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 4th in NIRF 2023)

DEPARTMENT OF BIOTECHNOLOGY

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

(Semester I-V)

BACHELOR OF SCIENCE -BIOTECHNOLOGY

2022 – 2025 BATCH

B.Sc BIOTECHNOLOGY

PROGRAMME LEARNING OUTCOME (PLO):

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

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

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

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

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

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

PROGRAMME SPECIFIC OUTCOME:

At the end of the programme the student will

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

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

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

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

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

DEPARTMENT OF BIOTECHNOLOGY-UG
CHOICE BASED CREDIT SYSTEM & OUTCOME BASED EDUCATION
BACHELOR OF SCIENCE (B.Sc.) – 2022-2025 BATCH
SYLLABUS & SCHEME OF EXAMINATION
Applicable to students admitted during the academic year 2022-2023 onwards (I & II Sem)

SEM	Part	Subject Code	Title of the Paper		Instruction hours/week	Contact hours	Tutorial	Duration of Examination	Examination Marks			Credits
									CA	ESE	TOTAL	
I	I	TAM2201/ HIN2201/ FRE2201	Language Tamil I/ Hindi I/ French Paper I	Language	6	86	4	3	50	50	100	3
	II	ENG2101	English paper I	English	6	86	4	3	50	50	100	3
	III A	BT22C01	**Core Paper I –** Cell and Molecular biology	CC	5	71	4	3	50	50	100	4
		BT22CP1	**Core Practical I** – Lab in Cell and Molecular biology	CC	3	45	-	-	-	-	-	-
	III A	BT22A01/ CE22A01/ PS22A01	**Allied I –Paper I** Biochemistry/ Allied Chemistry for Biologist Paper I/ Allied Physics Paper –I	GE	5	71	4	3	30	45	75	4
	III A	BT22AP1/ CE21AP1/ PS21AP1	**Allied Practical I** Lab in Biochemistry/ Allied Chemistry Practical for Biologist / Allied Physics practical	GE	3	45	-	-	-	-	-	-
	IV	NME22B1/ NME22A1/ NME21ES	Basic Tamil I/ Advanced Tamil I/WS/AS/GS/ Introduction to Entrepreneurship	AEC	2	28	2	2	50	50	100	2
II	I	TAM2202/ HIN2202/ FRE2202	Language Tamil II/ Hindi II/ French II	Language	6	86	4	3	50	50	100	3
	II	ENG2102	English paper II	English	5	86	4	3	50	50	100	3
	III A	BT22C02	**Core Paper II –** Microbiology	CC	5	71	4	3	50	50	100	4
		BT22CP1	**Core Practical I-** (Core Paper I & II)	CC	3	45	-	3	50	50	100	4
	III A	BT22A02/ CE22A02/ PS22A02	**Allied Paper II-** Instrumentation and Analysis/ Allied Chemistry for Biologist Paper- II/ Allied Physics Paper-II	GE	5	71	4	3	30	45	75	4

		BT22AP1/ CE21AP1/ PS21AP1	**Allied Practical I** Lab in Biochemistry & Instrumentation and Analysis/ Allied Chemistry Practical for Biologists Allied Physics practical	GE	3	45	-	3	20	30	50	2
	IV	21PELS1	Professional English for Life Sciences		3	26	4	2	50	50	100	2
		NME22B2/ NME22A2/ OPS1808	Basic Tamil II / Advanced Tamil II**/ Open Course Self study online courses	AEC	-	-	-	-	-	-	-	-
		NME12GAW	Foundation Course I (General Awareness)	AEC	Self-Study Online				100	-	100	Grade

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

CA – Continuous Assessment
ESE - End Semester Examination

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

CIA PATTERN

1. Theory

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

2. Practical - 50 : 50 = 100 Marks

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

3. CIA Question Paper Pattern: 2 x 25 = 50 Marks

One question from each unit with each question comprising of

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

4. ESE Question Paper Pattern: 5 x 20 = 100 Marks

One question from each unit with each question comprising of

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

COURSE NUMBER	COURSE NAME	CATEGORY	L	T	P	CREDIT

BT22C01	**Core paper I-Cell and Molecular Biology**	**CORE**	**71**	**4**	**-**	**4**

Preamble

To facilitate the students to

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

Course Outcomes

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

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

Mapping with Programme Outcomes

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

S- Strong; M-Medium

Syllabus

UNIT I: Basics of Cells **14 hrs**

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

UNIT II: Mechanisms of Cell Transport **14 hrs**

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

UNIT III: Cell Division, Cell cycle Regulation and Cell Signaling **14 hrs**

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

UNIT IV: Organization and functions of DNA **14 hrs**

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

UNIT V: **Gene Regulation and Expression** **15 hrs**

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

TEXT BOOKS

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

REFERENCE BOOKS

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

Course Designer:

Dr.R.Nirmal Kumar

Dr.A.Dhivya

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

Objectives

To facilitate the students to

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

Course Outcomes

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

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

Mapping with Programme Outcomes

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

S- Strong; M-Medium

SYLLABUS

UNIT I: Structure and Function of Carbohydrates **14 hrs**

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

UNIT II: Enzymes **14 hrs**

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

UNIT III: Lipids **14 hrs**

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

UNIT IV: Vitamins & Proteins **14 hrs**

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

UNIT V: Metabolism of Biomolecules **15 hrs**

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

TEXT BOOKS

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

REFERENCE BOOKS

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

Course Designer:

Dr.R.Nirmal Kumar

Dr.A.Dhivya

COURSE NUMBER	COURSE NAME	CATEGORY	L	T	P	CREDIT
BT22C02	Core Paper II- Microbiology	CORE	71	4	-	4

Preamble

To facilitate the students to

- 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 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	K2
CLO 4	Inculcate knowledge on Industry 4.0, need for digital transformation	K2

Mapping with Programme Outcomes

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

S- Strong; M-Medium

Syllabus

UNIT I: Introduction to Microscopy **14 hrs**

Historical developments in microbiology, 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 and infected tissue; Techniques of pure culture, maintenance and Preservation; Staining: stains and types of staining.

UNIT III: Microbial nutrition, growth and control **14 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: Microbes and its association **14 hrs**

Soil borne- *Azotobacter* sp, *Rhizobium* sp, *Azospirillum*,Nostoc, *Anabaena*, *Saccharomyces cerevisiae*, **Algae:** *Chlorella*, *Spirulina*, *Cyanobacteria Nannochloropsis* sp, Food borne- *Staphylococcus aureus*, *Salmonella* sp. *Clostridium sp*, *Escherichia coli*, *Bacillus subtilis*, *Pseudomonas* sp **Fungal Species:** *Aspergillus* sp, *Agaricus* sp , *Candida* sp, *Fusarium sp*, *Mycoplasma* sp **Viruses:** TMV, Baculovirus; Mammalian viruses: retroviruses, SARS-CoV-2 virus (COVID-19).Protozoa.

UNIT V: Introduction to Industrial Microbiology **15 hrs**

Introduction to microbes based enzyme production. Need for Enzyme production. Reasons for adopting enzyme based Industries. Definition Goals, Design and Principles of Enzyme production. Technologies used to produce enzymes from microorganisms. Skills required for setting up an enzyme based industry. Advancements in enzyme production. Impact of microbes based enzyme production on Society, Business, Government and People - Introduction to 5.0.

TEXT BOOKS

S.No	Authors	Year	Title of the book	Publishers
1.	Michael J. Pelczar.Jr, E.C.S Chan, Noel R.Krieg	2020	Pelczar Microbiology 7th Edition	McGraw Hill
2.	Madigan Michael T. Martinko John M. Bender Kelly S.Buckley Daniel H. Stahl DavidA.	2017	Brock's Biology of Microorganisms 14th ed	Pearson
3.	Joanne Willey and Kathleen Sandman and Dorothy Wood	2020	Prescott's Microbiology , 11th Edition	McGraw Hill
4.	Simon Baker, Jane Nicklin, Caroline Griffiths	2011	BIOS Instant Notes in Microbiology	Taylor & Francis
5.	P. Kaliraj and T. Devi . Higher Education for Industry 4.0 and Transformation to Education 5.0			
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]				
6.	Introduction to Industry 4.0 and Industrial Internet of Things by Prof.Sudip Misra, IIT Kharagpur.			
7.	A Complete Guide to Industry 4.0-Udemy			

REFERENCE BOOKS

S.No	Authors	Year	Title of the book	Publishers
1.	M.T. Madigan, J.M. Martinko,J.Parker.	2002	Brock's Biology of Microorganisms 10 th ed	Prentice Hall
2.	Moat Albert. G, Foster. John.W, Speetor,Michel P	2002	Microbial Physiology 4thed	Wiley Liss Publishers.
3.	Das,H.K.	2004	Text Book of Biotechnology	Wiley Dream tech India Pvt. Ltd

Course Designer:
Dr.R.Nirmal Kumar
Dr.A.Dhivya

COURSE NUMBER	COURSE NAME	CATEGORY	L	T	P	CREDIT
BT22A02	**Allied paper II – Instrumentation and Analysis**	**Allied**	**71**	**4**	**-**	**4**

Objectives

To facilitate the students to

- Acquire knowledge on design and application of instruments in biological field
- Become familiar with separation and purification techniques

Course 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	K3

Mapping with Programme Outcomes

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

S- Strong; M-Medium

Syllabus

UNIT I: **Basic Instrumentation** **14 hrs**

pH meter, Buffer of biological importance, Centrifuge- Preparative, Analytical and Ultra, Laminar Air Flow, Autoclave, Hot Air Oven and Incubator-General and BOD

UNIT II: Electrophoresis and Blotting **14 hrs**

EC meter, Weighing Balance, UV Trans illuminator. Gel electrophoresis- Horizontal Agarose and Image analysis software. PAGE-Native and SDS. Blotting- Principles, types, Steps involved Southern Blotting, Western Blotting and Northern Blotting

UNIT III: Chromatography **14 hrs**

Chromatographic Techniques: Principles, Types- Paper, Thin Layer, Column, HPLC, uHPLC, LC-MS, GC and GC MS.

UNIT IV: Colorimetric analysis and Spectroscopy **14 hrs**

Colorimetric Analysis: Lambert's law, Beer's law, methods of color measurement or color comparison, basic principles and working of Colorimeter, Spectrophotometer, fluorescence, FT-IR, AAS, MS Applications.

UNIT V: Other methods of Analysis **15 hrs**

Polarimetry, potentiometry, Thermo gravimetry -Introduction, basic principles, types, procedure & applications, Radio Immuno Assay, Scintillation counting (Solid, Liquid, gas),ELISA.

Text Books

S.No	Authors	Year of publication	Title of the book	Publishers
1	RS Khandpur	2015	Hand Book Of Analytical Instruments	McGraw Hill
2	Dinesh Kumar Chatanta, Prahlad Singh Mehra	2012	Instrumental Methods of Analysis in Biotechnology	I K International Publishing House Pvt. Ltd; First Edition
3.	Sabari Ghoshal, A. K. Srivastava	2010	Fundamentals of Bioanalytical Techniques and Instrumentation	Prentice-Hall Of India Pvt. Limited
4	Rana, S.V.S	2012	Bio Techniques. Theory and Practices	Rastogi Publications, Meerut

Reference Books:

S.No	Authors	Year of publication	Title of the book	Publishers
1	John G. Webster, Amit J. Nimunkar	2020	Medical Instrumentation: Application and Design, 5th Edition	Wiley

Course Designer:

Dr.R.Nirmal Kumar

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

Objectives

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

Course Outcomes

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

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

Mapping with Programme Outcomes

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

S- Strong; M-Medium

Syllabus **45 hrs**

Lab in Cell and molecular biology

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

Syllabus **45 Hrs**

Lab in Microbiology:

1. Microbiological techniques–Sterilization techniques, Media preparation
2. Isolation and enumeration of microbes (bacteria & fungi) from soil.
3. Pure culture method - streak plate method
4. Identification of Bacteria: Staining methods–simple, Grams and Spore Staining
5. Biochemical Identification –IMViC–test, Oxidase and Catalase
6. Growth curve of bacteria.
7. Anti-microbial sensitivity test – Disk diffusion test.
8. Fungal identification: lactophenol cotton blue staining and KOH moulding (morphology)

Course Designer:

Dr. R. Nirmal Kumar

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

Objectives

To facilitate the students to

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

Course Outcomes

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

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

Mapping with Programme Outcomes

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

S- Strong; M-Medium

Syllabus **45 Hrs**

Lab in Biochemistry

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

Lab in Instrumentation and Analysis

Syllabus **45 hrs**

1. Laboratory rules and regulations –Safety principles and Handling
2. pH measurement of samples using pH meter
3. Preparation of buffers-Phosphate and Tris Buffers
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 Heavy metals from drinking water through AAS/ICP OES

Course Designer:

Dr.R. Nirmal Kumar

PSGR Krishnammal College for Women

DEPARTMENT OF BIOTECHNOLOGY-UG
CHOICE BASED CREDIT SYSTEM & OUTCOME BASED EDUCATION
BACHELOR OF SCIENCE (B.Sc.) BIOTECHNOLOGY– 2022-2025 BATCH
SYLLABUS & SCHEME OF EXAMINATION
Applicable to students admitted during the academic year 2022-2023 onwards (III Sem)

Sem	Part	Subject Code	Title of the Paper		Instruction hours/week	Contact hours	Tutorial	Duration of Examination	Examination Marks			Credits
									CA	ESE	Total	
III	I	TAM2203/	Language Tamil-III/	Language	6	88	2	3	50	50	100	3
		HIN2203/	Hindi-III/									
		FRE2203	French Paper-III									
	II	ENG2203	English Paper-III	English	5	73	2	3	50	50	100	3
	IIIA	BT22C03	**Core Paper-III** Immunology and Immunotechnology	CC	5	73	2	3	50	50	100	5
	IIIA	BT22CP2	**Core Practical- II** Lab in Immunology and Immunotechnology & Genetics and Genetic Engineering	CC	3	45	-	-	-	-	-	-
	IIIA	TH22A28/ BT22A03	**IDC Allied paper III** Statistics for Biotechnology **IDC Allied paper III** Basics of Computer application I	GE	4	58	2	3	30	45	75	4
	IIIA	TH22AP1/ BT22AP2	**Allied Practical II** Lab in Statistics for Biotechnology /Lab in Basics of Computer Application I	GE	2	30	-	-	-	-	-	-
	III	BT22SB01	**Skill based subject-Basics of Bioinformatics**	SEC	3	41	4	-	100	-	100	3
	IIIB	NM22EVS/	**Foundation Course-II** (Environmental Studies)**	AEC	Self study	-	-	-	100	-	100	Grade
		NM22UHR	**Foundation Course-III** (Universal Human Values And Human Rights)	AEC	2	30	-	-	100	-	100	2
	IV	JOB2196	**Job Oriented course** **– Food Safety and Quality Analysis	Before 12.30 pm – Total 60 hrs								Grade

#Allied theory papers with practicals will be evaluated for 50/50 and converted into 30/45 whereas Allied practical's will be evaluated for 50/50 and converted into 25/25

CC – Core Courses
GE – Generic Elective
SEC- Skill Enhancement Course
**Outside regular class hours

CA – Continuous Assessment
ESE - End Semester Examination
AEC – Ability Enhancing Course

QUESTION PAPER PATTERN

CIA Test	-	10	Conducted for 60 marks, 3 units after 50 days
Model Exam	-	20	Conducted for 100 marks after 85 days
Seminar/Assignment/Quiz	-	10	(Q.P. Pattern (2,6,12) Each Unit 20 Marks)
Class Participation	-	7	
Attendance	-	3	
		50	**+ ESE 50 Marks (Conducted for 100 Marks)**

CIA Question Paper Pattern: 1 x 60=60 Marks

One question from each unit with each question comprising of

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

Model Question Paper Pattern: 1 x100 =100 Marks (Each unit carries 20 marks)

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

Internal component for Practicals (for 50 Marks)

Lab Performance	-	24 marks
Regularity	-	8 marks
Model Exam	-	15 marks
Attendance	-	3 marks (96-100%- 3 marks; 91-95%- 2 marks; 85-90%- 1 mark)
Total	-	50 marks

ESE Practicals Pattern

The End Semester Examination will be conducted for a maximum of 100 marks with a maximum 20 marks for the record and other submissions if any.

Skill Based Subject : 100 Marks
Test 1 (Theory / Practical) : 50marks
Test 2 (Theory / Practical / Project) : 50marks
Total : 100 Marks

COURSE NUMBER	COURSE NAME	CATEGORY	L	T	P	CREDIT
BT22CO3	Core Paper III- IMMUNOLOGY AND IMMUNOTECHNOLOGY	CORE THEORY	73	2	-	5

Objectives:

This course presents the basic defence mechanism of animals

- To make the student to understood the concept immunology
- To understand the immune response made in humans to foreign antigens including microbial pathogens
- To give the description of cells involved in the immune response as well to understand how the immune system recognizes self from non-self
- To introduce the basic concepts of immuno diagnosis and therapy

Course 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 basic concepts of immunological processes	K1
CLO 2	Understand the genetic basis for immunological diversity and the generation of adaptive immune responses	K2
CLO 3	Apply the ideology of antigen –antibody reactions in various immune techniques and its potential therapeutic applications	K3
CLO 4	Analyse the principle behind the Immunodeficiency disorders and screen the suitable drug utilizing advanced molecular techniques	K4

Mapping with Programme Outcomes

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

*S- Strong; M-Medium;

IMMUNOLOGY AND IMMUNOTECHNOLOGY

SYLLABUS
73 hrs

Unit: I Basics of Immunology and Immune System

14 hrs

Introduction- Historical Development in Immunology. Types of immunity – Innate and acquired, Primary and Secondary immune response. Cells involved in immune response. Primary and Secondary lymphoid organs – Thymus, Bone marrow, Lymph nodes and Spleen. Lymphocytes traffic and regulation.

Unit: II Components of Immune Cells

15 hrs

Antigen- Essential features, classification of antigens, Epitopes, Haptens, Adjuvants, Cross reactivity, Synthetic antigens. Antibody – Structure, Types, properties and their biological functions, Monoclonal and polyclonal antibody. Hematopoiesis: Development, maturation, activation, regulation, differentiation and classification of T-cells and B-cells.

Unit: III Humoral and Cellular Immunity

15 hrs

Components of complement system, Complement – activation and regulation. Cytokines- Interleukins and interferons production and their biological functions. Antigen presenting cells; Major histocompatibility complex structure and function - Antigen processing and presentation, HLA typing.

Unit: IV Immune Tolerance and Hypersensitivity

14 hrs

Immune tolerance, Immuno deficiencies; Immunosuppression, Transplantation – genetics of transplantation, laws of transplantation. Allergy and hypersensitivity – Types of hypersensitivity. Primary and secondary Immunodeficiency disorders. Immune response to infectious diseases, Immunodeficiency diseases (AIDS).

Unit: V Applied Immunology

15 hrs

Monoclonal antibodies - antibodies production and applications. Engineering of antibodies; Classification of Vaccines - Attenuated, sub-unit vaccine -COVID vaccines, DNA and RNA vaccines and anti-idiotype vaccines, methods of vaccine development, Immunodiagnostic methods-Immunodiffusion, agglutination, precipitation, complement fixation, Immunofluorescence, Immunoblotting ELISA, FACS),Immuno- modulatory drugs and Immunotherapy.

TEXT BOOKS

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

REFERENCE BOOKS

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

Course designers:

Dr. R. Nirmal Kumar

Dr. G. Anbarasi

BT22CO3-Core Paper III- IMMUNOLOGY AND IMMUNOTECHNOLOGY				
Module No.	**Topic**	**No. of periods**	**Content delivery methods**	**CLO'S**
UNIT I-Basics of Immunology and Immune System				
1	Introduction- Historical Development in Immunology	2	Lecture and PPT, Quiz (Wordcloud-mentimeter)	CLO1
2	Types of immunity – Innate and acquired, Primary and Secondary immune response	3	PPT and Quiz (Kahoot)	CLO1
3	Primary and secondary immune response	2	Lecture PPT (synthesia) https://www.youtube.com/watch?v=qKGm3CXBCGU	CLO1
4	Cells involved in immune response	2	Demonstration and PPT	CLO1
5	Primary and Secondary lymphoid organs – Thymus, Bone marrow, Lymph nodes and Spleen	3	Model making -PPTs	CLO1
6	Lymphocytes traffic and regulation	2	PPT and Video https://www.youtube.com/watch?v=rOb_rburbv0	CLO1
UNIT II-Components of Immune Cells				
7	Antigen- Essential features, classification of antigens, Epitopes, Haptens, Adjuvants, Cross reactivity, Synthetic antigens	3	Lecture-PPTs-Video-Quiz (Socrative) https://www.pearson.com/channels/biology/asset/d4f6d275/b-cell-development	CLO2
8	Antibody – Structure, Types, properties and their biological functions	4	Lecture-PPTs (synthesia)-	CLO2
9	Monoclonal and polyclonal antibody	3	Lecture and PPT(Synthesia)	CLO2
10	Hematopoiesis: Development, maturation, activation, regulation, differentiation and classification of T-cells and B-cells	5	Model making -PPTs-Video https://www.youtube.com/watch?v=0deCbmh7PHs	CLO2
UNIT III-Humoral and Cellular Immunity				
11	Components of complement system	2	Lecture-PPTs- Quiz (Google forms)	CLO3
12	Complement – activation and regulation medication	3	Lecture-PPTs-Video https://www.youtube.com/watch?v=d6qFPegEYV0 https://www.youtube.com/watch?v=IUDSWPvfHgU	CLO3
13	Cytokines- Interleukins and interferons production and their biological functions	3	Lecture-PPTs, Gaming	CLO3

14	Antigen presenting cells; Major histocompatibility complex structure and function	3	Group presentation Model making	CLO3
15	Antigen processing and presentation	2	Lecture-PPTs-Video https://www.youtube.com/watch?v=LwLYGTS_3EI	CLO3
16	HLA typing	2	Seminar and Discussion	CLO3
UNIT IV-Immune Tolerance and Hypersensitivity				
17	Immune tolerance, Immuno deficiencies	2	Lecture-PPTs- Quiz (Socrative)	CLO4
18	Immunosuppression Transplantation-genetics of transplantation, laws of transplantation	3	Seminar and Discussion	CLO4
19	Allergy and hypersensitivity – Types of hypersensitivity	3	Video Lecture and Discussion https://www.youtube.com/watch?v=1B0AIPYTH70	CLO4
20	Primary and secondary Immunodeficiency disorders	3	Flipped classroom –Quiz (kahoot)	CLO4
21	Immune response to infectious diseases, Immunodeficiency diseases (AIDS)	3	Lecture-PPTs- Quiz (mentimeter)	CLO4
UNIT V-Applied Immunology				
22	Monoclonal antibodies - antibodies production and applications. Engineering of antibodies	4	Discussion and Seminar	CLO3,CLO4
23	Classification of Vaccines - Attenuated, sub-unit vaccine -COVID vaccines, DNA and RNA vaccines and anti-idiotype vaccines, methods of vaccine development	4	Interaction on topics and Assignment (Creating Blogs)	CLO3,CLO4
24	Immunodiagnostic methods-Immunodiffusion, agglutination, precipitation, complement fixation, Immunofluorescence, Immunoblotting ELISA, FACS)	4	Flipped Classroom- Quiz (mentimeter)	CLO3,CLO4
25	Immuno- modulatory drugs, Immunotherapy	3	Lecture-PPTs- Quiz (Quizizz) https://www.youtube.com/watch?v=UbFjiWOBErA	CLO3,CLO4

COURSE NUMBER	COURSE NAME	CATEGORY	L	T	P	CREDIT
BT22CP2	Core Practical II- Lab in Immunology and Immunotechnology & Genetics and Genetic Engineering	CORE PRACTICAL	-	-	90	4

Objective

To facilitate the students to

- Gain adequate expertise required to identify and enumerate immune cells and also execute agglutination reactions.
- To familiarize the students plant genetic engineering and gene transfer techniques.
- To Provide an opportunity to experimentally verify the theoretical principles of genetic Engineering in a more explicit and concentrated manner.

Course Outcomes

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

CLO	CLO Statement	Knowledge Level
CLO 1	Understand various immune cells and enumerate them and identify blood groups and types	K1
CLO 2	Employ the ideology of antigen –antibody reactions in various immune techniques and its potential therapeutic applications	K2
CLO 3	Apply the molecular techniques employed to study the genetic make up of an individual and manipulate it	K3
CLO 4	Develop and apply the recent technology in screening the recombinant clones	K4

Mapping with Programme Outcomes

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

*S- Strong; M-Medium; L- Low

SYLLABUS **45 Hrs**

LAB IN IMMUNOLOGY AND IMMUNOTECHNOLOGY

1. Separation of Serum and plasma from Blood
2. Cell Counting using Haemocytometer– RBC and WBC
3. Differential leukocyte count by Leishmann's staining
4. Identification of blood group and Rh typing
5. Testing for typhoid antigens by Widal test
6. Testing for Anti streptolysin– O
7. Single Radial Immunodiffusion
8. Immunodiffusion – Ouchterlony Double Diffusion
9. Immunoelectrophoresis – Rocket immunoelectrophoresis
10. Enzyme Linked Immuno Sorbent Assay (ELISA) (Demo)

SYLLABUS **45 Hrs**

LAB IN GENETICS AND GENETIC ENGINEERING:

1. Dominant and Recessive trait in Pea plant- Mendelian Inheritance
2. Barr body identification in buccal cavity
3. Mitotic Preparation in Onion root tip
4. Meiosis – flower buds of Rheo discolor
5. Staining of Chromosomes - Giemsa staining
6. DNA Laddering/DNA fragmentation Assay
7. Gene amplification by Gradient temperature PCR
8. Restriction digestion of pUC8/pCambia 1302
9. Ligation of digested vector and amplified gene
10. Competent cell preparation and transformation of gene
11. Screening of recombinants- Blue white selection
12. Isolation of recombinant plasmid and restriction Digestion

TEXT BOOKS

S.No	Authors	Year	Title of the book	Publishers
1.	Carson, S and Miller, H.B.	2019	Molecular Biology Techniques	Academic Press.4th Edition
2.	Frank C Hay, Olwyn M.R.	2008	Practical Immunology	Wiley- Blackwell, 4th edition
3.	David Male, Jonathan Brost, David Roth, Ivan Roitt	2012	Immunology	Elsevier, 8th edition

Course Designers:

Dr.R. Nirmal Kumar
Dr. G. Anbarasi

COURSE NUMBER	COURSE NAME	CATEGORY	L	T	P	CREDIT
BT22A03	Allied Paper II – BASICS OF COMPUTER APPLICATION I	ALLIED THEORY	58	2	-	4

Objective

The main objectives of this course are

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

Course 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 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

BASICS OF COMPUTER APPLICATION I

SYLLABUS **58 hrs**

Unit-1 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. Pagelayout. Margins, Orientation, Page Borders and Shading. Inserting Bookmark, Shapes, Word Art, Page Numbers, Mail Merge.

Unit-III MS-Excel 12 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 11 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

REFERENCE BOOKS

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

Course Designer:

Dr.R.Nirmal Kumar

BT22A03 - Allied Paper II - BASICS OF COMPUTER APPLICATION I				
Module No.	**Topic**	**No. of periods**	**Content delivery methods**	**CLO'S**
Unit-1 Basics of Computers				
1	Definition of a Computer - Characteristics of computers, Applications of Computers.	3	Lecture and PPT, Quiz (Word cloud-mentimeter)	CLO1
2	Block Diagram of a Digital Computer. Input devices and Output devices. Devices, hardware, software human ware, application software, system software	3	PPT and Quiz (Kahoot)	CLO1
3	Memories - Primary, Auxiliary and Cache Memory. MS Windows – Desktop, Recycle bin,	3	Lecture PPT (synthesia)	CLO1
4	My Computer, Documents, Pictures, Music, Videos, Task Bar, Control Panel	3	Model making -PPTs	CLO1
Unit-II MS Word				
5	Microsoft Word – Components of MS Word - Creating, Editing, Formatting and Printing of word.	3	Lecture-PPTs-Video-Quiz (Socrative)	CLO2
6	Documents, Insert Headers and Footers, Draw Tables, Table Auto format. Pagelayout.	3	Lecture-PPTs (synthesia)-	CLO2
7	Margins, Orientation, Page Borders and Shading.	3	Lecture and PPT(Synthesia)	CLO2
8	Inserting Bookmark, Shapes, Word Art, Page Numbers, Mail Merge.	3	Model making -PPTs-Video	CLO2
Unit-III MS-Excel				
9	Overview of Excel features – Create new worksheet, Selecting cells,	3	Lecture-PPTs- Quiz (Google forms)	CLO3
10	Entering and editing Text, Numbers, Inserting Rows/Columns	3	Lecture-PPTs-Video https://www.youtube.com/watch?v=d6qFPegEYV0 https://www.youtube.com/watch?v=IUDSWPvfHgU	CLO3
11	Changing column widths and row heights, Insert formulas-Statistical, mathematical and basic	3	Lecture-PPTs, Gaming	CLO3

12	Formulae, Insert graphs, graph types and Interpreting the Data. Change font size, Colouring and shading the texts.	3	Group presentation Model making	CLO3
Unit-IV PowerPoint				
17	PowerPoint: Basic of power point, creating and editing slides, formatting slides.	2	Lecture-PPTs- Quiz (Socrative)	CLO4
18	Master slides, Templates, coloring text and objects	3	Seminar and Discussion	CLO4
19	Transitions, heading slides, using clip art gallery	3	Video Lecture and Discussion	CLO4
20	Chart creations, Managing files	3	Flipped classroom –Quiz (kahoot)	CLO4
Unit- V Internet of Things and Development of India in IOT				
22	Internet of Things: Introduction, Definition & characteristics of IOT, IOT in everyday life	3	Discussion and Seminar	CLO3,CLO4
23	Internet of everything. IOT Applications: Intelligent Traffic systems, Smart Parking, Smart cities and location sharing	3	Interaction on topics and Assignment (Creating Blogs)	CLO3,CLO4
24	Smart Agriculture, IOT in education. Development of India in IOT: Solar Plant System, ATM chip card system , IOT in health care industry	3	Flipped Classroom- Quiz (mentimeter)	CLO3,CLO4
25	IOT in rural empowerment. Challenges in IOT: Big Data Management, Connectivity challenges	2	Lecture-PPTs- Quiz (Quizizz)	CLO3,CLO4

COURSE NUMBER	COURSE NAME	CATEGORY	L	T	P	CREDIT
BT22AP2	**Allied Practical II - Lab in Basics of Computer application**	**ALLIED PRACTICAL**		**-**	**30**	**2**

Objectives

- 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 Outcomes

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

CLO	CLO Statement	Knowledge Level
CLO 1	Understand the basics of Microsoft office and its various applications	K1
CLO 2	Comprehend the power point usage in creating presentations for seminar	K2
CLO 3	Apply the knowledge of MS excel in drawing graphs and interpreting the data	K3
CLO 4	Analyze the usage of MS access in creating databases	K4

Mapping with Programme Outcomes

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

*S- Strong; M-Medium

LAB IN BASICS OF COMPUTER APPLICATION

SYLLABUS **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	Year	Title of the book	Publishers
1.	N.Krishnan	2001	Computer fundamentals and windows with internet technology	SCITECH Publications

Course Designer:

Dr.R.Nirmal Kumar

COURSE NUMBER	COURSE NAME	CATEGORY	L	T	P	CREDIT
BT22SB01	**Skill based subject –Basics of Bioinformatics**	**SBS THEORY**	41	4	-	3

Objective

- 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 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 Course Learning Outcomes

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

* S-Strong, M-Medium

BASICS OF BIOINFORMATICS

SYLLABUS **41 hrs**

Unit I- Biological Sequence 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. Modeled Structure visualization and validation.

Unit V- Application of Bioinformatics **9 hrs**

Computer aided drug design - Introduction to docking, types, virtual screening, steps in molecular docking, drug-receptor interaction. Waste cleanup - prediction of toxic chemicals and biodegradation pathway.

TEXT BOOKS

S.No	Authors	Year	Title of the book	Publishers
1.	R. Amjesh, S.S. Vinodchandra	2019	Bioinformatics for beginners	LAP LAMBERT Academic Publishing
2.	Arthur M. Lesk	2019	Introduction to Bioinformatics5th	Oxford University Press;
3.	S. C. Rastogi, N. Mendiratta and P. Rastogi	2022	Bioinformatics: Methods And Applications: Genomics,Proteomics And Drug Discovery 5th edition	Phi Learning
4.	Pevsner J.	2015	Bioinformatics and Functional Genomics 3rd edition	Wiley-Blackwell

REFERENCE BOOKS

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

Course Designers:

Dr. G. Shalini

Dr. V. Bhuvaneshwari

BT22SB01- Skill based subject –Basics of Bioinformatics				
Module No.	**Topic**	**No. of periods**	**Content delivery methods**	**CLO'S**
UNIT I- Biological Sequence Databases				
1	Introduction to bioinformatics	1	Lecture	CLO1
2	National Center for Biotechnology Information (NCBI)- Tools and Databases of NCBI, Nucleotide Database, Protein Database, Gene Expression Database	2	PPTs and Video https://www.youtube.com/watch?v=QLcmEqBayr0	CLO1
3	EMBL Nucleotide Sequence Database (EMBL-Bank)- Introduction, SequenceRetrieval, Sequence Submission to EMBL, Sequence analysis tools.	2	Demonstration and Video https://www.youtube.com/watch?v=Hb8oWM-NQLE	CLO1
4	DNA Data Bank of Japan (DDBJ): Introduction, Resources at DDBJ, DataSubmission at DDBJ.	2	PPTs and Quiz((kahoot)	CLO1
5	Swiss-Prot- Introduction and Salient Features	1	Lecture and demonstration	CLO1
UNIT II- Sequence alignment and Phylogenetic analysis				
6	Introduction to Sequence analysis (Proteins and Nucleic acids) – FASTA formatting, Sequence alignment methods- Pairwise alignment (Local and Global) – BLAST, Multiple alignment – CLUSTAL W.	4	Lecture –demonstration and Quiz (Socrative)	CLO2
7	Phylogenetic Basics- Molecular evolution and Phylogeny, Terminology, forms of tree representation.	2	PPTs and Discussion	CLO2
8	Phylogenetic tree construction methods and programs- Distance-Based methods, Character-Based methods.	2	Lecture and PPTs	CLO2
UNIT III- Nucleotide sequence analysis				
9	Analyze nucleotide sequences – detecting ORFs, finding genes, constructing restriction maps, designing primers and probes	3	PPTs and Quiz(Quizizz)	CLO3
10	Plant genomic databases-Ensembl Plants and TAIR	1	Lecture and demonstration	CLO3
11	Animal genomic databases - Mouse Genome Informatics and FlyAtlas	2	PPTs and video https://www.youtube.com/watch?v=qZ8P_6Mwtc4	CLO3
12	Specialized Genome databases- SGD, TIGR, and ACeDB.	2	Lecture and video https://www.youtube.com/watch?v=zq7OIWBE34g	CLO3
Unit IV- Structural Bioinformatics				
13	Protein structure basics, structure databases- PDB, CATH, SCOP, and PDBsum	2	Lecture and video	CLO4

			https://www.youtube.com/watch?v=piXHivrTT-E	
14	Methods for protein structure prediction- Secondary structure predictions - Chou-Fasman and Garnier- Osguthorpe- Robson (GOR) method	2	Demonstration and PPTs	CLO4
15	Tertiary structure predictions – Homology Modelling and threading	2	Lecture and PPTs	CLO4
16	Modeled Structure visualization and validation.	2	Demonstration and Quiz (Mentimeter)	CLO4
UNIT V- Application of Bioinformatics				
17	Computer aided drug design - Introduction to docking, types, virtual screening.	3	PPTs-Quiz (Quizizz)	CLO4
18	Steps in molecular docking, drug-receptor interaction.	3	Demonstration and Hands-on	
19	Waste cleanup - prediction of toxic chemicals and biodegradation pathway.	3	Case study and Lecture	CLO4

Course Number	Course NAME	CATEGORY	L	T	P	Credit
JOB2196	JOB ORIENTED COURSE-Food Safety and Quality Analysis	JOC Theory	40	-	-	

Objectives

To enable the students to

- Learn about the methods of sample preparation
- Understand the working principle of different instrumentation techniques
- Gain knowledge about quality parameters of a food products

COURSE OUTCOMES

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

CLO	CO Statement	Knowledge Level
CLO1	Acquire knowledge on sample preparation and laboratory safety measures	K1
CLO2	Outline the underlying principle behind different instrumentation techniques	K2
CLO3	Understand the procedures involved in the analysis of different components of food	K2
CLO4	Explain the quality parameters of different food products	K3

MAPPING WITH PROGRAMME OUTCOMES

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

*S: Strong, M: Medium

FOOD SAFETY AND QUALITY ANALYSIS

SYLLABUS 40 hrs

Unit I Introduction to food Analysis 8 hrs

Scope and Importance of Analysis. Adulteration. Composition of Foods, Proximate constituents and analysis, sampling and sample preparation- preparation of laboratory samples and storage of samples, safety rules in a laboratory, preparation of primary and secondary solutions, quality of data

Unit II Proximate Analysis of Foods 8 hrs

Analysis of moisture content, ash content, mineral content, Carbohydrates, proteins, fats, pigments, vitamins and miscellaneous components. Microbial parameters of food products.

Unit III Quality analysis of Various food products 8 hrs

Principle, theory and methods of analysis for – Cereals, Millets, Pulses and related products, Fruits and Vegetables, Oil and Oil seeds, Milk and milk products, Beverages-Tea coffee and cocoa, alcoholic and non – alcoholic beverages, sugar confectionery, Honey and honey related products

Unit IV Water Quality Analysis 8 hrs

Packaged drinking water and water quality standards, sampling, water quality monitoring, hardness, chloride, pH, sulphates, phosphates, pesticides. Microbial parameters

Unit V Food Laws and Regulations 8 hrs

Introduction to food laws, FSSAI, HACCP- Introduction, Definition, Principles and Role of HACCP in food industry. Laws and Regulations. Basics and Principles of GMP/GHP, GLP,AOAC,ISI,BIS.

TEXT BOOKS

S.No	Name of the Authors	Title of the Book	Publishers	Year of Publication
1	A.Y.Sathe`	A first course in food Analysis	New Age International Publishers	1999
2.	Kirk, RS and Sawyer, R.	Pearson's Chemical Analysis of Foods.	Longman Scientific and Technical	1991
3.	S. Suzanne Nielsen	Introduction to Chemical Analysis of Foods	CBS Publishers and Distributers	2002

REFERENCE BOOKS

S.No	Name of the Authors	Title of the Book	Publishers	Year of Publication
1.	Ranganna S.	Handbook of Analysis and Quality Control for Fruit and Vegetable Products	Tata-McGraw-Hill Publishers	2001
2.	Leo ML Nollet	Handbook of food analysis: Physical characterization and nutrient analysis	CRC Press	2004
3.	Pomrenz Y & Meloan CE	Food Analysis - Theory and Practice.	CBS	1996

Course Designer:

Dr. R. Nirmal Kumar

COURSE NUMBER	COURSE NAME	CATEGORY	L	T	P	CREDIT
JOB2196	JOC - Food Safety and Quality Analysis	JOC PRACTICALS	-	-	20	

Objectives

To enable the students to

- Understand fundamental constituents of proximate analysis of food
- To obtain knowledge on various attributes of food and water samples as per recommended standards
- To Analyze the microbiological safety of food items
- To develop new methodologies to measure the quality of food

COURSE OUTCOMES

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

CLO	CO Statement	Knowledge Level
CLO1	Understand major food constituents in food	K1
CLO2	Gain knowledge on analysis of various attributes in food and water sample	K2
CLO3	To Analyse the microbiological parameters from food and water	K3
CLO4	Apply the concept of food safety in maintaining the food quality	K4

MAPPING WITH PROGRAMME OUTCOMES

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

*S: Strong, M: Medium

LAB IN FOOD SAFETY AND QUALITY ANALYSIS

SYLLABUS **20 hrs**

1. Determination of pH and moisture content in food
2. Estimation of protein content in food through kjeldahl analyser
3. Estimation of fat content in food through Soxhlet apparatus
4. Determination of chlorides in water sample
5. Determination of hardness in water sample
6. Determination of Alkalinity of water sample
7. Microbiological Analysis : Total Plate count and total coliform count
8. Analysis using Atomic Absorption Spectrophotometer
9. Adulteration test- Baudin Test, Furfural Test and Quick test for Milk,turmeric and Oil, Honey suggested in FSSAI manual

TEXT BOOKS

S.No	Name of the Authors	Title of the Book	Publishers	Year of Publication
1.	Dr. GeethaSwaminathan Ms. Mary George	Laboratory Chemical Methods in Food Analysis	Margham Publishers	2002
2.	Kirk, RS and Sawyer, R.	Pearson's Chemical Analysis of Foods.	Longman Scientific and Technical	1991
3.	S. Suzzane Neilsen	Introduction to the chemical analysis of foods	CBS	2001
4.	Food safety and standards Authority of India, Ministry of health and family welfare	FSSAI Manual of methods for analysis of foods	Government of India	2016

Course Designer:

Dr. R. Nirmal Kumar

COURSE NUMBER	PROFESSIONAL ENGLISH FOR LIFE SCIENCES	Category	L	T	P	Credit
21PELS1			26	4		2

Objectives

1. To develop the language skills of students by offering adequate practice in professional contexts.
2. To enhance the lexical, grammatical and socio-linguistic and communicative competence of first year students
3. To focus on developing students' knowledge of domain specific registers and the required language skills.
4. To develop strategic competence that will help in efficient communication
5. To sharpen students' critical thinking skills and make students culturally aware of the target situation.

Course Outcomes

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

CLO Number	CLO Statement	Knowledge Level
CLO1	Recognize their own ability to improve their own competence in using the language	K1
CLO2	Use language for speaking with confidence in an intelligible and acceptable manner	K2
CLO3	Read independently unfamiliar texts with comprehension and understand the importance of reading for life	K3
CLO4	Understand the importance of writing in academic life	K3
CLO5	Write simple sentences without committing error of spelling or grammar	K3

(Outcomes based on guidelines in UGC LOCF – Generic Elective)

Mapping with Programme Outcomes

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	S	M	S	M	S
CLO2	M	M	S	S	M
CLO3	S	M	M	S	M
CLO4	S	S	M	M	M
CLO5	M	S	S	M	M

S- Strong; M-Medium

Syllabus

UNIT 1: COMMUNICATION **8 hours**

Listening: Listening to audio text and answering question, Listening to Instructions, **Speaking**: Pair work and small group work. **Reading:** Comprehension passages –Differentiate between facts and opinion, **writing:** Developing a story with pictures**. Vocabulary:** Register specific - Incorporated into the LSRW tasks

UNIT 2: DESCRIPTION **8 hours**

Listening: Listening to process description.-Drawing a flow chart. **Speaking:** Role play (formal context) **Reading:** Skimming/Scanning- Reading passages on products, equipment and gadgets. **Writing:** Process Description –Compare and Contrast Paragraph-Sentence Definition and Extended definition- Free Writing. **Vocabulary:** Register specific -Incorporated into the LSRW tasks.

UNIT 3: NEGOTIATION STRATEGIES **8 hours**

Listening: Listening to interviews of specialists / Inventors in fields (Subject specific), **Speaking:** Brainstorming. (Mind mapping), Small group discussions (Subject- Specific) **Reading:** Longer Reading text. **Writing**: Essay Writing (250 words) **Vocabulary:** Register specific - Incorporated into the LSRW tasks

UNIT 4: PRESENTATION SKILLS **8 hours**

Listening: Listening to lectures. **Speaking:** Short talks. **Reading:** Reading Comprehension passages, **Writing:** Writing Recommendations Interpreting Visuals inputs, **Vocabulary:** Register specific - Incorporated into the LSRW tasks

UNIT 5: CRITICAL THINKING SKILLS **8 hours**

Listening: Listening comprehension- Listening for information. Speaking: Making presentations (with PPT- practice). Reading : Comprehension passages –Note making. Comprehension: Motivational article on Professional Competence, Professional Ethics and Life Skills),Writing: Problem and Solution essay– Creative writing –Summary writing ,Vocabulary: Register specific - Incorporated into the LSRW tasks

Textbook

S.No.	Authors	Title of the Book	Publishers	Year of Publication
1	Tamil Nadu State Council for Higher Education (TANSCHE)	English for Life Sciences Semester 1	--	--

Reference Books

S.No	Authors	Title of the Book	Publishers	Year of Publication
1	Sreedharan, Josh	The Four Skills for Communication	Foundation books	2016
2	Pillai, G Radhakrishna, K Rajeevan, P Bhaskaran Nair	Spoken English for you	Emerald	1998
3	Pillai, G radhakrishna, K Rajeevan, P Bhaskaran Nair	Written English for you	Emerald	1998

Evaluation pattern: Internal 50 marks
ESE 50 marks

NOTE :
Internals 5 tests x 10 marks each =50 marks
Test 1 : Listening
Test 2 : Speaking
Test 3 : Reading
Test 4 : Listening
Test 5 : Speaking

ESE: **Only Reading, Writing and Vocabulary components from all 5 units**
Question Paper pattern for ESE
Section A : 5 x 2 = 10 marks
Section B : 4/6 x 5 = 20 marks
Section C : 2/3 x 10 = 20 marks
Total = 50 Marks

PSGR
Krishnammal College for Women

DEPARTMENT OF BIOTECHNOLOGY

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

(Semester –IV)

BACHELOR OF SCIENCE -BIOTECHNOLOGY

2022 – 2025 BATCH

B.Sc BIOTECHNOLOGY

PROGRAMME LEARNING OUTCOME (PLO):

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

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

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

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

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

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

PROGRAMME SPECIFIC OUTCOME:

At the end of the programme the student will

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

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

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

PSO4: Initiate new start ups in areas of biotechnology.

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

PSGR Krishnammal College for Women

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

Applicable to students admitted during the academic year 2022-2023 onwards (IV Sem)

SEM	Part	Subject Code	Title of the Paper		Instruction hours/week	Contact hours	Tutorial	Duration of Examination	Examination Marks			Credits
									CA	ESE	Total	
IV	I	TAM220/ HIN2204/ FRE2204	Language Tamil/ Hindi/ French Paper IV	Language	5	73	2	3	50	50	100	3
	II	ENG2204	English Paper-IV	English	6	88	2	3	50	50	100	3
	IIIA	BT22C04	**Core Paper -IV-** Genetics and Genetic Engineering	CC	5	73	2	3	50	50	100	5
	IIIA	BT22CP2	**Core Practical - II -** Lab in Immunology and Immunotechnology & Genetics and Genetic Engineering (Core paper III & IV)	CC	3	45	-	-	50	50	100	4
	IIIA	TH22A30	**IDC Allied paper II-** Advanced Statistics For Biotechnology	GE	4	58	2	3	30	45	75#	4
		BT21A04	**IDC Allied paper II** Programming for Computer application									
	IIIA	TH22AP1/ BT21AP2	**IDC Allied Practical II** Lab in Statistics for Biotechnology/ Lab in Basics of Computer application & Programming in Computer application	GE	2	30	-	3	25	25	50#	2
	IIIB	BT22SBP1 / BT22SBCE	**Skill based subject Practicals**– Biomolecular Computing / Coursera course – Personalized Medicine	SEC	3	41/ 45	4/-	-	100	-	100	3
	IIIB	NM22DTG	**Design Thinking**	FSA	2	30	-	-	100	-	100	2
	IV	JOB2196	**Job Oriented course** –** Food Safety and Quality Analysis	Before 12.30 pm – Total 60 h								Grade**

	V		NSS/NCC/YRC/Sports /Ecowatch/ YiNET/ Rotract/ Gender Championship Club/Well Being Campaigner Club/E-Cell/Consumer Club/Lions Club		-	-	-	-	-	-	100	1
		COM15SER	Community Oriented Programme**	30 h					-	-	100	Grade**

CC – Core Courses CA – Continuous Assessment
GE – Generic Elective ESE - End Semester Examination
FSA- Finishing School Part A SEC- Skill Based Subject
AECC – Ability Enhancing Course

#Allied theory papers with practical's will be evaluated for 50/50 and converted into 30/45 for Theory

**** Outside regular working hours**

QUESTION PAPER PATTERN

CIA Test	- 10 Conducted for 60 marks, 3 units after 50 days
Model Exam	- 20 Conducted for 100 marks after 85 days (Q.P. Pattern (2,6,12) Each Unit 20 Marks)
Seminar/Assignment/Quiz	- 10
Class Participation	- 7
Attendance	- 3
	50 + ESE 50 Marks (Conducted for 100 Marks)

CIA Question Paper Pattern: 1 x 60 = 60 Marks

One question from each unit with each question comprising of

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

ESE/Model Question Paper Pattern: 1 x 100 = 100 Marks (Each unit carries 20 marks)

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

Skill Based Subject	**: 100 Marks**
Test 1 (Theory/Practical)	- 50 marks
Test 1 (Theory/Practical/Project)	- 50 marks
Total	**-100 marks**

Internal component for Practicals (for 50 Marks)

Lab Performance	-24 marks
Regularity	-8 marks
Model Exam	-15 marks
Attendance	-3 marks (96-100%- 3 marks; 91-95%- 2 marks; 85-90%- 1 mark)
Total	-50 marks

ESE Practicals Pattern

The End Semester Examination will be conducted for a maximum of 100 marks with a maximum 20 marks for the record and other submissions if any

COURSE NUMBER	COURSE NAME	CATEGORY	L	T	P	CREDIT
BT22C04	**Core Paper -IV- Genetics and Genetic Engineering**	**CORE**	**73**	**2**	**-**	**5**

Learning Objectives

- To study the basic mendelian genetics
- To enumerate the effects on gene alterations
- To analyze the enzymes and tools involved in cloning
- To evaluate plasmids used and the strategies to execute them
- To evaluate screening techniques to identify clones

Course Outcomes

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

CLO Number	CLO Statement	Knowledge Level
CLO 1	Understand the principles of genetics and chromosomal theories	K1
CLO 2	Acquire the knowledge on alterations in chromosomes and their ill effects on human beings	K2
CLO 3	Understand and apply basic tools employed in genetic engineering	K2
CLO 4	Acquire the knowledge of the cloning strategies, analyze, evaluate and screen the putative clones	K3

Mapping with Programme Outcomes

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

S- Strong; M-Medium; L-Low

GENETICS AND GENETIC ENGINEERING

SYLLABUS

UNITI: Principles of Mendelian Inheritance **15 h**

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, Sex limited and sex influenced characters.

UNIT II: Alterations in chromosome **15 h**

Chromosomal abberations: 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, FISH, CGH. Human Genetic Diseases - Down's, Turner's, Klinefelter's syndrome.

UNIT III: Tools for rDNA technology **15 h**

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 **14 h**

Bacterial plasmids, pBR322, pUC18.Cosmids (pJB8), Phagemids (pGEM).M13 based Single strand vectors (M13-mp8), Shuttle vectors (YEp) 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.

UNITV: Gene cloning and Screening **14 h**

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, colony and plaque hy

TEXT BOOKS

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

REFERENC BOOKS

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

Course Designers:

1. Dr.Anabarasi. G

2. Dr.R.Nirmal Kumar

3. Dr.V.Bhuvaneshwari

COURSE NUMBER	COURSE NAME	CATEGORY	L	T	P	CREDIT
BT22CP2	**Core Practical II-** Immunology and Immunotechnology & Genetics and Genetic Engineering	**CORE PRACTICAL**	**-**	**-**	**90**	**4**

Learning Objectives

- To gain adequate expertise required to identify and enumerate immune cells and also execute agglutination reactions.
- To familiarize the students plant genetic engineering and gene transfer techniques.
- To provide an opportunity to experimentally verify the theoretical principles of genetic Engineering in a more explicit and concentrated manner.

Course Outcomes

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

CLO	CLO Statement	Knowledge Level
CLO 1	Understand various immune cells and enumerate them and identify blood groups and types	K1
CLO 2	Employ the ideology of antigen –antibody reactions in various immune techniques and its potential therapeutic applications	K2
CLO 3	Apply the molecular techniques employed to study the genetic makeup of an individual and manipulate it	K3
CLO 4	Develop and apply the recent technology in screening the recombinant clones	K4

Mapping with Programme Outcomes

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

*S- Strong; M-Medium; L- Low

SYLLABUS **45 h**

LAB IN IMMUNOLOGY AND IMMUNOTECHNOLOGY

- Separation of Serum and plasma from Blood
- Cell Counting using Haemocytometer– RBC and WBC
- Differential leukocyte count by Leishmann's staining
- Identification of blood group and Rh typing
- Testing for typhoid antigens by Widal test
- Testing for Anti streptolysin– O
- Single Radial Immunodiffusion
- Immunodiffusion – Ouchterlony Double Diffusion
- Immunoelectrophoresis – Rocket immunoelectrophoresis
- Enzyme Linked Immuno Sorbent Assay (ELISA) (Demo)

SYLLABUS **45 h**

LAB IN GENETICS AND GENETIC ENGINEERING:

- Dominant and Recessive trait in Pea plant- Mendelian Inheritance
- Barr body identification in buccal cavity
- Mitotic Preparation in Onion root tip
- Meiosis – flower buds of Rheo discolor
- Staining of Chromosomes - Giemsa staining
- DNA Laddering/DNA fragmentation Assay
- Gene amplification by Gradient temperature PCR
- Restriction digestion of pUC8/pCambia 1302
- Ligation of digested vector and amplified gene
- Competent cell preparation and transformation of gene
- Screening of recombinants- Blue white selection
- Isolation of recombinant plasmid and restriction Digestion

TEXT BOOKS

S.No	Authors	Year	Title of the book	Publishers
1.	Carson, S and Miller, H.B.	2019	Molecular Biology Techniques	Academic Press.4thEdition
2.	Frank C Hay, Olwyn M.R.	2008	Practical Immunology	Wiley- Blackwell, 4thedition
3.	David Male, Jonathan Brost, David Roth, Ivan Roitt	2012	Immunology	Elsevier, 8thedition

REFERENCE BOOKS

S.No	Authors	Year	Title of the book	Publishers
1.	Bineeta Singh,G.M.Lal	2022	Practical manual of Genetics and Plant breeding	SS Publishing House
2.	Venison, S.John	2009	Practical manual for Genetic Engineering	PHI Learning Pvt.Ltd.,

Course Designers:

Dr. R. Nirmal Kumar

Dr. G. Anbarasi

COURSE NUMBER	COURSE NAME	CATEGORY	L	T	P	CREDITS
BT22SBP1	**Skill based subject Practicals–** Biomolecular Computing	**SBS-Practicals**	-	**4**	**41**	**3**

Learning Objectives:

- To learn the fundamentals of protein structure and modelling
- To learn phylogenetic relationships
- To learn the concepts of docking
- To effectively utilize docking platforms

Course Outcomes

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

CLO	CLO Statement	Knowledge Level
CLO1	Understand the biological databases and its applications	**K1**
CLO2	Ability to design phylogenetic trees and interpret the evolution pattern	**K2**
CLO3	Apply the concept of protein structure, design drugs and dock	**K3**
CLO4	To inculcate research into the minds of biologists and innovate new drugs for safeguarding the society	**K4**

Mapping with Course Learning Outcomes

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

S-Strong, M-Medium

SYLLABUS

Biological databases and Gene Prediction

a. Sequence database – NCBI, GenBank, DDBJ, EMBL, Swiss-Prot, PFAM

b. Structural database – PDB, SCOP, CATH

c. Gene structure and function prediction – GenScan and GeneMark

d. Primer Designing concepts – Primer3 (tool)

Sequence alignment and Phylogenetic analysis

a. Protein sequence analysis - ExPASy proteomics tools

b. Pairwise sequence alignment- BLAST and FASTA

c. Multiple sequence alignment – ClustalW, Omega

d. Phylogenetic tree evaluation and Phylogenetic Program – MEGA

Macromolecular Structure Prediction and Validation

a. Homology Modeling –SWISS-MODEL

b. Model validation using ProSA, WhatCheck, Errat and ProCheck

c. Structure visualization- RasMol and PyMol

Chemical structure and ADME rules

a. Small molecule building, using ISIS DRAW and CHEMSKETCH

b. Chemical database – PubChem, DrugBank, ChemBank, Hazardous Substances Data Bank

c. File formats and conversion – Open Babel, SMILES

d. Drug properties, Toxicity, Drug likeness, Lipinski's rule of five- SWISSADME tool

Molecular Docking and analysis

a. Active site prediction (CASP, PDBSum)

b. Structure-based drug design and Ligand based drug design

c. Virtual Screening and Scoring Function

d. Pharmacophore design and identification

e. Molecular docking - PyRx

f. Drug-Receptor interaction - Discovery Studio

TEXT BOOKS

S.No	Authors	Year	Title of the book	Publishers
1.	Jin Xiong	2006	Essential Bioinformatics	Cambridge University Press
2.	Andréa's D. Baxevanis and B.F. Francis Ouellette	2004	Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins	Wiley-Interscience
3.	David W Mount	2001	Bioinformatics: Sequence and Genome	Cold Spring Harbor Laboratory Press
4.	Andrew R. Leach	2001	Molecular Modelling: Principles and Applications. 2nd edition	Pearson

REFERENCE BOOKS

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

Course Designer:

Dr. G. Shalini

Dr. V. Bhuvaneshwari

COURSE NUMBER	COURSE NAME	CATEGORY	L	T	P	CREDIT
BT21A04	**Allied Paper II – Programming for Computer application**	**ALLIED**	**58**	**2**	**-**	**4**

Learning Objectives:

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

Course 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	To inculcate knowledge on basic Python programming skills.	**K4**

Mapping with Programme 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

SYLLABUS

Unit I: Computer Algorithms and Fundamentals in C **12 h**

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 h**

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 h**

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 h**

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 h**

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

TEXT BOOKS

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

REFERENCE BOOKS

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

Course Designers:

Dr. G. Shalini

Dr. R. Nirmal Kumar

COURSE NUMBER	COURSE NAME	CATEGORY	L	T	P	CREDIT
BT21AP2	**Allied Practicals-** Basics of Computer application & Programming in Computer application	**Allied**		**-**	**60**	**2**

Learning Objectives:

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

Course Outcomes

On completion of the course, the 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 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

BASICS OF COMPUTER APPLICATION

SYLLABUS: 30 h

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

PROGRAMMING IN COMPUTER APPLICATION

SYLLABUS: 30 h

Write a C program to find the sum, average, standard deviation for a given set of numbers.

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

TEXT BOOKS

S.No	Authors	Year of publication	Title of the book	Publishers
1.	Mark Summerfield	2009	Programming in Python 3: A Complete introduction to the Python Language	Addison-Wesley Professional
2.	Martin C. Brown	2001	PYTHON: The Complete Reference	McGraw-Hill Education Pvt Limited
3.	Wesley J Chun	2012	Core Python Applications Programming	Prentice Hall

REFERENCE BOOKS

S.No	Authors	Year of publication	Title of the book	Publishers
1.	Mrs. Sneha Akash Mane, Dr. Sampat D. Navale, Dr. Tushar T. Shelke, Prof. Nitin B. Kohale	2022	Text book And Lab Manual of Computer Applications	Pritam Publications
2.	Brian W.Kernighan and Dennis M.Ritchie	2018	The C Programming Language	Prentice-Hall

Course Designer:

Dr. R. Nirmal Kumar

COURSE NUMBER	COURSE NAME	Category	L	T	P	Credits
NM22DTG	DESIGN THINKING	Theory	30	-	-	2

Learning Objectives:

- To expose the students to the concept of design thinking as a tool for innovation
- To facilitate them to analyze the design process in decision making
- To impart the design thinking skills

Course Outcome

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

CLO S	CLO Statement	Knowledge Level
CLO 1	Understand the concepts of Design thinking and its application in varied business settings	K1
CLO 2	Describe the principles, basis of design thinking and its stages	K2
CLO 3	Apply design thinking process in problem solving	K3
CLO 4	Analyse the best practices of design thinking and impart them in business and individual day to day operations.	K4

Mapping with Programme Outcomes

CLOs	PLO 1	PLO2	PLO3	PLO4	PLO5
CLO1	S	M	M	S	S
CLO2	M	S	S	M	M
CLO3	S	S	S	M	S
CLO4	S	S	S	S	S

S-Strong; M-Medium; L-Low

SYLLABUS

UNIT – 1 **6h**

Design Thinking Overview: Introduction to Design Thinking and Design Research Strategies -Design Thinking Skills

UNIT II **6h**

Design Thinking Mindset - Principles of Design Thinking - Basis for design thinking - Design Thinking Hats - Design thinking team

UNIT – III **6h**

Empathize - definition - Listen & Empathize with the Customers and / or Users - Tools and Techniques

UNIT– IV **6h**

Define - Definition - Defining the Problem - Tools and Techniques - Journey mapping and Ideate - definition - Ideation techniques

UNIT–V **6h**

Prototype - Definition - Prototype Alternate Solutions - Test the Solutions - Visualization - Story Telling - Cautions and Pitfalls - Best Practices

TEXT BOOKS:

S.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Christin Mueller-Roterberg	Handbook of Design Thinking Tips & Tools for how to design thinking	Amazon Kindle Version	2018
2.	Gavin Ambrose Paul Harris	Design Thinking	AVA Publishing Switzerland	2010

REFERENCE BOOKS:

S. No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Maurício Vianna Ysmar Vianna Isabel K. Adler Brenda Lucena Beatriz Russo	Design Thinking - Business Innovation	MJV Press	2011
2.	Moritz Gekeler	A practical guide to design thinking	Friedrich- Ebert-Stiftung	2019
3.	J. Berengueres	The Brown Book of Design Thinking	UAE University College, Al Ain	2014

Blended Learning Links

UNIT	TOPICS	LINK
UNIT I	Introduction to Design Thinking	https://www.digimat.in/nptel/courses/video/109104109/L01.html
	Design Thinking skills	https://www.youtube.com/watch?v=b-9Id-Jt_PI
UNIT II	Principles & Basis of Design Thinking	https://youtu.be/6-NRiom8K9Y
	Design Thinking hats	https://www.youtube.com/watch?v=bc-BvFQDmmk
UNIT III	Empathize	http://acl.digimat.in/nptel/courses/video/109104109/L02.html http://acl.digimat.in/nptel/courses/video/109104109/L03.html https://youtu.be/ls2mqHs02B0
UNIT IV	Define	http://acl.digimat.in/nptel/courses/video/109104109/L04.html https://youtu.be/veixQsRnZZU https://youtu.be/6-bDSKZJEAM
	Ideate	http://acl.digimat.in/nptel/courses/video/109104109/L11.html http://acl.digimat.in/nptel/courses/video/109104109/L12.html http://acl.digimat.in/nptel/courses/video/109104109/L13.html
UNIT V	Prototype	http://acl.digimat.in/nptel/courses/video/109104109/L15.html
	Testing	http://acl.digimat.in/nptel/courses/video/109104109/L16.html http://acl.digimat.in/nptel/courses/video/109104109/L17.html http://acl.digimat.in/nptel/courses/video/109104109/L18.html http://acl.digimat.in/nptel/courses/video/109104109/L19.html

PSGR
Krishnammal College for Women

DEPARTMENT OF BIOTECHNOLOGY
CHOICE BASED CREDIT SYSTEM (CBCS) & LEARNING OUTCOME BASED CURRICULAR FRAMEWORK (LOCF)
BACHELOR OF SCIENCE (B.Sc.) – 2022-2025 BATCH
SYLLABUS & SCHEME OF EXAMINATION
Applicable to students admitted during the academic year 2022-2023 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	
V	III	BT22C05	Nanobiotechnology	CC	4	58	2	3	50	50	100	4
		BT22C06	Plant Biotechnology	CC	4	58	2	3	50	50	100	4
		BT22C07	Animal Biotechnology	CC	4	58	2	3	50	50	100	4
		BT22CP3	**Core practical III-** Nanobiotechnology, Plant Biotechnology and Animal Biotechnology Practical	CC	5	75	-	5	50	50	100	5
		BT22E01/ BT22E02/ BT22E03	**Elective I** Pharmaceutical Biotechnology/ Bioentrepreunership / Bioethics, Biosafety and IPR	DSE	3	43	2	3	50	50	100	4
		BT21AC1/ BT21AC2	**ALC** # **-** Cancer Biology/ Stem cell Technology & Tissue Engineering	ACC	-			3	25	75	100	5$
		BT21PROJ	**Project and Viva Voce**	DSE	5	-	-	-	50	50	100	5
		BT22SBP1	**Skill based subject Practicals**–Biomolecular Computing Practical	SEC	3	41	4	-	100	-	100	3
		BT22COM	Comprehensive Examination	GC	-	-	-	1	-	100	100	Gr.
	IV	NM21CS1	Cyber Security I	AECC	-	30	-	-	100	-	100	Gr.
		BT22INST	Internship/Field Training	DSE	2 weeks outside class hours				100	-	100	2
I-V	VI	16BONL1 16BONL2	Online Course 1 Online Course 2	ACC	-	-	-	-	-	-	-	-
I-V	VI	COM15SER	Community Services	GC	30 hrs outside class hours				Completed or not			-

CC: Core Courses DSE : Discipline Specific Elective AECC : Ability Enhancement Compulsory Courses
GC : General Courses SEC: Skill Enhancement Course ACC : Additional Credit Courses

CA – Continuous Assessment ESE - End Semester Examination Gr. : Grade

 # : Self study

$: Credits applicable to candidates who take up Advanced level Course examination

QUESTION PAPER PATTERN

CA Question Paper Pattern: 1 x 60 = 60 Marks

One question from each unit with each question comprising of

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

ESE/Model Question Paper Pattern: 1 x 100 = 100 Marks (Each unit carries 20 marks)

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

Internal component for theory (for 50 Marks)

CA Test	-	10	Conducted for 60 marks, 3 units after 50 days
Model Exam	-	20	Conducted for 100 marks after 85 days (Q.P. Pattern (2,6,12) Each Unit 20 Marks)
Seminar/Assignment/Quiz	-	10	
Class Participation	-	7	
Attendance	-	3	
		50	**+ ESE 50 Marks (Conducted for 100 Marks)**

Internal component for Practicals (for 50 Marks)

Lab Performance	-	24 marks
Regularity	-	8 marks
Model Exam	-	15 marks
Attendance	-	3 marks
Total	-	**50 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 Marks

ESE Practicals Pattern

The End Semester Examination will be conducted for a maximum of 100 marks with a maximum 20 marks for the record and other submissions if any.

Internal component for ALC-25 marks

CA	-10 marks
Model exam	-15 marks
Total	-25 marks

Model/End Semester for UG - Advance Learner Courses

Section A : 5 questions out of 8 - open choice 5x5 : 25 marks
Section B : 5 questions out of 8-open choice 5x10 : 50 marks
Total : 75 marks

Cyber Security

Quiz	: 60 Marks
Case Study	: 20 Marks
Poster	: 20 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 1 (Theory/Practical/Project)	- 50 marks
Lab Performance	- 10 marks
Regularity	- 10 marks
Total	**- 100 marks**

Internal Evaluation of Project

I	Review: Selection of the field of study, Topic & Literature College	– 15 Marks
II	Review: Research Design & Data Collection	- 15 Marks
III	Review: Analysis & Conclusion Preparation of rough draft	- 15 Marks
	Total	**- 50 Marks**

End Semester Examination of Project

Evaluation of the project	- 30 Marks
Viva Voce	- 20 Marks
Total	-**50 Marks**

COURSE CODE	TITLE OF THE COURSE	CATEGORY	L	T	P	CREDITS
BT22C05	NANOBIOTECHNOLOGY	THEORY	58	2	-	4

Objectives

- To understand the concepts and types of Nanomaterials.
- To realize the physical, chemical and biological method of synthesis of nanomaterials.
- To know about the importance of molecular nanotechnology
- To apply the nanomaterials for biological applications

Course Learning Outcomes

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

CLO Number	CLO Statement	Knowledge Level
CLO1	Students will be able to understand the concepts and types of Nanomaterials.	K1
CLO2	Will realize the impact of physical, chemical and biological method of synthesis of nanomaterials.	K2
CLO3	Will know about the importance of molecular nanotechnology	K3
CLO4	Will apply the nanomaterials for biological applications	K4

Mapping with Programme Learning Outcomes

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

*S- Strong; M-Medium; L- Low

BT22C05 - NANOBIOTECHNOLOGY

Unit I: Introduction to Nanobiotechnology (12 hrs)

Introduction to Nano-world. The nanoscale dimension and paradigm, Types, Nanocrystal, Nanorods, Nanoshells, Nanotubes, Quantum dots. ***Properties of nanomaterials and their classifications (1D, 2D and 3D etc).**

Unit II: Physical and Chemical Synthesis of Nanomaterials (11 hrs)

***Approaches for synthesis of nanoparticles: Top-down -Ultra sonication, and bottom up – microemulsion.** Physical method-Ball milling, Electro spinning, Physical vapor deposition Chemical method – Sol gel Process, Chemical Precipitation, Hydrothermal Method, Pyrolysis**.**

Unit III: Biosynthesis and Characterization of Nanomaterials (12 hrs)

Introduction to biosynthesis - Biological method of Synthesis-Plant, bacteria, fungi mediated method. Biological Methods Growth and stabilization. ***Characterization- FT-IR, UV Spectroscopy, Nanoparticle track analyzer, Zeta potential, SEM, TEM, EDS and XRD.**

Unit IV: Molecular Nanotechnology (11 hrs)

***DNA-based Nanostructures, Mastering the complex DNA nanostructure, DNA tweezers, DNA actuators, DNA scissors,** Lipid-based Nanostructures, Self-assembly of protein nanoarchitecture, Applications of protein nanostructures

Unit V: Applications of Nanobiotechnology (12 hrs)

Nanobiotechnology in Diagnostic equipment, Biosensors, Surgical supplements, Tissue engineering, ***Gene delivery, Drug delivery, Cancer therapy**, Cosmetics. Environment-Photocatalysis of pollutants and Heavy metals. Applications in food and agriculture.

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

S.No	Topics	Links
	Unit I: Introduction to Nanobiotechnology	
1.	Properties of nanomaterials	https://www.youtube.com/watch?v=0cGw6M9ODl8
2.	classifications (1D, 2D and 3D etc).	https://www.youtube.com/watch?v=xEd4NYpc5OU
	Unit II: Physical and Chemical Synthesis of Nanomaterials	
3.	Approaches for synthesis of nanoparticles	https://www.youtube.com/watch?v=bLKsHAtxDrM
4.	Top-down -Ultra sonication,	https://www.youtube.com/watch?v=1Xw8oLyH7P0
5.	bottom up – microemulsion	https://www.youtube.com/watch?v=gnceaaxlgAo
	Unit III: Biosynthesis and Characterization of Nanomaterials	
6.	Characterization-FT-IR, UV Spectroscopy,	https://www.youtube.com/watch?v=lFYs3XDu4fQ
7.	Nanoparticle track analyzer, Zeta potential,	https://www.youtube.com/watch?v=lFYs3XDu4fQ
8.	SEM, TEM	https://www.youtube.com/watch?v=qvIWpLSzRhs
9.	EDS and XRD	https://www.youtube.com/watch?v=sYxWcdz273s&list=PLbc81v3FNszodghMOUCpkJIZbzNLwyivd&index=7 https://www.youtube.com/watch?v=vMv1l18CEeg&list=PLbc81v3FNszodghMOUCpkJIZbzNLwyivd&index=12
	Unit IV: Molecular Nanotechnology	
10.	DNA-based Nanostructures	https://www.youtube.com/watch?v=hSYOaKYeDI4
11.	Mastering the complex DNA nanostructure	https://www.youtube.com/watch?v=QtgB6iApaHA
12.	DNA tweezers	https://www.youtube.com/watch?v=x3GgdqKC9WI
13.	DNA actuators	https://www.youtube.com/shorts/f5v5UQQrZwI
14.	DNA scissors	https://www.youtube.com/watch?v=ZQf7ewZGZXg
	Unit V: Applications of Nanobiotechnology	
15.	Gene delivery	https://www.youtube.com/watch?v=SZIBFWmQqBc
16.	Drug delivery	https://www.youtube.com/watch?v=f7hMhL_N4k8
17.	Cancer therapy	https://www.youtube.com/watch?v=6kmfDNVjRdw

TEXT BOOKS

S.No	Authors	Title of the book	Publishers	Year & Edition
1	Chris Binns	Introduction to Nanoscience and Nanotechnology	Wiley Publication	2010 & 2nd Edition
2	Stuart Lindsay	Introduction to Nanoscience	Oxford University Press.	2009

REFERENCE BOOKS

S.No	Authors	Title of the book	Publishers	Year & Edition
1	Murthy, Shankar, Raj, Rath, Murday	Text book of Nanoscience and nanotechnology	Springer, Universities Press	2013
2	MA Shah, Tokeer Ahmed	Principles of Nanoscience and nanotechnology	Alpha Science International	2010

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: Introduction to Nanobiotechnology						
1.	Introduction to Nano-world.	CLO1	1	PPT / OER	Quiz (Quizalize/ Socrative)	Participatory Learning
2.	The nanoscale dimension and paradigm	CLO1	1	Lecture – Chalk and Talk / Group reading	Word cloud/ Mind map / Think Write and Share	Participatory Learning
3.	Types of Nanoparticles	CLO1	1	Chalk and talk/ Picture	Diagrams, Sketchboard	Participatory Learning
4.	Types of Nanoparticles	CLO1	1	PPT / OER	Quiz (Quizalize/ Socrative)	Participatory Learning
5.	Nanocrystals	CLO1	1	Chalk and talk/ Picture	Diagrams, Sketchboard	Problem-based Learning
6.	Nanorods	CLO1	1	Research paper presentation	Debate/Group discussion	Problem-based Learning
7.	Nanoshells	CLO1	1	Research paper presentation	Debate/Group discussion	Problem-based Learning
8.	Nanotubes	CLO1	1	OER/PPT	Debate/Group discussion	Experiential Learning
9.	Quantum dots	CLO1	1	OER/PPT	Debate/Group discussion	Experiential Learning
10.	Properties of nanomaterials	CLO1	1	Video/OER/ PPT	Flipped classroom, Poster	Experiential Learning
11.	Classifications (1D, 2D and 3D etc).	CLO1	1	Video/Book/ Article review	Group discussion	Experiential Learning
12.	Classifications (1D, 2D and 3D etc).	CLO1	1	Research paper presentation	Flipped classroom, Poster	Experiential Learning
Unit II: Physical and Chemical Synthesis of Nanomaterials						
13.	Approaches for synthesis of nanoparticles	CLO2	1	Video/Lecture – Chalk and Talk / Group reading	Word cloud/ Mind map / Think Write and Share	Participatory Learning

14.	Top-down approach- Ultra sonication	CLO2	1	Video/PPT / OER	Quiz (Quizalize/ Socrative)	Participatory Learning
15.	Bottom-up approach- microemulsion	CLO2	1	Video/Chalk and talk/ Picture	Diagrams, Sketchboard	Participatory Learning
16.	Physical method- Ball milling,	CLO2	1	Video/Research paper presentation	Debate/Group discussion	Problem-based Learning
17.	Electro spinning	CLO2	1	Video	Group Discussion/ Debate	Problem-based Learning
18.	Physical vapor deposition	CLO2	1	Student Seminar	Debate/Group discussion	Problem-based Learning
19.	Chemical method	CLO2	1	Virtual lab	Flipped classroom, Poster	Experiential Learning
20.	Sol gel Process	CLO2	1	Book/ Article review	Group discussion	Experiential Learning
21.	Chemical Precipitation,	CLO2	1	Virtual lab	Flipped classroom, Poster	Experiential Learning
22.	Hydrothermal Method,	CLO2	1	Research paper presentation	Debate/Group discussion	Problem-based Learning
23.	Pyrolysis	CLO2	1	Book/ Article review	Group discussion	Problem-based Learning
Unit III: **Biosynthesis and Characterization of Nanomaterials**						
24.	Introduction to biosynthesis - Biological method of Synthesis-Plant mediated synthesis	CLO2	1	Lecture – Chalk and Talk / Group reading	Word cloud/ Mind map / Think Write and Share	Participatory Learning
25.	Bacteria mediated synthesis	CLO2	1	PPT / OER	Quiz (Quizalize/ Socrative)	Problem-based Learning
26.	Fungi mediated Method	CLO2	1	Chalk and talk/ Picture	Diagrams, Sketchboard	Problem-based Learning
27.	Biological Methods Growth and stabilization	CLO2	1	Lecture and Discussion	Just a minute, discussion	Experiential Learning

28.	Characterization-FTIR	CLO2	1	Video/Lecture and Discussion	Just a minute, discussion	Participatory Learning
29.	UV-Vis spectroscopy	CLO2	1	Video/PPT / OER	Quiz (Quizalize/ Socrative)	Participatory Learning
30.	Nanoparticle track analyzer	CLO2	1	Video/Virtual lab	Flipped classroom, Poster	Experiential Learning
31.	Zeta potential	CLO2	1	Video/Demonstration	Diagrams, Sketchboard	Participatory Learning
32.	Electron Microscopy-Scanning Electron Microscopy (SEM)	CLO2	1	Video/Research paper presentation	Debate/Group discussion	Problem-based Learning
33.	Transmission Electron Microscopy (TEM)	CLO2	1	Video/Research paper presentation	Debate/Group discussion	Problem-based Learning
34.	EDS	CLO2	1	Video/Student Seminar	Debate/Group discussion	Experiential Learning
35.	XRD	CLO2	1	Video/Chalk and talk/ Picture	Culturing Techniques	Experiential Learning
Unit IV: Molecular Nanotechnology						
36.	Molecular Nanotechnology	CLO3	1	Lecture – Chalk and Talk / Group reading	Word cloud/ Mind map / Think Write and Share	Participatory Learning
37.	DNA-based Nanostructures	CLO3	1	Video/PPT / OER	Quiz (Quizalize/ Socrative)	Participatory Learning
38.	Mastering the complex DNA nanostructure	CLO3	1	Video/Chalk and talk/ Picture	Diagrams, Sketchboard	Participatory Learning
39.	DNA tweezers	CLO3	1	Video/Chalk and talk/ Picture	Just a minute, discussion	Participatory Learning
40.	DNA actuators	CLO3	1	Video/Demonstration	Designing	Experiential Learning
41.	DNA scissors	CLO3	1	Video/Student Seminar	Debate/Group discussion	Experiential Learning

42.	Lipid-based Nanostructures	CLO3	1	Book/ Article review	Group discussion	Problem-based Learning
43.	Lipid-based Nanostructures	CLO3	1	Virtual lab	Flipped classroom, Poster	Problem-based Learning
44.	Lipid-based Nanostructures	CLO3	1	Research paper presentation	Debate/Group discussion	Problem-based Learning
45.	Self assembly of protein nanoarchitecture	CLO3	1	Research paper presentation	Debate/Group discussion	Problem-based Learning
46.	Application of protein nanostructures	CLO3	1	Field observations and observation of renewable organic material	Field visit	Problem-based Learning
Unit V: Applications of Nanobiotechnology						
47.	Applications of nanomaterials in various fields	CLO4	1	Lecture – Chalk and Talk / Group reading	Word cloud/ Mind map / Think Write and Share	Participatory Learning
48.	Nanobiotechnology in medicine Surgical supplements	CLO4	1	PPT / OER	Quiz (Quizalize/ Socrative)	Participatory Learning
49.	Application in Diagnostic equipment	CLO4	1	Chalk and talk/ Picture	Diagrams, Sketchboard	Participatory Learning
50.	Tissue engineering with a focus on wound healing	CLO4	1	Video Lecture and Discussion	Just a minute, discussion	Problem-based Learning
51.	Cancer treatment	CLO4	1	Video/Demonstration	Culturing Techniques	Experiential Learning
52.	Gene delivery	CLO4	1	Video/Student Seminar	Debate/Group discussion	Experiential Learning
53.	Drug delivery	CLO4	1	Video/Virtual lab	Flipped classroom, Poster	Experiential Learning

54.	Photocatalysis of dye	CLO4	1	Book/ Article review	Group discussion	Problem-based Learning
55.	Heavy metal removal	CLO4	1	Virtual lab	Flipped classroom, Poster	Problem-based Learning
56.	Application in Cosmetics	CLO4	1	Research paper presentation	Debate/Group discussion	Problem-based Learning
57.	Application in food and agriculture	CLO4	1	Field observations and observation of renewable organic material	Field visit	Problem-based Learning
58.	Biosensors	CLO4	1	Research paper presentation	Case study	Problem-based Learning

Name of the course	BT22C05-Nanobiotechnology
Name of the Faculty	Dr. V. Bhuvaneshwari
Participatory Learning	29.3 %
Experiential Learning	29.3 %
Problem-based Learning	41.4 %

COURSE CODE	TITLE OF THE COURSE	CATEGORY	L	T	P	CREDITS
BT22C06	**PLANT BIOTECHNOLOGY**	**THEORY**	**58**	**2**	**-**	**4**

Objectives:

- To understand the evolution of plant and its genome
- To explore the compounds present in plants and how they influence the cell culture
- To study the vital components require for plant tissue culture
- To understand the role of plant vectors and how they are utilized for human welfare

Course Learning Outcomes:

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

CLO Number	CLO Statement	Knowledge Level
CLO1	Explore the history of Biotechnology and state the importance of organization of plant genome	K1
CLO2	Be acquainted with the molecular basis of action of plant hormones and gene expression	K2
CLO3	Illustrate about various culture medium preparations, haploid, triploid plant production and its applications	K3
CLO4	Exploit symbiotic organisms as a vector for gene transfer to produce transgenic plants and develop molecular technique skills for crop improvement.	K4

Mapping with Programme Learning Outcomes

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

S- Strong; M-Medium; L-Low

BT22C06 - PLANT BIOTECHNOLOGY

Unit I: Introduction and Scope **(12 hrs)**

History of plant biotechnology, Conservation of Plant using Biotechnology. Plant genome organization: ***Structural features of a representative plant gene. Organization of chloroplast genome and mitochondrial genome**.

Unit II: Phytohormones and their roles **(11 hrs)**

Auxins, cytokinins and gibberellins- Molecular basis of action. phytochrome– role in photomorphogeneisis. ***Abscisic acid and stress induced promoter switches in the control of gene expression. Ethylene and fruit ripening**.

Unit III: Plant Tissue Culture **(12 hrs)**

Media composition (MS media). ***Micropropagation techniques - direct and indirect organogenesis.** Somaclonal variation, somatic embryogenesis - haploid and triploid. ***Protoplast isolation, fusion and culture. Hybrid and cybrid production. Synthetic seed production.** Secondary metabolite production.

Unit IV: Cloning of Plant Vectors **(11 hrs)**

***Agrobacterium and crown gall tumors. Mechanism of T-DNA transfer to plants; Ti and Ri Plasmid vectors and their utility**. Plant viral vectors. Symbiotic nitrogen fixation in Rhizobia, nif gene.

Unit V: Applications of Plant Biotechnology **(12 hrs)**

***Crop improvement, herbicide resistance, insect resistance, virus resistance, plants as bioreactors.** Transgenic plants- plant vaccines, genetically modified food - future perspectives & ecological impact of transgenic plants.

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

S.No	Topics	Links
	Unit I: Introduction and Scope	
1.	Structural features of a representative plant gene.	https://youtu.be/kz4f7vlQFnM?si=CUdFMZpgNXgigflO
2.	Organization of chloroplast genome and mitochondrial genome.	https://youtu.be/4r1L_hVRhGU?si=KZRQ45PjuNTSMH-i http://ndl.iitkgp.ac.in/he_document/swayamprabha/swayam_prabha/ hd_lpzfhk2k?e=9|chloroplast%20genome
	Unit II: Phytohormones and their roles	
3.	Abscisic acid and stress-induced promoter switches in the control of gene expression.	http://ndl.iitkgp.ac.in/he_document/inflibnet_epgp/inflibnet_epgp/ IN__I_e_P_P__1_B__409_P_0_P_I__411_M_0_A_a__4383_4384?e=3 |Abscisic%20acid%20and%20stress
4.	Ethylene and fruit ripening.	https://youtu.be/bCOo7BFb1ZA?si=eHfa6APJZd1ndMVR
	Unit III: Plant Tissue Culture	
5.	Micropropagation techniques - direct and indirect organogenesis.	http://ndl.iitkgp.ac.in/he_document/aklectures/aklectures/ 4_3_9_1654?e=0|organogenesis|||
6.	Protoplast isolation, fusion, and culture	https://youtu.be/4lKDkxBb4uY?si=UAjlFkhnO0U6mEro
7.	Hybrid and cybrid production.	http://ndl.iitkgp.ac.in/he_document/nptel/102103016_ module1_lec13_1
8.	Synthetic seed production	http://ndl.iitkgp.ac.in/he_document/swayam_ugc_moocs/ synthetic_seed_technology_28_1544_cec_Self_learning
	Unit IV: Cloning of Plant Vectors	
9.	Agrobacterium and crown gall tumors.	http://ndl.iitkgp.ac.in/he_document/inflibnet_epgp/ IN__I_e_P_P__1_B__409_P_0_g_E__ 4541_M_0_A_t_a_a_r_i_g_e__4567_4568
10.	Mechanism of T-DNA transfer to plants;	http://ndl.iitkgp.ac.in/he_document/inflibnet_epgp/ IN__I_e_P_P__1_B__409_P_0_g_E__ 4541_M_0_A_t_a_a_r_i_g_e__4567_4568
11.	Ti and Ri Plasmid vectors and their utility.	http://ndl.iitkgp.ac.in/he_document/inflibnet_epgp/
	Unit V: Applications of Plant Biotechnology	
12.	Crop improvement	http://ndl.iitkgp.ac.in/he_document/nptel/IN__ N__1_B__1188_P_B__1603_A_o_p_B_i_c_i__1605_1606
13.	herbicide resistance	http://ndl.iitkgp.ac.in/he_document/nptel/IN__
14.	insect resistance	http://ndl.iitkgp.ac.in/he_document/nptel/nptel/courses_ 104_108_104108056_video_lec36?e=2|transgenic%20plants
15.	virus resistance	http://ndl.iitkgp.ac.in/he_document/nptel/IN__
16.	plants as bioreactors	https://www.youtube.com/watch?v=iyVCeDUZ3BY

TEXT BOOKS

S.No	Authors	Title of the book	Publishers	Year & Edition
1	Singh B.D.	Plant Biotechnology.	Kalyani Publishers	2015 & 3rd edition
2	H S Chawla	Introduction to Plant Biotechnology.	Oxford & IBH Publishing	2020 & 3rd edition
3	Adrian Slater, Nigel Scott, Mark Fowler	Plant Biotechnology: The Genetic Manipulation of Plants.	Oxford	2008 & 2nd Edition
4	Razdan M K	Introduction to Plant Tissue Culture	Oxford & IBH Publishing	2019 & 3rd edition

REFERENCE BOOKS

S.No	Authors	Title of the book	Publishers	Year & Edition
1	Paul Christou and Harry Klee	Handbook of Plant Biotechnology. Volume 2	Wiley India Pvt Ltd	2009
2	Agnès Ricroch, Surinder Chopra, Shelby J. Fleische	Plant Biotechnology: Experience and Future Prospects	Springer	2016

Course designers:
Dr. R. Nirmal Kumar
Dr. G. Anbarasi

Module No.	Topic	CLO level	No. of periods	Content delivery method	Student engagement	Participatory Learning / Experiential Learning / Problem based Learning
Unit – I Introduction and Scope						
1	Plant Biotechnology	CLO1	1	Lecture – Chalk and Talk / Group reading	Think to Write and Share /Mind mapping	Participatory Learning
2	History of Plant Biotechnology	CLO1, CLO2	1	PPT	Quiz	Participatory Learning
3	Conservation of Plants	CLO1, CLO2	1	Flipped classroom	Presentation	Participatory Learning
4	Plant conservation through Biotechnology	CLO1, CLO2	1	Chalk and talk	Diagrams, Sketch board	Experiential Learning
5	Gene	CLO1, CLO2	1	Chalk and talk	Sketch board	Experiential Learning
6	Structural features of a representative plant gene	CLO1, CLO2	1	Video, Virtual lab	Presentation	Experiential learning
7	Genome	CLO1, CLO2	1	Video, PPT	Debate, Pro-con grid	Participatory Learning
8	Genome Organization	CLO1, CLO2	1	Video, Student seminar	Presentation	Participatory Learning
9	Plant Genome	CLO1, CLO2	1	Video, Virtual lab	Flipped classroom, Poster	Experiential Learning
10	Endosymbiosis	CLO1, CLO2	1	Lecture	Gaming and Discussion-Kahoot	Problem-based Learning
11	Chloroplast genome	CLO1, CLO2	1	Video, Flipped class room	Presentation	Participatory Learning
12	Mitochondrial Genome	CLO1, CLO2	1	Video, Lecture / OER	Simulation	Experiential Learning
Unit – II Phytohormones and their roles						
13	Auxins	CLO2, CLO3	1	Lecture / Seminar	Think write and share	Experiential Learning

14	Cytokinin	CLO2, CLO3	1	Lecture / Seminar	Diagrams,Sketchboard	Participatory Learning
15	Gibberellins	CLO2, CLO3	1	Lecture / Seminar	Diagrams, Sketchboard	Participatory Learning
16	Molecular basis of action.	CLO2, CLO3	1	Lecture / Seminar	Diagrams, Sketch board	Problem-based Learning
17	Phytochrome	CLO2, CLO3	1	Lecture / Seminar	Diagrams, Sketchboard	Participatory Learning
18	Photomorphogenesis	CLO2, CLO3	1	Lecture	Post it parade	Experiential Learning
19	Role in Photomorphogenesis	CLO2, CLO3	1	OER	Flipped classroom, Presentation	Participatory Learning
20	Abscisic acid	CLO2, CLO3	1	Video, Lecture / OER	Model making	Experiential Learning
21	Stress-induced promoter	CLO2, CLO3	1	Video, Lecture / OER	Case study	Problem-based Learning
22	Promoter switching Gene expression	CLO2, CLO3	1	Video, Lecture / OER	Model making	Participatory Learning
23	Ethylene and fruit ripening	CLO2, CLO3	1	Video, Lecture/ Virtual lab	Case study	Problem-based Learning
Unit – III Plant Tissue Culture						
24	Media Composition (MS Media.)	CLO2, CLO3, CLO4	1	Lecture	Hands on in lab	Experiential Learning
25	Micropropagation technique	CLO2, CLO3, CLO4	1	Video, Lecture	Hands on in lab	Experiential Learning
26	Direct and indirect organogenesis.	CLO2, CLO3, CLO4	1	Video / Observation	Group discussion	Problem-based Learning
27	Somaclonal variation	CLO2, CLO3, CLO4	1	Lecture	Hands on in lab	Problem-based Learning
28	Somatic embryogenesis	CLO2, CLO3, CLO4	1	Lecture PPT	Student seminar	Participatory Learning
29	Types of somatic embryogenesis	CLO2, CLO3, CLO4	1	Lecture	Hands-on Tissue culture	Experiential Learning
30	haploid and triploid	CLO2, CLO3, CLO4	1	Lecture	Hands-on tissue culture	Experiential Learning

31	Protoplast isolation	CLO2, CLO3, CLO4	1	Video, Demonstration	Discussion	Experiential Learning
32	Protoplast fusion and culture.	CLO2, CLO3, CLO4	1	Video, Lecture PPT	Quiz	Participatory Learning
33	Hybrid and cybrid production.	CLO2, CLO3, CLO4	1	Video, Demonstration	Discussion	Participatory Learning
34	Synthetic seed production.	CLO3, CLO4	1	Video, Lecture PPT	Pro/con grid	Problem-based Learning
35	Secondary metabolite production.	CLO3, CLO4	1	Video	Quescussion	Problem-based Learning
Unit – IV Cloning of Plant Vectors						
36	Agrobacterium-Crown gall tumors.	CLO3, CLO4	1	Video, Lecture	Design thinking	Problem-based Learning
37	Gene transfer techniques	CLO3, CLO4	1	Video, Demonstration	Industry visit	Experiential Learning
38	Mechanism of T-DNA transfer to plants	CLO3, CLO4	1	Video, Research article reading	Group reading and discussion	Problem-based Learning
39	Ti plasmid Vectors	CLO3, CLO4	1	Video, PPT	Review collection, case thinking	Problem-based Learning
40	Ri plasmid	CLO3, CLO4	1	Video, PPT	Review collection	Experiential learning
41	Utility of the vectors	CLO3, CLO4	1	Video, PPT	Review collection, Case study	Problem-based Learning
42	Plant viral vectors	CLO3, CLO4	1	Video, PPT	Review collection	Participatory Learning
43	Nitrogen fixation	CLO3, CLO4	1	Brainstorming	Flipped classroom, Discussion	Problem-based Learning
44	Symbiotic nitrogen fixation in Rhizobia	CLO3, CLO4	1	Brainstorming	Discussion	Experiential learning
45	Types of Nif genes and their role	CLO3, CLO4	1	PPT	Model making	Participatory Learning
46	Mechanism of Nif genes in nitrogen fixation	CLO3, CLO4	1	PPT	Model making	Experiential Learning

Unit -V Applications of Plant Biotechnology						
47	Crop improvement.	CLO1, CLO3, CLO4	1	Video, Research article reading	Group reading and discussion	Participatory Learning
48	Herbicide resistance	CLO1, CLO3, CLO4	1	Video, Discussion	Quiz	Problem-based Learning
49	Insect resistance	CLO1, CLO3, CLO4	1	Video, Research article reading	Case thinking	Problem-based Learning
50	Virus resistance	CLO1, CLO3, CLO4	1	Video, Lecture	Case thinking	Problem-based Learning
51	Coat Protein mediated resistance	CLO1, CLO3, CLO4	1	Video, Virtual lab	Trouble shooting	Problem-based Learning
52	Recombinant proteins	CLO1, CLO3, CLO4	1	PPT, Socrative	Case study	Problem-based Learning
53	Plants as bioreactors.	CLO1, CLO3, CLO4	1	PPT, Socrative	Case study	Problem-based Learning
54	Transgenic plants	CLO1, CLO3, CLO4	1	PPT	Case study	Problem-based Learning
55	Plant vaccines	CLO1, CLO3, CLO4	1	PPT	Case study	Problem-based Learning
56	Genetically modified food	CLO1, CLO3, CLO4	1	Lecture	Flipped classroom	Problem-based Learning
57	Future perspectives	CLO1, CLO3, CLO4	1	Lecture	Poster	Problem-based Learning
58	Ecological impact of transgenic plants	CLO1, CLO3, CLO4	1	Lecture	Presentation	Problem-based Learning

Name of the course	BT22C06-Plant Biotechnology
Name of the Faculty	Dr. R. Nirmal Kumar
Participatory Learning	29.3 %
Experiential Learning	29.3 %
Problem-based Learning	40.4 %

COURSE CODE	TITLE OF THE COURSE	CATEGORY	L	T	P	CREDITS
BT22CO7	ANIMAL BIOTECHNOLOGY	THEORY	58	2	-	4

Objectives

To teach the basics of animal cell culture and required media

- To inculcate the practical knowledge on animal cell culture techniques and transformation methods
- To study the method of genetic transformation in animal cells
- To make students understand the improved cell culture preservation 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 Animal cell culture and cell laboratory	K1
CLO2	Describe the media preparation, preservation, trypsinization, counting, maintenance and application of cell lines.	K2
CLO3	Discuss the strategies for gene transfer and gene expressions with their applications.	K3
CLO4	Be acquainted with genetic modification and stem cell technology in production of transgenic animals and learn the assisted reproductive technology and its applications	K4

Mapping with Programme Learning Outcomes

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

S- Strong; M-Medium; L-Low

BT22CO7 - ANIMAL BIOTECHNOLOGY

Unit 1: Introduction to Animal cell culture **(12 hrs)**

Animal cell culture; History and development. Pluripotency, Media, balanced salt solutions. Physical, chemical and metabolic functions of constituents of culture media. Role of carbon dioxide, Serum, growth factors and amino acids in media. Serum containing and serum free media. Constitution of a media for cell line. ***Essential equipments required for animal cell culture. Contaminations in Animal Cell Culture.**

Unit II: Animal cell culture and types **(12 hrs)**

Types of cell culture- Primary, Secondary, Organ culture and cell lines. Role of feeder layers in cell culture, Cell separation techniques, cell synchronization, ***Cell counting methods, Biology of cultured cells- Apoptosis and PCD.**

Unit III: Methods of transformation in cell culture **(12 hrs)**

Transfection of cells in culture- ***Animal viral vectors for transfection**, Physical methods of transfection, HAT selection, selectable markers. Micro manipulation of cells, ***Gene targeting**, **Gene silencing and Gene knockout and their applications.**

Unit IV: Recombinant DNA technology **(11 hrs)**

Protein production by genetically engineered mammalian cell lines, ***Stem cells and their applications; Cell culture as a source of valuable products -Transgenic Animals.**

Unit V: Storage and Preservation **(11 hrs)**

Collection and preservation of embryos, Semen banking, ***AI, IVF, ICSI and Test tube babies. Case Study-any two relevant studies, Cryopreservation**, Cell banking procedures. Ethical issues in Animal Biotechnology.

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

S.No	Topics	Video Link
Unit 1: Introduction to Animal cell culture		
1.	Essential equipments required for animal cell culture. Contaminations in Animal Cell Culture.	https://www.youtube.com/watch?v=d-roLEvRfMk https://www.youtube.com/watch?v=VN1LkyBkKzs https://www.youtube.com/watch?v=CGOHvdKBGnA
Unit II: Animal cell culture and types		
2.	Cell counting methods, Biology of cultured cells- Apoptosis and PCD	https://www.youtube.com/watch?v=MZV4_QkonAE https://www.youtube.com/watch?v=CMQsyBqQB6s&t=115s https://www.youtube.com/watch?v=Iw--t_NfZHg
Unit III: Methods of transformation in cell culture		
3.	Animal viral vectors for transfection, Gene targeting, Gene silencing and Gene knockout and their applications	https://www.youtube.com/watch?v=vKEixrIat-Y https://www.youtube.com/watch?v=U3Z4u0DKbx0&t=39s https://www.youtube.com/watch?v=9O3uxdDD1cA
Unit IV: Recombinant DNA technology		
4.	Stem cells and their applications; Cell culture as a source of valuable products - Transgenic Animals	https://www.youtube.com/watch?v=poj2Eg9Ho9M https://www.youtube.com/watch?v=Awtjro5At3g https://www.youtube.com/watch?v=x0ZqjULMcw4 https://www.youtube.com/watch?v=RzYhcXjksKc
Unit V: Storage and Preservation		
5.	AI, IVF, ICSI and Test tube babies. Case Study-any two relevant studies, Cryopreservation	https://www.youtube.com/watch?v=OSyxbp8tXkk https://www.youtube.com/watch?v=uXsCngh89fI https://www.youtube.com/watch?v=xNmX3tBeC58 https://www.youtube.com/watch?v=6jx8bD6wWTs https://www.youtube.com/watch?v=tCNtKrxlZPs

TEXT BOOKS

S.No	Authors	Title of the book	Publishers	Year & Edition
1	Rajesh Kumar Yadav	Animal Biotechnology and Genetic Engineering.	Oxford Book Company	2021 & 1st Edition
2	B. Singh and S.K Gautam	Textbook of Animal Biotechnology.	The Energy and Resources Institute, TERI	2014 & 1st Edition
3	A. K. Srivastava	Animal Biotechnology	Oxford and IBH Publishing Company Pvt. Limited	2018

REFERENCE BOOKS

S.No	Authors	Title of the book	Publishers	Year & Edition
1	Portner, R.	Animal cell Biotechnology.	Human Press.	2012 & 2nd Edition
2	R. Ian Freshney	Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications.	Wiley-Blackwell	2016 & 7th edition

Course designers:
Dr. D. S. Ranjith Santhosh Kumar

Module No.	Topic	CLO level	No. of periods	Content delivery method	Student engagement	Participatory Learning / Experiential Learning / Problem based Learning
Unit I : Introduction to Animal cell culture						
1.	Animal cell culture - Introduction	CLO1	1	Lecture – Chalk and Talk / Group reading	Word cloud/ Mind map / Think Write and Share	Participatory Learning
2.	History and development	CLO1	1	Displays	Gallery walk, Post it parade	Experiential Learning
3.	Pluripotency, Media,	CLO1	1	OER	Debate, Quescussion, Pro-con grid	Problem-based Learning
4.	balanced salt solutions.	CLO1, CLO2	1	PPT / OER	Quiz (Quizalize/ Socrative)	Problem-based Learning
5.	Physical, chemical and metabolic functions of constituents of culture media	CLO1, CLO2	1	Chalk and talk/ Picture	Debate, Quescussion, Pro-con grid	Problem-based Learning
6.	Role of carbon dioxide, Serum.	CLO1, CLO2	1	PPT / OER	Gallery walk, Post it parade	Experiential Learning
7.	Growth factors and amino acids in media.	CLO1, CLO2, CLO3	1	Virtual lab	Presentation	Problem-based Learning
8.	Serum containing Media	CLO1, CLO2, CLO3	1	Lecture – Chalk and Talk / Group reading	Word cloud/ Mind map / Think Write and Share	Problem-based Learning
9.	Serum free media	CLO1, CLO2, CLO3	1	OER	Debate, Quescussion, Pro-con grid	Problem-based Learning

10.	Constitution of a media for cell line.	CLO1, CLO2, CLO3	1	Lecture – Chalk and Talk / Group reading	Word cloud/ Mind map / Think Write and Share	Problem-based Learning
11.	Essential equipments required for animal cell culture.	CLO1, CLO2, CLO3	1	Video, Lecture – Chalk and Talk / Group reading	Word cloud/ Mind map / Think Write and Share	Participatory Learning
12.	Contaminations in Animal Cell Culture.	CLO1, CLO2	1	Video, Lecture / Seminar	Diagrams, Sketchboard	Problem-based Learning
Unit II: Animal cell culture and types						
13.	Types of cell culture-	CLO1, CLO2	1	PPT	Group reading and discussion	Experiential Learning
14.	Primary,	CLO1, CLO2	1	Lecture / Seminar	Diagrams, Sketchboard	Experiential Learning
15.	Secondary,	CLO1, CLO2, CLO3	1	PPT	Word cloud/ Mind map / Think Write and Share	Experiential Learning
16.	Organ culture	CLO1, CLO2, CLO3	1	PPT	Review collection, Case study	Problem-based Learning
17.	cell lines	CLO1, CLO2, CLO3	1	Lecture / Seminar	Diagrams, Sketchboard	Problem-based Learning
18.	Role of feeder layers in cell culture	CLO1, CLO2, CLO3	1	OER	Flipped classroom, Presentation	Problem-based Learning
19.	Cell separation techniques	CLO1, CLO2, CLO3	1	Lecture / OER	Simulation	Participatory Learning
20.	Cell synchronization	CLO1, CLO2, CLO3	1	Lecture / OER	Simulation	Participatory Learning
21.	Cell counting methods	CLO1, CLO2, CLO3	1	Video, Lecture / OER	Simulation	Problem-based Learning

22.	Biology of cultured cells	CLO1, CLO2, CLO3	1	Video, Lecture/ Virtual lab	Simulation	Participatory Learning
23.	Apoptosis	CLO1, CLO2, CLO3	1	Video, Lecture/ Virtual lab	Simulation	Participatory Learning
24.	Programmed Cell Death	CLO2, CLO3	1	Video, OER / PPT	Flipped classroom, Assignment	Experiential Learning
Unit III: Methods of transformation in cell culture						
25.	Transfection of cells in culture	CLO2, CLO3	1	Lecture PPT	Peer teaching	Participatory Learning
26.	Animal viral vectors for transfection	CLO2, CLO3	1	Video / Observation	Group discussion	Experiential Learning
27.	Animal viral vectors for transfection	CLO2, CLO3	1	Video / Observation	Student seminar	Experiential Learning
28.	Physical methods of transfection	CLO2, CLO3	1	Lecture PPT	Student seminar	Participatory Learning
29.	Physical methods of transfection	CLO2, CLO3	1	Lecture PPT	Student seminar	Participatory Learning
30.	HAT selection	CLO2, CLO3	1	Seminar / PPT	Flipped classroom	Participatory Learning
31.	selectable markers.	CLO2, CLO3	1	Observation	Discussion	Experiential Learning
32.	Micro manipulation of cells,	CLO2, CLO3	1	Lecture PPT	Quiz	Problem-based Learning
33.	Gene targeting	CLO2, CLO3	1	Video / Observation	Discussion	Problem-based Learning
34.	Transfection of cells in culture	CLO2, CLO3	1	Video, Lecture PPT	Peer teaching	Participatory Learning
35.	Animal viral vectors for transfection	CLO2, CLO3	1	Video / Observation	Group discussion	Experiential Learning
36.	Gene knockout and their applications.	CLO2, CLO3	1	Video, Chalk and talk/ Picture	Group reading and discussion	Experiential Learning

Unit IV: Recombinant DNA technology						
37.	Protein production	CLO2, CLO3	1	Chalk and talk/ Picture	Group reading and discussion	Experiential Learning
38.	Protein production by genetically engineered mammalian cell lines	CLO4	1	Lecture	Design thinking	Problem-based Learning
39.	Protein production by genetically engineered mammalian cell lines	CLO4	1	Seminar / PPT	Word cloud/ Mind map / Think Write and Share	Problem-based Learning
40.	Stem cells	CLO4	1	Video, Research article reading	Group reading and discussion	Problem-based Learning
41.	Stem cells and their applications	CLO4	1	Video, PPT	Word cloud/ Mind map / Think Write and Share	Participatory Learning
42.	Stem cells and their applications	CLO4	1	Video, PPT	Review collection	Participatory Learning
43.	Stem cells and their applications	CLO4	1	Video, Demonstration	Discussion	Experiential Learning
44.	Cell culture as a source of valuable products	CLO4	1	Video, Brainstorming	Flipped classroom, Discussion	Participatory Learning
45.	Cell culture as a source of valuable products	CLO4	1	Video, PPT	Word cloud/ Mind map / Think Write and Share	Participatory Learning
46.	Transgenic Animals.	CLO4	1	Video, PPT	Discussion	Problem-based Learning
47.	Transgenic Animals.	CLO4	1	Video, PPT	Case study	Problem-based Learning
48.	Protein production	CLO2, CLO3	1	Chalk and talk/ Picture	Group reading and discussion	Experiential Learning
49.	Protein production by genetically engineered mammalian cell lines	CLO4	1	Lecture	Design thinking	Problem-based Learning

Unit V: Storage and Preservation						
50.	Collection of embryos.	CLO4	1	Research article reading	Group reading and discussion	Experiential Learning
51.	Preservation of embryos	CLO4	1	PPT	Review collection, Case study	Problem-based Learning
52.	Artificial Insemination	CLO3, CLO4	1	Video, Research article reading	Group reading and discussion	Problem-based Learning
53.	In Vitro Fertilization	CLO3, CLO4	1	Video, PPT	Word cloud/ Mind map / Think Write and Share	Participatory Learning
54.	ICSI	CLO3, CLO4	1	Video / Observation	Group discussion	Experiential Learning
55.	Test tube Babies	CLO3, CLO4	1	Video / Observation	Group discussion	Problem-based Learning
56.	Case Study -I	CLO3, CLO4	1	Video, PPT, Socrative	Group reading and discussion	Experiential Learning
57.	Case Study -II	CLO3, CLO4	1	Video, PPT, Socrative	Case study	Problem-based Learning
58.	Cryopreservation	CLO3, CLO4	1	Video, PPT	Word cloud/ Mind map / Think Write and Share	Participatory Learning

Name of the course	BT22CO7 Animal Biotechnology
Name of the Faculty	Dr. D. S. Ranjith Santhosh Kumar
Participatory Learning	30 %
Experiential Learning	30 %
Problem-based Learning	40 %

COURSE CODE	TITLE OF THE COURSE	CATEGORY	L	T	P	CREDITS
BT22CP3	CORE PRACTICAL III - NANOBIOTECHNOLOGY, PLANT BIOTECHNOLOGY AND ANIMAL BIOTECHNOLOGY PRACTICAL	PRACTICALS	-	-	75	5

Objectives:

- To develop the knowledge on plant and animal culture techniques
- To synthesize nanoparticles using different methods
- To teach different plant culture techniques using various explants
- To understand the presence of different phytochemicals in the plants

Course Learning Outcomes

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

CLO Number	CLO Statement	Knowledge Level
CLO1	Explain plant tissue culture and illustrate callus development.	K1
CLO2	Develop technical skills in Protoplast isolation and phytochemical analysis	K2
CLO3	Enhance technical skills in preparation of nanoparticles using different methods	K3
CLO4	Examine the techniques involved in cryopreservation and animal cell culture	K4

Mapping with Programme Learning Outcomes

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

S- Strong; M-Medium

BT22CP3 - NANOBIOTECHNOLOGY, PLANT BIOTECHNOLOGY AND ANIMAL BIOTECHNOLOGY PRACTICAL

NANOBIOTECHNOLOGY

1. Synthesis of copper oxide nanoparticles by sol-gel method
2. Synthesis of Zinc oxide nanoparticles by microwave method
3. Synthesis of Silver Nanoparticles by biogenic methods
4. Determination of surface plasmon resonance using UV-visible spectroscopy
5. Characterization of Nanoparticles using FTIR spectroscopy
6. Determination of average size and charge of nanoparticles using Particle Size Analyzer (Demo)

PLANT BIOTECHNOLOGY

1. Plant tissue culture media preparation & sterilization techniques.
2. Callus induction
3. Micropropagation
4. Isolation of plant protoplast & viability test.
5. Embryo culture
6. Anther culture for haploid production
7. Artificial seed preparation
8. Phytochemical screening of plant secondary metabolites -Qualitative analysis

ANIMAL BIOTECHNOLOGY

1. Preparation of Animal Tissue culture medium and membrane filtration
2. Preparation of Primary cell culture using Chick embryo
3. Cell viability Test -Trypan blue staining
4. MTT Assay
5. Cryopreservation and thawing (Demo)

TEXT BOOKS

S.No	Authors	Title of the book	Publishers	Year & Edition
1	Winkelmann, Kurt	Practical Aspects of Creating an Interdisciplinary Nanotechnology Laboratory Course for Freshmen	Journal of Nano Education 1.1	2009
2	Jenkins, N	Animal Cell Biotechnology: Methods and Protocols.	Humana press, New Jesey	1999
3	Nagar Santosh, Adhav Madhavi	Practical Biotechnology and Plant Tissue Culture	S Chand & Company	2010
4	Karl- Hermann Neumann, Ashwani Kumar, Jafargholi Imani	Plant Cell and Tissue Culture - A Tool in Biotechnology: Basics and Application.	Springer	2020 & 2nd edition

REFERENCE BOOKS

S.No	Authors	Title of the book	Publishers	Year & Edition
1	Poinern, G.E.J	A Laboratory Course in Nanoscience and Nanotechnology	CRC Press	2014
2	R. Ian Freshney	Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications.	Wiley-Blackwell	2016 & 7th edition
3	Razdan M K	Introduction to Plant Tissue Culture	Oxford & IBH Publishing	2019 & 3rd edition

Course Designers:

Dr. V. Bhuvaneshwari

Dr. D.S. Ranjith Santhosh Kumar

COURSE CODE	TITLE OF THE COURSE	CATEGORY	L	T	P	CREDITS
BT22E01	PHARMACEUTICAL BIOTECHNOLOGY	THEORY	43	2	-	4

Objectives:

- To learn about the essential qualities of a candidate drug and testing methods.
- To understand the basic science and clinical application of biotechnology-products.
- Provides a well-balanced framework in various aspects including dosage forms, administration and therapeutic application.

Course Learning Outcomes

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

CLO Number	CLO Statement	Knowledge Level
CLO1	Determine the likelihood of using biotechnological principles in pharmaceutical industries.	K1
CLO2	Examine the dynamics and kinetics of drugs in relation to the routes of administration.	K2
CLO3	Compare how different drug formulations were developed for the market.	K3
CLO4	Evaluate the various modes of action for the developed pharmaceutical products and understand the roles, responsibilities and organizational structure of regulatory bodies.	K4

Mapping with Programme Learning Outcomes

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

S- Strong; M-Medium

BT22E01 - PHARMACEUTICAL BIOTECHNOLOGY

Unit I-Introduction to Pharmaceutical biotechnology (9 hrs)

Introduction to concepts and technologies in pharmaceutical biotechnology. New classes of pharmaceuticals, pharmaceutical industry in the modern era. Source of drugs – plant, animals, microbes and minerals. Drug isolation and evaluation. Physico – chemical properties of the drugs and Drug receptors.

Unit II- Pharmacokinetics (9 hrs)

Routes of Drug Administration - Enteral Routes and Parenteral Routes. Drug absorption-Biologic Factors. Drug distribution- Compartments, Protein Binding, Apparent volume of distribution (AVD or Vd). Drug biotransformation-Sites of drug metabolism, Enzyme Induction, Enzyme inhibition. Drug elimination-Renal Glomerular Filtration, Renal Tubular Secretion, Renal Tubular Reabsorption and Biliary Excretion.

Unit III- Product forms (9 hrs)

Tablets-formulation, binding agent, coating, tablet presses and types, Excipients, Capsules, Solutions-oral liquids, Injections and topical medication. Preservatives and phenolic compounds in drug formulations, Pharmaceutical labeling and Guidelines for packing procedure and use of different techniques.

Unit IV- Pharmaceutical Products (8 hrs)

Therapeutic categories such as vitamins, laxatives, analgesics, non-steroidal contraceptives, Antibiotics, interferons, hormones (insulin, growth hormone) examples with respect to system.

Unit V- Manufacturing Principles and Regulatory Aspects (8 hrs)

Good Manufacturing Practice (GMP): Quality control, Chemical reactions that affect pharmaceutical products – Oxidation, reduction, hydrogenation, dehydrogenation. Regulatory authorities –Central drug standards control organization, food and drug administration, European regulations.

TEXT BOOKS

S. No	Authors	Title of the book	Publishers	Year & Edition
1.	Shayne Cox Gad	Drug discovery-Handbook	Wiley	2005
2.	Ronald D. Schoenwald	Pharmacokinetics in Drug Discovery Development	CRC Press	2002

REFERENCE BOOKS

S. No	Authors	Title of the book	Publishers	Year & Edition
1.	Kristian Stromgaard, Povl Krogsgaard-Larsen and Ulf Madsen	Textbook of drug design and discovery	CRC Press-Taylor & Francis group	2017

Course designers:
Dr. G. Shalini
Dr. V. Bhuvaneshwari

COURSE CODE	TITLE OF THE COURSE	CATEGORY	L	T	P	CREDITS
BT22E02	BIOENTREPRENEURSHIP	THEORY	43	2	-	4

Objectives:

- To motivate and help students in inculcating entrepreneurial mind-set
- To teach students various life science related business opportunities and take them forward
- To address the strength and interest of a student and shaping them to become a successful entrepreneur
- To teach students formulate a business plan in taking their business forward

Course Learning Outcomes

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

CLO Number	CLO Statement	Knowledge Level
CLO1	Students will be able to identify the challenges of being a Bioentrepreneur	K1
CLO2	Will understand the Business proposal for starting a company	K2
CLO3	Will learn about Vermicomposting and Sericulture	K3
CLO4	Will aspire to set up Mushroom Cultivation and business plan	K4

Mapping with Programme Learning Outcomes

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

S- Strong; M-Medium

BT22E02 - BIOENTREPRENEURSHIP

Unit I: Introduction and Scope **(9 hrs)**

Basics of Bioentrepreneurship -Biotechnology in a Global scale; ***Types of Bio-industries – Biopharma, Bioagri and Bioservice innovations** – **Successful Entrepreneur** – **Creativity, Leadership, Managerial skills**, Team building, Decision making; Public and private funding agencies (MSME, DBT, BIRAC, Startup & Make in India).

Unit II: Single Cell Protein and Vermiculture **(8 hrs)**

***Single Cell Protein Production: Algae-Spirulina, Bacteria, Yeast. Experimental design; harvesting and Drying.** Vermi composting–Earthworms-Ecological types - Vermiculture-Compost pit- Vermi bed- applications.

Unit III: Medical innovation **(8 hrs)**

Medical Device entrepreneurship - A New Era of Surgeries through Robotic Operations, remote patient monitoring devices, ***3D Printing in Medical Devices. Scaffold preparation**, **Diagnostic kits. Impact of innovation in medical devices, Case studies.**

Unit IV: Mushroom cultivation **(9 hrs)**

***Phases of Mushroom Cultivation; Selection of an acceptable mushroom species/strains, Management of mushroom development, Mushroom harvesting;** Mushroom diseases, Medicinal and Nutritional properties of mushroom.

Unit V: Business plan (9 hrs)

Business plan preparation; business feasibility analysis by SWOT, business plan proposal for virtual startup company; statutory and legal requirements for starting a company/venture; basics in accounting practices. ***Market Conditions, Identifying the need of the customers.**

***Link provided for the highlighted content offered in Blended Mode**

S.No.	Topics	Links
Unit – I- Introduction and Scope		
1	Types of Bio-industries – Biopharma, Bioagri and Bioservice innovation	https://www.youtube.com/watch?v=C7khbRcOV_A
2	Successful Entrepreneur	https://www.youtube.com/watch?v=-sQeREfZY-8
3	Creativity, Leadership, Managerial skills	https://www.youtube.com/watch?v=cx_RXvE1qic
Unit – II- Single Cell Protein and Vermiculture		
4	Single Cell Protein Production	https://www.youtube.com/watch?v=T2gCCNyO8Kw
5	Algae-Spirulina, Bacteria, Yeast	https://www.youtube.com/shorts/6CvWZqWqRO8
6	Experimental design	https://www.youtube.com/watch?v=10ikXret7Lk
7	Harvesting and Drying	https://www.youtube.com/watch?v=m8HOjKRDGMs
Unit – III- Medical innovation		
8	3D Printing in Medical Devices	https://www.youtube.com/watch?v=KhgKZ1dcl0c
9	Scaffold preparation	https://www.youtube.com/watch?v=uHbn7wLN_3k
10	Diagnostic kits	https://www.youtube.com/watch?v=exCo61pg6A0
11	Impact of innovation in medical devices	https://www.youtube.com/watch?v=h_fyv91C7Z0
12	Case studies	https://www.youtube.com/watch?v=TfkHrvct1hg
Unit – IV- Mushroom cultivation		
13	Phases of Mushroom Cultivation	https://www.youtube.com/watch?v=CDjuk07E6rI
14	Selection of an acceptable mushroom species/strains	https://www.youtube.com/watch?v=Edh0LKyhgqc
15	Management of mushroom development	https://www.youtube.com/watch?v=4kuSWWiH-7s
16	Mushroom harvesting	https://www.youtube.com/watch?v=dFhvP7hbn6Y&t=279s
Unit –V- Business plan		
17	Market Conditions	https://www.youtube.com/watch?v=3TXTRg4gN6A
18	Identifying the need of the customers	https://www.youtube.com/watch?v=2C-2v99paQM

TEXT BOOKS

S.No	Authors	Title of the book	Publishers	Year & Edition
1	Craig Shimasaki	Biotechnology Entrepreneurship: Starting, Managing, and Leading Biotech Companies Hardcover	Academic Press	2014
2	Alberto Onetti Antonella Zucchella	Business Modeling for Life Science and Biotech Companies: Creating Value and Competitive Advantage with the Milestone Bridge. (8 June 2018)	CBS Publishers & Distributors Pvt. Ltd	2018 & 1st edition
3	David Adams, John Sparrow	Enterprise for Life Scientists: Developing Innovation and Entrepreneurship in the Biosciences.	Scion Publishing Ltd	2007 & 1st edition

REFERENCE BOOKS

S.No	Authors	Title of the book	Publishers	Year & Edition
1	Stephen Russell	The Essential Guide to Cultivating Mushrooms: Simple and Advanced Techniques for Growing Shiitake, Oyster, Lion's Mane, and Maitake Mushrooms at Home	Storey Publishing LLC	2014
2	Pushpa Srivastava	Nutraceutical Spirulina: Commercial Cultivation Using Rural Technology in India. First Edition	Aavishkar Publishers, Distributors, Jaipur	2017 & 1st edition

Course designers:

Dr. G. Anbarasi

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- Introduction and Scope						
1	Basics of Bio entrepreneurship	CLO1	1	Lecture	Quiz (Kahoot)	Participatory Learning
2	Biotechnology in a Global scale	CLO1	1	PPT	Pro-con grid	Participatory Learning
3	Types of Bio-industries – Biopharma, Bioagri and Bioservice innovation	CLO1	1	Lecture and Video	Blog	Participatory Learning
4	Types of Bio-industries – Biopharma, Bioagri and Bioservice innovation	CLO1	1	PPT and Video	Virtual Industry visit	Experiential Learning
5	Successful Entrepreneur	CLO1	1	PPT and Video	Group discussion	Experiential Learning
6	Creativity, Leadership, Managerial skills	CLO1	1	Video and discussion	Troubleshooting	Problem-based Learning
7	Team building, Decision making	CLO1	1	PPT	One-minute presentation	Problem-based Learning
8	Public and private funding agencies	CLO1	1	Lecture and PPT	Demonstrations	Experiential Learning
9	MSME, DBT, BIRAC, Startup & Make in India	CLO1	1	PPT	Quescussion	Problem-based Learning
Unit – II- Single Cell Protein and Vermiculture						
10	Single Cell Protein Production	CLO2	1	Video and PPT	Posters	Problem-based Learning
11	Algae-Spirulina, Bacteria, Yeast	CLO2	1	Video and Discussion	Demonstration	Participatory Learning
12	Experimental design	CLO2	1	Video, Lecture and PPT	Group discussion	Participatory Learning

13	Harvesting and Drying	CLO2	1	Video and PPT	Case thinking	Problem-based Learning
14	Vermi composting– Earthworms	CLO2	1	Lecture and video	Demonstrations	Experiential Learning
15	Ecological types	CLO2	1	PPT and Discussion	Simulation	Experiential Learning
16	Vermiculture- Compost pit-	CLO2	1	Lecture and video	Demonstrations	Problem-based Learning
17	Vermi bed- applications	CLO2	1	Discussion	Presentation	Problem-based Learning
Unit – III- Medical innovation						
18	Medical Device entrepreneurship	CLO3	1	Lecture	Design thinking	Problem-based Learning
19	A New Era of Surgeries through Robotic Operations	CLO3	1	Research article reading	Group reading and discussion	Problem-based Learning
20	Remote patient monitoring devices	CLO3	1	Discussion	Webinar	Participatory Learning
21	3D Printing in Medical Devices	CLO3	1	Video and PPT	Case study	Problem-based Learning
22	Scaffold preparation	CLO3	1	Video and Demonstration	Simulation	Experiential Learning
23	Diagnostic kits	CLO3	1	Video and PPT	Sketchboard	Participatory Learning
24	Impact of innovation in medical devices	CLO3	1	Video and Lecture	Student seminar	Experiential Learning
25	Case studies	CLO3	1	Video and Seminar	Flipped classroom	Participatory Learning
Unit – IV- Mushroom cultivation						
26	Phases of Mushroom Cultivation	CLO4	1	Video and PPT	Case study	Problem-based Learning
27	Selection of an acceptable mushroom species/strains	CLO4	1	Video and Lecture	Poster	Problem-based Learning
28	Selection of an acceptable mushroom species/strains	CLO4	1	Video and Discussion	Quiz	Participatory Learning
29	Management of mushroom development	CLO4	1	Video and Research article reading	Group reading and discussion	Experiential Learning

30	Management of mushroom development	CLO4	1	Video and Brainstorming	Flipped classroom,	Participatory Learning
31	Mushroom harvesting	CLO4	1	Video and Observation	Quiz	Experiential Learning
32	Mushroom diseases	CLO4	1	PPT	Case study	Problem-based Learning
33	Medicinal and Nutritional properties of mushroom	CLO4	1	PPT	Review collection	Experiential Learning
34	Medicinal and Nutritional properties of mushroom	CLO4	1	PPT	Case study	Problem-based Learning
Unit –V- Business plan						
35	Business plan preparation	CLO4	1	Lecture	Diagrams	Participatory Learning
36	Business feasibility analysis by SWOT	CLO4	1	OER	Pro-con grid	Problem-based Learning
37	Business plan proposal for virtual startup company	CLO4	1	Seminar	Sketchboard	Participatory Learning
38	Statutory and legal requirements for starting a company/venture	CLO4	1	Lecture	Group discussion	Participatory Learning
39	Statutory and legal requirements for starting a company/venture	CLO4	1	OER	Simulation	Experiential Learning
40	Basics in accounting practices	CLO4	1	Virtual lab	Group discussion	Experiential Learning
41	Market Conditions	CLO4	1	Video and Virtual lab	Simulation	Experiential Learning
42	Identifying the need of the customers	CLO4	1	Video and PPT	Case study	Problem-based Learning
43	Identifying the need of the customers	CLO4	1	Video and Lecture	Case study	Problem-based Learning

Name of the course	**BT22E02-Bioentrepreneurship**
Name of the Faculty	Dr Shalini G
Participatory Learning	30 %
Experiential Learning	30 %
Problem-based Learning	40 %

COURSE CODE	TITLE OF THE COURSE	CATEGORY	L	T	P	CREDITS
BT22E03	BIOETHICS, BIOSAFETY AND IPR	THEORY	43	2	-	4

Objectives:

- To understand the concepts of Bioethics and Biosafety
- To realize the impact of Gene cloning in societal problems and Bioethics, Biosafety and GLP
- To know about the importance of Ethical Clearance
- To get knowledge about Patents Rights in the field of Research

Course Learning Outcomes

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

CLO Number	CLO Statement	Knowledge Level
CLO1	Students will be able to understand the concepts of Bioethics and Biosafety.	K1
CLO2	Will realize the impact of Gene cloning in societal problems and Bioethics, Biosafety and GLP.	K2
CLO3	Will know about the importance of Ethical Clearance	K3
CLO4	Will get knowledge about Patents Rights in the field of Research.	K4

Mapping with Programme Learning Outcomes

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

S- Strong; M-Medium

BT22E03 - BIOETHICS , BIOSAFETY AND IPR

Unit 1: Human Rights (8 hrs)

Human Rights: Definition, Classification and Scope of Human Rights. United Nations Commission for Human Rights, National and State Human Rights Commission. Article 21 of Indian Constitution – UDHR. Social issues of Human rights.

Unit II: Bioethics (9 hrs)

Impact of gene cloning & Bioethics-Issues concerning reproduction, Birth, life and Death (Artificial insemination, egg donation, IVF, embryo transplants, Prenatal diagnosis and sex selection & Abortion).

Unit III: IPR (9 hrs)

Patents - Introduction -Treaties and Conventions of Patents, Patent Cooperation Treaty - TRIPS Basis of Patentability – Non Patentable Inventions - Patent Application Procedure in India. Other Forms of IP: Copyright - Trade Mark – Industrial designs – Farmer's Rights. Patenting of Biotechnology products and processes.

Unit IV: Ethical issues in IPR (8 hrs)

Bioethics of IPR - ethical criteria in biotechnology- animal ethics; Licensing of animal house - Human cloning - Ethical issues - Ethical clearance norms for conducting studies on human subjects.

Unit V: Biosafety regulations and guidelines (9 hrs)

Biosafety - General guidelines - DBT guidelines on biosafety in conducting research in biology / biotechnology - Risk assessment studies- Hazardous materials used in Biotechnology- Handling and Disposal - Good manufacturing practices & Good Laboratory practices, Containment facilities and Biosafety practices - Regulation on field experiments and release of GMO's - Labelling of GM foods - Guidelines for research in transgenic plants and Animals.

TEXT BOOKS

S. No	Authors	Title of the book	Publishers	Year & Edition
1	Ignacimuthu. S	Bioethics	Narosa Publication house	2009
2	Sree Krishna. V	Bioethics and Biosafety in Biotechnology	Blackstone Press.	2007

REFERENCE BOOKS

S. No	Authors	Title of the book	Publishers	Year & Edition
1	John.A.Thomas	Biotechnology and safety assessment	CRC Press-Taylor and Francis.	2004
2	Beauchamp & Leroy	Contemporary issues in Bioethics	Wardsworth Pub. Co. Belmont, California	1999

Course designer:
Dr. V. Bhuvaneshwari

COURSE CODE	TITLE OF THE COURSE	CATEGORY	L	T	P	CREDITS
BT21AC1	CANCER BIOLOGY	THEORY	-	-	-	5

Objectives

- To learn the principles of cancer biology.
- Explore the molecular pathways responsible for genome instability in cancer cells.
- To gain core knowledge of the cellular targets and molecular mechanisms.

Course Learning Outcomes

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

CLO Number	CLO Statement	Knowledge level
CLO1	Understand the basics of Cancer Biology	K1
CLO2	Comprehend the Cancer at the Molecular level	K2
CLO3	Learn about the types of Cancer	K3
CLO4	Analyze the different techniques of detection and Treatment and prevention of Cancer	K4

Mapping with Programme Learning Outcomes

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

S- Strong; M-Medium

BT21AC1- CANCER BIOLOGY

Unit I-Introduction to cancer biology

Cancer: Introduction; Origin of Cancer- The Mutation Concept, The Epigenetic Concept, Viral Concept, Unified genetic concept of cancer; Difference between Normal and Cancer cells; Signs and symptoms.

Unit II- Cancer at the Molecular level

Cancer as a genetic disease; Genetic Alterations in Cancer cells, Point mutation, splice mutation, alternate splicing; Mutation in regulatory sequences, deletions, Insertion, Chromosome abnormalities, Genetic defects and the time course of hereditary cancer.

Unit III-Types of Cancer

Blood & Lymph – Leukemia, Malignant lymphoma, Bone- Soft tissue Sarcoma, Thorax- Breast cancer, Male genitalia- Prostate cancer, Female genitalia- Cervical cancer; Tumor suppressor genes; Classification of Tumor suppressor genes.

Unit IV- Detection and Treatment of Cancer

Early detection, Molecular detection of Carcinomas, Cancer warning signals; Markers in blood urine; Therapies- Chemotherapy, Gene therapy, Radiotherapy, Biological therapy (Immuno therapy).

Unit V-Prevention

Tobacco smoking, sunlight, diet, ionizing radiation, alcohol drugs, promiscuity, lifestyle and cancer prevention, Environmental factors and cancer, potentially carcinogenic substances for humans.

TEXT BOOKS

S.No	Authors	Title of the book	Publishers	Year & Edition
1	A. Sarkar	Biology of Cancer	Discovery Publishing House	2011
2	Ranajit Sen	Principles and Management of Cancer	B.I. Publications Pvt Ltd	2004
3	M.R.Ahuja	Cancer- Causes and Prevention	UBS Publishers Distributors Pvt	1997

REFERENCE BOOKS

S.No	Authors	Title of the book	Publishers	Year & Edition
1.	Francesco Pezzella, MahvashTavassoli, David J. Kerr	Textbook of Cancer Biology	Oxford University Press	2019
2.	Robin Hesketh	Introduction to Cancer Biology	Cambridge University Press	2012

Web Resources

1. http://csbl.bmb.uga.edu/mirrors/JLU/DragonStar2017/download/introduction-to-cancer-biology.pdf
2. http://webserver1.oneonta.edu/faculty/bachman/cancer/207lectures.htm

Course designer:

Dr. G. Shalini

COURSE CODE	TITLE OF THE COURSE	CATEGORY	L	T	P	CREDITS
BT21AC2	STEM CELL TECHNOLOGY AND TISSUE ENGINEERING	THEORY	-	-	-	5

Objectives

- To understand the basic of stem cell
- To gain knowledge in the Mechanisms and applications of Stem Cell
- To acquire knowledge in the areas of tissue engineering.

Course Learning Outcomes

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

CLO Number	CLO Statement	Knowledge level
CLO1	Comprehend the concept of stem cells.	K1
CLO2	Describe the concept of stem cell cloning and its applications.	K2
CLO3	Recognize treatment of human diseases connected to stem cell therapy.	K3
CLO4	Evaluate the structural and organization of tissues, analyze the role of different biomaterials and its applications in tissue engineering. .	K4

Mapping with Programme Learning Outcomes

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

S- Strong; M-Medium

.

BT21AC2 - STEM CELL TECHNOLOGY AND TISSUE ENGINEERING

Unit I- Concept and types of stem cells

Introduction to stem cells, Basic concepts and properties, Totipotency, Pluripotency, Embryonic stem cells, Germinal stem cells, Adult stem cells, Tumor stem cells, Stem cell plasticity, General methods of characterization of stem cells, Early events in development.

Unit II- Stem Cells and Cloning

Cell cycle regulation in stem cells, Therapeutic and reproductive cloning, Nuclear Transfer (NT) method, Isolation of Embryonic stem (ES) cells, Salient features and application of NT and ES cells, Safety of NT and ES cells.

Unit III- Overview of embryonic and adult stem cells for therapy

Neurodegenerative diseases; Parkinson's, Alzheimer, Spinal Code Injuries and other brain Syndromes; Tissue system Failures; Diabetes; Cardiomyopathy; Kidney failure; Liver failure; Cancer and Hemophilia. Applications of stem cells in medicine and different disease models, Biosafety and Stem cell research, Regulatory considerations and FDA requirements for stem cell therapy.

Unit IV- Structural and organization of tissues

Tissue organization, Tissue Components, Tissue types, Functional subunits. Tissue Dynamics, Homeostasis in highly prolific tissues and Tissue repair. Angiogenesis. Epithelial, connective; vascularity and angiogenesis, basic wound healing, cell migration, current scope of development and use in therapeutic and in-vitro testing.

Unit V- Engineering biomaterials for tissue engineering

Degradable materials (collagen, silk and polylactic acid), porosity, mechanical strength, 3-D architecture and cell incorporation. Engineering tissues for replacing bone, cartilage, tendons, ligaments, skin and liver, Bioreactors for Tissue Engineering.

TEXT BOOKS

S.No	Authors	Title of the book	Publishers	Year & Edition
1	Atala A &Lanza R	Handbook of Stem Cells	Academic Press	2012
2	Robert Lanza and Anthony Atala	Essential of Stem Cell Biology	Elsevier Academic Press	2013

REFERENCE BOOKS

S.No	Authors	Title of the book	Publishers	Year & Edition
1.	Marshak L	Stem Cell Biology	Cold Spring Harbor Publication	2001
2.	Robert Lanza, Robert Langer, Joseph Vacanti	Principles of Tissue Engineering	Academic Press	2000

Web Resources

1. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1129084/
2. https://www.sciencedirect.com/topics/engineering/tissue-engineering

Course designer:

Dr. G. Shalini

COURSE CODE	TITLE OF THE COURSE	CATEGORY	L	T	P	CREDITS
BT22SBP1	**SBS PRACTICALS-BIOMOLECULAR COMPUTING PRACTICAL**	**PRACTICALS**	**-**	**4**	**41**	**3**

Objectives

- To learn the fundamentals of protein structure and modelling
- To learn phylogenetic relationships
- To learn the concepts of docking
- To effectively utilize docking platforms

Course Learning Outcomes

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

CLO	CLO Statement	Knowledge Level
CLO1	Understand the biological databases and its applications	**K1**
CLO2	Ability to design phylogenetic trees and interpret the evolution pattern	**K2**
CLO3	Apply the concept of protein structure, design drugs and dock	**K3**
CLO4	To inculcate research into the minds of biologists and innovate new drugs for safeguarding the society	**K4**

Mapping with Programme Learning Outcomes

CLO	PLO1	PLO2	PLO3	PLO4	PLO5
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

BT22SBP1 - BIOMOLECULAR COMPUTING PRACTICAL

1. Biological databases and Gene Prediction

a. Sequence database – NCBI, GenBank, DDBJ, EMBL, Swiss-Prot, PFAM

b. Structural database – PDB, SCOP, CATH

c. Gene structure and function prediction – GenScan and GeneMark

d. Primer Designing concepts – Primer3 (tool)

2. Sequence alignment and Phylogenetic analysis

a. Protein sequence analysis - ExPASy proteomics tools

b. Pairwise sequence alignment- BLASTn, BLASTp and BLASTx

c. Multiple sequence alignment – ClustalW, Omega

d. Phylogenetic tree evaluation and Phylogenetic Program – MEGA

3. Macromolecular Structure Prediction and Validation

a. Homology Modeling –SWISS-MODEL

b. Model validation using ProSA, WhatCheck, Errat and ProCheck

c. Structure visualization- RasMol and PyMol

4. Chemical structure and ADME rules

a. Small molecule building, using ISIS DRAW and CHEMSKETCH

b. Chemical database – PubChem, DrugBank, ChemBank, Hazardous Substances Data Bank

c. File formats and conversion – Open Babel, SMILES

d. Drug properties, Toxicity, Drug likeness, Lipinski's rule of five- SWISSADME tool

5. Molecular Docking and analysis

a. Active site prediction (CASP, PDBSum)

b. Structure-based drug design and Ligand based drug design

c. Virtual Screening and Scoring Function

d. Pharmacophore design and identification

e. Molecular docking - PyRx

f. Drug-Receptor interaction - Discovery Studio

TEXT BOOKS

S. No	Authors	Title of the book	Publishers	Year & Edition
1.	Jin Xiong	Essential Bioinformatics	Cambridge University Press	2006
2.	Andréa's D. Baxevanis and B.F. Francis Ouellette	Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins	Wiley-Interscience	2004
3.	David W Mount	Bioinformatics: Sequence and Genome	Cold Spring Harbor Laboratory Press	2001
4.	Andrew R. Leach	Molecular Modelling: Principles and Applications.	Pearson	2001 & 2nd edition

REFERENCE BOOKS

S. No	Authors	Title of the book	Publishers	Year & Edition
1.	Guido van Rossum and 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:
Dr. G. Shalini
Dr. V. Bhuvaneshwari