	2006 & 2 nd Edn.
2	Mount, D.W.	Bioinformatics Sequence and genome analysis	CBS Publishers. New Delhi	2005 & 2 nd Edn.

Course Designers:

Dr. G. Shalini

***Link Provided for the Highlighted Content Offered in Blended Mode**

S.No.	Topics	Links
Unit I- Biological Databases		
1	Gene expression database	https://youtu.be/A3IStwOr4N0
2	Sequence Submission to EMBL	https://youtu.be/9hFuuSGIeeg?feature=shared
Unit II- Sequence alignment and Phylogenetic analysis		
3	Sequence alignment methods- Pairwise alignment (Local and Global) – BLAST	https://www.youtube.com/watch?v=WRKQGwh_Mw0&t=625s
4	Multiple sequence alignment (CLUSTALW).	https://www.youtube.com/watch?v=dSsyohu9F1c
5	Phylogenetic tree construction methods and programs	https://www.youtube.com/watch?v=y5GgkBXmYDk
Unit III - Nucleotide sequence analysis		
6	Mouse Genome Informatics	https://youtu.be/9hFuuSGIeeg?feature=shared
Unit IV- Structural Bioinformatics		
7	Modeled Structure visualization and validation	https://youtu.be/l06ljePcg8U?feature=shared
Unit V - Artificial Intelligence mediated Computer aided drug discovery		
8	AI mediated Computer aided drug design	https://youtu.be/qkY2ezNX1SE

Module No.	Topic	CLO level	No. of periods	Content delivery method	Learning methods
Unit I- Biological Databases					
1	Introduction to bioinformatics	CLO1	1	Lecture – Chalk and Talk	Participatory Learning
2	National Center for Biotechnology Information (NCBI)- Tools and Databases of NCBI	CLO1	1	PPT and Video https://www.youtube.com/watch?v=QLcmEqBayr0	Participatory Learning
3	Nucleotide Database, Protein Database and Gene Expression Database	CLO1	1	Virtual lab	Experiential Learning
4	EMBL Nucleotide Sequence Database (EMBL-Bank)- Introduction.	CLO1	1	PPT and Video https://www.youtube.com/watch?v=Hb8oWM-NQLE	Participatory Learning
5	Sequence Retrieval, Sequence Submission to EMBL	CLO1	1	Virtual lab, Demonstration	Experiential Learning
6	Sequence analysis tools	CLO1	1	Virtual lab	Problem-based Learning
7	DNA Data Bank of Japan (DDBJ): Introduction, Resources at DDBJ, Data Submission at DDBJ	CLO1	1	Demonstration and Lecture	Experiential Learning
8	Swiss-Prot- Introduction and Salient Features	CLO1	1	Virtual lab, Demonstration	Experiential Learning
Unit II- Sequence alignment and Phylogenetic analysis					
9	Introduction to Sequence analysis (Proteins and Nucleic acids).	CLO2	1	Lecture	Participatory Learning
10	FASTA formatting, Sequence alignment methods- Pairwise alignment (Local and Global).	CLO2	1	PPT and Discussion	Experiential Learning
11	BLAST, Multiple alignment – CLUSTAL W.	CLO2	1	Virtual lab and Demonstration	Problem-based Learning

12	Phylogenetic Basics- Molecular evolution and Phylogeny	CLO2	1	Lecture and video https://www.youtube.com/watch?v=_LPQw5Hjo1o	Participatory Learning
13	Terminology, forms of tree representation	CLO2	1	PPT	Participatory Learning
14	Phylogenetic tree construction methods and programs	CLO2	1	PPT and Virtual lab	Experiential Learning
15	Distance-Based methods	CLO2	1	Lecture	Participatory Learning
16	Character-Based methods	CLO2	1	Lecture	Participatory Learning
Unit III- Nucleotide sequence analysis					
17	Analyze nucleotide sequences – detecting ORFs	CLO3	1	Lecture and PPT	Problem-based Learning
18	Finding genes and constructing restriction maps	CLO3	1	Video https://www.youtube.com/watch?v=uNvF9ZBufTk	Experiential Learning
19	Designing primers and probes.	CLO3	1	Virtual lab	Problem-based Learning
20	Plant genomic databases	CLO3	1	Lecture	Experiential Learning
21	Ensembl Plants and TAIR.	CLO3	1	Lecture and demonstration	Experiential Learning
22	Animal genomic databases	CLO3	1	PPTs and video https://www.youtube.com/watch?v=qZ8P_6Mwtc4	Experiential Learning
23	Mouse Genome Informatics and FlyAtlas. Specialized	CLO3	1	Virtual lab	Experiential Learning
24	Genome databases- SGD, TIGR, and ACeDB.	CLO3	1	Demonstration	Experiential Learning
Unit IV- Structural Bioinformatics					
25	Protein structure basics and structure databases	CLO4	1	Lecture and discussion	Participatory Learning
26	PDB, CATH, SCOP and PDBsum	CLO4	1	PPTs and demonstration	Experiential Learning
27	Methods for protein structure prediction	CLO4	1	Brainstorming	Participatory Learning
28	Secondary structure predictions	CLO4	1	PPT	Experiential Learning
29	Chou-Fasman and Garnier-Osguthorpe- Robson (GOR) method	CLO4	1	Demonstration	Experiential Learning

30	Tertiary structure predictions – Homology Modelling	CLO4	1	PPT and virtual lab	Problem-based Learning
31	Threading	CLO4	1	PPT	Experiential Learning
32	Modeled Structure visualization and validation.	CLO4	1	Virtual lab	Problem-based Learning
Unit V- Artificial Intelligence mediated Computer aided drug discovery					
33	AI mediated Computer aided drug design	CLO4	1	Research article reading	Participatory Learning
34	Introduction to docking	CLO4	1	Discussion	Participatory Learning
35	Types of docking	CLO4	1	Research article reading	Experiential Learning
36	Protein preparation	CLO4	1	Virtual lab	Experiential Learning
37	Ligand preparation	CLO4	1	Demonstration	Experiential Learning
38	Virtual screening	CLO4	1	PPT	Problem-based Learning
39	ADMET prediction	CLO4	1	PPT and discussion	Experiential Learning
40	SWISS ADME	CLO4	1	Brainstorming	Problem-based Learning
41	Docking- Auto dock	CLO4	1	PPT and video https://www.youtube.com/watch?v=db3sqA8-RUU	Experiential Learning
42	Drug-receptor interaction-Pymol	CLO4	1	Virtual lab	Experiential Learning
43	Rasmol	CLO4	1	Virtual lab	Experiential Learning

Name of the course	Basics of Bioinformatics
Name of the Faculty	Dr Shalini G and Mrs. R. Kiruba
Participatory Learning	30 %
Experiential Learning	50 %
Problem-based Learning	20 %

BACHELOR OF SCIENCE IN BIOTECHNOLOGY
CHOICE BASED CREDIT SYSTEM (CBCS) &
LEARNING OUTCOMES - BASED CURRICULUM FRAMEWORK (LOCF)
SCHEME & SYLLABUS OF EXAMINATION
2024-2027 BATCH
SEMESTER IV

Semester	Part	Course Code	Title of the Course	Course Type	Instruction hours /week	Contact hours	Tutorial hours	Duration of Examinations	Examination Marks			Credits
									CA	ESE	Total	
IV	I	TAM2304/ HIN2304/ FRE2304	Tamil Paper IV/ Hindi Paper IV/ French Paper IV	L	5	73	2	3	25	75	100	3
	II	ENG2404	English Paper IV	E	6	88	2	3	25	75	100	3
	III	BT24C04	Genetics and Genetic Engineering	CC	4	58	2	3	25	75	100	4
	III	BT24CP3	Genetics and Genetic Engineering Practical	CC	4	60	-	4	15*	35*	50	3
	III	TH24A26	Advanced Statistics For Biotechnology	GE	4	58	2	3	20	55	75 [€]	4
		BT24A04	Programming for Computer Application	GE	4	58	2	3	20	55	75 [€]	3
	III	TH23AP1/ BT24AP3	Statistics for Biotechnology Practical/ Programming for Computer application practical	GE	2	30	-	3	15	35	50 [§]	2
				GE	2	30	-	4	15	35	50 [§]	2
	III	BT24SCE1	AI in Healthcare Specialization	SEC	3	45	2	-	100	-	100	3
	IV	NM24EVS	Environmental Studies	AECC	SS	-	-	-	100	-	100	Gr.
I-V	IV	NM23EII	Entrepreneurship and Innovation (Ignite X)	AECC	2	30	-	-	100	-	100	2
	V	COCOACT	Co-Curricular Activities	GC	-	-	-	-	100	-	100	1
	VI	24BONL1 24BONL2 24BONL3	Online course I Online course II Online course III	ACC	-	-	-	-	-	-	-	-

L: Language

E: English

ACC: Additional Credit Courses

CA – Continuous Assessment

€: CA conducted for 25 and converted into 20, ESE conducted for 75 and converted into 55

§: CA conducted for 25 and converted into 15, ESE conducted for 75 and converted into 35

CC: Core Courses

GE: Generic Elective

SEC: Skill Based Course

ESE - End Semester Examination

AECC: Ability Enhancement Compulsory Courses

GC: General Courses

SS: Self Study

Gr: Grade

QUESTION PAPER PATTERN

For Core and Allied theory paper (First 3 Units)

CA Question from each unit comprising of

One question with a weightage of 2 Marks : $2 \times 3 = 6$

One question with a weightage of 5 Marks (Internal Choice at the same CLO level) : $5 \times 3 = 15$

One question with a weightage of 8 Marks (Internal Choice at the same CLO level) : $8 \times 3 = 24$

Total : 45 Marks

End Semester Examination – Question Paper Pattern and Distribution of Marks

ESE Question Paper Pattern for Core and Allied Course: $5 \times 15 = 75$ Marks

Question from each unit comprising of One question with a weightage of 2 Marks : $2 \times 5 = 10$

One question with a weightage of 5 Marks (Internal Choice at the same CLO level) : $5 \times 5 = 25$

One question with a weightage of 8 Marks (Internal Choice at the same CLO level) : $8 \times 5 = 40$

Attendance component in CA

From the academic year 2024-25 and onwards marks allotted for attendance component in CA is modified as

91-100% attendance: 3 Marks

81-90% attendance : 2 Marks

75-80% attendance : 1 Marks

Continuous Internal Assessment Pattern

Theory

CIA Test : 5 marks (Conducted for 45 marks after 50 days)

Model Exam : 7 marks (Conducted for 75 marks after 85 days (Each Unit 15 Marks))

Seminar/Assignment/Quiz : 5 marks

Class Participation : 5 marks

Attendance : 3 marks

Total : 25 Marks

Practical

Lab Performance : 7 marks

Regularity : 5 marks

Model Exam : 10 marks

Attendance : 3 marks

Total : 25 marks

Evaluation pattern for ESE Practical

The End Semester Examination will be conducted for a maximum of 75 marks with a maximum 15 marks for the record and other submissions if any.

Evaluation pattern for Skill Based Theory Subject

Test 1 (Theory)	:30 marks (Conducted for 50 marks and converted to 30 marks)
Test 2 (Theory)	:50 marks
Assignment	:10 marks
Seminar	:10 marks
Total	:100 marks

Evaluation pattern for Skill Based Practical Subject

Test 1 (Theory/Practical)	:30 marks (Conducted for 50 marks and converted to 30 marks)
Test 2 (Theory/Practical/Project)	:50 marks
Lab Performance	:10 marks
Regularity	:10 marks
Total	:100 marks

COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CREDIT
BT24C04	GENETICS AND GENETIC ENGINEERING	THEORY	58	2	-	4

Preamble

- This course introduces the fundamentals of genetics and genetic engineering, covering Mendelian inheritance, chromosomal alterations, and population genetics. It explores key enzymes, molecular tools, and cloning vectors used in recombinant DNA technology and modern genome editing techniques like CRISPR-Cas9. Emphasis is placed on screening and characterization of clones, enabling students to connect genetic principles with practical applications.

Course Learning Outcomes

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

CLO Number	CLO Statement	Knowledge Level
CLO1	Explain the principles of Mendelian inheritance, gene interaction, and the chromosomal basis of inheritance.	K1 & K2
CLO2	Analyze and interpret chromosomal aberrations, their role in genetic disorders, and apply concepts of population genetics for understanding human inheritance patterns.	K2 & K3
CLO3	Apply molecular tools such as restriction enzymes, ligases, polymerases, and DNA modifying enzymes for genetic manipulation.	K3
CLO4	Design and construct recombinant DNA clones using appropriate vectors and evaluate cloning strategies for different hosts	K3 & K4

Mapping with Programme Learning Outcomes

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	M	S	M	S	M
CLO2	M	S	M	M	M
CLO3	M	S	S	S	M
CLO4	S	S	S	M	S

S- Strong; M-Medium

GENETICS AND GENETIC ENGINEERING- BT24C04- 58 HRS

UNIT I: Principles of Mendelian Inheritance (12 hrs)

Mendel's experiments - Dominance, Segregation, Independent assortment. Gene Interaction; Incomplete dominance, Codominance, Complementary, Supplementary, Duplicate and Lethal gene interactions. Multiple allele: Epistasis, Dominant and Recessive epistasis. Chromosomal theory of inheritance. Linkage and crossing over, Sex determination and Sex linkage in diploids.

UNIT II: Alterations in chromosome (11 hrs)

Chromosomal aberrations: Euploidy, Aneuploidy - Deletion, Duplication, Insertion and Translocation. Population genetics: Hardy - Weinberg genetic equilibrium, Gene frequency, Gene pool, Inbreeding, Outbreeding. Genetic drift, Pedigree analysis and genetic counseling. Human cytogenetics; Landmarks, Banding pattern, Karyotyping, CGH. Human Genetic Diseases - Down's, Turner's, Klinefelter's syndrome.

UNIT III: Tools for rDNA technology (12 hrs)

Steps involved in gene cloning in prokaryotic and eukaryotic hosts. Manipulating Enzymes: Restriction Endonucleases and types, Exonucleases. DNA Polymerases-Taq polymerase, Pfu DNA polymerase. Ligases-T4 ligase, DNA ligase DNA modifying enzymes-Alkaline phosphatases, Calf Intestine Alkaline phosphatase (CIAP), Terminal deoxynucleotidyl transferases, Polynucleotide kinase.

UNIT IV: Cloning Vectors and their applications (11 hrs)

Bacterial plasmids, pBR322, pUC18. Cosmids (pJB8), Phagemids (pGEM). M13 based Single strand vectors (M13-mp8), Shuttle vectors (YE_p) and Expression vectors (pET) for prokaryotes. Problems encountered in expressing foreign genes in *E. coli*, BAC and YAC. Mammalian vector-SV40, Plant vector-Ti plasmid.

UNIT V: Gene cloning and Screening (12 hrs)

Polymerase chain reaction: Primer designing. Types of PCR: Semi quantitative, Multiplex, Reverse Transcriptase-PCR, Real time - PCR. Methods of labeling probes, Genomic library, cDNA library and PCR based cloning approach (TA cloning). Detection of cloned gene, Selection of clones by hybridization probes – Blue white selection. Genome Editing: CRISPR- Cas9, advancing genome editing with artificial intelligence.

***Reference Link**

S.No	TOPIC	Links
UNIT I: Principles of Mendelian Inheritance		
1	Gene Interaction; Incomplete dominance, Codominance	https://www.youtube.com/watch?v=Bo1rlIFcehM
2	Sex determination and Sex linkage in diploids	https://www.youtube.com/watch?v=AzkXQBzZEIE
UNIT II: Alterations in chromosome		
3	Population genetics	https://www.youtube.com/watch?v=SRWXEMII0_U
4	Karyotyping	https://www.youtube.com/watch?v=AtGfc-ebRP8
UNIT III: Tools for rDNA technology		
5	Restriction Endonucleases and types	https://www.youtube.com/watch?v=VfRThB2VWkA
6	DNA modifying enzymes	https://www.youtube.com/watch?v=RjlGvRRVYuw
7	DNA Polymerases-Taq polymerase, Pfu DNA polymerase.	https://www.youtube.com/watch?v=j3wd1kCSrUg https://www.youtube.com/watch?v=gwYkOhC-TKA
UNIT IV: Cloning Vectors and their applications		
8	Cosmids (pJB8), Phagemids (pGEM)	https://www.youtube.com/watch?v=qBhBJzc-CRM
9	Plant vector-Ti plasmid	https://www.youtube.com/watch?v=yesNHd9h8k0
UNIT V: Gene cloning and Screening		
10	Methods of labeling probes	https://www.youtube.com/watch?v=29EC7L3t19c
11	cDNA library	https://www.youtube.com/watch?v=URtcaoNEIrI https://www.youtube.com/watch?v=E7eqc4r2iwI
12	Selection of clones by hybridization probes – Blue white selection	https://www.youtube.com/watch?v=4fnS2xKjIbg

Text Book

S. No	Authors	Title of the book	Publishers	Year & Edition
1.	Harvey Lodish, Arnold Berk, Chris A. Kaiser, Monty Krieger, Anthony Bretscher, Hidde Ploegh, Kelsey C. Martin, Michael Yaffe & Angelika Amon.	Molecular Cell Biology	Macmillan's Publishers	2021 9 th Edn
2.	Brown, T. A	Gene cloning and DNA analysis an introduction.	Wiley Blackwell	2016 7 th Edn
3.	Brown, T. A	Introduction to Genetics. A molecular Approach.	Garland Science	2011 1 st Edn
4.	Hugh Fletcher & Ivor Hickey	BIOS Instant Notes in Genetics.	Garland Science	2012 4 th edn

Books for Reference

S. No	Authors	Title of the book	Publishers	Year & Edition
1.	Freifelder, D.	Freifelders Essentials of Molecular Biology	Jones & Bartlett Publishers	2015 4 th Edn
2.	Anthony, J.F, Griffiths, John Doebley & Catherine Peichel	An Introduction to Genetic Analysis.	W. H. Freeman & Co Ltd	2020 12 th Edn

Course Designers

1. Dr. R.K. Selvakesavan

Pedagogy

- PowerPoint Presentations, Group Discussion, Seminar, Quiz Assignment, Experience Discussion

Course Content and Presentation Schedule

Module No.	Topic	CLO Level	No. of periods	Content delivery method	Student engagement	Participatory Learning / Experiential Learning / Problem based Learning
Unit I: Principles of Mendelian Inheritance- 12 hrs						
1.	Mendel's experiment- Dominance, Segregation	CLO1 CLO2	1	Lecture – Chalk and Talk / Group reading	Debate, Quescussion, Pro-con grid	Problem-based Learning
2.	Independent assortment	CLO1 CLO2	1	PPT / OER	Case thinking	Problem-based Learning
3.	Gene Interaction; Incomplete & Codominance dominance	CLO1 CLO2	1	Chalk and talk/ Picture	One-minute presentation	Participatory Learning
4.	Complementary gene interactions	CLO1 CLO2	1	Research paper presentation	Case thinking	Problem-based Learning
5.	Supplementary gene interactions	CLO1 CLO2	1	Lecture PPT	One-minute presentation	Participatory Learning
6.	Duplicate and Lethal gene interactions	CLO1 CLO2	1	Student Seminar	Student Seminar	Participatory Learning
7.	Multiple allele: Epistasis	CLO1 CLO2	1	Virtual lab	Quiz	Participatory Learning
8.	Dominant and Recessive epistasis	CLO1 CLO2	1	Lecture PPT	Group Discussion	Participatory Learning
9.	Chromosomal theory of inheritance	CLO1 CLO2	1	Virtual lab	Design thinking	Problem-based Learning
10.	Linkage and crossing over	CLO1 CLO2	1	Research paper presentation	Group Discusssion	Participatory Learning
11.	Sex determination	CLO1 CLO2	1	Lecture PPT	Case thinking	Problem-based Learning
12.	Sex linkage in diploids	CLO1 CLO2	1	Lecture PPT	Diagrams, Sketchboard	Experiential Learning
UNIT II: Alterations in Chromosome- 11 hrs						
13.	Chromosomal abberations: Euploidy,	CLO1 CLO2	1	Lecture – Chalk and Talk / Group reading	Design thinking	Problem-based Learning
14.	Aneuploidy - Deletion, Duplication, Insertion and Translocation	CLO1 CLO2	1	PPT / OER	Design thinking	Problem-based Learning
15.	Population genetics: Hardy - Weinberg genetic equilibrium	CLO1 CLO2	1	Chalk and talk/ Picture	Design thinking	Problem-based Learning

16.	Gene frequency, Gene pool	CLO1 CLO2	1	Research paper presentation	Case thinking	Problem-based Learning
17.	Inbreeding & Outbreeding	CLO1 CLO2	1	Lecture PPT	Panel discussion	Participatory Learning
18.	Genetic drift	CLO1 CLO2	1	Lecture PPT	Diagrams, Sketchboard	Experiential Learning
19.	Pedigree analysis and genetic counseling	CLO1 CLO2	1	Virtual lab	Quiz	Participatory Learning
20.	Human cytogenetics	CLO1 CLO2	1	Lecture PPT	Design thinking	Problem-based Learning
21.	Landmarks, Banding pattern, Karyotyping	CLO1 CLO2	1	Virtual lab	Simulation	Experiential Learning
22.	FISH, CGH	CLO1 CLO2	1	Research paper presentation	Case thinking	Problem-based Learning
23.	Human Genetic Diseases - Down's, Turner's, Klinefelter's syndrome	CLO1 CLO2	1	Brainstorming	Review collection, Case study	Problem-based Learning
UNIT III: Tools for rDNA technology- 12 hrs						
24.	Steps involved in gene cloning in prokaryotic	CLO2 CLO3	1	Lecture – Chalk and Talk / Group reading	Optimization	Problem-based Learning
25.	Steps involved in gene cloning in eukaryotic hosts	CLO2 CLO3	1	PPT / OER	Optimization	Problem-based Learning
26.	Manipulating Enzymes: Restriction Endonucleases and types	CLO2 CLO3	1	Demonstration	Workshop	Experiential Learning
27.	Exonucleases	CLO2 CLO3	1	Student Seminar	Design thinking	Problem-based Learning
28.	DNA Polymerases-Taq polymerase	CLO2 CLO3	1	Virtual lab	One-minute presentation	Participatory Learning
29.	Pfu DNA polymerase	CLO2 CLO3	1	Lecture PPT	Presentation	Problem-based Learning
30.	Ligases-T4 ligase, DNA ligase	CLO2 CLO3	1	Demonstration	Workshop	Experiential Learning
31.	Ligases-T4 ligase, DNA ligase	CLO2 CLO3	1	Demonstration	Workshop	Experiential Learning
32.	DNA modifying enzymes- Alkaline phosphatases	CLO2 CLO3	1	Lecture PPT	Presentation	Problem-based Learning
33.	Calf Intestine Alkaline phosphatase (CIAP)	CLO2 CLO3	1	Virtual lab	Simulation	Experiential Learning

34.	Terminal deoxynucleotidyl transferases	CLO2 CLO3	1	Virtual lab	Simulation	Experiential Learning
35.	polynucleotide kinase	CLO2 CLO3	1	Student seminar	Student seminar	Participatory Learning
UNIT IV: Cloning Vectors and their applications- 11 hrs						
36.	Bacterial plasmids	CLO3 CLO4	1	Lecture – Chalk and Talk	Simulation	Experiential Learning
37.	pUC18	CLO3 CLO4	1	Lecture PPT	Group Discussion	Participatory Learning
38.	Cosmids (pJB8)	CLO3 CLO4	1	PPT / OER	Article review	Experiential Learning
39.	Phagemids (pGEM)	CLO3 CLO4	1	Chalk and talk/ Picture	Simulation	Experiential Learning
40.	M13 based Single strand vectors (M13-mp8)	CLO3 CLO4	1	Chalk and talk/ Picture	One-minute presentation	Participatory Learning
41.	Shuttle vectors (YE _p) and Expression vectors (pET) for prokaryotes	CLO3 CLO4	1	Lecture PPT	One-minute presentation	Participatory Learning
42.	Problems encountered in expressing foreign genes in E.coli	CLO3 CLO4	1	Book/ Article review	Article review	Experiential Learning
43.	BAC and YAC	CLO3 CLO4	1	Research paper presentation	Presentation	Problem-based Learning
44.	Mammalian vector-SV40	CLO3 CLO4	1	Student seminar Lecture	Debate	Problem-based Learning
45.	Plant vector-Ti plasmid	CLO3 CLO4	2	Lecture PPT	Optimization	Problem-based Learning
UNIT V: Gene cloning and Screening- 12 hrs						
46.	Polymerase chain reaction: Primer designing	CLO3 CLO4	1	Lecture – Chalk and Talk / Group reading	Troubleshooting	Problem-based Learning
47.	Types of PCR: Semi quantitative PCR	CLO3 CLO4	1	PPT / OER	Troubleshooting	Problem-based Learning
48.	Multiplex PCR	CLO3 CLO4	1	Field observations	Industry visit	Experiential Learning
49.	Reverse Transcriptase-PCR	CLO3 CLO4	1	Field observations	Industry visit	Experiential Learning
50.	Real time - PCR	CLO3 CLO4	1	Field observations	Industry visit	Experiential Learning
51.	Methods of labeling probes	CLO3 CLO4	1	Student Seminar	Student seminar	Participatory Learning

52.	Genomic library	CLO3 CLO4	1	Virtual lab	Quiz	Participatory Learning
53.	cDNA library and PCR based cloning approach (TA cloning)	CLO3 CLO4	1	Book/ Article review	Debate	Problem-based Learning
54.	cDNA library and PCR based cloning approach (TA cloning)	CLO3 CLO4	1	Virtual lab	Troubleshooting	Problem-based Learning
55.	Detection of cloned gene	CLO3 CLO4	1	Research paper presentation	Troubleshooting	Problem-based Learning
56.	Selection of clones by hybridization probes- Blue white selection	CLO3 CLO4	1	Field observations	Industry visit	Experiential Learning
57.	Genome Editing: CRISPR-Cas9, advancing genome editing with artificial intelligence.	CLO3 CLO4	1	Student seminar	Student seminar	Participatory Learning

Participatory Learning	29.3%
Experiential Learning	29.3%
Problem-based Learning	41.4%

COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CREDIT
BT24CP3	GENETICS AND GENETIC ENGINEERING PRACTICAL	PRACTICAL	-	-	60	3

Preamble

- Gain adequate expertise required to understand the concepts of genetics and understanding of evolution. Familiarize the students genetic engineering and gene transfer techniques. Provide an opportunity to experimentally verify the theoretical principles of genetic Engineering in a more explicit and concentrated manner.

Course Learning Outcomes

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

CLO Number	CLO Statement	Knowledge Level
CLO1	Illustrate the genetic techniques applied for sex determination	K1
CLO2	Understand the genetic tools utilized to investigate heredity and lineage.	K2
CLO3	Apply the molecular techniques employed to study the genetic make-up of an individual and manipulate it	K3
CLO4	Develop and apply the recent technology in screening the recombinant Clones	K4

Mapping with Programme Learning Outcomes

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	S	S	S	S	S
CLO2	S	M	S	M	M
CLO3	S	S	M	S	S
CLO4	S	M	S	S	M

S- Strong; M-Medium

GENETICS AND GENETIC ENGINEERING PRACTICAL- BT24CP3- 60 HRS

1. Preparation and analysis of Pedigree Charts
2. Barr body identification in buccal cavity
3. Mitotic Preparation in Onion root tip
4. Meiosis – flower buds of *Rhoeo discolor*
5. Staining of Chromosomes - Giemsa staining
6. Plant Gene amplification by Polymerase Chain Reaction
7. Restriction digestion of pUC 8/ pCambia 1302
8. Ligation of digested vector and amplified gene
9. Competent cell preparation
10. Transformation and Screening of recombinants- Blue white selection

Text Book

S.No	Authors	Title of the book	Publishers	Year& Edition
1.	Carson, S. & Miller H.B.	Molecular Biology Techniques	Academic Press.	2019 4 th Edn
2.	Chiyedza Small	Genetics Laboratory Manual	Kendall/Hunt Publishing Co, U.S.; Lab Manual edition	2019 1 st Edn

Books for Reference

S.No	Authors	Title of the book	Publishers	Year& Edition
1.	Bineeta Singh & Lal, G.M.	Practical manual of Genetics and Plant breeding	Satish Serial Publishing House	2021 1 st Edn
2.	Venison S. John	Practical manual for Genetic Engineering	PHI Learning Pvt. Ltd.	2009 1 st Edn
3.	Sambrook, J.E.F & Fritsch, T. Maniatis	Molecular cloning: A Laboratory Manual	Cold Spring Harber Laboratory Press, New York	2000 4 th Edn

Course Designers

1. Dr. R. Nirmal Kumar

COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CREDIT
BT24A04	PROGRAMMING FOR COMPUTER APPLICATION	THEORY	58	2	-	3

Preamble

- To learn about the fundamentals of C programming. To learn the concepts of Python language. To develop applications to analysis with data.

Course Learning Outcomes

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

CLO	CLO Statement	Knowledge Level
CLO1	Understand the programming ability in C Language	K1
CLO2	Ability to write C Programming for logical concepts	K2
CLO3	Apply algorithms for sequence analysis	K3
CLO4	Inculcate knowledge on basic Python programming skills	K4

Mapping with Programme Learning Outcomes

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	S	S	S	M	S
CLO2	S	S	S	M	S
CLO3	S	S	M	M	M
CLO4	S	S	M	M	M

S- Strong; M-Medium

PROGRAMMING FOR COMPUTER APPLICATION- BT24A04- 58 HRS

Unit I: Computer Algorithms and Fundamentals in C

(12 hrs)

Basics of Algorithms- Pseudo code -Flowchart-Stack-Queues.

Fundamentals in C: History of C- Basic Structure of a C program- Simple C Program- Character set - C tokens - Keywords - Identifiers - Constants – Variables – Data Types -Declaration of Variable - Assigning Values to Variables –Initialization.

Unit II: Operators and Expressions: Arrays

(12 hrs)

Arithmetic operators – relational operators – logical operators – assignment operators – increment and decrement operators – conditional operators – special operators – arithmetic expression – evaluation of expression – Precedence of arithmetic operators – type conversion in expression – operator precedence and associativity – mathematical functions.

Arrays:

Introduction – One dimensional array – declaration of array – Initiating on two and multidimensional arrays.

Unit III: Decision Making, Branching and looping

(11 hrs)

Introduction to if, if...else, nesting of if ...else statements- else if ladder – The switch statement, The: Operator – The goto Statement.

Decision Making and Looping:

Introduction - while loop –do loop –do while loop –for loop –Nested Loops–break–continue– goto–exit–return.

Unit IV: Python

(11 hrs)

About python, features of python, python set up, fundamentals of python, values and data types, variables, key word, identifier of python, quotations, indentation, multi-line statement, input- output and import function in python, advantages and disadvantages of python.

Unit V: Fruitful functions in python:

(12 hrs)

Defining a function, function call, types of function, python function arguments, composition, python recursion and python lambda function.

Text Book

S. No	Authors	Title of the book	Publishers	Year& Edition
1.	Mark Summerfield	Programming in Python 3: A Complete introduction to the Python Language	Addison-Wesley Professional	2009 2 nd Edn
2.	Martin C. Brown	PYTHON: The Complete Reference	McGraw-Hill Education Pvt Limited	2001 4 th Edn

Books for Reference

S. No	Authors	Title of the book	Publishers	Year& Edition
1.	Guido van Rossum, Fred L. Drake Jr	An Introduction to Python, Revised and updated for Python 3.2	Network Theory Ltd.	2011
2.	Wesley J. Chun	Core Python Applications Programming	Prentice Hall	2012

Course Designers

1. Dr. G. Shalini
2. Dr. R. Nirmal Kumar

COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CREDIT
BT24AP3	PROGRAMMING FOR COMPUTER APPLICATION PRACTICAL	PRACTICAL	-	-	30	2

Preamble

- To learn about the fundamentals of C programming. To learn the concepts of Python language. To develop applications to analysis with data.

Course Learning Outcomes

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

CLO	CLO Statement	Knowledge Level
CLO1	Understand practical way of program in C Language.	K1
CLO2	Ability to write C Programming for problem solving	K2
CLO3	Apply algorithms for DNA and NGS based sequence analysis	K3
CLO4	To inculcate knowledge on basic Python programming skills and develop application-based tools.	K4

Mapping with Programme Learning Outcomes

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	S	S	S	M	S
CLO2	S	M	S	M	S
CLO3	S	S	S	M	M
CLO4	S	M	M	S	M

S- Strong; M-Medium

**PROGRAMMING FOR COMPUTER APPLICATION PRACTICAL-
BT24AP3- 30 HRS**

1. Write a C program to find the sum, average, standard deviation for a given set of numbers.
2. Write a C program to generate n prime numbers.
3. Write a C program to generate Fibonacci series.
4. Write a C program to sort the given set of numbers in ascending order.
5. Write a python program that displays the following information: Your name, Full address, Mobile number, College name, Course subjects.
6. Write a python program to make a simple calculator
7. Write a python program to find the largest three integers using if-else and conditional operator.

Text Book

S. No	Authors	Title of the book	Publishers	Year & Edition
1.	Krishnan, N.	Computer fundamentals and windows with internet technology	SCITECH Publications	2001 1 st Edn
2.	Mark Summerfield	Programming in Python 3: A Complete introduction to the Python Language	Addison-Wesley Professional	2009 1 st Edn
3.	Martin C. Brown	PYTHON: The Complete Reference	McGraw-Hill Education Pvt Limited	2001 1 st Edn
4.	Wesley J. Chun	Core Python Applications Programming	Prentice Hall	2012 3 rd Edn

Books for Reference

S. No	Authors	Title of the book	Publishers	Year & Edition
1.	Srinivasa, K.G., Siddesh G.M & Hanumantha Raju, R	Internet of Things	Cengage Learning India pvt. Ltd	2018 1 st Edn
2.	Taxali, R.K.	Pc Software for Windows 98 Made Simple	McGraw-Hill Education (India) Pvt Limited	2002 1 st Edn
3.	Mrs. Sneha Akash Mane, Dr. Sampat D. Navale, Dr. Tushar T. Shelke & Prof. Nitin B. Kohale	Text book And Lab Manual of Computer Applications	Pritam Publications	2022 1 st Edn
4.	Brian W. Kernighan & Dennis M. Ritchie	The C Programming Language	Prentice-Hall	2018 1 st Edn

Course Designers

1. Dr. R. Nirmal Kumar