SRI SHAKTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY, COIMBATORE
(AUTONOMOUS)

DEPARTMENT OF BIOTECHNOLOGY

VISION AND MISSION OF THE INSTITUTION

Vision

To make the institution one of our nation's great engineering schools, recognized nationally and internationally for excellence in teaching, research and public service. We seek to be the preferred destination for students, practitioners seeking an engineering education, employers hiring engineering graduates and organizations seeking engineering knowledge.

Mission

To Provide an encouraging environment to develop the intellectual capacity, critical thinking, creativity and problem solving ability of the students.

VISION AND MISSION OF THE DEPARTMENT

Vision

To cultivate scientific and technical manpower in Biotechnology to solve various problems and challenges faced by industry and academia for the betterment of society.

Mission

- To provide an academic environment that emphasizes critical thinking
- To equip students with knowledge and practical skills required for the industry and academia.
- To constitute Institute-Industry relationship via in plant training programs and projects.
- To establish Centre for excellence (COE) in the frontier areas of biotechnology.

PROGRAMME EDUCATIONAL OBJECTIVES

PEO1	:	Identify, analyze and solve the biotechnological problems in product and process development.
PEO2	:	Identify and control hazards in bioprocess industries
PEO3	:	Apply modern computational, analytical tools and techniques to address biotechnologicalchallenges.
PEO4	:	Pursue life-long learning as a means of enhancing the knowledge base and skills forprofessional advancements.
PEO5	:	Communicate effectively and demonstrate entrepreneurial and leadership skills.

PROGRAMME OUTCOMES:
Engineering Graduates will be able to:

PO1	a	Engineering knowledge: Apply the knowledge of mathematics, science, engineering, fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	b	Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	c	Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4	d	Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	e	Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an Understanding of the limitations.
PO6	f	The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7	g	Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	h	Ethics: Apply ethical principles and commit to professional ethics and responsibilities andnorms of the engineering practice.
PO9	i	Individual and team work: Function effectively as an individual, and as a member or leader indiverse teams, and in multidisciplinary settings.
PO10	j	Communication: Communicate effectively on complex engineering activities with the engineering Community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	k	Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	l	Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OBJECTIVES (PSOs)

PSO1		Knowledge and hands on training to solve engineering and scientific problems.
PSO2		Ability to work in interdisciplinary areas of science and technology towards industrialand academic research applications.
PSO3		Infer the potentials and impact of biotechnological innovations for finding sustainableethical solutions to issues pertaining to health, environment and agriculture

MAPPING OF PROGRAMME EDUCATIONAL OBJECTIVES WITH PROGRAMMEOUTCOMES

A broad relation between the programme objective and the outcomes is given in thefollowing table

PROGRAMME EDUCATIONAL OBJECTIVES	PROGRAMME OUTCOMES											
	A	B	C	D	E	F	G	H	I	J	K	L
1	2	2	2	3	2	2	2	2	2	2	2	1
2			1	1	1	1	1	1	1	1	1	1
3	1	1	2	2	3	2	2		2	2	2	2
4	2	1	1	1	2	2	1		3	3	3	2
5	2	2	2	3	3	2	2		2	2	3	2

MAPPING OF PROGRAM SPECIFIC OBJECTIVES WITH PROGRAMMEOUTCOMES

A broad relation between the Program Specific Objectives and the outcomes is given in the following table

PROGRAMMESPECIFIC OBJECTIVES	PROGRAMME OUTCOMES											
	A	B	C	D	E	F	G	H	I	J	K	L
1	2	2	1	2	3		2				2	1
2	2	2	1	2	1	1	2		2	1	2	1
3	1		3		1	2	2	1				2

SRI SHAKTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY,
COIMBATORE
(AUTONOMOUS)

B. Tech. BIOTECHNOLOGY
REGULATIONS – 2021
CHOICE BASED CREDIT SYSTEM

MAPPING OF COURSE OUTCOMES WITH PROGRAMME OUTCOMES:

A broad relation between the Course Outcomes and Programme Outcomes is given in thefollowing table

COURSE OUTCOMES		PROGRAMME OUTCOMES											
Sem	**Course Name**	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**
I	Communicative English										✓		
	Matrices and calculus for Biotechnologists	✓	✓										
	Chemistry for Biotechnology	✓	✓										✓
	Computational Thinking and Problem Solving using C	✓		✓		✓	✓						
	Introduction to Biotechnology	✓	✓										✓
	Engineering Exploration I				✓		✓	✓		✓	✓	✓	
	Crop Production - I Laboratory				✓			✓					
	Chemistry laboratory for biotechnology	✓	✓										✓
	Computational Thinking and Problem solving using C laboratory	✓		✓		✓	✓						
	Introduction to Biotechnology Laboratory	✓	✓										✓
	Language - Tamil, Language - English										✓		
II	Applied English Skills										✓		
	Applied Physics for Biosciences	✓	✓										
	Laplace Transforms and Advanced Calculus for Biotechnologists	✓	✓										
	Cell Biology	✓		✓		✓	✓						
	Microbiology	✓	✓		✓								✓
	Programming in C and Data structures	✓	✓	✓	✓								✓
	Engineering Exploration II				✓		✓	✓		✓	✓	✓	
	Applied Physics Laboratory	✓	✓										
	Automobile Engine Assembly Laboratory												
	Cell biology laboratory	✓		✓		✓	✓						
	Microbiology laboratory	✓	✓		✓								✓
	Programming in C and data structure laboratory	✓	✓	✓	✓								✓
III	Environmental Science for Biotechnology	✓		✓	✓		✓	✓					✓
	Transforms and numerical methods for Biotechnology	✓	✓		✓								
	Unit Operation and Unit Principles	✓	✓	✓									
	Biochemistry	✓	✓										
	Enzyme Technology	✓			✓			✓					✓
	Basics of bioinformatics	✓		✓	✓	✓							
	Engineering Exploration III			✓	✓			✓		✓	✓	✓	
	Career Enhancement Program-I										✓		
	Program Paradigms	✓			✓	✓							

IV	Probability and Statistics for Biotechnology	✓	✓										
	Applied Thermodynamics for Biotechnologists	✓	✓	✓									✓
	Plant Biotechnology	✓					✓	✓					✓
	Professional Elective I												
	Molecular Biology	✓					✓						✓
	Basic Industrial Biotechnology	✓					✓	✓				✓	✓
	Engineering Exploration IV	✓	✓	✓	✓		✓		✓	✓	✓	✓	
	Career Enhancement Program-II		✓	✓				✓	✓	✓	✓	✓	✓
V	Marine Biotechnology	✓	✓	✓	✓	✓	✓	✓		✓			
	Instrumental Methods of Analysis	✓	✓	✓	✓		✓						
	Genetic Engineering	✓	✓	✓	✓	✓	✓		✓			✓	✓
	Bioprocess Engineering	✓	✓	✓	✓	✓						✓	✓
	Professional Elective II												
	Professional Elective III												
	Engineering Exploration V	✓	✓	✓	✓		✓		✓	✓	✓	✓	
	Career Enhancement Program III		✓	✓				✓	✓	✓	✓	✓	✓

SRI SHAKTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY, COIMBATORE (AUTONOMOUS)

B.TECH BIOTECHNOLOGY
REGULATIONS – 2021
CHOICE BASED CREDIT SYSTEM

CURRICULUM FOR I-V SEMESTERS

SEMESTER I							
S.No.	**Course Code**	**Course Title**	**Category**	**L**	**T**	**P**	**C**
THEORY							
1	21EN101	Communicative English	HS	2	1	0	3
2	21MA103	Matrices and Calculus for Biotechnologists	BS	3	1	0	4
3	21CH102	Chemistry for Biotechnology	BS	3	0	0	3
4	21CS101	Computational Thinking and Problem Solving using C	ES	3	0	0	3
5	21BT101	Introduction to Biotechnology	PC	3	0	0	3
6	21TA101 21EL101	Language - Tamil Language – Foundation English	HS	2	0	0	2
LABORATORY							
7	21BT111	Engineering Exploration I	EEC	1	0	2	2
8	21AG112	Crop Production – I Laboratory	BS	0	0	4	2
9	21CH112	Chemistry Laboratory for Biotechnology	BS	0	0	2	1
10	21CS112	Computational Thinking and Problem Solving using C Laboratory	ES	0	0	2	1
11	21BT112	Introduction to Biotechnology Laboratory	PC	0	0	2	1
			TOTAL	17	2	12	25

SEMESTER II							
S.No.	**Course Code**	**Course Title**	**Category**	**L**	**T**	**P**	**C**
THEORY							
1	21EN201	Applied English Skills	HS	2	1	0	3
2	21PH202	Applied Physics for Biosciences	BS	3	0	0	3
3	21MA203	Laplace Transforms and Advanced Calculus for Biotechnologists	BS	3	0	0	3
4	21BT201	Cell Biology	PC	3	0	0	3
5	21BT202	Microbiology	PC	3	0	0	3
6	21CS201	Programming in C and Data Structures	ES	3	0	0	3
LABORATORY							
7	21BT212	Engineering Exploration II	EEC	0	0	2	2
8	21PH111	Applied Physics Laboratory	BS	0	0	1	1
9	21BT212	Cell Biology Laboratory	PC	0	0	2	1
10	21BT213	Microbiology Laboratory	PC	0	0	2	1
11	21CS212	Programming in C and Data Structures Laboratory	ES	0	0	2	1
12	21ME214	Automobile Engine Assembly Laboratory	ES	0	0	2	1
			TOTAL	17	1	11	25

SEMESTER III							
S.No.	**Course Code**	**Course Title**	**Category**	**L**	**T**	**P**	**C**
THEORY							
1	21BT301	Environmental Science for Biotechnology	PC	2	1	0	3
2	21MA303	Transforms and numerical methods for Biotechnology	BS	3	1	0	4
3	21BT302	Unit Operation and Unit Principles	PC	2	1	0	3
4	21BT303	Enzyme Technology	PC	3	1	0	4
THEORY WITH LABORATORY COMPONENTS (BLENDED)							
5	21BT321	Biochemistry	PC	3	0	2	4
6	21BT322	Basics of Bioinformatics	PC	3	0	2	4
LABORATORY							
7	21BT311	Engineering Exploration III	EEC	1	0	2	1
8	21EN301	Career Enhancement Program I	EEC	1	1	0	1
9	21IT312	Program Paradigms	ES	0	0	4	2
			TOTAL	17	1	11	25

SEMESTER IV							
S.No.	**Course Code**	**Course Title**	**Category**	**L**	**T**	**P**	**C**
THEORY							
1	21MA403	Probability and Statistics for Biotechnology	BS	3	0	0	3
2	21BT401	Applied Thermodynamics for Biotechnologists	PC	2	1	0	3
3		Professional Elective I	PE	3	0	0	3
THEORY WITH LABORATORY COMPONENTS (BLENDED)							
4	21BT421	Plant Biotechnology	PC	3	0	2	4
5	21BT422	Molecular Biology	PC	3	0	2	4
6	21BT423	Basic Industrial Biotechnology	PC	3	0	2	4
LABORATORY							
7	21BT411	Engineering Exploration IV	EEC	1	0	2	1
8	21EN401	Career Enhancement Program II	EEC	0	0	2	1
9	21IT312	Program Paradigms II	ES	0	0	4	1
			TOTAL	18	1	14	24

SEMESTER V							
S.No.	**Course Code**	**Course Title**	**Category**	**L**	**T**	**P**	**C**
THEORY							
1	21BT501	Marine Biotechnology	BS	3	0	0	3
2	21BT502	Instrumental Methods of Analysis	PC	3	1	0	4
3		Professional Elective II	PE	3	0	0	3
4		Professional Elective III	PE	3	0	0	3
THEORY WITH LABORATORY COMPONENTS (BLENDED)							
5	21BT521	Genetic Engineering	PC	3	0	2	4
6	21BT522	Bioprocess Engineering	PC	3	0	2	4
LABORATORY							
7	21BT511	Engineering Exploration V	EEC	1	0	2	1
8	21EN501	Career Enhancement Program III	EEC	0	0	2	1
			TOTAL	19	1	8	23

SEMESTER VI							
S.No.	**Course Code**	**Course Title**	**Category**	**L**	**T**	**P**	**C**
THEORY							
1	21BT601	Precision Medicine	PC	3	0	0	3
3	21BT602	Biological Data Analysis	PC	3	0	0	3
		Professional Elective IV	PE	3	0	0	3
3		Professional Elective V	PE	3	0	0	3
4		Open Elective I	PE	3	0	0	3
THEORY WITH LABORATORY COMPONENTS (BLENDED)							
5	21BT621	Immunology	PC	3	0	2	4
LABORATORY							
7	21BT611	Mini Project	EEC	1	0	2	1
8	21EN601	Career Enhancement Program IV	EEC	0	0	2	1
			TOTAL	19	1	8	22

SEMESTER VII							
S.No.	**Course Code**	**Course Title**	**Category**	**L**	**T**	**P**	**C**
THEORY							
1	21MG701	Principles of Management and Professional Ethics	PC	3	0	0	3
3	21BT701	Downstream Processing	PC	4	0	0	4
	21BT702	Molecular Pathogenesis and Disease Diagnosis	PE	3	0	0	3
3	21BT703	Waste Management and Upcycling	PE	3	0	0	3
4		Open Elective I	PE	3	0	0	3
LABORATORY							
7	21BT711	Project Phase I	EEC	0	0	3	2
			TOTAL	19	1	8	18

SEMESTER VIII							
S.No.	Course Code	Course Title	Category	L	T	P	C
PROJECT							
1	21BT811	Project Phase II	EEC	2	0	0	8
			TOTAL	19	1	8	18

HUMANITIES AND SOCIAL SCIENCES (HS)

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	21EN101	Communicative English	HS	4	2	1	0	3
I	21TA101, 21EL101	Language-Tamil Language – Foundation English	HS	2	2	0	0	2
II	21EN201	Applied English Skills	HS	2	2	1	0	3

BASIC SCIENCES (BS)

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
I	21MA103	Matrices and calculus for Biotechnology	BS	4	3	1	0	4
I	21CH102	Chemistry for Biotechnology	BS	3	3	0	0	3
I	21PH212	Applied Physics Laboratory	BS	2	0	0	1	1
I	21AG112	Crop Production Laboratory I	BS	3	0	0	3	2
II	21MA203	Laplace transform and advanced calculus forBiotechnology	BS	3	3	0	0	3
II	21PH202	Applied Physics for Biosciences	BS	5	3	0	0	3
II	21CH112	Chemistry laboratory for Biotechnology	BS	2	0	0	2	1
III	21MA303	Transforms and numerical methods for Biotechnology	BS	4	3	0	0	3
IV	21MA403	Probability and Statistics for Biotechnology	BS	4	3	0	0	3
IV	21MA413	MAT Lab Programming	BS	2	0	0	2	1
V	21BT501	Marine Biotechnology	BS	4	3	0	0	3

ENGINEERING SCIENCES (ES)

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
I	21CS101	Computational Thinking andProblem Solving using C	ES	4	3	0	0	3
I	21CS112	Computational Thinking andProblem Solving using C Laboratory	ES	2	0	0	2	1

II	21CS201	Programming in C and Data Structures	ES	3	3	0	0	3
II	21ME214	Basic Engine Laboratory	ES	2	0	0	2	1
II	21CS212	Programming in C and Data Structures Laboratory	ES	2	0	0	2	1
III	21IT314	Program Paradigms	ES	3	0	0	4	2
IV	21IT312	Program Paradigms II	ES	3	0	0	4	1

PROFESSIONAL CORE (PC)

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
I	21BT101	Introduction to Biotechnology	PC	5	3	0	0	3
I	21BT112	Introduction to Biotechnology Laboratory	PC	2	0	0	2	1
II	21BT201	Cell Biology	PC	3	3	0	0	3
II	21BT212	Cell Biology Laboratory	PC	2	0	0	2	1
II	21BT202	Microbiology	PC	3	3	0	0	3
II	21BT213	Microbiology Laboratory	PC	2	0	0	2	1
III	21BT301	Environmental Science for Biotechnology	PC	4	2	0	0	2
III	21BT302	Unit Operation and Unit Principles	PC	3	2	1	0	3
III	21BT321	Biochemistry	PC	4	3	0	2	4
III	21BT303	Enzyme Technology	PC	4	3	1	0	4
III	21BT322	Basics of Bioinformatics	PC	4	3	0	2	4
IV	21BT401	Applied Thermodynamics for Biotechnologists	PC	4	2	1	0	3
IV	21BT421	Plant Biotechnology	PC	4	3	0	2	4
IV	21BT422	Molecular Biology	PC	4	3	0	2	4
IV	21BT423	Basic Industrial Biotechnology	PC	4	3	0	2	4
V	21BT521	Genetic Engineering	PC	4	3	0	2	4
V	21BT522	Bioprocess Engineering	PC	4	3	0	2	4
V	21BT502	Instrumental Methods of Analysis	PC	3	3	1	0	4

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
I	21BT111	Engineering Exploration I	EEC	3	1	0	2	2
II	21BT211	Engineering Exploration-II	EEC	2	1	0	2	2
III	21BT311	Engineering Exploration III	EEC	3	0	0	2	1
III	21EN301	Career Enhancement Program-I	EEC	2	1	1	0	1
IV	21BT411	Engineering Exploration IV	EEC	3	0	0	2	1
IV	21EN401	Career Enhancement Program-II	EEC	2	1	1	0	1
V	21BT511	Engineering Exploration V	EEC	3	1	0	2	1
V	21EN501	Career Enhancement Program - III	EEC	3	1	1	0	1

PROFESSIONAL ELECTIVE COURSES : VERTICALS

VERTICAL I	VERTICAL II	VERTICAL III	VERTICAL IV	VERTICAL V	VERTICAL VI	VERTICAL VII	VERTICAL VIII
Biosciences	**Bioprocess Technology**	**Medical Biotechnology**	**Biochemical Engineering**	**Animal Biotechnology**	**Computational Biotechnology**	**Quality and Regulatory Affairs**	**Agro Biotechnology**
Biosensors	Bioprocess Control and Instrumentation	Human Genetics	Mass Transfer Operations	Fundamentals of Animal Biotechnology	Programming of Bioinformatics Applications	Clinical trials and healthcare policies in Biotechnology	Plant anatomy
Bio-Nanotechnology	Sustainable Bioprocess Development	Cancer Biology	Transport Phenomena in Biological System	Animal Health and Nutrition	Fundamentals of Algorithms for Bioinformatics	Biotechnological Products and its Validation	Therapeutics application of phytochemicals
Protein Engineering	Industrial Food Processing	Biopharmaceuticals and Biosimilars	Bioenergy and Biofuels	Animal Physiology and Metabolism	Molecular Modelling	Quality Assurance and Quality control in Biotechnology	Biofertilizer production and Mushroom cultivation
Bioengineered Materials	Bioreactor Design and Scaleup process	Tissue Engineering	Bioremediation Technology	Animal Cell Culture Technology	Computer Aided Drug Design	Entrepreneurship and patent design	Biotechnological Approach in Crop Improvement
Stem cell Technology	Bioprocess modelling and simulation	Molecular Therapeutics and Diagnostics	Chemical Reaction Engineering	Advances in Animal Biotechnology	Metabolomics and Metabolic Engineering	Intellectual Property Rights in Biotechnology	Advance Techniques in Agro forestry
Modern Bioanalytical Techniques	Bioreactor consideration for Recombinant Products	Biomedical Engineering	Petroleum Biotechnology	Biotechniques in Animal Breeding	Data Mining and Machine Learning Techniques for Bioinformatics	Biosafety and Hazard Management	Plant Tissue Culture and Transformation Techniques
Forensic Science	Bioprocess calculations	Medical Biotechnology	Process Calculation & Heat Transfer	Animal Genomics	Bio-python	Biostatistics	Plant Physiology
Biopolymers	Separation Techniques	Vaccine Biotechnology	Computational Methods for Biochemical Engineering	Developmental Biology	Genomics and Proteomics	Total Quality Management for Biotechnologists	Plant Pathology

* Professional Elective Courses will be registered in Semesters IV to VII. These courses are listed in groups called verticals that represent a particular area of specialisation. Students are permitted to choose all Professional Electives from a particular vertical or from different verticals. Further, only one Professional Elective course shall be chosen in a semester horizontally (row-wise). However, two courses are permitted from the same row, provided one course is enrolled in Semester V and another in semester VI. The registration of courses for B.E./B.Tech (Honours) or Minor degree shall be done from Semester V to VIII.

SUMMARY

S.No	SUBJECT AREA	CREDITS AS PER SEMESTER								CREDITS TOTAL	Percentage
		I	II	III	IV	V	VI	VII	VIII		
1	**HS**	5	3							8	6.55%
2	**BS**	10	7	4	3	3				27	22.13%
3	**ES**	4	5	2						11	9.01%
4	**PC**	4	8	18	15	12				57	46.72 %
5	**PE**				3	6				9	7.38 %
6	**OE**										
7	**EEC**	2	2	2	2	2				10	8.20%
Total		25	25	26	23	23				122	100%

SEMESTER I

21EN101	COMMUNICATIVE ENGLISH	L	T	P	C
		2	1	0	3

Course Objectives

- To develop the basic reading and writing skills of first year engineering and technology students.
- To help learners develop their listening skills, which will, enable them listen to lectures and comprehend them by asking questions; seeking clarifications.
- To help learners develop their speaking skills and speak fluently in real contexts.
- To help learners develop vocabulary of a general kind by developing their reading skills

Course Outcomes

At the end of the course, learners will be able to

- CO1: Read articles of a general kind in magazines and newspapers.
- CO2: Participate effectively in informal conversations; introduce themselves and their friends and express opinions in English.
- CO3: Comprehend conversations and short talks delivered in English
- CO4: Write short essays of a general kind and personal letters and emails in English
- CO5: Develop flair for any kind of writing with rich vocabulary and proper syntax.
- CO6: Proficiency in writing technical articles and presenting papers on any topic of any genre.

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1										2		3			
2									2	2		3			
3										2		3			
4										2		3			
5										2		3			
6									3	3		2			

3 - High, 2 - Medium, 1 – Low

UNIT I COMMUNICATION CONCEPTS **9**

Process of Communication - Inter and Intrapersonal Communication - Essentials for effectiveness.

UNIT II FOCUS ON SOFT SKILLS **9**

Etiquette - Work Place etiquette - Telephone etiquette - Body Language - Persuasive Communication Speaking - Critical Reasoning and Conflict Management based on Case Studies -Group Communi Meetings - Interview Techniques.

UNIT III TECHNICAL WRITING **9**

Technical Writing Principles - Style and Mechanics - Genres of Technical Writing - Technical Definitions - Physical, Functional and Process Descriptions - Technical Report Writing - Preparing Instructions and Manuals– Interpretation of Technical Data.

UNIT IV BUSINESS CORRESPONDENCE **9**

Writing Emails, Preparing Resumes, Memos, Technical and Business Proposals.

UNIT V TECHNICAL COMMUNICATION **9**

Seminars, Process Description and Group Discussions, Use of Visual Aids.

TOTAL: 45 HOURS

TEXT BOOKS

1. Monograph prepared by the Faculty, Department of English, 2015.

REFERENCES

1. Jeff Butterfield, “Soft Skills for Everyone”, Cengage Learning, New Delhi, 2013.
2. Jean Naterop B. and Rod Revel , “Telephoning in English”, Cambridge University Press, Cambridge, 2011.
3. David A. Mc Murrey and Joanne Buckley, “Handbook for Technical Writing”, Cengage Learning, New Delhi, 2011.
4. Simon Sweeney, “English for Business Communication”, Cambridge University Press, New Delhi, 2012.

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

M.h.
(HoD/English)

21MA103 MATRICES AND CALCULUS FOR BIOTECHNOLOGY

L	T	P	C
3	1	0	4

Course Objectives

- Engineering Mathematics is an essential tool for describing and analyzing engineering process and systems. It enables precise representation and communication of knowledge. The objective of the course is to expose students to understand the basics and importance of Matrix Theory, Differential Calculus, Integral Calculus and Ordinary Differential Equations which are being widely used in Bio technology studies.

PREREQUISITES

- Basics concepts of Matrices
- System of linear equations
- Limits and Continuity
- Basic concepts of Differentiation
- Basic concepts of Integration

Course Outcomes

At the end of the course, learners will be able to

- CO1 Evaluate solutions of system of linear equations , Eigen values, and Eigen vectors of the given matrix.
- CO2 Use the applicability of Cayley - Hamilton theorem to find the inverse of a matrix and diagonalization of matrix.
- CO3 Gain knowledge to find the radius of curvature and torsion of a curve, which are used for analyzing the output data.
- CO4 Determine values of definite integrals exactly and apply Multiple integrals to evaluate area and volume over the given region.
- CO5 Solve the differential equations arising in Biotechnology.

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	2		2							2	3	3	
2	3	3	2		2							2	3	3	
3	3	3	2		2							2	3	3	
4	3	3	2		2							2	3	3	
5	3	3	2		2							2	3	3	

3 - High, 2 - Medium, 1 – Low

UNIT I MATRICES 9+3

Consistency and Linear dependence of linear system of equations –Vectors - Eigen values and Eigen vectors of a real matrix – Properties of Eigen values and Eigen vectors (excluding proof) – Applications of Matrices in Biotechnology.

UNIT II DIAGONALIZATIONOFAREALSYMMETRICMATRICES 9+3

Cayley – Hamilton theorem (excluding proof) – Reduction to Diagonal form: Similarity matrices – Orthogonal matrix – Reduction of Quadratic form to Canonical form by orthogonal transformation – Applications of Diagonalization of a real matrix in Biotechnology.

UNIT III DIFFERENTIAL CALCULUS AND ITS GEOMETRICAL APPLICATIONS 9+3

Derivatives – Simple problems – Curvature – Radius of curvature in Cartesian and Parametric forms – Simple problems – Centre of curvature – Circle of curvature – Involutes and Evolutes – Applications of Differential Calculus in Biotechnology.

UNIT IV INTEGRAL CALCULUS AND MULTIPLE INTEGRALS 9+3

Definite and Indefinite integrals – Substitution rule – Integration by parts – Double integrals – Double integrals in polar coordinates – Simple problems - Change of order of integration in Cartesian coordinators - Area enclosed by plane curves in Cartesian coordinators –Triple integrals in Cartesian coordinates –

Volume of solids as Triple integral in Cartesian coordinates – Simple Problems – Applications of Integral calculus in Biotechnology.

UNIT V ORDINARY DIFFERENTIAL EQUATIONS 9+3

Higher order linear differential equations with constant coefficients - Cauchy's linear equations - Legendre's linear equations - Simultaneous first order linear equations with constant coefficients - Applications of Ordinary Differential Equations in Biotechnology.

TOTAL: 60 HOURS

TEXT BOOKS

1. Grewal. B. S., "Higher Engineering Mathematics", 44th Edition, Khanna Publications, Delhi, 2017
2. James Stewart., "Calculus: Early Transcendentals", Cengage Learning, 7th Edition, New Delhi, 2015. [For Unit IV-Sections 5.2, 5.4(excluding net change Theorem),5.5 and 7.1]

REFERENCES

1. Kreyzig E., "Advanced Engineering Mathematics", 10th Edition, John Wiley and sons, 2016.
2. Veerarajan T., "Engineering Mathematics", Tata McGraw Hil Publishing Company, New Delhi (2008).
3. Peter V.O. Neil., "Advanced Engineering Mathematics", 7th Edition Cengage learning, India pvt Ltd, New Delhi. 2010
4. Weir. M. D and Joel Hass., " Thomas Calculus", 14th Edition, Pearson India, 2017.

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

Head of the Department
Mathematics
Sri Shakthi Institute of
Engineering and Technology
Coimbatore 641 062.

21CH102 **CHEMISTRY FOR BIOTECHNOLOGY**

L	T	P	C
3	0	0	3

Course Objectives

- To equip the students to understand the water quality parameters and treatment techniques.
- To acquire the knowledge of types of fuels and manufacture of fuels and biofuels.
- To know the properties and applications of important Nanomaterials.
- To provide a basic knowledge on different instrumental analysis.
- To gain knowledge on fermentation reaction and applications.

Course Outcomes

At the end of the course, learners will be able to

- CO1. Understand the water and its parameters influencing treatment process.
- CO2. Understand the manufacturing of various types of fuels.
- CO3. Understand the importance of nanomaterials and concepts.
- CO4. Learn about instrumental analysis of chemical compounds.
- CO5. Gain knowledge of chemical reactions in fermentation and biomass.
- CO6.Apply the fermentation techniques in industrial research studies

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2														
2	3														
3	2														
4	2														
5	3														
6	2									2					

3 - High, 2 - Medium, 1 – Low

UNIT I AQUATIC CHEMISTRY **10**

Introduction to water and its treatments -Quality parameters (physical, chemical & biological) – Hardness – Expression of hardness - Boiler Feed Water: Boiler troubles (scale and sludge formation only) -Conditioning methods: External conditioning (Demineralization process) - Internal conditioning; Desalination: Desalination of brackish water – Reverse osmosis.

UNIT II FUELS **10**

Fuels: Classification – Calorific value; Coal: Proximate analysis of coal - Carbonization - Manufacture of metallurgical coke (Otto Hoffmann method); Petroleum: Manufacture of synthetic petrol (Bergius process) - Knocking - Gaseous fuels; Natural gas: Compressed natural gas (Composition only) – Bio fuels – Types – Advantages and disadvantages – production of Biodiesel.

UNIT III NANOMATERIALS **8**

Nanomaterials – Distinction among Molecule, nano materials & Bulk materials, Types (Nanoparticles, Nanoclusters, Nanowires, Nanorods and Nanotubes) – Properties – Synthesis of nano material by bottom up and top down process (CVD , Electro deposition , Laser ablation & Sol gel process) – Synthesis , properties and application of Carbon Nanotubes – Application of Nanomaterials.

UNIT IV INSTRUMENTALS METHODS OF ANALYSIS **8**

Basic principles of Potentiometry, Conductometry and Colorimetry - Instrumental Analysis – Principles, Instrumentation and Applications - UV – visible spectroscopy and IR spectroscopy - Flame photometry, Atomic Absorption spectroscopy - Estimation of nickel by AAS.

UNIT V CHEMICAL ASPECTS OF BIO TECHNOLOGY **9**

Introduction – Fermentation – Manufacture of ethyl alcohol and acidic acid by fermentation - Deamination – Bio fertilizers – Need for bio fertilizers - Types – Biomass – Applications of Bio technology.

TOTAL: 45 HOURS

TEXT BOOKS

1. OG PALANNA, “Engineering chemistry” McGraw-Hill Education Pvt. Ltd, Chennai, 2017, Second edition.
2. P.C.Jain and Monica Jain, “Engineering Chemistry”, Dhanpat Rai Publications Pvt. Ltd, New Delhi, 16th Edition, 2017.

REFERENCES

1. Dr.A.Ravikrishnan, “Engineering Chemistry”, Sri Krishnan Publications, Chennai,2018.
2. S. Vairam, P. Kalyani and Suba Ramesh, “Engineering Chemistry’, Wiley India Pvt. Ltd, New Delhi, 2nd Edition 2014.
3. S. S. Dara and S.S. Umare, “Textbook of Engineering Chemistry”, S. Chand & Company Ltd, New Delhi, 2017.
4. Vogel’s textbook of quantitative chemical analysis (8th edition, 2014).

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

CARAJI

Professor and Head
DEPARTMENT OF CHEMISTRY
Sri Sakthi Inst. of Engg. & Tech.
L&T By-Pass Road
Coimbatore-641 062

21CS101	COMPUTATIONAL THINKING AND PROBLEM SOLVING	L	T	P	C
		3	0	0	3

Course Objectives

The course aims to provide the students

- To understand the various general steps in problem solving.
- To analyze the efficiency of the algorithms.
- To learn to solve problems using C.
- To understand the concept of arrays and strings.
- To learn C functions and storage classes.

Course Outcomes

At the end of the course, learners will be able to

CO1: Understand the fundamental concepts of computer and operating systems

CO2: Understand and apply number system conversions

CO3: Create the algorithm and flow charts for a given problem

CO4: Understand the basics of C programming , choose the right data representation formats

CO5: Design and implement applications in C using arrays and strings

CO6: Develop and implement application applications in C using function

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2		3		1								3	3	
2	3													2	
3		2	3											2	
4	3		3		3								3	2	2
5	3	2		2					2		2	2	1	2	2
6	3	2	3	2					2		2	2	2	3	3

3 - High, 2 - Medium, 1 – Low

UNIT I INTRODUCTION TO COMPUTER PROBLEM SOLVING 9

Computers - Introduction, CPU - ALU, Memory – RAM/ROM, Input/Output, hard disk, storage. The problem solving Aspect, Top-Down Design, Implementation of Algorithms, Program Verification, Introduction, Information and data, Data encoding, number systems. Logic: Boolean logic.

UNIT II PROBLEM SOLVING TECHNIQUES AND ALGORITHMIC THINKING 9

Problem definition, logical reasoning, problem decomposition, abstraction. Flowchart: Name binding, Selection, Repetition, Modularization. Data Organization: List and Arrays. Simple algorithms,Factoring and recursion techniques.

UNIT III C PROGRAMMING FUNDAMENTALS 9

Introduction to C Language - Background, C Programs, Identifiers, Data Types, Variables, Constants, Input / Output Statements Arithmetic, Operators and Expressions: Evaluating Expressions, Precedence and Associativity of Operators, Type Conversions. If, If-Else, Switch-Statement and Examples. Loop Control Statements: For, While, Do While and Examples. Continue Break and Goto statements.

UNIT IV ARRAYS & STRINGS 9

Arrays - Concepts, Using Arrays in C, Array Applications, Two- Dimensional Arrays, Multidimensional Arrays, Linear Search. Strings - Concepts, C Strings, String Input/output Functions, Arrays of Strings, String Manipulation Functions.

UNIT V FUNCTIONS 9

Function Basics, User-defined Functions, Calls, Standard Functions, and Methods of Parameter Passing. Recursion- Recursive Functions.

Storage Classes: Auto, Register, Static, Extern, Scope Rules, and Type Qualifiers.

TOTAL: 45 HOURS

TEXT BOOKS

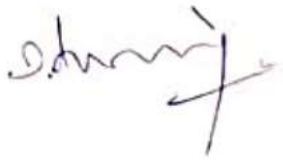
1. David Riley and Kenny Hunt, “Computational Thinking for Modern Solver”, Chapman & Hall/CRC 2014.
2. R.G.Dromey, “How to Solve it by Computer”, PHI, 2008.

REFERENCES

1. Seyed H Roosta,"Foundations of programming languages design & implementation", Cengage Learning. 2009.
2. Karl Beecher, "Computational Thinking: A beginner's guide to problem-solving and programming", BCS, The Chartered Institute for IT; 1 edition, 2017.
3. Wladston Ferreira Filho, "Computer Science Distil ed : Learn the Art of Solving Computational Problems", Code Energy LLC, 2017.

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.



21BT101 **INTRODUCTION TO BIOTECHNOLOGY**

L	T	P	C
3	0	0	3

Course Objectives

- Define biotechnology and understand the many scientific disciplines that contribute to biotechnology.
- Provide examples of historic and current applications of biotechnology and its products.
- List and describe different types of biotechnology and their applications.
- Provide examples of potential advances in biotechnology.

Course Outcomes

At the end of the course, learners will be able to

- CO1: To comprehend the historical development, current and future trends of the field of biotechnology
- CO2 To understand Chemistry, Classification of life forms and Cellular components
- CO3: To acquire knowledge in the basic functions of Large Biomolecules
- CO4: To understand the fundamental calculations and preparations of solutions
- CO5: To acquaint students with applications of General applications and Ethical issues in biotechnology
- CO6: To

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	1		2	3				1					2	
2	1	2		3	2				1					1	
3	1	3		2	1				1					1	
4	1	2		1											
5	1			2					2					2	
6	2			2									1	2	

3 - High, 2 - Medium, 1 – Low

UNIT I **ORIGIN AND DEVELOPMENT OF BIOTECHNOLOGY** **9**

Introduction and definitions, Historic perspectives- biotechnology in prehistoric times, microorganisms and fermentation, Origin of genetics, DNA and genetic Engineering, Hybridoma technology, Beginning of modern Biotechnology, Classical and modern concepts of Biotechnology, Scope of Biotechnology- Commercial potential, Biotechnology in India and its global trends, Major Biotechnology institutes and companies in India.

UNIT II **PLANT BIOTECHNOLOGY** **9**

Crop improvement through Biotechnology, Herbicide tolerance, Insect resistance, Virus tolerance, other engineered products. Production of bio active secondary metabolites by plant tissue culture- Production of antibodies, viral antigens and peptide hormones in plants, biodegradable plastics in plants.

UNIT III **ANIMAL BIOTECHNOLOGY** **9**

Gene expression and regulation. - Basic principles and techniques of recombinant DNA technology - Gene transfer methods for mammalian cells and animal transgenics - Valuable genes in animals - Animal germ cells, development and animal cloning - Functional genomics, ethics and the future of animal biotechnology. Genetically modified Livestock and poultry

UNIT IV **MICROBIAL BIOTECHNOLOGY** **8**

Bioprocess and Fermentation Technology, Biological fuel generation, Sewage and Effluent treatment; Safer and cheaper medicines by biotechnology, antibiotics, medicines from cell cultures, new medicines through genetic engineering, Biopharming.

UNIT V **FOOD AND BEVERAGE BIOTECHNOLOGY** **9**

Food and health, application of biotechnology in food processing, Traditional and modern food processing.

TOTAL: 45 HOURS

TEXT BOOKS

1. William J. Thieman, Michael A. Palladino, 2012, Introduction to Biotechnology, 3rd edition, Pearson
2. Campbell -patt Edited, “Food Science and Technology”, Blackwel publishing Ltd, NewYork, 2009.

REFERENCES

1. Brown TA., Genomes 2, 3rd edition Bios Scientific Publishers Ltd, Oxford, 2006.
2. Freshney IR, “Culture of Animal Cel s: A Manual of Basic Technique”, Wiley-Liss Inc., New York, 2000.
3. Mousdale D M., “Biofuels: Biotechnology, Chemistry, & Sustainable Development “CRC Press, 2008.

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

21TA101 **TAMIL** **L T P C**
2 0 0 2

Course Objectives

- The students should be made
- To enhance listening skill of the learners and practicing it for a better professional as well as moral skills
- To read different text without barriers using reading strategies

Course Outcomes

At the end of the course, learners will be able to

CO1. Learn the language literature concepts
CO2. Speak fluently using the proper vocabulary.
CO3. Familiarize the functional understanding of the language grammar
CO4. Understand the concepts of new era tamil literature works
C05: To develop the reading skills of tamil novels and stories
C06: To enhance the features of story telling, conversation and creative skills of writing in students

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1									3	3	2	2	1		
2									3	3	2	2	1		
3									3	3	2	1	1		
4									3		2	1	1		
5									3	3	2	3	1		
6									3	3	2	2	1		

3 - High, 2 - Medium, 1 – Low

THEORY COMPONENT CONTENTS

UNIT I **அலகு – 1** **5**

சங்ககாலம்- மூன்றுசங்கங்கள்- முதற்சங்கம் (கடல்கொண்டதென்மதுரை)- இடைச்சங்கம் (கபாடபுரம்)-கடைச்சங்கம்(மதுரை)-சங்க இலக்கியங்கள்- பதினெண்மேற்க்கணக்கு நூல்கள்: எட்டுத்தொகைநூல்கள் (ஐங்குறுநூறு, குறுந்தொகை,கலித்தொகை, நற்றிணை, அகநானூறு, புறநானூறு, பதிற்றுப்பத்து, பரிபாடல்)- பத்துப்பாட்டு நூல்கள் (சிறுபாணாற்றுப்படை, பெரும்பாணாற்றுப்படை, திருமுருகாற்றுப்படை, பொருநராற்றுப்படை, மலைபடுகடாம், குறிஞ்சிப்பாட்டு, முல்லைப்பாட்டு, பட்டினப்பாலை, நெடுநல்வாடை, மதுரைக்காஞ்சி.)- சங்கம்மருவியகாலம்- பதினெண்கீழ்க்கணக்கு நூல்கள் (திருக்குறள், நாலடியார், நான்மணிக்கடிகை, இன்னாநாற்பது, இனியவைநாற்பது, திரிகடுகம், ஆசாரக்கோவை, பழமொழி, சிறுபஞ்சமூலம், முதுமொழிக்காஞ்சி, ஏலாதி, கார்நாற்பது, களவழிநாற்பது, ஐந்திணைஐம்பது, திணைமொழிஐம்பது, ஐந்திணைஎழுபது, திணைமாலை நூற்றைம்பது, கைந்நிலை)- காப்பியங்கள்- ஐம்பெருங்காப்பியங்கள்- (சிலப்பதிகாரம், மணிமேகலை, சீவகசிந்தாமணி, வளையாபதி, குண்டலகேசி)- ஐஞ்சிறுகாப்பியங்கள் (நாககுமாரகாவியம், உதயணகுமாரகாவியம், யசோதரகாவியம், சூளாமணி, நீலகேசி)- இலக்கணம் - எழுத்து, சொல், பொருள், யாப்பு, அணி - தமிழ் எழுத்துக்கள்- உயிரெழுத்துக்கள், மெய்யெழுத்துக்கள், உயிர்மெய் எழுத்துக்கள், ஆய்தஎழுத்து- வகைகள்- குறில், நெடில், வல்லினம், மெல்லினம், இடையினம், குற்றியலுகரம், குற்றியலிகரம்.

UNIT II **அலகு – 2** **5**

மயங்கொலிப்பிழைகள் - ர, ற-ஒலிவேறுபாடுகள-ல, ள, ழஒலிவேறுபாடுகள்-ந, ன, ண-ஒலி வேறுபாடுகள்- சொல் இலக்கணம்- திணை, பால், எண், இடம், காலம் - பேச்சுவழக்கு- எழுத்துவழக்கு- இழிவழக்குச்சொற்கள்-வழுவுச்சொற்கள் - இணைச்சொற்கள்-தொகைச்சொற்கள்-நிறுத்தற்குறியீடுகள்-
உவமைத்தொடர்கள் - மரபுத்தொடர்கள்- வாக்கியத்தில் அமைத்தல்-மரபுப்பிழை திருத்தம் -ஐந்திணை- பலபொருள்ஒருசொல்-ஒருசொல்பலபொருள்

UNIT III **அலகு – 3** **5**

அணி இலக்கணம் – இயல்புநவிற்சி அணி, உயர்வுநவிற்சி அணி, உவமை அணி-எடுத்துக்காட்டுஉவமை அணி, உருவக அணி, ஏகதேச உருவக அணி, சொற்பொருள் பின்வருநிலைஅணி, தற்குறிப்பேற்ற அணி, வேற்றுமை அணி, வஞ்சப்புகழ்ச்சி அணி, மடக்கணி. பொருந்திய சரியான சொல்லைத் தேர்ந்தெடுத்தல் செய்யுள் பொருளுணர்திறன்.

UNIT IV **அலகு – 4** **5**

திருக்குறள்- 50 குறள்கள்- ஆத்திச்சூடி- கவிதைகள்- பாரதியார் (மனதில் உறுதி வேண்டும்)- பாரதிதாசன் (கனியிடை ஏறியசுளையும்)- வைரமுத்து (ஆதலால்மனிதா...) பெய்யெனப் பெய்யும் மழை கவிதைத்தொகுப்பு-காசி ஆனந்தன் (மாடியிலிருந்து...)-நறுக்குகள் கவிதைத் தொகுப்பு- பழமொழிகள்-விடுகதைகள்

UNIT V **அலகு – 5** **5**

சிறுகதைகள் – ஜெயமோகன், ஜெயகாந்தன், கி.ராஜநாராயணன், பிரபஞ்சன்
நீதிக்கதைகள், மொழிபெயர்ப்பு- மூன்றில் ஒருபங்காகச் சுருக்குதல்
வினாவிற்கேற்ற விடைகள்- கடிதங்கள்-தலைவர்கள் மற்றும் அறிஞர்கள் பற்றிய கட்டுரைகள்

UNIT VI **அலகு – 6** **5**

படைப்பாற்றல்பயிற்சி – பேச்சுப்பயிற்சி (கதைசொல்லுதல், விவாதித்தல், கவியரங்கம், பட்டிமன்றம்)-எழுத்துப்பயிற்சி (கவிதை, கட்டுரை, சிறுகதை, கடிதங்கள்)

TOTAL: 30 HOURS

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

21EL101 **FOUNDATION ENGLISH** **L T P C**
2 0 0 2

Course Objectives

The course aims to provide the students,

- Educate students in both the artistry and utility of the English language through the study of literature and other contemporary forms of culture.
- Provide students with the critical faculties necessary in an academic environment, on the job, and in an increasingly complex, interdependent world.
- Graduate students who are capable of performing research, analysis, and develop content from different genres.
- Assist students in the development of intellectual flexibility, creativity, and cultural literacy so that they may engage in life-long learning.
- Write analytically in a variety of formats, including essays, research papers, reflective writing and critical reviews of secondary sources.

Course Outcomes

At the end of the course, learners will be able to

- CO1. Students should be familiar with literary and cultural texts within a significant number of historical, geographical, and cultural contexts.
- CO2. Students should be able to apply critical and theoretical approaches to the reading and analysis of literary and cultural texts in multiple genres.
- CO3. Students should be able to ethically gather, understand, evaluate and synthesize Information from a variety of written and electronic sources from different genres.
- CO4. Students should be able to write analytically in a variety of formats, including essays,
- research papers, reflective writing, and critical reviews of secondary sources.
- CO5. Students should be able to understand the process of communicating and interpreting human experiences through literary representation using historical contexts and disciplinary methodologies.

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1							3	1	2	3		2			2
2								2		3		2			2
3							3		3	3		2			3
4							1		2	3		3			3
5								1	3	3		3			3

3 - High, 2 - Medium, 1 – Low

THEORY COMPONENT CONTENTS

UNIT I **INTRODUCTION** **6**

Introduction to English Language – Introduction to Indian writing in English - Palanquin Bearers by Sarojini Naidu – To me, fair friend, you never can be old, Sonnet 104 by Shakespeare

UNIT II **FAMOUS POEM** **6**

Ode on a Grecian Urn by John Keats – Gitanjali by Rabindranath Tagore

UNIT III **SHORT STORIES** **6**

Short Stories: A Christmas Carol by Charles Dickens - The Open Window by Saki - The Interpreter of Maladies by Jhumpa Lahiri – Success Stories of inspirational leaders: Martin Luther King, Malala Yousafzai & Saalumarada Thimmakka, also known as Aalada Marada Timakka, an Indian environmentalist.

UNIT IV **NOVEL** **6**

Novel: The Man-Eater of Malgudi by R.K.Narayan

UNIT V **A DOLL'S HOUSE** **6**

A Doll's House by Norwegian playwright Henrik Ibsen

TOTAL: 30 HOURS

TEXTBOOKS

1. Palanquin Bearers Paperback by Sarojini Naidu (Author), Indu Harikumar (Illustrator)
2. Sonnet 104: To Me, Fair Friend, You Never Can Be Old
3. Emma Abbate & Ashley Riches From the Album Mario Castelnuovo-Tedesco: Shakespeare Sonnets
4. Ode On A Grecian Urn And Other Poems (English, Paperback, Keats John), Publisher: Kessinger Publishing Co, Genre: Poetry, ISBN: 9781419137730
5. Gitanjali by Rabindranath Tagore, Kindle edition
6. The Man-eater of Malgudi by R.K. Narayan (Author), Repro Books
7. A Doll's House by Henrik Ibsen, Maple Press, Genre: Fiction, ISBN: 9789350330685

REFERENCES

1. The Open Window and Other Short Stories, Kindle Edition
2. Charles Dickens' Christmas Stories: A Classic Collection, 2019, Kindle Edition

WEB RESOURCES

https://www.deccanchronicle.com/lifestyle/books-and-art/220418/saalumarada-thimmakka-the-green-legend-now-on-stage.html
https://malala.org/malalas-story
https://www.nobelprize.org/prizes/peace/1964/king/biographical/

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

M.h.
(HOD/English)

21BT111	ENGINEERING EXPLORATION I	L	T	P	C
		1	0	2	2

COURSE OBJECTIVES

- To enable the students to design and build simple systems on their own
- To help experiment with innovative ideas in design and team work
- To create an engaging and challenging environment in the engineering lab
- To inculcate ethics and sustainability perspectives and enable students to work in a team

CONTENTS

S No	Topics	No of Hours
1	Introduction to Engineering	3
2	Platform based development	12
3	Mechanisms	9
4	Requirements	3
5	Design	
6	Ethics	6
7	Sustainability	
8	Project Management Principles	3
9	Guided Project	
10	Final Project	9

COURSE OUTCOMES

CO1. Understand the role of an engineer as a problem solver

CO2. Apply multi-disciplinary principles and build systems using engineering design process and tools

CO3. Analyze engineering solutions from ethical and sustainability perspectives

CO4. Use basics of engineering project management skills while doing projects

CO5. Communicate, Collaborate and work as a team

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	1		2		2	2	2	2	1	1	1	1
2	3	3	3	3		2		2	2	2	2	1	2	2	2
3	3	3	3	3		2		2	2	2	2	1	2	2	2
4	3	3	3	3		2		2	2	2	2	1	2	2	2
5	3	3	3	3		2		2	2	2	2	1	2	2	2

3 - High, 2 - Medium, 1 – Low

GUIDELINES

1. Practical based learning carrying credits.
2. Multi-disciplinary/ Multi-focus group of 3-4 students.
3. Groups can select to work on specific tasks, or projects related to real world problems.
4. Each group has a faculty coordinator/Instructor who will guide/evaluate the overall group as well as individual students.
5. The students have to display their model at the end of semester.
6. The progress of the course is evaluated based on class performance and final demonstration of prototype.

Total:45 Hours

EVALUATION PATTERN	
Continuous Internal Assessment	100
TOTAL	

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

21AG112 **CROP PRODUCTION-I LABORATORY**

L	T	P	C
0	0	4	2

Course Objectives

- To introduce the different crop production practices in wet land, dry land and garden land through hands on experience and demonstrations.

Course Outcomes

At the end of the course, learners will be able to

- CO1 : Students completing this course would have acquired knowledge on crop selection, crop production and crop management.
- CO2 : The students will have the required knowledge in the area of production of agricultural crop
- CO3: Analysis the different harvesting technology
- CO4: Understand the nutrient management studies
- CO5: Study of transplanting techniques
- CO6: Apply the crop production methods in real time

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3											2	2	
2	3	3											2	2	
3	3	3											2	2	
4	3	3											2	2	
5	3	3											2	2	
6	3	3											2	2	

3 - High, 2 - Medium, 1 – Low

List of Components

To introduce the different crop production practices in wet land, dry land and garden land through hands on experience and demonstrations.

1. Identification of different crops in local region
2. Visit to meteorological observatory
3. Visit to wetlands and irrigate dry lands to learn important cropping systems and Hi Tec nursery
4. Seed selection and seed treatment procedures
5. Seed bed and nursery preparation
6. Sowing / Transplanting
7. Biometric observation for crops
8. Nutrient management studies
9. Water management and irrigation scheduling
10. Weed management studies
11. Integrated Pest Management studies
12. Harvesting
13. Post harvesting

TOTAL: 30 HOURS

TEXT BOOKS

1. Rajendra Prasad, Text Book of Field Crop Production. Directorate of Information and Publication, Krishi Anusandhan Bhavan, Pusa, New Delhi, 2015.
2. Hand Book of Agriculture. 2009 (6th revised edition), Indian Council of Agricultural Resarch (ICAR), New Delhi
3. Balasubramanian P and Palaniappan SP. 2001. Principles and practices of Agronomy. Agrobios Publishers, Ludhiana

REFERENCES

- Ramasamy S and Siddeswran K 2018. Agriculture and crop production. Sri Shakthi Institute of Engineering and Technology, Coimbatore
- Crop Production Guide, Tamil Nadu Agricultural University Publication, Coimbatore. 2005

EVALUATION PATTERN	
Continuous Internal Assessment	100
TOTAL	

Dr. Ranceesh KY, M.E., Ph.D.
Associate Professor and Head
Department of Agriculture Engineering
Sri Shakthi Institute of Engineering and Technology
Sri Shakthi Nagar, L&T By-Pass, Chinniyampalayam Post,
Coimbatore - 641 062, Tamilnadu, India.

21CH112 CHEMISTRY FOR BIOTECHNOLOGY LABORATORY

L	T	P	C
0	0	2	1

Course Objectives

- To equip the students to understand the water quality parameters and treatment techniques.
- To acquire the knowledge of types of fuels and manufacture of fuels and biofuels.
- To know the properties and applications of important Nanomaterials.
- To provide a basic knowledge on different instrumental analysis.
- To gain knowledge on fermentation reaction and applications.

Course Outcomes

At the end of the course, learners will be able to

- CO1. Understand the water and its parameters influencing treatment process.
- CO2. Understand the manufacturing of various types of fuels.
- CO3. Understand the importance of nanomaterials and concepts.
- CO4. Learn about instrumental analysis of chemical compounds.
- CO5. Gain knowledge of chemical reactions in fermentation and biomass.
- CO6.Apply the bioorganic reactions and energy transfer in projects

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2														
2	3														
3	2														
4	2														
5	3														
6	2									2					

3 - High, 2 - Medium, 1 – Low

List of Experiments

1. Testing the conductivity and pH of various types of water (municipal water, distilled water, salt water, and waste water).
2. Redox reactions – Finding emf of Fe in sample by Potentiometry.
3. Estimation of Ca, Mg, total, permanent and temporary hardness of water by EDTA method.
4. Estimation of chloride in water sample by Argentometric method.
5. Determination of strength of HCl using pH meter.
6. Determination of strength of HCl using conductivity meter.
7. Determination of strength of mixture of acids using Conductivity meter.
8. Determination of Dissolved Oxygen content of water sample by Winkler's method.
9. Synthesis of silver nanoparticles and its electrochemical characterization.
10. Isolation of lycopene from tomato paste.
11. Hydrolysis of sucrose.
12. Synthesis of aspirin.

TOTAL: 45 HOURS

TEXT BOOKS

3. OG PALANNA, "Engineering chemistry" McGraw-Hill Education Pvt. Ltd, Chennai, 2017, Second edition.
4. P.C.Jain and Monica Jain, "Engineering Chemistry", Dhanpat Rai Publications Pvt. Ltd, New Delhi, 16th Edition, 2017.

REFERENCES

5. Dr.A.Ravikrishnan, "Engineering Chemistry", Sri Krishnan Publications, Chennai,2018.

6. S. Vairam, P. Kalyani and Suba Ramesh, “Engineering Chemistry’, Wiley India Pvt. Ltd, New Delhi, 2nd Edition 2014.
7. S. S. Dara and S.S. Umare, “Textbook of Engineering Chemistry”, S. Chand & Company Ltd, New Delhi, 2017.
8. Vogel’s textbook of quantitative chemical analysis (8th edition, 2014).

EVALUATION PATTERN	
Evaluation of Laboratory Observation, Record and Test	**End Semester Examination**
100	100
60	40
TOTAL : 100	

CARAN]
Professor and Head
DEPARTMENT OF CHEMISTRY
Sri Sakthi Inst. of Engg. & Tech.
L&T By-Pass Road
Coimbatore-641 062

21CS112 COMPUTATIONAL THINKING AND PROBLEM SOLVING LABORATORY

L	T	P	C
0	0	2	1

Course Objectives

- To understand the various general steps in problem solving.
- To analyze the efficiency of the algorithms.
- To learn to solve problems using C.
- To understand the concept of arrays and strings.
- To learn C functions and storage classes.

Course Outcomes

At the end of the course, learners will be able to

CO1. Understand the syntax and semantics of the C language

CO2. Recognize how to develop and implement a program in the C language

CO3. Understand the concept of a branching and looping

CO4. Develop various forms of data representation and array supported by the C language

CO5. Understand string representation and its opertions supported by the C language

CO6. Implementing function concept with examples

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2										2		
2	3	2	3									2	2		
3	3	2	2	2					2	2			2		
4	3	3	2	2									2	2	2
5	3	2	3	2										2	
6	3	2	3	2					2	2		2		2	2

3 - High, 2 - Medium, 1 – Low

List of Experiments

1. Search, generate, manipulate data using MS office/ Open Office
2. Presentation and Visualization – graphs, charts, 2D, 3D
3. Simple statements and expressions
4. Scientific problem-solving using decision making and looping.
5. Simple programming for arrays.
6. Solving problems using String functions
7. Programs with user defined functions – Includes Parameter Passing
8. Program using Recursive Function

TOTAL: 30 HOURS

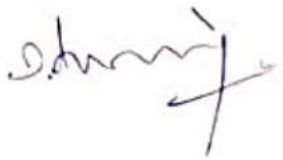
TEXT BOOKS

1. David Riley and Kenny Hunt, “Computational Thinking for Modern Solver”, Chapman & Hall/CRC 2014.
2. R.G.Dromey, “How to Solve it by Computer”, PHI, 2008.

REFERENCES

1. Seyed H Roosta, “Foundations of programming languages design & implementation”, Cengage Learning. 2009.
2. Karl Beecher, “Computational Thinking: A beginner's guide to problem-solving and programming”, BCS, The Chartered Institute for IT; 1 edition, 2017.
3. Wladston Ferreira Filho, “Computer Science Distil ed: Learn the Art of Solving Computational Problems”, Code Energy LLC, 2017.

EVALUATION PATTERN	
Evaluation of Laboratory Observation, Record and Test	**End Semester Examination**
100	100
60	40
TOTAL : 100	



21BT112 INTRODUCTION TO BIOTECHNOLOGY LABORATORY

L	T	P	C
0	0	2	1

Course Objectives

- Define biotechnology and understand the many scientific disciplines that contribute to biotechnology.
- Provide examples of historic and current applications of biotechnology and its products.
- List and describe different types of biotechnology and their applications.
- Provide examples of potential advances in biotechnology.

Course Outcomes

At the end of the course, learners will be able to

- CO1 : Understand the safety aspects in biotechnology laboratory
- CO2 : Demonstration of basic instruments and media preparation
- CO3 : Isolation of microbes from natural sources
- CO4 : Interpret the methods to extract microbial enzymes and basic meristem culturing
- CO5 : Preparation of environment friendly compost
- CO6: Identification of microbes present in soil

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	1		2	3				1					2	
2	1	2		3	2				1					1	
3	1	3		2	1				1					1	
4	1	1		2	3				1					2	
5	1	2		3	2				1					1	
6	1	3		2	1				1					1	

3 - High, 2 - Medium, 1 – Low

List of Experiments

1. Safety aspects in Biotechnology
2. Preparation of Reagents, Buffers etc
3. Media preparation and sterilization.
4. Hands on training on basic laboratory equipments – Centrifuge, Biosafety cabinet.
5. Isolation of microbes from soil.
6. Isolation of microbes from water.
7. Isolation of microbes from air.
8. Isolation of DNA from microbes.
9. Quantification of DNA using UV-Visible spectrophotometer.
10. Gene amplification using PCR.

TOTAL: 30 HOURS

TEXT BOOKS

1. Analytical Techniques in Biotechnology: A Complete Laboratory Manual. Goutam Bhowmik, Sujoy Bose.
2. Microscopic Techniques in Biotechnology. Michael Hoppert.
3. Laboratory Techniques In Microbiology & Biotechnology. Abhishek Publications. Tiwari, G. S. Hoondal.

EVALUATION PATTERN	
Evaluation of Laboratory Observation, Record and Test	**End Semester Examination**
100	100
60	40
TOTAL : 100	

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

SEMESTER II

21EN201 **APPLIED ENGLISH SKILLS** **L T P C**
2 1 0 3

Course Objectives

- The Course prepares second semester engineering and Technology students to:
- Develop strategies and skills to enhance their ability to read and comprehend engineering and technology texts.
- Foster their ability to write convincing job applications and effective reports.
- Develop their speaking skills to make technical presentations, participate in group discussions.
- Strengthen their listening skill which will help them comprehend lectures and talks in their areas of specialisation.

Course Outcomes

At the end of the course, learners will be able to

- CO1. Able to listen to advanced level of language and make note on it.
- CO2. Give an oral presentation in class using effective delivery strategies.
- CO3. Make inferences and predictions based on information in the text.
- CO4. Produce coherent and unified paragraph with adequate support and detail..
- CO5. To make effective contribution in Group Discussions
- CO6. Apply pragmatic and sociolinguistic aspect of communication for professional presentations.

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1										2					
2										2					
3										2					
4										2					
5										2					
6										2		3			

3 - High, 2 - Medium, 1 – Low

UNIT I **APPLIED GRAMMAR** **9**

Verb and Adverb, Subject Verb Agreement, Adjectives and its types, Articles, Gerunds, Infinitives and Prepositions, Tenses, Clauses

UNIT II **READING** **9**

Skimming and Scanning using newspapers, Reading Comprehension and Cloze test, Summarizing and note-taking., Reading scientific articles and news.

UNIT III **LISTENING COMPREHENSION** **9**

Listening to conversation between people, Listening to newspapers, Listening to short documentary, Summerizing and answering.

UNIT IV **SPEAKING** **9**

Speak up, Narration, Presentations (Grammar), Reading aloud.

UNIT V **PRINCIPLES OF WRITING** **9**

Be Forms, Sentence Patterns, Kinds of Sentences, Writing a Paragraph, Writing an Essay – Open Essay, Writing a scientific review article.

TOTAL: 45 HOURS

TEXT BOOKS

1. Oxford Advanced Learners's Dictionary. 8th edition, 2013.
2. Martin Hewings. Advanced Grammar in Use. Cambridge University Press, 2013.
3. Michael Swan. Practical English Usage. 3rd ed. OUP, 2005.
4. John Seely. The Oxford Guide to Effective Writing and Speaking. OUP, 2005.

REFERENCES

1. Dr.A.Ravikrishnan, "Engineering Chemistry", Sri Krishnan Publications, Chennai,2018.

2. S. Vairam, P. Kalyani and Suba Ramesh, “Engineering Chemistry’, Wiley India Pvt. Ltd, New Delhi, 2nd Edition 2014.
3. S. S. Dara and S.S. Umare, “Textbook of Engineering Chemistry”, S. Chand & Company Ltd, New Delhi, 2017.
4. Vogel’s textbook of quantitative chemical analysis (8th edition, 2014).

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

M.h.
(HoD/English)

21PH202	APPLIED PHYSICS FOR BIOSCIENCES (Common for Biomedical and Biotechnology)	L 3	T 0	P 0	C 3

Course Objectives

- To understand the difference between classical and quantum free electron theory, and able to know the concept of holes
- To enrich the understanding of charge carriers in semiconducting materials and devices
- To ensure the physical properties of materials of superconductor
- To understand the basic concepts of magnetic moment.
- To ensure the electrical behaviour of dielectric materials
- To learn nanotechnology with applications and different characteristic methods for nanomaterials

PRE-REQUISITES: As a prerequisite for this course on Engineering Physics, knowledge in physics like Mechanics, Optics, Waves and basic mathematics is essentially required.

Course Outcomes

At the end of the course, learners will be able to

- CO1. Understand the phenomenon of free electron and band theories
- CO2. Have a fundamental knowledge of semiconducting materials
- CO3. Understand the concept of super conducting materials
- CO4. Understand the classification of magnetic materials
- CO5. Know the concept of dielectric phenomenon.
- CO6. Understand the principle of Nano-sciences

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3													
2	3	3													
3	3	3													
4	3	3													
5	3	3													
6	3	3													

3 - High, 2 - Medium, 1 – Low

UNIT I FREE ELECTRON AND BAND THEORIES OF SOLIDS 6

Electronic Materials: Classical free electron theory of metals (Drude Lorentz Theory)-Electrical and Thermal conductivity – Widemann Franz Law-Fermi energy and Fermi - Dirac distribution function- Density of states-Thermionic Emission. Band Theory of Solids-Electronic periodic potential-Concepts of Effective mass—Concept of Holes- Classification of solids into conductor, semiconductor-Insulator.

UNIT II SEMICONDUCTING MATERIALS 6

Intrinsic Semiconductors – Energy band diagram – direct and indirect semiconductors – Carrier Concentration in intrinsic semiconductors – extrinsic semiconductors – Carrier concentration in N type & P-type semiconductors – Carrier transport: Velocity-electric field relations – drift and diffusion transport – Einstein's relation – Hall effect and devices.

UNIT III SUPERCONDUCTOR AND MAGNETIC MATERIALS 6

Superconducting phenomena, properties of superconductors – Meissner effect and isotope effect. Type I and Type II superconductors, BCS theory - High Tc superconductors – Magnetic levitation and SQUIDS. Introduction to magnetic materials – Domain theory of ferromagnetism, Hysteresis, Soft and Hard magnetic materials – Anti-ferromagnetic materials – Ferrites, Super para-magnetism- Applications

UNIT IV DIELECTRIC MATERIALS 6

Electric susceptibility-Dielectric Constant – Electronic, Ionic, Orientational and space charge polarization – Frequency and temperature dependence of polarization- Internal field and deduction of Clausius-Mosotti equation – dielectric loss – different types of dielectric breakdown –Use of dielectric materials (Capacitor and transformer)-Ferro electricity and application.

UNIT V NANOSTRUCTURE AND TECHNOLOGY 6

Nano science and origin of nano technology- Nanoscale and its significance-surface to volume ratio-Quantum Confinement (Quantum Well, wire and Dots) - synthesis of nano particles and Quantum Dots (SOLGEL, CVD, PVD, Pulsed Laser Deposition, plasma arching, Ball milling) properties-carbon nanotubes-synthesis-properties, Application of nanotechnology.

TOTAL: 30 HOURS

TEXT BOOKS

1. S.J.Gupta, Sanjeev Gupta, Modern Engineering Physics, DhanpatRai Publication, New Delhi, 2015.
2. V. Rajendran, Engineering Physics, Mc GrawHill Education, tenthprint,2017
3. Brijlal and Subramaniam, Properties of Matter, Educational & university, Agra, 1995
4. Brijlal& N. Subramaniam, Heat & Thermodynamics, S. CHAND Publications, 2008

REFERENCE BOOKS

1. H Askeland, D. “Materials Science and Engineering”. Brooks/Cole, 2010.
2. Garcia, N. & Damask, A. —Physics for Computer Science Students‖. Springer-Verlag, 2012.
3. Rogers, B., Adams, J. & Pennathur, S. —Nanotechnology: Understanding Small Systems. CRC Press, 2014.
4. B.K.Pandey, S. Chaturvedi, Engineering Physics, Cengage, New Delhi, 2018.

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

Dr. C. Pitchumani Violet Mary M.Sc., M.Phil., Ph.D
Assistant Professor & Head
Department of Physics
Sri Shakthi Institute of Engineering and Technology
Coimbatore -641062, India

21MA203	LAPLACE TRANSFORMS AND ADVANCED CALCULUS FOR BIOTECHNOLOGY	L	T	P	C
		3	0	0	3

Course Objectives

- Engineering Mathematics is an essential tool for describing and analyzing engineering process and systems. It enables precise representation and communication of knowledge. The objective of the course is to expose students to understand the basics and importance of Laplace Transforms, Vector Differentiation, Vector Integration, Complex Differentiation and Complex Integration which are being widely used in Bio Technology studies.

PREREQUISITES

- Basic concepts of Differentiation
- Basic concepts of Integration
- Basics concepts of Vectors and Trigonometric functions

Course Outcomes

At the end of the course, learners will be able to

- CO1 Apply the knowledge of Laplace transforms to solve the differential and integral equations.
- CO2 Perform vector calculus operations such as gradient, divergence and curl in vector and scalar fields.
- CO3 Apply the techniques of line, surface and volume integrals to solve application problems.
- CO4 Gain knowledge to construct the analytic function and to find the image of given region under conformal mapping.
- CO5 Gain knowledge to solve the problems by using complex integration.

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	2		2							2	2	2	
2	3	3	2		2							2	1	1	
3	3	3	2		2							2	1	1	
4	3	3	2		2							2	2	2	
5	3	3	2		2							2	2	2	

3 - High, 2 - Medium, 1 – Low

UNIT I LAPLACE TRANSFORMS AND ADVANCED CALCULUS FOR BIOTECHNOLOGY 9

Definition –Transforms of Elementary functions – Properties of Laplace transforms (Statement only) – Transforms of Periodic functions –Transforms of derivatives and integrals (Statement only) – Inverse transforms – Convolution theorem (Problems only) – Application to linear ODE of second order with constant coefficients – Applications of Laplace transforms in Bio Technology.

UNIT II VECTOR DIFFERENTIATION 9

Scalar and Vector Point functions – Gradient – Directional derivative – Divergence and Curl – Irrotational and Solenoidal vector fields – Del applied twice to Point functions (Problems only) – Applications of Vector Differentiation in Bio Technology.

UNIT III VECTOR INTEGRATION 9

Line Integral – Green's theorem in the plane (excluding proof) – Stoke's theorem (excluding proof) – Gauss divergence theorem (excluding proof) – Simple applications involving cubes and rectangular parallelepipeds – Applications of Vector Integration in Bio Technology.

UNIT IV COMPLEX DIFFERENTIATION 9

Limit and derivative of a complex function – Analytic functions – Cauchy-Riemann equations(Statement only) – Harmonic functions – Orthogonal properties of analytic functions (excluding proof) – Construction of analytic functions by Milne – Thomson's Method(Problems only) – Conformal transformation :w = z + c, cz, 1/z(Problems only) and Bilinear transformation (Problems only) – Applications of complex differentiation in Bio Technology.

UNIT V COMPLEX INTEGRATION 9

Complex integration – Statements of Cauchy's theorem and Cauchy's integral formula – Laurent's series(Problems only) – Singular points – Residues – Calculation of Residues – Cauchy's Residue theorem (excluding proof)- Problems– Applications of complex integration in Bio Technology.

TOTAL: 45 HOURS

TEXT BOOKS

1. Grewal. B.S., "Higher Engineering Mathematics", 44th Edition, Khanna Publications, Delhi, 2017.

REFERENCES

1. Bali. N. P and Manish Goyal., "A Text book of Engineering Mathematics", 9th Edition, Laxmi Publications Pvt Ltd., 2016.
2. Glyn James," Advanced Modern Engineering Mathematics", 5th Edition, Pearson Education - 2018.
3. Kreyzig E., "Advanced Engineering Mathematics", 10th Edition, John Wiley and sons, 2016.
4. Peter V. O'Neil," Advanced Engineering Mathematics", 7th Edition, Cengage learning, India pvt Ltd 2010.
5. Ramana. B.V., "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company Limited , New Delhi, 2008.

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

Head of the Department
Mathematics
Sri Shakthi Institute of
Engineering and Technology
Coimbatore 641 062.

21BT201 **CELL BIOLOGY** **L T P C**
3 0 0 3

Course Objectives

- To provide knowledge on the fundamentals of cell biology
- To help students understand the signaling

Course Outcomes

At the end of the course, learners will be able to

- CO1. Explain the basic concepts of biology.
- CO2. Analyze the ion channels and their mechanism.
- CO3. Analyze the receptors and cell signaling concepts.
- CO4. Apply broad knowledge on the molecular interaction between cells.
- CO5. Evaluate the mechanism in regulating cell cycle.
- CO6. Apply critical thinking in the analysis of cell and its genetics

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	3				1			2	3		2	3		
2	3	3		2	3	3			2	2		3	3		
3	3	2	3			2	1			3		2			
4		2		3	3	1			2	3		2		2	
5	3	3		3		2			2	3		3	2		
6	3		3	1	3							2	1		

3 - High, 2 - Medium, 1 – Low

UNIT I CELL STRUCTURE AND FUNCTIONAL OF ORGANELLES 9

Eukaryotic and prokaryotic cells-Sub cellular structures - chromatin organization, biogenesis of nucleus, mitochondria and chloroplast, cytosketeton, endoplasmic reticulum, golgi body, ribosomes, lysosomes; cell junctions; extracellular matrix; cell movement

UNIT II MEMBRANE ARCHITECTURE AND FUNCTION 9

Membrane synthesis; Membrane proteins – pumps, channels transporters and receptors; types of membrane transport;Osmosis and cell volume; Endocytosis, Exocytosis; Intracellular Compartments; protein Trafficking and secretion.

UNIT III INTERCELLULAR INTERACTION 9

Cell signaling- autocrine, paracrine, juxtacrine, endocrine and synaptic signaling; Types of cell membrane receptors – GPCR, RTKs and voltage gated ion channel receptors; Signal transduction - Cellular response mechanisms to primary messengers; secondary signaling molecules – adenylate cyclase, calcium flux, phospholipases, protein kinases

UNIT IV SPECIALIZED CELL TYPES 9

Epithelial and mesenchymal cells; Stem cells –differentiation and lineage; neurons; gametes – sperm, egg, pollen, ovule; cells of immune system; plant cells – parenchyma, collenchyma, sclerenchyma.

UNIT V CELL CYCLE AND REGULATION 9

Mitosis, meiosis, cell cycle regulation – checkpoints, mitosis promoting factors, cyclins and cyclin dependent kinases, Eukaryotic life cycles- gametic, sporic and zygotic.

TOTAL: 45 HOURS

TEXTBOOKS

1. Cooper, G.M. and R.E. Hansman “The Cell: A Molecular Approach”, VII Edition, ASM Press, 2007.
2. Alberts, Bruce etal., “Molecular Biology of the Cell”, IVth Edition, Garland Science (Taylors Francis), 2002.

REFERENCES

1. Sadava, D.E. “Cell Biology: Organelle Structure and Function”, Panima Publishing, 2004.
2. Rastogi, S.C. “Cell Biology” IInd Edition, New Age International, 2002.

3. Gardner, E.J., Simmons, M.J., and Snustad. D.P. 2005. Principles of genetics. 8th edition. Wiley India, Nice Printing press, New Delhi.
4. Agarwal V.K., and Verma, P.S. Genetics. Sultan Chand & co. New Delhi. 2004.

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

21BT202 **MICROBIOLOGY** **L T P C**
3 0 0 3

Course Objectives

- To introduce students to the principles of Microbiology to emphasize structure and biochemical aspects of various microbes.
- To solve the problems in microbial infection and their control.

Course Outcomes

At the end of the course, learners will be able to

- CO1. Examine microbes using the various microscopic techniques.
- CO2. Apply the staining techniques for visualizing microbes.
- CO3. Explain microbial cell structure, growth and metabolism.
- CO4. Understanding the control of microbes using physical and chemical method
- CO5. Acquire Knowledge about industrial and environmental application
- CO6:Associate Microbiological concepts in practical applications in various industries

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2	1			1	1							2	
2	3	1	2											1	
3	2	1	3	1	1	3								1	
4	2	2	1	1	1	3	2								
5	1	1	1	2		3	2								
6	2	2	1	2								2	2	2	2

3 - High, 2 - Medium, 1 – Low

UNIT I INTRODUCTIONTO MICROBIOLOGY 9

Historical Developments in the field of Microbiology; Techniques in Microscopy - Microscopy, Types of Microscopes, Light, Electron and Scanning probe Microscope,; Staining Techniques - Types of Dyes, Fixation, simple staining, differential staining and selective staining of endospore, flagella and capsule.

UNIT II BASIC MICROBIAL STRUCTURE, GROWTH AND REPRODUCTION 9

Structural and reproductive aspects of bacteria, Virus and Fungi; Microbial nutritional requirements - different types of media; Microbial growth kinetics; Batch and continuous microbial culture systems.

UNIT III CONTROL OF MICROORGANISMS 9

Agents for control of microorganisms - Physical and chemical agents; Host-microbial interactions; anti-viral, anti-bacterial and anti-fungal agents; mode of action of antibiotics.

UNIT IV MICROBIAL PRODUCTION OF METABOLITES 9

Primary and secondary metabolites; Microbial production of vitamins-B12; Production of Antibiotics-penicillin G & V

UNIT V MICROBIAL FERMENTATIONS AND FOOD 9

Production of mushrooms; Microbial production of alcoholic beverages - Beer, Wine and distilled beverages - whisky and gen; Production of bread and baker's yeast.

TOTAL: 45 HOURS

TEXTBOOKS

1. Prescott, Harley and Klein, Microbiology, 10th Edition, Mcgraw hill Higher Education Publication, 2017.
2. Pelczar MJ,Chan ECS and Krein NR,Microbiology,Tata McGraw Hill Edition, New Delhi,India.

REFERENCES

1. Waites and Morgan, Industrial microbiology: An Introduction, Blackwell Sciences Publication 2002.
2. Pelczar MJ, Chan ECS and Krieg NR. Microbiology, 5th Edition, Tata McGraw Hill Edition, 2005.
3. Black , Text book of Microbiology. Freeman Publishers, 2004 .

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

21CS201 PROGRAMMING IN C AND DATA STRUCTURES

L	T	P	C
3	0	0	3

Course Objectives

- To Learn basic principles of Problem solving,.
- To understand the basic concepts of pointers and structures of C.
- Design applications using sequential and random access file processing.
- To understand the concepts of ADTs
- To Implement linear data structure operations using C

Prerquisite

Computational Thinking and Problem Solving

Course Outcomes

At the end of the course, learners will be able to

- CO1:Achieve Knowledge of design and development of C problem solving skills.
- CO2:Design and develop modular programming skills.
- CO3:Effective utilization of memory using pointer technology
- CO4:Understands the basic concepts of pointers and data structures.
- CO5: Define data structures like array, stack, queues and linked list.
- CO6:Suggest appropriate linear data structure operations for solving a given problem

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2	2	1									1		
2	2	3	1	1	2								2	3	1
3	3	2	2	1	3								1	2	
4	3	2	2	1	3								2	2	
5	2	1	1	1	2								2	3	
6	2	1	1	1	2								1	2	

3 - High, 2 - Medium, 1 – Low

UNIT I POINTERS **9**

Pointers and address, pointers and functions (call by reference) arguments, pointers and arrays, address arithmetic, character pointer and functions, pointers to pointer ,Initialization of pointer arrays, Dynamic memory allocations methods, Introduction to Preprocessors, compiler control Directives

UNIT II STRUCTURE , UNION and FILES **9**

Basic of structures, structures and Functions, Array of structures, structure Data types, type definition, Files :Defining, opening and closing of files, Input and output operations, Command Line arguments . Structure Vs Union.

UNIT III INTRODUCTION TO DATA STRUCTURES **9**

Elementary Data Organization, Algorithm, Efficiency of an Algorithm, Time and Space Complexity, Asymptotic notations: Big-Oh, Time-Space trade-off. Abstract Data Types (ADT)Arrays: Definition, Single and Multidimensional Arrays, Representation of Arrays : Row Major Order, and Column Major Order, Application of arrays, Sparse Matrices and their representations.

UNIT IV LIST **8**

List ADT – array-based implementation – linked list implementation –– singly linked lists- circularly linked lists- doubly-linked lists – applications of lists –Polynomial Manipulation – All operations (Insertion, Deletion, Merge, Traversal).

UNIT V STACK AND QUEUE **9**

Stack ADT – Operations – Applications – Evaluating arithmetic expressions- Conversion of Infix to postfix expression – Queue ADT – Operations – Circular Queue – Priority Queue – – applications of queues

TOTAL: 45 HOURS

TEXT BOOKS

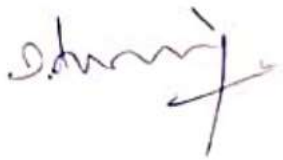
1. Mark Allen Weiss, —Data Structures and Algorithm Analysis in C, 2nd Edition, Pearson Education,1997.
2. Reema Thareja, —Data Structures Using C, Second Edition , Oxford University Press, 2011
3. Reema Thareja, Programming in C, Oxford University Press, Second Edition, 2016.

REFERENCES

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L.Rivest, Clifford Stein, —Introduction to Algorithms", Second Edition, Mcgraw Hill, 2002.
2. Aho, Hopcroft and Ullman, —Data Structures and Algorithms‖, Pearson Education,1983.
3. Stephen G. Kochan, —Programming in C, 3rd edition, Pearson Education.
4. Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, —Fundamentals of Data Structures in C, Second Edition, University Press, 2008

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.



21BT211	ENGINEERING EXPLORATION I	L	T	P	C
		1	0	2	2

COURSE OBJECTIVES

- To enable the students to design and build simple systems on their own
- To help experiment with innovative ideas in design and team work
- To create an engaging and challenging environment in the engineering lab
- To inculcate ethics and sustainability perspectives and enable students to work in a team

CONTENTS

S No	Topics	No of Hours
1	Introduction to Engineering	3
2	Platform based development	12
3	Mechanisms	9
4	Requirements	3
5	Design	
6	Ethics	6
7	Sustainability	
8	Project Management Principles	3
9	Guided Project	
10	Final Project	9

COURSE OUTCOMES

CO1. Understand the role of an engineer as a problem solver

CO2. Apply multi-disciplinary principles and build systems using engineering design process and tools

CO3. Analyze engineering solutions from ethical and sustainability perspectives

CO4. Use basics of engineering project management skills while doing projects

CO5. Communicate, Collaborate and work as a team

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	1		2		2	2	2	2	1	1	1	1
2	3	3	3	3		2		2	2	2	2	1	2	2	2
3	3	3	3	3		2		2	2	2	2	1	2	2	2
4	3	3	3	3		2		2	2	2	2	1	2	2	2
5	3	3	3	3		2		2	2	2	2	1	2	2	2

3 - High, 2 - Medium, 1 – Low

GUIDELINES

7. Practical based learning carrying credits.
8. Multi-disciplinary/ Multi-focus group of 3-4 students.
9. Groups can select to work on specific tasks, or projects related to real world problems.
10. Each group has a faculty coordinator/Instructor who will guide/evaluate the overall group as well as individual students.
11. The students have to display their model at the end of semester.
12. The progress of the course is evaluated based on class performance and final demonstration of prototype.

Total:45 Hours

EVALUATION PATTERN	
Continuous Internal Assessment	100
TOTAL	

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

21PH111	APPLIED PHYSICS LABORATORY	L	T	P	C
		0	0	2	1

Course Objectives

- To learn the proper use of various kinds of physics laboratory equipment.
- To learn how data can be collected, presented and interpreted in a clear and concise manner.
- To learn problem solving skills related to physics principles and interpretation of experimental data.
- To determine error in experimental measurements and techniques used to minimize such
- error.
- To make the student as an active participant in each part of all lab exercises.
- To make the students to apply the physics concepts to engineering applications

Course Outcomes

At the end of the course, learners will be able to

- CO1. Understand the functioning of various physics laboratory equipment.
- CO2. Use graphical models to analyse laboratory data
- CO3. Use mathematical models as a medium for quantitative reasoning and describing physical Reality
- CO4. Access, process and analyse scientific information.
- CO5. Solve problems individually and collaboratively.
- CO6. Understand how to apply the physics concepts for the engineering applications

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3													
2	3	3													
3	3	3													
4	3	3													
5	3	3													
6	3	3													

3 - High, 2 - Medium, 1 – Low

List of Experiments

1. Determination of rigidity modulus of the material of a wire-Torsional Pendulum
2. Determination of Viscosity of a liquid – Poiseuille's method.
3. Uniform Bending - Determination of Young's Modulus.
4. Determination of thickness of a thin wire –Air Wedge
5. Determination of wavelength of mercury spectrum – spectrometer grating
6. Basic operation of Logic Gates
7. Laser (i) Determination of Wavelength and (ii) Determination of Particles size analysis
8. V-I characterization of PNP and NPN transistors
9. V-I characterization of Solar Cells
10. Energy band gap using p-n junction
11. Determination of thermal conductivity of a bad conductor by Lee's disc method
12. Determination of Velocity of Ultrasonic waves in a given liquid using Ultrasonic Interferometer.

TOTAL: 30 HOURS

TEXT BOOKS

1. H.Sathayaseelam, Laboratory Manual in Applied Physics, Second edition, -New age International Publication, 2015.

EVALUATION PATTERN	
Evaluation of Laboratory Observation, Record and Test	**End Semester Examination**
100	100
60	40
TOTAL : 100	

Dr. C. Pitchumani Violet Mary M.Sc., M.Phil., Ph.D
Assistant Professor & Head
Department of Physics
Sri Shakthi Institute of Engineering and Technology
Coimbatore -641062, India

21BT212 **CELL BIOLOGY LABORATORY**

L	T	P	C
0	0	2	1

Course Objectives

- To provide knowledge on the fundamentals of cell biology
- To help students understand the signaling

Course Outcomes

At the end of the course, learners will be able to

- CO1. : Study the cell morphology using microscopic techniques
- CO2. : Calculate the cell concentration using haemocytometer in unit volume
- CO3. : Determine cell viability using membrane permeability assay
- CO4. : Identification of cellular components using various labelling techniques
- CO5. : Distinguish different stages of Mitotic cell division
- CO6: Would learn about different types of Blood Cells

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	3				1			2	3		2	3		
2	3	3		2	3	3			2	2		3	3		
3	3	2	3			2	1			3		2			
4		2		3	3	1			2	3		2		2	
5	3	3		3		2			2	3		3	2		
6	3		3	1	3							2	1		

3 - High, 2 - Medium, 1 – Low

List of Experiments

1. Study of plant cell morphology
2. Study of animal cell morphology
3. Cell fractionation
4. Osmosis - Effect of solute concentration on onion cells
5. Enumeration of RBC & WBC
6. Study of mitosis in onion root tips
7. Study of meiosis in Rheo discolor
8. Study of barr bodies in buccal epithelia lcells
9. Study of polytene chromosomes from *Chironomous* larvae
10. Identification of inheritance pattern based on offspring data
11. Leishman staining
12. Giemsa staining

TOTAL: 30 HOURS

TEXTBOOKS

1. Allyn A. Bregman, Laboratory Investigations in Cell and Molecular Biology, 4th Edition, Wiley, 2001.

EVALUATION PATTERN	
Evaluation of Laboratory Observation, Record and Test	**End Semester Examination**
100	100
60	40
TOTAL : 100	

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

21BT213 **MICROBIOLOGY LABORATORY**

L	T	P	C
0	0	2	1

Course Objectives

- To introduce students to the principles of Microbiology to emphasize structure and biochemical aspects of various microbes.
- To solve the problems in microbial infection and their control.

Course Outcomes

At the end of the course, learners will be able to

- CO1. Examine microbes using the various microscopic techniques.
- CO2: Apply the staining techniques for visualizing microbes.
- CO3. Explain microbial cell structure, growth and metabolism
- CO4:Would uses of various media and testing protocols with focus on clinical applications
- CO5:understand the micrometry and different staining techniques
- CO6:inspect the evidence of bacterial and fungal metabolism

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	1											2	
2	2	1	2			3	3							1	
3	1	1	1	1	1	3	3							1	
4	3	1											1		3
5	2	1							2			2	3	2	2
6	2	2	3												2

3 - High, 2 - Medium, 1 – Low

List of Experiments

1. Light microscopy and components of microscope
2. Morphology of bacteria, fungi and algae
3. Simple & Differential staining and Gram's staining
4. Micrometry
5. Preparation and sterilization of medium and glassware
6. Purification of microorganisms by serial dilution and pour plate technique
7. Streak plate technique and single spore isolation
8. Biochemical tests for identification of microorganisms
9. Antibiotic profiling of microorganisms
10. Growth of microorganism under shake flaks culture

TOTAL: 30 HOURS

TEXTBOOKS

1. Prescott, Harley and Klein, Microbiology, 10th Edition, Mcgraw hill Higher Education Publication, 2017.

REFERENCES

1. Waites and Morgan, Industrial microbiology: An Introduction, Blackwell Sciences Publication 2002.
2. Pelczar MJ, Chan ECS and Krieg NR. Microbiology, 5th Edition, Tata McGraw Hill Edition, 2005.
3. Black , Text book of Microbiology. Freeman Publishers, 2004 .
4. Cappuccino, J.G. and N. Sherman "Microbiology: A Laboratory Manual", 4th Edition, Addison-Wesley, 1999.
5. Collee, J.G. etal., "Mackie & McCartney Practical Medical Microbiology" 4th Edition, Churchill Livingstone, 1996.

EVALUATION PATTERN	
Evaluation of Laboratory Observation, Record and Test	**End Semester Examination**
100	100
60	40
TOTAL : 100	

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

21CS212 PROGRAMMING IN C AND DATA STRUCTURE LABORATORY

L	T	P	C
0	0	2	1

Course Objectives

The course aims to provide the students

- To Learn basic principles of Problem solving,.
- To Understand the basic concepts of pointers and structures of C.
- Design applications using sequential and random access file processing.
- To understand the concepts of ADTs
- To Implement linear data structure operations using C

Course Outcomes

At the end of the course, learners will be able to

- CO1. Develop simple C Programs using pointers and Functions
- CO2 Develop C program for Linear data structure operations and its applications
- CO3. Experiment with File Manipulation concepts
- CO4. Develop programs using various sorting algorithms
- CO5. Develop programs using different searching methods
- CO6.Apply the program developing skills in C

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2	2	1									1		
2	2	3	1	1	2								2	3	1
3	3	2	2	1	3								1	2	
4	3	2	2	1	3								2	2	
5	2	1	1	1	2								2	3	
6	2	1	1	1	2								1	2	

3 - High, 2 - Medium, 1 – Low

List of Experiments

1. Pointer operators, call by reference, pointers with arrays
2. Structures and unions.
3. File handling Operations
4. Array implementation of Stack and Queue ADTs
5. Array implementation of List ADT
6. Linked list implementation of List, Stack and Queue ADTs
7. Applications of List, Stack and Queue ADTs

TOTAL: 30 HOURS

TEXT BOOKS

1. Programming in ANSI C by E. Balguruswamy, Tata Mc-Graw Hill
2. M.A.Weiss, “Data Structures and Algorithm Analysis in C”, Second Edition, Pearson Education Asia, 2007.

EVALUATION PATTERN	
Evaluation of Laboratory Observation, Record and Test	**End Semester Examination**
100	100
60	40
TOTAL : 100	

21ME214 **AUTOMOBILE ENGINE ASSEMBLY LABORATORY**

L	T	P	C
0	0	2	1

Course Objectives

- To learn the components of IC Engines
- To learn about working of various types of engines
- To dismantle and assemble of two wheeler (2/4 stroke) engines

Course Outcomes

Upon the Completion of this course, the student will be able to:

CO1. Introduction to heat engines and understand various cycles of operations of Internal combustion engines

CO2. Discuss the mixture requirement and fuel injection system in IC engines

CO3. Understand the practical operation of 2 stroke and 4 stroke I.C engines

CO4. Understand the concept of knocking and fuel ignition system in various engines

CO5. Describe the lubrication system of engine and evaluate its performance parameters.

CO6. Discuss the recent trends taking place in automobile industries

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3		3											
2	3	3		3											
3	3														
4	3	3		2										3	
5	3	3		3											
6	2									3		3		1	

3 - High, 2 - Medium, 1 – Low

List of Experiments

13. Study of various components in IC engines
14. Comparative study of Fuel Operated Engines (Petrol, Diesel, Gas)
15. Dismantling and Assembling of Single Cylinder Four Stroke Petrol Engine
16. Dismantling and Assembling of Single Cylinder Two Stroke Petrol Engine
17. Dismantling and Assembling of Clutch
18. Dismantling and Assembling of Gear box
19. Dismantling and Assembling of Single Cylinder Four Stroke Diesel Engine
20. Cut section and demonstrative study of Multi cylinder Four Stroke Diesel Engine
21. Cut section and demonstrative study of Multi cylinder Four Stroke Petrol Engine
22. Study of Hybrid Electric Vehicle.

TOTAL: 30 HOURS

EVALUATION PATTERN	
Continuous Internal Assessment	100
TOTAL	

SEMESTER III

		L	T	P	C
21BT301	**ENVIRONMENTAL SCIENCE FOR BIOTECHNOLOGY**	**2**	**1**	**0**	**3**

Course Objectives

The general objective of the course is to provide theoretical and methodological knowledge for the study and understanding of the use of biotechnology for environmental goals, with the following specific objectives:

- Understand the microbiological and ecological foundations that explain the participation of microorganisms in ecosystems and the great power that exists in their biotechnological use.
- Know the possibilities of environmental application presented by the biotechnology of higher organisms.

Course Outcomes

At the end of the course, learners will be able to

- CO1 : Identify the key concepts and scope of biotechnology in environmental protection
- CO2 : Summarize wastewater characteristics and treatment protocols
- CO3 : Construct systems for biotreatment of industrial effluents and solid wastes
- CO4 : Apply the concepts in developing environment-friendly bioproducts
- CO5 : Understand concepts of environmental monitoring
- CO6: Understands the importance of biosensors

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1			2								1		
2	2				3			1					1		
3	3				2			1						2	
4	2	1			3									2	
5	2					3		1						2	
6	2	1				2	3			2					2

3 - High, 2 - Medium, 1 – Low

UNIT I CONCEPT OF ENVIRONMENTAL BIOTECHNOLOGY 9

Definition – concept and scope – Application of biotechnology – Role of microbial systems – Principles – Characteristics - Genetically engineered organisms – Merits and demerits – Bio tools for environmental monitoring – Role of biotechnology in environmental protection.

UNIT II BIOTECHNOLOGY AND POLLUTION ABATEMENT 9

Biotechnology of wastewater treatment - Bioreactors - Microbial system in waste water stabilization – Biofilms - immobilization technology in waste water treatment – Microbial metabolism and growth kinetics – oil degradation – bio decolourization – Reed bed technology – Rhizosphere engineering - Biofiltration and Bioindicators.

UNIT III ROLE OF BIOTECHNOLOGY IN BIOREMEDIATION 9

Soil pollution - Bioremediation – Principles - Biodegradation of agro chemicals and other organic compounds – Biotransformation of xenobiotic compound - Role of GEMS in degradation of xenobiotics; Bioscrubbers – Biomining of metals - Biopulping.

UNIT IV BIOTECHNOLOGY AND VALUE ADDITION 9

Bio processes in waste treatment - Production of value added products from waste – single Cell Protein (SCP), ethanol, methane and hydrogen, amino acids, vitamins-Enzyme production from wastes – Biodegradable plastics - Environmental implications- .Biotechnology of Microbial composting - Biofertilizers- Biopesticides

UNIT V ENVIRONMENTAL MONITORING 9

Bioindicators –Biomarkers –Biosensors –Biomonitoring –Polluted environment – Short and long term monitoring of remediated sites.

TOTAL: 45 HOURS

TEXTBOOKS

1. Chatterji. A.K., 2003. Introduction to Environmental Biotechnology. Prentice Hall of India Pvt. Ltd., New Delhi.
2. Miller Jr. G. T., 2004. Environmental Science. Tenth Edition. Thompson Brooks/Cole. United States.
3. Kumar H.D, 1998. A text book on biotechnology. II Edition, Affiliated east west press Pvt. Ltd., New Delhi.
4. Microbiology, M. J. Pelczer ,E.C.S Chan (1993), McGraw Hill Education Private limited , New Delhi.
5. Environmental Microbiology, S.K.Agarwal (2009), APH Publishing corporation, New Delhi
5. Introduction to Environmental biotechnology, A.K.Chatterji (2011), PHI Learning private limited, New Delhi.
6. Environmental Microbiology R.M Maier, I.L. Pepper and C.P.Gerba, Academic Press. (2000).

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

21MA303 TRANSFORMS AND NUMERICAL METHODS FOR BIOTECHNOLOGY

L	T	P	C
3	0	0	3

Course Objectives

- Engineering Mathematics is an essential tool for describing and analyzing engineering process and systems. It enables precise representation and technology of knowledge. The objective of this course is to familiarize the Bio technological engineers with techniques of Fourier series, Fourier transforms, Boundary value problem, Interpolation and Approximation techniques, Numerical differentiation and Integration which are being widely used in Biotechnology. In addition, this course provides the MATLAB techniques for solving the mathematical problems.

PREREQUISITES

- Differentiation
- Integration
- Trigonometric Identities

Course Outcomes

At the end of the course, learners will be able to

- CO1 Apply the concepts of the Fourier series for the Periodic function.
- CO2 Analyse the given system using the Fourier transform techniques.
- CO3 Identify and solve the one-dimensional heat equation and steady state two-dimensional heat equation by using the Fourier series techniques.
- CO4 Apply Numerical techniques for solving the problems involving the interpolation concepts.
- CO5 Apply Numerical techniques for solving the problems involving a differentiation and Integration concepts.

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2	2		2							2	2	2	2
2	2	2	2		2							2	1	1	2
3	2	2	2		2							2	2	2	2
4	3	3	2		2							2	2	2	3
5	3	3	2		2							2	2	2	3

3 - High, 2 - Medium, 1 – Low

UNIT I FOURIER SERIES **9**

Dirichlet's conditions – General Fourier series – Odd and Even functions – Half range series – Harmonic Analysis – Applications of Fourier series in Bio Technology.

UNIT II FOURIER TRANSFORM **9**

Fourier integral theorem (statement only) – Fourier transform pair – Fourier sine and cosine transforms – Transform of elementary functions – properties (problems only) – Applications of Fourier transform in Bio Technology.

UNIT III BOUNDARY VALUE PROBLEM **9**

One dimensional heat flow (concept only) – Solution of one dimensional heat equation (excluding insulated ends) by Fourier series – Two dimensional heat flow (concepts only) – Steady state solution of two dimensional heat equation in cartesian coordinates (excluding insulated edges): Long plates and finite plates by Fourier series - Problems – Applications of Boundary value problem in Bio Technology.

UNIT IV INTERPOLATION AND APPROXIMATION **9**

Introduction –Interpolation with equal intervals – Newton's forward and backward difference formulae – Interpolation with unequal intervals – Lagrange's interpolation – Inverse interpolation – Divided differences – Newton's divided difference formula – Applications of Interpolation and approximation in Bio Technology.

UNIT V NUMERICAL DIFFERENTIATION AND INTEGRATION **9**

Approximation of derivatives using interpolation polynomials – Derivative of Newton's forward and backward difference formulae – Numerical integration using Trapezoidal, Simpson's rule –Problems-

Evaluation of double integrals by Trapezoidal, Simpson's rule –Problems – Applications of Numerical Differentiation and Integration in Bio Technology.

TOTAL: 45 HOURS

TEXTBOOKS

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 44rd Edition, 2017.
2. Grewal. B.S., and Grewal. J.S.,"Numerical methods in Engineering and Science", Khanna Publishers, 43th Edition, New Delhi, 2015.

REFERENCES

1. Glyn James, Advanced Modern Engineering Mathematics, Prentice Hall of India, Fifth Edition, 2018.
2. Ramana. B.V., " Higher Engineering Mathematics ", McGraw Hill Education Pvt. Ltd,New Delhi, 2017.
3. Bali, N.P. and Manish Goyal, A Text Book of Engineering Mathematics, Lakshmi Publications Pvt. Ltd., New Delhi, 2016.
4. Erwin Kreyszig ," Advanced Engineering Mathematics ", John Wiley and Sons,10th Edition, New Delhi, 2016.
5. Chapra. S.C., and Canale.R.P., "Numerical Methods for Engineers, Tata McGraw Hill, 7th Edition, New Delhi, 2015.
6. Brian Bradie. "A friendly introduction to Numerical analysis", Pearson Education, Asia, New Delhi, 2007.

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

Head of the Department
Mathematics
Sri Shakthi Institute of
Engineering and Technology
Coimbatore 641 062.

21BT302 **UNIT OPERATION AND UNIT PRINCIPLES**

L	T	P	C
2	1	0	3

Course Objectives

- To apply chemical engineering principles and process simulation to solve complex, open-ended problems in kinetics, separations, process dynamics and control in high-performance teams working on physicalequipment.

Course Outcomes

At the end of the course, learners will be able to

- CO1 : Understand the basic principle behind various mixers used in chemical Industries
- CO2 : Knowledge of basic principles on fluid mechanics
- CO3 : Analyse the fluid flow measurements
- CO4 : Knowledge on material and energy balances
- CO5 : Study the principles of heat exchangers
- CO6 : Apply the enthalpy balances in design of evaporators

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	1	1	2										
2	1	2	2	1	2										
3	2	2	2	2	3								2	1	
4	1	1	1	2	3								3	2	
5	1	1	1	2	3								2	1	
6	1	2													1

3 - High, 2 - Medium, 1 – Low

UNIT I BASIC CONCEPTS AND COMPOSITION OF MIXTURES **9**

Units and dimensions conversion -Temperature, Pressure. Properties of gases using the ideal gas law equation. Composition of mixtures, Basis of calculations, average molecular weight. Composition of gases based on mole, mole fraction, mass, mass fraction, volume, Density, concentrations and partial pressure.

UNIT II FLUID FLOW PHENOMENA **9**

Nature of fluid, Types of Fluid, Fluid properties, Rheological behaviour of fluids & Newton's Law of viscosity-Newtonian and non-Newtonian fluid; Pressure measurement devices; Types of flow – laminar , turbulent and transition

UNIT III FLOW MEASUREMENTS DEVICES **9**

Flow measuring devices: Orifice meter, Venturi meter, Rotameter; Pumps – types of pumps (Centrifugal & Reciprocating pumps), Mechanism of heat transfer Steady state conduction, unsteady state conduction; lumped heat capacity

UNIT IV MATERIAL BALANCE AND ENERGY BALANCES **9**

Basic concepts involved in material balance calculations. Material balance problems without chemical reactions: mixing, Drying, Evaporation, filtration Distillation and extraction. Material balances for processes with reactions- Limiting reactant, excess reactant, conversion, selectivity, yield and recycle; Energy balance for non-reactive systems; Hess law, Sensible heat, latent heat, Standard Heat of formation and standard heat of combustion.

UNIT V HEAT EXCHANGERS **9**

Equipment's; overall heat transfer coefficients; design of heat exchangers; NTU concept; evaporators; single and multiple effects; mass and enthalpy balances.

TOTAL: 45 HOURS

TEXTBOOKS

1. McCabe, W.L., Smith, J.C., and Harriot, P., "Unit Operations in Chemical Engineering", 7th Edition, McGraw-Hill, 2005.

2. David M. Himmelblau, James B. Riggs "Basic Principles and Calculations in Chemical Engineering", 8th Edn., Pearson - Prentice Hall International .
3. I. Bhatt and S. B Thakore., "Stoichiometry", 5thEdn., Tata McGraw-Hill Publishing Company, New Delhi
4. B. Lakshmikutty, K. V. Narayanan, "Stoichiometry and Process Calculations", PHI Publishers, Delhi

REFERENCES

1. Geankoplis, Transport Processes and Separation Process Principles, Prentice-Hall.
2. McCabe, Smith, and Harriot, Unit Operations of Chemical Engineering, McGraw-Hill.
3. Foust, et al, Principles of Unit Operations, Wiley.
4. Perry's Chemical Engineers Handbook.

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

21BT303 **ENZYME TECHNOLOGY**

L	T	P	C
3	1	0	4

Course Objectives

To enable the students

- To learn enzyme reactions and its characteristics along with the production and purification process
- To give the student a basic knowledge concerning biotransformation reactions with the usage of enzymes

Course Outcomes

At the end of the course, learners will be able to

- CO1. Describe the basics of enzymes, nomenclature and classification.
- CO2. Apply the knowledge to derive the kinetics for enzymes, Explain types of enzyme inhibitors.
- CO3. Illustrate and apply the different techniques for immobilization of enzymes and kinetics.
- CO4. Apply the knowledge on purification and characterization of enzyme.
- CO5. Discuss the applications of enzymes in different industries.
- CO6: Understands the importance of purification of crude enzyme

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1			2								2	1	
2	2				3								3	3	
3	3				2								3	3	
4	2	1			3								3	3	
5	2					3								2	
6	1	1	2	1							3				

3 - High, 2 - Medium, 1 – Low

UNIT I INTRODUCTION TO ENZYMES **9**

Introduction of enzymes: Nomenclature and Classification of enzymes; concept of active site, substrate binding site, allosteric site, and energetics of enzyme substrate complex formation; specificity of enzyme; Mechanisms of enzyme action; Introduction to enzyme activity and specific activity calculations.

UNIT II ENZYME KINETICS **9**

Kinetics of single substrate reactions: Michelis & Menten equation, Estimation of Michaelis & Menten parameters: Lineweaver-Burk plot, Eadie-Hofstee plot and Hanes plot; Bisubstrate reactions: single displacement and ping pong mechanism; Multi substrate reactions- mechanisms and kinetics: turnover number; Types of inhibition: Competitive, Uncompetitive, noncompetitive inhibition; Allosteric regulation of enzymes; Monod Changeux Wyman model, pH and temperature effect on enzymes & deactivation kinetics.

UNIT III ENZYME IMMOBILIZATION **9**

Physical and chemical techniques for enzyme immobilization: adsorption, matrix entrapment, encapsulation, cross-linking and covalent binding and their advantages and disadvantages; Applications of immobilized enzymes.

UNIT IV PURIFICATION AND CHARACTERIZATION OF ENZYMES FROM NATURAL SOURCES **9**

Production and purification of crude enzyme extracts from plant, animal and microbial sources; Methods of characterization of enzymes; Development of enzymatic assays.

UNIT V BREWING, BAKING AND CHEESE INDUSTRIES **9**

Brewing industry; Baking industry: Commercial enzymes used in baking and brewing industry. Dough production process, Milk coagulating enzymes, ripening of cheese, enzymes used in cheese manufacture and proceessing of whey.

TOTAL: 45 HOURS

TEXTBOOKS

1. Trevor Palmer, Enzymes (2007); Biochemistry, Biotechnology and Clinical Chemistry, 2nd Edition, Horwood Publishing Limited, United Kingdom.
2. Voet D and Voet G. (2010), Biochemistry, 4th edition, John Wiley & Sons
3. Shanmugham.S and Sathishkumar.T, (2012); Enzyme Technology, 2nd edition, I.K. International Publishing House Pvt. Ltd., New Delhi, India.
4. Dugas, Hermann " Bioorganic Chemistry: A Chemical Approach to Enzyme Action" 3rd Edition, Springer, 2003.
5. Faber K , Biotransformations in Organic Chemistry, IV edition , Springer

REFERENCES

1. Ashok Pandey, Collin Web, Carlos Ricard and Christian Larroche, (2006); Enzyme Technology, 2nd Edition, Springer Science + Business Media Inc. and Asiatech Publishers, Netherlands.
2. Nicholas Price and Lewis Stevens, (2009); Fundamentals of Enzymology, 3rd Edition, Oxford University Press, India.
3. Industrial Enzymology. Eds. Godfrey and West, Macmillan Press Ltd. 2nd Edition 1996.

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

21BT321 **BIOCHEMISTRY** **L T P C**
3 0 2 4

Course Objectives

- To impart knowledge on the chemical basis of life.
- To the structure and function of biomolecules.

Course Outcomes

At the end of the course, learners will be able to

- CO1. Learn the fundamental structure and reactions of carbohydrates
- CO2. Correlate the structure and biochemical processes of lipids with applications in biotechnology
- CO3.Interpret the metabolic disorders of amino acid metabolism and evaluate the functions of proteins
- CO4: Imbibe the conformation and metabolism of nucleic acids and analyze the metabolic disorders of nucleic acids
- CO5: Conceptualize the biological oxido-reduction reactions and respiratory chain
- CO6: Understand the way to analyse various Biomolecules

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	2	2	3	3						1	1	2	2
2	2	2	2	3	2	2						3	1	3	3
3	3	3	3	2	1	3						2	2	2	2
4	2	2	2	2	2	2						2	1	2	2
5	1	1	3	1	1	3						3	2	3	3
6	3		3	1	3							2			

3 - High, 2 - Medium, 1 – Low

UNIT I CARBOHYDRATES **9**

Nutritional importance and dietary requirements of carbohydrates. An outline of monosaccharides – Glucose & Fructose, disaccharides – lactose, sucrose and polysaccharides – starch & cellulose - structure and functions, Introduction to metabolism – Glycolysis, Gluconeogenesis, TCA cycle, Glycogenesis and Glycogenolysis. Blood glucose and its regulation.

Case Study: Importance of zinc implementation in diabetes mellitus.

UNIT II LIPIDS **9**

Nutritional importance and dietary requirements of lipids. An outline of lipids – structure, classifications and functions – Triglycerides and phospholipids. Biosynthesis of fatty acids, Oxidation of fatty acids – β – oxidation, Biosynthesis of phospholipids and triglycerides. Biosynthesis of Cholesterol. Metabolic disorders of lipid metabolism: familial hypercholesterolemia.

UNIT III AMINO ACIDS AND PROTEINS **9**

Nutritional importance and dietary requirements of proteins. Amino acids – Structure, classification, properties and functions. Reactions - transamination and oxidative deamination. Biosynthesis of aliphatic and aromatic amino acids (any one each). Formation of Urea.Proteins – Classifications and functions. Metabolic disorders of amino acid metabolism: phenylketonuria, Albinism.

Case study – Role of proteins in Alzheimer's disease

UNIT IV NUCLEIC ACIDS **9**

Three dimensional structures of DNA and RNA. Biosynthesis of purines and pyrimidines; Biodegradation of Purines and Pyrimidines. Metabolic disorders of nucleic acid metabolism : Gout

UNIT V BIOENERGITICS AND OXIDATIVE PHOSPHORYLATION **9**

Biological oxidation-reduction reactions; redox potentials; High energy phosphate compounds; Mitochondrial respiratory complexes and free radical complex; oxidative phosphorylation.

List of Experiments (15 Hours)

1. Laboratory practices in biochemistry

2. Preparation of buffers
3. Qualitative tests for carbohydrates – distinguishing reducing from non-reducing sugars and keto from aldo sugars.
4. Quantitative estimation of reducing sugars
5. Estimation of total sugars
6. Quantitative estimation of amino acids
7. Estimation of proteins by Lowry's Method
8. Estimation of proteins by Bradford's Method
9. Extraction of lipids and analysis by TLC
10. Estimation of nucleic acids

TOTAL: 60 HOURS

TEXTBOOKS

1. Lehninger Principles of Biochemistry 6th Edition by David L. Nelson, Michael M. Co
2. Satyanarayana, U. and U. Chakerapani, "Biochemistry" 3rd Rev. Edition, Books & Allied (P) Ltd., 2006.

REFERENCES

1. Harpers Biochemistry Ed. R.K. Murray, D.K. Granner, P.A. Mayes and V.W.Rodwell, Appleton and Lange, Stanford.
2. Textbook of Biochemistry with clinical correlations. Ed. Thomas M. Devlin. Wiley Liss Publishers

<table>
<tr><th colspan="8">EVALUATION PATTERN</th></tr>
<tr><th colspan="6">Continuous Internal Assessment</th><th colspan="2">End Semester Examination</th></tr>
<tr><th colspan="2">Assessment I*</th><th colspan="2">Assessment II*</th><th colspan="2">Assessment III*</th><td rowspan="2">Theory Examinations</td><td rowspan="2">Practical Examinations</td></tr>
<tr><td>Theory</td><td>Lab</td><td>Theory</td><td>Lab</td><td>Theory</td><td>Lab</td></tr>
<tr><td>50</td><td>50</td><td>50</td><td>50</td><td>50</td><td>50</td><td>100</td><td>100</td></tr>
<tr><td colspan="6">Theory : 25 %
Laboratory : 25 %</td><td>35 %</td><td>15 %</td></tr>
<tr><td colspan="6">50</td><td colspan="2">50</td></tr>
<tr><td colspan="8">TOTAL = 100</td></tr>
</table>

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course for Theory

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

21BT322 **BASICS OF BIOINFORMATICS** **L T P C**
3 0 2 4

Course Objectives

- To improve the programming skills of the student
- To let the students know the recent evolution in biological science
- Bioinformatics tools aid in comparing, analyzing and interpreting genetic and genomic data
- Generally in the understanding of evolutionary aspects of biology.

Course Outcomes

At the end of the course, learners will be able to

- CO1: Understand the importance of biological databases and their usage.
- CO2: Apply different database for the analyzing BLAST and FASTA
- CO3: Alignment of nucleotide and protein sequences using Phylogenetic Analysis
- CO4: Analyse and predict protein structure and function.
- CO5: Importance of Bioinformatics in different fields like Pharmaceuticals.
- CO6: Students would learn the experiments with respect to databases (DNA and PROTEINS)

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1										1		
2	1	2	2		2	3								2	
3		2				3	2	1		2				2	
4		2				3	2	1			1	3		2	
5							2	1				3		2	
6			2		2									2	

3 - High, 2 - Medium, 1 – Low

UNIT I DATABASES **9**

Introduction to Bioinformatics-Basics of database, Biological databases and retrieval system, Protein and Nucleic AcidDatabases, PDB, NCBI, Swissprot, KEGG, Uniprot

UNIT II SEQUENCE ALIGNMENT AND DATABASE SEARCHES **9**

Database searches and Sequence Alignment-Pair wise and multiple sequence alignment-Methods of local and global alignment-Dynamic programming, Scoring matrix, PAM, searching sequence databases by sequence similarity-BLAST and FASTA.

UNIT III PHYLOGENY ANALYSIS **9**

Phylogenetics, Molecular Phylogeny and evolutionary analysis-ClustalW, MSA, Dendrogram-Maximum likelihood, Maximum Parsimony, convergent and parallel evolution, Bootstrapping, Jackknifing-Phylograms.

UNIT IV STRUCTURAL BIOINFORMATICS **9**

Structural bioinformatics, analysis for protein structure, Predicting protein structure and function from Sequence-Homology modeling-Microarray Data analysis-proteomic data analysis-Visualization of molecular structures.

UNIT V APPLICATIONS OF BIOINFORMATICS **9**

Scope of bioinformatics-Bioinformatics in the Pharmaceutical Industry- Structure-Based Rational Drug Design and discovery-Chemi-informatics in Biology.

List of Experiments (15 hours)

1. Biological databases (NCBI)
2. Retrieval of sequences from biological databases – BLAST and FASTA
3. Pairwise Alignment of sequences
4. Multiple sequence alignment
5. Alignment of two sequences and determination of PAM scoring matrix
6. Phylogenetic analyses

7. Gene prediction
8. Prediction of secondary structures of protein
9. Protein structure Visualization (Rasmol, Deepview, Cn3D)
10. Submission of sequences to databases

TOTAL: 60 HOURS

TEXTBOOKS

1. Bioinformatics : The Machine Learning Approach, by Pierre Baldi and Soren Brunak
2. Fundamentals of Bioinformatics, S. Harish, 2007 I.K. International Publishing House Pvt. Ltd, Delhi
3. Introduction To Bioinformatics 4th edition by ARTHUR M LESK
4. Bioinformatics: Basics, Algorithms and Applications, Ruchi & Sharma Singh, 2010, Universities Press (India) Pvt. Ltd.

REFERENCES

1. Rui Jiang et. al. Basics of Bioinformatics, 2013, Springer.

EVALUATION PATTERN							
Continuous Internal Assessment						**End Semester Examination**	
Assessment I*		**Assessment II***		**Assessment III***		Theory Examinations	Practical Examinations
Theory	Lab	Theory	Lab	Theory	Lab		
50	50	50	50	50	50	100	100
Theory : 25 % Laboratory : 25 %						35 %	15 %
50						50	
TOTAL = 100							

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course for Theory

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

21BT311 **ENGINEERING EXPLORATION III**

L	T	P	C
1	0	2	1

COURSE OBJECTIVES

- To enable the students to design and build simple systems on their own
- To help experiment with innovative ideas in design and team work
- To create an engaging and challenging environment in the engineering lab
- To inculcate ethics and sustainability perspectives and enable students to work in a team

CONTENTS

S No	Topics	No of Hours
1	Introduction to Engineering	3
2	Platform based development	12
3	Mechanisms	9
4	Requirements	3
5	Design	
6	Ethics	6
7	Sustainability	
8	Project Management Principles	3
9	Guided Project	
10	Final Project	9

COURSE OUTCOMES

CO1. Understand the role of an engineer as a problem solver

CO2. Apply multi-disciplinary principles and build systems using engineering design process and tools

CO3. Analyze engineering solutions from ethical and sustainability perspectives

CO4. Use basics of engineering project management skills while doing projects

CO5. Communicate, Collaborate and work as a team

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	1		2		2	2	2	2	1	1	1	1
2	3	3	3	3		2		2	2	2	2	1	2	2	2
3	3	3	3	3		2		2	2	2	2	1	2	2	2
4	3	3	3	3		2		2	2	2	2	1	2	2	2
5	3	3	3	3		2		2	2	2	2	1	2	2	2

3 - High, 2 - Medium, 1 – Low

GUIDELINES

1. Practical based learning carrying credits.
2. Multi-disciplinary/ Multi-focus group of 3-4 students.
3. Groups can select to work on specific tasks, or projects related to real world problems.
4. Each group has a faculty coordinator/Instructor who will guide/evaluate the overall group as well as individual students.
5. The students have to display their model at the end of semester.
6. The progress of the course is evaluated based on class performance and final demonstration of prototype.

Total:45 Hours

EVALUATION PATTERN	
Continuous Internal Assessment	100
TOTAL	

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

21EN301 **CAREER ENHANCEMENT PROGRAM – I**

L	T	P	C
1	1	0	1

Course Objectives

- To develop active listening skills in various contexts.
- To develop the students' ability to use English accurately, appropriately and fluently in different social and professional situations.
- To enable students to gain a strong foundation by expanding their logical, numerical and reasoning skills.
- To ensure students develop ability to comprehend, work with, and apply general mathematical techniques and models to different situations.

Course Outcomes

At the end of the course, learners will be able to

- CO1. Listen and comprehend technical and non-technical spoken experts critically and functionally.
- CO2. Able to use English accurately, appropriately and fluently in different social and professional situations
- CO3. Able to gain a strong foundation by expanding their logical, numerical and reasoning skills.
- CO4. Ability to comprehend, work with, and apply general mathematical techniques and models to different situations.
- CO5. Proficiency in writing technical articles and presenting papers on any topic of any genre
- CO6. Develop flair for any kind of writing with rich vocabulary and proper syntax.

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1										3		2			1
2							2		2	3		2			2
3	3	2				2			1			2	2	3	
4	2	2						2				2			3
6									2	3		2			

3 - High, 2 - Medium, 1 – Low

UNIT I **6**

Applied Language Skills : Pronunciation - Homophones/ Homonyms / Homographs - Listening to Business conversation and answering MCQs

Quants: Number Series - Sequence - Alphabet Series - Odd man out.

UNIT II **6**

Applied Language Skills : Telephone Etiquette - Understanding the tone - Listening to Telephone conversation and filling the forms

Quants: Seating Arrangements - Linear , Circular , Square , Rectangular Arrangement

UNIT III **6**

Applied Language Skills : Idioms & Phrases - Phrasal Verbs - Listening to Self introductions / conversations - Understanding the structure of the speech

Quants: Family Tree- Statement Problems on Blood Relations - Direction Problems – Left Right Movement – Clockwise – Anti-clockwise.

UNIT IV **6**

Applied Language Skills : Listening to describing the products - Interpretation of Charts- Usage of discourse markers

Quants: LOGICAL DEDUCTION - Introduction to Sets-Venn Diagrams - Logic based questions using Venn diagram - Rules for to solve syllogism questions-Statement and conclusion.

UNIT V **6**

Applied Language Skills : Strategies for presentation - Practice- Decision Making - Problem Solving - Taking up a Listening Test

Quants: CLOCKS AND CALENDAR - Minute Spaces - Hour Hand and Minute Hand - Odd Days - Leap Year – Ordinary Year - Counting of Odd Days

TOTAL: 30 HOURS

TEXTBOOKS

1. Means,L. Thomas and Elaine Langlois. English & Communication for Colleges. CengageLearning ,USA: 2007
2. Redston, Chris & Gillies Cunningham. Face2Face (Pre-intermediate Student's Book). Cambridge University Press, New Delhi: 2005
3. Aggarwal, R.S. "Quantitative Aptitude", Revised Edition 2016, Reprint 2018, S.Chand& Co Ltd., New Delhi.
4. Pearson Publication, "A Complete Manual for the CAT", 2018

REFERENCES

1. Carter, R., & McCarthy, M. (2006). Cambridge grammar of English: A comprehensive guide: spoken and written English grammar and usage. Cambridge University Press.
2. Comfort, Jeremy, et al. Speaking Effectively: Developing Speaking Skills for Business English. Cambridge University Press, Cambridge: Reprint 2011
3. Dhaval Bathia, Vedic Mathematics, JAICO Publishing House, 29th Edition, Mumbai, 2014
4. https://learnenglish.britishcouncil.org/skills/listening
5. https://ieltspolska.pl/wp-content/uploads/2020/05/Listening-paper-assets.pdf
6. https://www.cambridgeenglish.org/learning-english/activities-for-learners/?skill=listening
7. https://testbook.com/aptitude-practice
8. https://www.indiabix.com/aptitude/questions-and-answers/

EVALUATION PATTERN	
Evaluation of Laboratory Observation, Record and Test	**End Semester Examination**
100	100
60	40
TOTAL : 100	

M.h.
(HoD/English)

SEMESTER IV

		L	T	P	C
21MA403	**PROBABILITY AND STATISTICS FOR BIOTECHNOLOGY**	**3**	**0**	**0**	**3**

Course Objectives

- Engineering Mathematics is an essential tool for describing and analyzing engineering process and systems. The objective of this course is to expose students to understand the basics and importance of Random variables, Two dimensional Discrete random variables, Testing of Hypothesis, Design of Experiments and Statistical quality control which are being widely used in Biotechnology Engineering. In addition this course provides the MATLAB statistics toolbox techniques for solving the mathematical problems.

PREREQUISITES

- Differentiation
- Integration
- Statistics

Course Outcomes

At the end of the course, learners will be able to

- CO1 Apply the concepts of probability for solving the engineering problems.
- CO2 Understand the basic concepts of two dimensional discrete random variables and apply in engineering applications.
- CO3 Apply the concept of testing of hypothesis for small and large samples in real life Problems.
- CO4 Apply the basic concepts of classifications of design of experiments in the field of Biotechnology.
- CO5 Analyze the charts and statistical techniques which are used in engineering and management Problems

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2	2		2							2	2	2	2
2	2	3	2		2							2	2	2	2
3	3	3	2		2							2	3	2	3
4	3	3	2		2							2	3	2	3
5	3	3	2		2							2	3	2	3

3 - High, 2 - Medium, 1 – Low

UNIT I RANDOM VARIABLES 9

Random variable – Discrete and Continuous random variables – Moment generating functions – Properties (statement only) – Binomial, Poisson, Uniform, Exponential and Normal distributions Properties (statement only) – Problems – Applications of Probability and Random variables in Bio Technology.

UNIT II TWO DIMENSIONAL RANDOM VARIABLES 9

Joint distributions – Marginal and conditional distributions – Covariance (concept only) – Correlation (discrete data)-problems –Regression - problems – Central limit theorem (statement only) – simple problems – Applications of two-dimensional random variables in Bio Technology.

UNIT III TESTING OF HYPOTHESIS 9

Sampling distributions – Statistical hypothesis - Large sample tests based on Normal distribution for single mean and difference of means – Small sample tests based on t for single mean, and difference of means and F distributions for difference of variances-Problems – Applications of Testing of Hypothesis in Bio Technology.

UNIT IV DESIGN OF EXPERIMENTS 9

Analysis of variance – One way classification – Completely Randomized Design (CRD) – Two way classification – Randomized Block Design (RBD) - Problems – Latin square Design- Problems – Applications of Design of

Experiments in Bio Technology..

UNIT V STATISTICAL QUALITY CONTROL 9

Control Charts for measurements ($\overline{X}$ and R Charts) – Control Charts for Attributes (p, c and np charts) – Applications of Statistical Quality Control in Bio Technology.

TOTAL: 30 HOURS

TEXTBOOKS

1. Johnson, R.A., Miller, I and Freund J., "Miller and Freund‘s Probability and Statistics for Engineers", Pearson Education, Asia, 9th Edition, 2017.
2. Milton. J. S. and Arnold. J.C., "Introduction to Probability and Statistics", Tata McGraw Hill, 4th Edition, 2007.

REFERENCES

1. Devore. J.L., "Probability and Statistics for Engineering and the Sciences‖, Cengage Learning, New Delhi, 9th Edition, 2016.
2. Papoulis, A. and Unnikrishnapillai, S., "Probability, Random Variables and Stochastic Processes", McGraw Hill Education India, 4th Edition, New Delhi, 2010.
3. Ross, S.M., "Introduction to Probability and Statistics for Engineers and Scientists", 4rd Edition, Elsevier, 2009.
4. Spiegel. M.R., Schiller. J. and Srinivasan, R.A., "Schaum‘s Outline of Theory and Problems of Probability and Statistics", Tata McGraw Hill, 4 th Edition, 2012.
5. Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics for Engineers and Scientists", Pearson Education, Asia, 9th Edition, 20.

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

Head of the Department
Mathematics
Sri Shakthi Institute of
Engineering and Technology
Coimbatore 641 062.

21BT401 APPLIED THERMODYNAMICS FOR BIOTECHNOLOGISTS

L	T	P	C
2	1	0	3

Course Objectives

- To make the students to understand the concepts thermodynamics with examples from Process Industries

Course Outcomes

At the end of the course, learners will be able to

- CO1 : Outline the applications of thermodynamic law and properties of fluids
- CO2 : Discuss the principles of partial molar properties and their applications in process unit
- CO3 : Explain the principles of phase equilibria problems and their applications in industrial biotechnology
- CO4 : Describe the basics principles of chemical reaction equilibria problems and their applications in industrial biotechnology
- CO5 : Illustrate the thermodynamic description of microbial growth and product formation
- CO6: students learnt their applications in industrial biotechnology

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	1	1	2										
2	1	2	2	1	2										
3	2	2	2	2	3								3	1	
4	1	1	1	2	3								2	1	
5		1	1	3	3								3	2	
6		1											1		

3 - High, 2 - Medium, 1 – Low

UNIT I THERMODYNAMIC LAW AND PROPERTIES OF FLUIDS 9

First Law of thermodynamics, a generalized balance equation and conserved quantities, Volumetric properties of fluids exhibiting non ideal behaviour; residual properties; Estimation of thermodynamic properties using equations of state; calculations involving actual property exchanges; Maxwell's relations and applications.

UNIT II SOLUTION THERMODYNAMICS 9

Partial molar properties; concepts of chemical potential and fugacity; ideal and non-ideal solutions; concepts and applications of excess properties of mixtures; activity coefficient; composition models; Gibbs Duhem equation.

UNIT III PHASE EQUILIBRIA 9

Criteria for phase equilibria; VLE calculations for binary and multi component systems liquid liquid equilibria and solid-solid equilibria

UNIT IV CHEMICAL REACTION EQUILIBRIA 9

Equilibrium criteria for homogeneous chemical reactions; evaluation of equilibrium constant; effect of temperature and pressure on equilibrium constant; calculation of equilibrium conversion and yields for single and multiple reactions.

UNIT V THERMODYNAMIC DESCRIPTION OF MICROBIAL GROWTH AND PRODUCTFORMATION 9

Thermodynamics of microbial growth stoichiometry thermodynamics of maintenance, Calculation of the Operational Stoichiometry of a growth process at Different growth rates, Including Heat using the Herbert –Pirt Relation for Electron Donor, thermodynamics and stoichiometry of Product Formation.

TOTAL: 45 HOURS

TEXTBOOKS

1. Smith J.M., Van Ness H.C., and Abbot M.M. Introduction to Chemical Engineering Thermodynamics, 6th Edition. Tata McGraw-Hill, 2003.
2. Narayanan, K. V. A Textbook of Chemical Engineering Thermodynamics. PHI Learning Pvt. Ltd., 2003
3. Christiana D. Smolke, The Metabolic Pathway Engineering Handbook Fundamentals, CRC Press Taylor & Francis Group, 2010

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

21BT421 **PLANT BIOTECHNOLOGY**

L	T	P	C
3	0	2	4

Course Objectives

- The course is tailored to provide an understanding of the basic concepts and state of art techniques
- and methods underlying plant biotechnology research including the genetic bases of several important plant properties and the molecular basis of plant breeding.

Course Outcomes

At the end of the course, learners will be able to

- CO1. Understand the structural complexity and diversity of plants
- CO2. Explore the principles underlying genetics and concept of breeding.
- CO3. Realize the principles underlying molecular and genetic improvement of plants.
- CO4. Understand the principles underlying breeding and hybrids.
- CO5. Appreciate the utility of GM plants and its applications.
- CO6. Develop the plant tissue culture

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2													3	
2	2													2	
3	2		1	1		1						2			3
4	2	2	3	2		1	1				2	2	3	2	2
5	2	2	3	2		1	1				2	2	3	2	2
6	2	2	3	2		1	1				2	2	3	2	2

3 - High, 2 - Medium, 1 – Low

UNIT I PLANT GENOME AND ORGANIZATION **9**

Molecular and classical genetics in modern agriculture; plant genomes- the organization and expression of plant genes; Concept of genetic selection; Chloroplast and Mitochondria genome- Organization and gene expression.

UNIT II CONCEPTS IN PLANT BREEDING **9**

History- Mendelian principles; concept of Green revolution; conventional practices for plant production; Selective and cross plant breeding programs; Plant breeder rights; classical genetic improvement- case study.

UNIT III PLANTS IMPROVEMENT **9**

Improvement of crop yield and quality; Molecular markers for crop improvement; application in agriculture and food industries; Transgenic plants- biotic and abiotic stress development.

UNIT IV PLANT BREEDING TECHNIQUES **9**

Plant breeding tools; concept of Hybrid, cybrid-procedure and establishment; screening and selection of hybrids; Concept of Male sterility- CMS, GMS, CGMS; Importance of plant breeding programme.

UNIT V GM CROPS AND ETHICAL ISSUES **9**

Gene manipulation and their impacts on Environmental, cultural, ethical and socioeconomical issues; Release of GMO's; In India, Role of IBSC (RCGM and GEAC); GM crops- Current status and concern about GM crops; Regulation of GM crops and products- for GMOs consumer acceptance in various varieties.

List of Experiments (15 Hours)

1. Organizing Plant tissue culture Laboratory
2. Preparation of Tissue Culture Media
3. Callus Induction
4. Shoot tip culture
5. Embryo / Endosperm Culture
6. Somatic Embryogenesis

7. Hardening and Planting infield
8. Isolation of protoplasts
9. Cell suspension culture
10. Economics of micro propagation project.

TOTAL: 60 HOURS

TEXTBOOKS

1. Keshavachandran R and Peter KV (2008). Plant Biotechnology- Methods in tissue culture and gene transfer, University press, Hyderabad, India
2. Brown TA., Genomes 2, 3rd edition Bios Scientific Publishers Ltd, Oxford, 2006.
3. Plant Biotechnology.Chelsea House.William G. Hopkins.
4. Plant biotechnology and genetics: principles, techniques, and applications. John Wiley & Sons Inc. C. Neal Stewart Jr

REFERENCE

1. Introduction to Plant Biotechnology (3/E).CRC Press.H.S. Chawla.
2. Plant Biotechnology: Current and Future Applications of Genetically Modified Crops Wiley. Nigel Halford.
3. Plant tissue culture, development and biotechnology. CRC Press. Trigiano, R. , Gray, Dennis J.
4. Biotechnology of Plant Secondary Metabolism: Methods and Protocols Humana Press Arthur Germano Fett-Neto.
5. Plant Biotechnology and Molecular Markers, Kluwer Academic Publishers; Anamaya Publishers.S. Srivastava, A. Narula.

<table>
<tr><th colspan="8">EVALUATION PATTERN</th></tr>
<tr><th colspan="6">Continuous Internal Assessment</th><th colspan="2">End Semester Examination</th></tr>
<tr><th colspan="2">Assessment I*</th><th colspan="2">Assessment II*</th><th colspan="2">Assessment III*</th><td rowspan="2">Theory Examinations</td><td rowspan="2">Practical Examinations</td></tr>
<tr><td>Theory</td><td>Lab</td><td>Theory</td><td>Lab</td><td>Theory</td><td>Lab</td></tr>
<tr><td>50</td><td>50</td><td>50</td><td>50</td><td>50</td><td>50</td><td>100</td><td>100</td></tr>
<tr><td colspan="6">Theory : 25 %
Laboratory : 25 %</td><td>35 %</td><td>15 %</td></tr>
<tr><td colspan="6">50</td><td colspan="2">50</td></tr>
<tr><td colspan="8">TOTAL = 100</td></tr>
</table>

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course for Theory

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

21BT422 **MOLECULAR BIOLOGY** **L T P C**
3 0 2 4

Course Objectives

- To familiarize students on macromolecule's properties, structures and functions
- To expose students to various molecular events in prokaryotes
- To create deeper understanding on regulation of genes activities

Course Outcomes

At the end of the course, learners will be able to

- CO1. : Analyze three major macromolecules and their properties in living organisms.
- CO2. : Organize the mechanism of DNA replication in prokaryotes.
- CO3. : Analyze the mechanism of transcription and universal genetic code in prokaryotes.
- CO4. : Analyze the process of translation and DNA repair system in prokaryotes.
- CO5. : Apply the concept of gene regulation and its significance in prokaryotes
- CO6: Articulate applications of molecular biology in the modern world

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3											1			
2	3			1			1					1			
3	3			1								1			
4	3			1			1								
5	3			1											
6	3	3	3	3	3	2	2		2		2	2	3	2	2

3 - High, 2 - Medium, 1 – Low

UNIT I NUCLEIC ACIDS AND DNA REPLICATION 9

Griffith; Hershey and Chase; Avery McLeod & McCarty experiments ; Cot value; C-value paradox; satellite DNA; Complexity of genes - Pseudogenes, jumping genes, split genes. Prokaryotic replication:Unidirectional and bidirectional replication; Replication in eukaryotic chromosomes; Replication oftelomeres in eukaryotes. Inhibitors of replication.

UNIT II DNA REPLICATION & REPAIR 9

Overview of Central dogma. Organization of prokaryotic and eukaryotic chromosomes. DNAreplication: Meselson & Stahl experiment, bi–directional DNA replication, Okazaki fragments,Proteomics of DNA replication, Fidelity of DNA replication, Inhibitors of DNA replication, Overviewof differences in prokaryotic and eukaryotic DNA replication, Telomere replication in eukaryotes.D-loop and rolling circle mode of replication. Mutagens, DNA mutations and their mechanism, various types of repair mechanisms.

UNIT III TRANSCRIPTION 9

Features of promoters and enhancers; Transcription factors; Classes of RNA molecules; Transcription inprokaryotes – initiation, elongation, termination. Transcription in eukaryotes. Post-transcriptionalprocessing – RNA splicing – trans-splicing of mRNA, processing of tRNA and rRNA, capping,polyadenylation. An outline of snRNA.

UNIT IV TRANSLATION AND MUTATION 9

Elucidation of genetic code, Wobble hypothesis, Redundancy, Codon-Anticodon interaction; Polycistronic mRNA. Protein synthesis in prokaryotes and eukaryotes (Initiation, elongation, termination).Inhibitors of translation, Post translational modifications. Introduction to Mutations – Physical, Chemical and Biological mutagens; Reversion

UNIT V REGULATION OF GENE ACTIVITY AND REPAIR MECHANISMS 9

Principles of Regulation. Constitutively expressed genes and Inducible genes. Transcriptional Regulation (*Lac* Operon, Tryptophan Operon) Attenuation; Autoregulation; Constitutively Expressed Genes.DNA Repair Mechanisms: Photo reactivation; Direct Reversal; Excision Repair; The SOS Response. **Case study:** DNA integrity scanning proteins in bacteria.

List of Experiments (15 Hours)

1. Isolation of genomic DNA from bacteria
2. Isolation of genomic DNA from plant tissue
3. Isolation of genomic DNA from animal tissue
4. Quantification of genomic DNA by UV Spectrophotometer / DNA Nano drop
5. Restriction Digestion of DNA
6. Agarose gel electrophoresis
7. PCR

TOTAL: 60 HOURS

TEXT BOOK

1. Lewin B, "Genes IX" Oxford University press, 2007.
2. Freifelder D and Malacinski G M, "Essentials of Molecular Biology", Panima Publishing Co, New Delhi, 2003.

REFERENCE

1. Lodish H, Berk A, Zipursky L, Matsudaria P, Baltimore D and Damell J, "Molecular Cell Biology",WH Freeman& Co, New York, 2000.

<table>
<tr><th colspan="8">EVALUATION PATTERN</th></tr>
<tr><th colspan="6">Continuous Internal Assessment</th><th colspan="2">End Semester Examination</th></tr>
<tr><th colspan="2">Assessment I*</th><th colspan="2">Assessment II*</th><th colspan="2">Assessment III*</th><td rowspan="2">Theory Examinations</td><td rowspan="2">Practical Examinations</td></tr>
<tr><td>Theory</td><td>Lab</td><td>Theory</td><td>Lab</td><td>Theory</td><td>Lab</td></tr>
<tr><td>50</td><td>50</td><td>50</td><td>50</td><td>50</td><td>50</td><td>100</td><td>100</td></tr>
<tr><td colspan="6">Theory : 25 %
Laboratory : 25 %</td><td>35 %</td><td>15 %</td></tr>
<tr><td colspan="6">50</td><td colspan="2">50</td></tr>
<tr><td colspan="8">TOTAL = 100</td></tr>
</table>

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course for Theory

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

21BT423 **BASIC INDUSTRIAL BIOTECHNOLOGY**

L	T	P	C
3	0	2	4

Course Objectives

- To make the students aware of the overall industrial bioprocess so as to help them to manipulate the process to the requirement of the industrial needs.
- The course prepares the students for the bulk production of commercially important modern Bioproducts, Industrial Enzymes, Products of plant and animal cell cultures

Course Outcomes

At the end of the course, learners will be able to

- CO1. Understand the basic principles of fermentation technology for industrial production
- CO2. Remember the importance of bioprocess for the production of metabolites
- CO3. Explain the steps involved in the design of fermentation types to improve the biologically important products via modern biotechnology
- CO4. Study the fermentation methods for producing commercially important bioproducts to meet the needs of the society
- CO5. To analyze the globally important and valuable products like enzymes and biopesticides through new processes to make bio-products in economically feasible way.
- CO6: Study of Microbial biopesticides

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2								3				2		3
2	3	3		2	3					2		2	3		3
3	3	2	3							3			3		2
4				3	3				2				2		2
5	3	3		2									3		2
6	3	3	3	3	1	1	1				2	2	3	2	3

3 - High, 2 - Medium, 1 – Low

UNIT I INTRODUCTION TO INDUSTRIAL BIOPROCESS **9**

Introduction to fermentation process - definition, scope, history, microorganisms and industrial products - Screening for microbes of industrial importance - Isolation and preservation of industrial microorganisms - Primary screening (screening for amylase, organic acid, antibiotic, amino acid and vitamin producing microorganisms) and secondary screening - Process flow sheeting- Basic concepts of Upstream and Downstream processing in Bioprocess.

UNIT II STRAIN IMPROVEMENT AND MEDIA PREPARATION **9**

Methods of strain improvement - inoculum media and inoculum preparation – Medium requirements for fermentation process. Examples of simple and complex media, raw materials, saccharides, starchy and cellulosic materials, nitrogen sources.

UNIT III FERMENTATION PROCESS **9**

Types of fermentation processes - Solid state, surface and submerged fermentations - batch, fed batch, continuous fermentations - Direct-dual or multiple fermentations - Scale up of fermentations.

UNIT IV PRODUCTION OF PRIMARY AND SECONDARY METABOLITES **9**

Fermentative production of ethanol,citric acid, acetic acid lactic acid, glutamic acid, vitamin B12, antibiotics – commercial production of benzyl penicillin and tetracycline, Single cell protein production

UNIT V PRODUCTION OF MODERN BIOTECHNOLOGICAL PRODUCT **9**

Production and application of industrially important microbial enzymes (amylase, protease, lipases) - Microbial biopesticides and biofertilizers, Recombinant products

List of Experiments (15 Hours)

1. Basic laboratory practices – handling of microbial cultures and Equipments
2. Microbial growth kinetics and preservation techniques

3. Production of yogurt and cheese
4. Physicochemical analysis of fermented milk.
5. Production of grape wine
6. Production of beer from cereals
7. Production of Bio fertilizers
8. Production of industrial enzymes – amylase and protease.
9. Production of single cell protein
10. Production of vermicomposting

TOTAL: 60 HOURS

TEXT BOOK

1. Satyanarayana, U. "Biotechnology" Books & Allied (P) Ltd., 2005.
2. Kumar, H.D. "A Textbook on Biotechnology" IInd Edition. Affiliated East West Press Pvt.Ltd., 1998.
3. Balasubramanian, D. etal., "Concepts in Biotechnology" Universities Press Pvt. Ltd., 2004.
4. Ratledge, Colin and Bjorn Kristiansen "Basic Biotechnology" IInd Edition Cambridge University Press, 2001.
5. Dubey, R.C. "A Textbook of Biotechnology" S.Chand & Co. Ltd., 2006.

REFERENCE

1. Casida, L.E. "Industrial Microbiology", New Age International (P) Ltd, 1968.
2. Presscott, S.C. and Cecil G. Dunn, "Industrial Microbiology", Agrobios (India), 2005.
3. Cruger,Wulf and Anneliese Crueger, "Biotechnology: A Textbook of Industrial Microbiology",IInd Edition, Panima Publishing, 2000.

<table>
<tr><th colspan="8">EVALUATION PATTERN</th></tr>
<tr><th colspan="6">Continuous Internal Assessment</th><th colspan="2">End Semester Examination</th></tr>
<tr><th colspan="2">Assessment I*</th><th colspan="2">Assessment II*</th><th colspan="2">Assessment III*</th><td rowspan="2">Theory Examinations</td><td rowspan="2">Practical Examinations</td></tr>
<tr><td>Theory</td><td>Lab</td><td>Theory</td><td>Lab</td><td>Theory</td><td>Lab</td></tr>
<tr><td>50</td><td>50</td><td>50</td><td>50</td><td>50</td><td>50</td><td>100</td><td>100</td></tr>
<tr><td colspan="6">Theory : 25 %
Laboratory : 25 %</td><td>35 %</td><td>15 %</td></tr>
<tr><td colspan="6">50</td><td colspan="2">50</td></tr>
<tr><td colspan="8">TOTAL = 100</td></tr>
</table>

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course for Theory

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

SSIET

21BT411	ENGINEERING EXPLORATION IV	L	T	P	C
		1	0	2	1

COURSE OBJECTIVES

- To enable the students to design and build simple systems on their own
- To help experiment with innovative ideas in design and team work
- To create an engaging and challenging environment in the engineering lab
- To inculcate ethics and sustainability perspectives and enable students to work in a team

CONTENTS

S No	Topics	No of Hours
1	Introduction to Engineering	3
2	Platform based development	12
3	Mechanisms	9
4	Requirements	3
5	Design	
6	Ethics	6
7	Sustainability	
8	Project Management Principles	3
9	Guided Project	
10	Final Project	9

COURSE OUTCOMES

CO1. Understand the role of an engineer as a problem solver

CO2. Apply multi-disciplinary principles and build systems using engineering design process and tools

CO3. Analyze engineering solutions from ethical and sustainability perspectives

CO4. Use basics of engineering project management skills while doing projects

CO5. Communicate, Collaborate and work as a team

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	1		2		2	2	2	2	1	1	1	1
2	3	3	3	3		2		2	2	2	2	1	2	2	2
3	3	3	3	3		2		2	2	2	2	1	2	2	2
4	3	3	3	3		2		2	2	2	2	1	2	2	2
5	3	3	3	3		2		2	2	2	2	1	2	2	2

3 - High, 2 - Medium, 1 – Low

GUIDELINES

1. Practical based learning carrying credits.
2. Multi-disciplinary/ Multi-focus group of 3-4 students.
3. Groups can select to work on specific tasks, or projects related to real world problems.
4. Each group has a faculty coordinator/Instructor who will guide/evaluate the overall group as well as individual students.
5. The students have to display their model at the end of semester.
6. The progress of the course is evaluated based on class performance and final demonstration of prototype.

Total : 45 Hours

EVALUATION PATTERN	
Continuous Internal Assessment	100
TOTAL	

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

21EN401 **CAREER ENHANCEMENT PROGRAM– II**

L	T	P	C
1	1	0	1

Course Objectives

- To Develop students ability to participate in conversation
- Develop an ability to use a number of key functional exponents with confidence and accuracy.
- To enable students to learn to interpret given information correctly, determine which mathematical model best describes the data, and apply the model correctly.
- To improve students' analytical and data interpretation skills.

Course Outcomes

At the end of the course, learners will be able to

- CO1. Able to participate in formal / informal conversations
- CO2. Speak in different contexts confidently and accurately
- CO3. Ability to interpret the given information correctly, determine which mathematical model best describes the data, and apply the model correctly.
- CO.4 To improve analytical and data interpretation skills.
- CO5. Apply the skills in speaking and writing
- CO6: Apply the language skills in SUDOKU

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1		3	3				2	1		3	3		2		2
2		3	3				2	1		3	2		2		2
3		3	2				2	1		3	3		2		2
4		3	2				3	1		3	3		2		3
5									2	2		2			

3 - High, 2 - Medium, 1 – Low

UNIT I **6**

Applied Language Skills : Self Introduction - Attending Interviews - Greeting - Starting a conversation- Social Conversation Skills Quants: ANALOGY PATTERN RECOGNITION - Relating two objects - Problems on Number Analogy - Pattern completion.

UNIT II **6**

Applied Language Skills : Asking and Giving Information - Apologising and Excusing - Giving Instructions - Role plays

Quants: CODING AND DECODING PATTERN RECOGNITION - Coding and decoding by letter shifting- Coding Letters of a Word-Coding and decoding in fictitious language

UNIT III **6**

Applied Language Skills : Agreeing and disagreeing - Inviting, accepting and declining invitations - Negotiating Skills - Persuasive Skills - Debate

Quants: ANALYTICAL REASONING - Problems related to shapes – To find the missing numbers - Shape Construction - Cubes & Dices.

UNIT IV **6**

Applied Language Skills : Expressing likes and dislikes - Complimenting - Mock Interviews - GD

Quants: Cognitive Problems & Puzzles - Find the next Image- Mirror Image- Water Image - Logical Puzzle

UNIT V **6**

Applied Language Skills : Taking up certificate speaking test

Quants: VEDIC MATHEMATICS AND SUDOKU - Addition- Subtraction- System of Multiplication- Squaring numbers- Cube roots – Square roots - Logic- based Sudoku

TOTAL: 30 HOURS

TEXT BOOK

1. Chris Anderson, TED Talks: The official TED guide to public speaking: Tips and tricks for giving unforgettable speeches and presentations The Newyork Times Paperback, 2018
2. by Kerry Patterson, Joseph Grenny,and Ron Mcmillan, Crucial Conversations Tools for Talking When Stakes Are High, McGraw Education, 2017
3. Aggarwal, R.S. "Quantitative Aptitude", Revised Edition 2016, Reprint 2018, S.Chand& Co Ltd., New Delhi.
4. Analytical Reasoning by M.K Pandey

REFERENCE

1. Interact English Lab Manual for Undergraduate Students. OrientBlackSwan: Hyderabad, 2016
2. Raman, Meenakshi and Sangeetha Sharma. Professional Communication. Oxford University Press: Oxford, 2014.
3. Arun Sharma "How to Prepare for Quantitative Aptitude for the CAT " , McGraw Hill Education; Eighth edition 2018
4. Arun Sharma "How to Prepare for Logical Reasoning for the CAT " , McGraw Hill Education; Eighth edition 2018
5. https://www.ted.com/talks
6. https://www.toastmasters.org/
7. https://www.edudose.com/reasoning/
8. https://testbook.com/aptitude-practice/

EVALUATION PATTERN	
Evaluation of Laboratory Observation, Record and Test	**End Semester Examination**
100	100
60	40
TOTAL : 100	

M.h.
(HoD/English)

SEMESTER V

21BT501	MARINE BIOTECHNOLOGY	L	T	P	C
		3	0	0	3

Course Objectives

- To understand the basics of marine environment that sustains life.
- Build better knowledge about marine ecosystem , biodiversity & taxonomy , tools and techniques used role of marine organisms in biogeochemical cycles.
- To let the students, develop applications out of aquatic life and ecology.
- To understand the marine pollution, biological indicators , prevention and conversation of marine ecosystem.
- Develop the students skill to take up employment, to pursue research as well as become an entrepreneur in marine biotechnology filed.

Course Outcomes

At the end of the course, learners will be able to

- CO1: Develop knowledge about the importance, opportunities and challenges in the field of marine biotechnology and compare about the various marine ecosystem, their characteristics and biodiversity.
- CO2: Distinguish various forms of organisms in marine environment.
- CO3: Analyze concepts related to marine pollution and fouling.
- CO4: Retrieving knowledge on process of drug discovery from marine organism and various assays and techniques related to it and utilize marine organisms for food. Fuel, agriculture, environment etc.
- CO5: Design aqua farms to grow economically viable aquatic organisms.
- CO6: Study the important of coastal aquaculture.

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1			1	3							2	
2	2	2	2											1	
3	1	3		2	1				1					1	
4	1	2	3												
5	2														
6	1	2	3						1					1	

3 - High, 2 - Medium, 1 – Low

UNIT I INTRODUCTION TO MARINE ENVIRONMENT 9

World oceans and seas, ocean currents, physical and chemical properties of sea water, abiotic and biotic factors of the sea, ecological divisions of the sea, history of marine biology, biochemical cycles, food chain and food web.

UNIT II IMPORTANT MARINE ORGANISMS 9

Phytoplanktons, zooplantons, nektons, benthos, marine mammals, marine algae,mangroves, coral reefs, deep sea animals and adaptation, intertidal zone, fauna and flora.

UNIT III MARINE ENVIRONMENTAL BIOTECHNOLOGY 9

Marine pollution, biology indicators (marine micro, algae), biodegradation and bioremediation, marine fouling and corrosion.

UNIT IV MARINE PHARMACOLOGY 9

Medicinal compound from marine flora and fauna, marine toxins, antiviral and antimicrobial agents.

UNIT V AQUACULTURE TECHNOLOGY 9

Important of coastal aquaculture, marine fishery resources, common fishing crafts and gears, aquafarm design and construction.

TOTAL: 45 HOURS

TEXT BOOKS

1. Recent advances in marine biotechnology volume 3 – M.Fingerman , R . Nagabhushanam Mary – Frances Thomson.
2. 2. Recent advances marine biotechnology volume 2 – M.Fingerman , R .Nagabhushanam Mary – Frances Thomson

REFERENCES

1. Jeffrey Levinton, Marine Biology: Function, Biodiversity, Ecology, 4th Edition, 2013 Front Matter

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

21BT502 INSTRUMENTAL METHODS OF ANALYSIS

L	T	P	C
2	1	0	3

Course Objectives

- To discuss the basic concepts and applications of spectrometric methods
- To apply and interpret the data originated from chromatography and electrophoretic methods
- To know the concept of centrifugal technique, and apply mass spectrometry, x-ray diffraction and NMR techniques

Course Outcomes

At the end of the course, learners will be able to

- CO1: Apply the principles and Properties of electromagnetic radiation in various Optical Instruments.
- CO2: Apply and interpret the data of biological solutions acquired from different spectroscopy techniques
- CO3: Evaluate the data originated by chromatographic techniques
- CO4: Evaluate the data obtained from radioisotopes mediated methods and different electrophoretic techniques
- CO5: Understand the fundamentals of centrifugation, mass spectrometry, x-ray diffraction and NMR techniques.
- CO6 : Analyse the centrifuge and other techniques

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3			2										2	
2	3	1	2	1		1							1	2	
3	3	2	3										1	1	
4	2	2	3											2	
5	2	2	3			3									
6	2	2													

3 - High, 2 - Medium, 1 – Low

UNIT I INTRODUCTION TO SPECTROMETRY 9

Properties of electromagnetic radiation- wave properties – components of optical instruments – Sources of radiation – wavelength selectors – sample containers – radiation transducers – Signal process and read-outs – a signal to noise ratio - sources of noise – Enhancement of signal to noise - types of optical instruments – Principle of Fourier Transform Optical Measurements.

UNIT II MOLECULAR SPECTROSCOPY 9

Photometry and spectro-photometry: The Beer-Lambert Law, percentage transmittance and absorbance; photoelectric colorimeters; spectrophotometers - types, UV visible, IR, atomic absorption; fluorometry, nephelometry.

UNIT III CHROMATOGRAPHIC TECHNIQUES 9

General description of chromatography-Liquid chromatography-Partition chromatography – Adsorption chromatography-Ion exchange chromatography-size exclusion chromatography- Affinity chromatography, principles of GC and applications – HPLC– Applications.

UNIT IV RADIOACTIVE ISOTOPE TECHNIQUES AND ELECTROPHORESIS 9

Radioisotope techniques - detection of radioactivity - Geiger counters— strip counters - labeling of biological material with radioactive isotope - scintillation counting - liquid scintillation counters - autoradiography. Paper, agarose gel, polyacrylamide gel (PAGE), SDS-PAGE, denaturing gradient gel electrophoresis (DGGE) or temperature gradient gel electrophoresis (TGGE), capillary electrophoresis, isoelectric focusing – principle, instrumentation, and applications

UNIT V CENTRIFUGATION AND STRUCTURAL ELUCIDATION METHODS 9

Basic principle of sedimentation; Analytical centrifugation; Mass spectrometry – principle, instrumentation (electron spray ionization [ESI] & chemical ionization [CI]) and applications; x-ray diffraction and nuclear magnetic resonance (NMR) – principle, instrumentation, and applications

TOTAL: 45 HOURS

TEXT BOOKS

1. Skoog, D., Holler, F., & Crouch, S. (2014). Principles of Instrumental Analysis (6th ed.). USA: Brooks Cole Publishing Company.
2. Sharma, B. (2014). Instrumental methods of chemical analysis (analytical chemistry) (24th ed.). India: GOEL Publishing House.

REFERENCES

1. Gurdeep R. Chatwal and Sham K. Anand, G. (2012). Instrumental Methods of Chemical Analysis (5th ed.). India: Himalaya Publishing House.
2. Wilson, K., & Walker, J. (2006). Principles and techniques of biochemistry and molecular biology (7th ed.). Cambridge: Cambridge University Press.

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

21BT521 **GENETIC ENGINEERING** **L T P C**
3 0 2 4

Course Objectives

- To familiarize students on various enzymes and vectors used in genetic engineering
- To give exposure on cloning techniques and their applications
- To create deeper understanding on various techniques of gene manipulation

Course Outcomes

At the end of the course, learners will be able to

- CO1 : Apply the microbial enzymes for constructing recombinant DNA
- CO2 : Apply the vectors for cloning and expression of gene of interest
- CO3 : Analyze the mechanism of construction of DNA libraries
- CO4 : Analyze the molecular techniques used in genetic engineering
- CO5 : Evaluate the applications of genetic engineering in biotechnology
- CO6 : Familiar of microarrays and analysis of Gene expression and proteomics

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1			2								1		
2	2				3			1					1		
3	3				2			1						2	
4	2	1			3									2	
5	2					3		1						2	
6	3	2	2	3		2					1	2	3	3	2

3 - High, 2 - Medium, 1 – Low

UNIT I ENZYMES USED IN GENETIC ENGINEERING 9

Nuclease- exonucleases and endonucleases; Restriction enzymes- nomenclature, types, applications; Restriction endonuclease- blunt and sticky ends; RNases, DNA Ligase, Polymerases; DNA Modifying enzymes- alkaline phosphatase, polynucleotide kinase and terminal deoxynucleotidyl transferase.

UNIT II VECTORS FOR GENE CLONING AND EXPRESSION 9

Characteristics of cloning and expression vectors; Plasmids-pSC101, pBR322, pSF2124, colE1, pUC, pGEMÃ-Â®, pMUTIN, pGEX-3X, pET and pTrcHis, Ti plasmid; Bacteriophage vector- lambda; Yeast vectors- plasmids and YAC; Shuttle vectors; Cosmid and phagemid vectors.

UNIT III CONSTRUCTION OF LIBRARIES 9

Linkers, adaptors and homopolymer tailing; Construction of genomic library; cDNA construction- hairpin loop strategies; Directional and non directional cDNA synthesis; Construction of full length cDNA library,Oligo capping; Okayama and Berg method of cDNA cloning; Screening of libraries.

UNIT IV TECHNIQUES FOR GENETIC ENGINEERING 9

Polymerase chain reactions; RAPD; RFLP; Molecular beacons and Taqman assay; Nucleic acid sequencing; Southern and northern blotting; Gene transfer technologies

UNIT V APPLICATIONS OF GENETIC ENGINEERING 9

Gene therapy- ex vivo and in vivo; Genetic engineering in medicine- recombinant therapeutics and biopharmaceuticals, antibiotics, vaccines; Genetic engineering in agriculture- bio pesticides, herbicides; Applications in environment-bioremediation or environment clean-up

Case Study:

Mammalian and plant expression vectors; In-situ hybridization; Site-directed mutagenesis; Primer designing; DNA fingerprinting; National regulatory mechanism for implementation of Biosafety guidelines for handling GMOs; Regulation for GM plants, Hybridization and labelling.

List of Experiments (15)

1. Isolation of gene of interest by PCR.
2. Purification of PCR amplicon and Ligation of foreign DNA

3. Ligation of Gene of interest into the vector
4. Preparation of competent cells by CaCl2 and Glycerol methods
5. Transformation of Heat Shock and Electroporation methods
6. Blue White screening and calculation of Transformation efficiency
7. Isolation of plasmid DNA from recombinants
8. Restriction digestion of cloned gene
9. Random amplified polymorphic DNA analysis
10. Real time PCR analysis

TOTAL: 60 HOURS

TEXT BOOK

1. Smita Rastogi and Neelam Pathak, Genetic Engineering, Oxford University Press, 2009
2. T.A.Brown, Gene Cloning an Introduction, U.K: Blackwell Publishers, 2001
3. Desmond S. T. Nicholl, An Introduction to Genetic Engineering, Cambridge University Press,3rd edition,2008
4. John C. Avise, The Hope,hype and reality of Genetic Engineering, Oxford University Press, 2004

REFERENCE

1. R.W.Old and S.B.Primrose, Principles of Gene Manipulation: An Introduction to Genetic Engineering, Blackwell Science Publications, 2001
2. B.D.Singh, Biotechnology, Kalyani Publishers, 2010

<table>
<tr><th colspan="8">EVALUATION PATTERN</th></tr>
<tr><th colspan="6">Continuous Internal Assessment</th><th colspan="2">End Semester Examination</th></tr>
<tr><th colspan="2">Assessment I*</th><th colspan="2">Assessment II*</th><th colspan="2">Assessment III*</th><td rowspan="2">Theory Examinations</td><td rowspan="2">Practical Examinations</td></tr>
<tr><td>Theory</td><td>Lab</td><td>Theory</td><td>Lab</td><td>Theory</td><td>Lab</td></tr>
<tr><td>50</td><td>50</td><td>50</td><td>50</td><td>50</td><td>50</td><td>100</td><td>100</td></tr>
<tr><td colspan="6">Theory : 25 %
Laboratory : 25 %</td><td>35 %</td><td>15 %</td></tr>
<tr><td colspan="6">50</td><td colspan="2">50</td></tr>
<tr><td colspan="8">TOTAL = 100</td></tr>
</table>

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course for Theory

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

21BT522 **BIOPROCESS ENGINEERING** **L T P C**
3 0 2 4

Course Objectives

- To learn the students with the basics knowledge of fermentor.
- To develop stoichiometry kinetics for the production of biochemical products using integrated biochemical processes.
- To impart interconnection between biology, engineering, and physical sciences.
- To analyse processes involved in production of chemicals, food, bioenergy and pharmaceuticals using biological agents.
- To study different types of bioreactors that are used in industrial production process.

Course Outcomes

At the end of the course, learners will be able to

- CO1: Learn fermentor configuration and ancilliaries
- CO2: Evaluate the stoichiometric kinetics in bioprocess
- CO3: Apply the knowledge of various optimization methods to design the media for fermentation broth.
- CO4: Apply the various scale-up criteria to design the bioreactors
- CO5: Create different types of bioreactors
- CO6 : Estimate and quantify the distribution and utilization of nutrients by Residence Time Distribution studies

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	1	1	1	2										
2	1	2	2	1	2										
3	2	2	2	2	3								3	2	
4	1	2	2	2	3								2	2	
5	2	1	2	3	3								3	2	
6		2	2		2						2	3	2	3	3

3 - High, 2 - Medium, 1 – Low

UNIT I FERMENTATION PROCESS AND STERILIZATION KINETICS 9

Overview of fermentation industry; Basic configuration of fermentor and ancillaries; Monitoring of bioprocess: Thermal death kinetics of microorganisms; Types of heat sterilization kinetics of liquid media.

UNIT II STOICHIOMETRY KINETICS IN BIOPROCESS 9

Stoichiometry of cell growth and product formation, elemental balances, degrees of reduction of substrate and biomass, available electron balances, yield coefficients of biomass and product formation, maintenance coefficients energetic analysis of microbial growth and product formation, oxygen consumption and heat evolution in aerobic cultures.

UNIT III SCOPE OF OPTIMIZATION METHODS 9

Criteria for good medium; Various carbon, nitrogen, minerals, vitamins and other complex nutrients for fermentation industry; Types of media; oxygen requirements; Physico-chemical parameters medium formulation for optimal growth and product formation; Medium optimization methods: Plackett-Burman design, simplex design and response-surface methodology.

UNIT IV MASS TRANSFER AND SCALE-UP PROCESS IN BIOREACTORS 9

Aeration and agitation in gas-liquid mass transfer, Oxygen transfer rate (OTR), Methods for determination of KLa, Factor affecting in OTR in bioreactor, Mass transfer correlation in Oxygen transfer; Scale-up criteria for bioreactors; Major factors involved in scale-up; Scaling-up of mixing systems: Scale-up of aeration/agitation regimes in stirred tank reactors.

UNIT V TYPES OF INDUSTRIAL BIOREACTORS 9

Bioreactor classification: Packed bed reactor, Stirred Tank Reactors Airlift reactor, Fluidized Bed Reactor and Bubble column reactor; Cultivation mode of organisms: batch, continuous and fed-batch systems.

List of Experiments (15)

1. Batch sterilization Process
    a. Calculation of Del factor
    b. Estimation of holding time
2. Batch cultivation and evaluation of growth parameters
3. Fed-batch cultivation and evaluation of growth parameters
4. Residence Time Distribution (RTD)
5. Medium optimization -Plackett-Burman design using mini tab tool
6. Medium optimization -Response surface methodology (RSM) using design expert tool
7. Estimation of KLa – Sodium Sulphite oxidation
8. Estimation of KLa-Dynamic Gassing Method
9. Estimation of KLa-Power Correlation method
10. Thermal Death Kinetics

TOTAL: 60 HOURS

TEXT BOOKS

1. Pauline M. Doran, “Bioprocess Engineering Principles, 2nd.” (2012) Academic Press, New York.
2. Shuler, M. L., and F. Kargi. “Bioprocess Engineering: Basic Concepts, 2nd.”(2002). New Delhi, Prentice-Hall of India.

REFERENCES

1. Stanbury P. F., Hall, S., and Whitaker A, “Principles of Fermentation Technology”, 2nd Edition, Butterworth-Heinesmann, 2003.
2. Blanch H. W. And Clark D. S, “Biochemical Engineering, 2nd.” (2007). CRC Press, London.
3. Bailey and Ollis, “*Biochemical Engineering Fundamentals, 2nd.”(2010). McGraw-Hill, New Delhi.*
4. Lee, J. M. (1992). *Biochemical engineering*. Englewood Cliffs, NJ: Prentice Hall.

<table>
<tr><th colspan="8">EVALUATION PATTERN</th></tr>
<tr><th colspan="6">Continuous Internal Assessment</th><th colspan="2">End Semester Examination</th></tr>
<tr><th colspan="2">Assessment I*</th><th colspan="2">Assessment II*</th><th colspan="2">Assessment III*</th><td rowspan="2">Theory Examinations</td><td rowspan="2">Practical Examinations</td></tr>
<tr><td>Theory</td><td>Lab</td><td>Theory</td><td>Lab</td><td>Theory</td><td>Lab</td></tr>
<tr><td>50</td><td>50</td><td>50</td><td>50</td><td>50</td><td>50</td><td>100</td><td>100</td></tr>
<tr><td colspan="6">Theory : 25 %
Laboratory : 25 %</td><td>35 %</td><td>15 %</td></tr>
<tr><td colspan="6">50</td><td colspan="2">50</td></tr>
<tr><td colspan="8">TOTAL = 100</td></tr>
</table>

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course for Theory

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

21BT511	ENGINEERING EXPLORATION V	L	T	P	C
		1	0	2	1

COURSE OBJECTIVES

- To enable the students to design and build simple systems on their own
- To help experiment with innovative ideas in design and team work
- To create an engaging and challenging environment in the engineering lab
- To inculcate ethics and sustainability perspectives and enable students to work in a team

CONTENTS

S No	Topics	No of Hours
1	Introduction to Engineering	3
2	Platform based development	12
3	Mechanisms	9
4	Requirements	3
5	Design	
6	Ethics	6
7	Sustainability	
8	Project Management Principles	3
9	Guided Project	
10	Final Project	9

COURSE OUTCOMES

CO1. Understand the role of an engineer as a problem solver

CO2. Apply multi-disciplinary principles and build systems using engineering design process and tools

CO3. Analyze engineering solutions from ethical and sustainability perspectives

CO4. Use basics of engineering project management skills while doing projects

CO5. Communicate, Collaborate and work as a team

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	1		2		2	2	2	2	1	1	1	1
2	3	3	3	3		2		2	2	2	2	1	2	2	2
3	3	3	3	3		2		2	2	2	2	1	2	2	2
4	3	3	3	3		2		2	2	2	2	1	2	2	2
5	3	3	3	3		2		2	2	2	2	1	2	2	2

3 - High, 2 - Medium, 1 – Low

GUIDELINES

1. Practical based learning carrying credits.
2. Multi-disciplinary/ Multi-focus group of 3-4 students.
3. Groups can select to work on specific tasks, or projects related to real world problems.
4. Each group has a faculty coordinator/Instructor who will guide/evaluate the overall group as well as individual students.
5. The students have to display their model at the end of semester.
6. The progress of the course is evaluated based on class performance and final demonstration of prototype.

Total:45 Hours

EVALUATION PATTERN	
Continuous Internal Assessment	100
TOTAL	

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

21EN501 **CAREER ENHANCEMENT PROGRAM – III** **L T P C**
1 1 0 1

Course Objectives

- To develop making inferences and predictions based on comprehension of a text
- To distinguish main idea(s) from supporting detail
- To enhance the problem solving skills, to improve the basic mathematical skills
- To help the students who are preparing for any type of competitive examinations.
- To draw conclusions and/or make decisions based on analysis and critique of quantitative information using proportional reasoning.

Course Outcomes

At the end of the course, learners will be able to

- CO1. Able to infer and predict content based on comprehension of a text
- CO2. Understand and distinguish main idea(s) from supporting detail
- CO3. Able to make decisions based on analysis and critique of quantitative information using proportional reasoning.
- CO4. Ability to enhance the problem solving skills
- CO5: Evaluate the simple interest and compound interest
- CO6: Apply the language skills to build leadership skills.

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1		3	3				2	1		3	3		2		2
2		3	3				2	1		3	2		2		2
3		3	2				2	1		3	3		2		2
4		3	2				3	1		3	3		2		3
5		3	2				2	1		3	3		2		2
6		3	2				3	1		3	3		2		3

3 - High, 2 - Medium, 1 – Low

UNIT I **6**

Applied Language Skills : Reading for main ideas - Making Inferences- Identifying the theme - Writing different types of paragraphs - Parajumbles

Quants: NUMBER SYSTEM – LCM & HCF – SIMPLIFICATION – SURDS & INDICES – CYCLICITY- EQUATIONS - Classification on Numbers -Power cycles and remainders - Concept of highest common factor - concept of least common multiple - Divisibility Rule - Number of zeros in an expression - Problems on Surds and Indices - Concept of Unit digit - Simultaneous equations- Quadratic equations – In equation.

UNIT II **6**

Applied Language Skills : Email etiquette - Email writing - Dangling modifiers - Writing different types of essays

Quants: FUNDAMENTALS OF ALGEBRA - AVERAGES - Variables - Algebraic expressions - Substitution & evaluating expressions - Writing algebraic expressions - PERCENTAGES – concept of percentage values through additions - fraction to percentage conversion table.

UNIT III **6**

Applied Language Skills : Resume and cover letter writing - Visumes - Practice- Preparation of Resumes for placements

Quants: RATIOS AND PROPORTION- comparison of ratios - proportions - relation among the quantities more than two – variation. - PARTNERSHIP - MIXTURES AND ALLEGATIONS - PROBLEM ON AGES - Definition - Allegation rule - mean value (cost price) of the mixture - Problems on ages and Problems related to ratios

UNIT IV **6**

Applied Language Skills : Technical Reports - Structure of the report - Critical Reasoning- Employee motivation, Satisfaction and commitment - Work Ethics

Quants: Problem on Ages - Profit & Loss - Discount - Simple Interest & Compound Interest - Data Interpretation.

UNIT V **6**

Applied Language Skills : Organisational Communication - Leadership skills- Stress management - Self Appraisal - Taking up Reading test

Quants: Time, Speed & Distance - Problems on Trains - Boats & Streams - Data Sufficiency.

TOTAL: 30 HOURS

TEXTBOOKS

1. Revised Edition of 'English for Engineers and Technologists' Volume 1 published by Orient Black Swan Limited 2019.
2. The Slight Edge, Jeff Olsen, Momentum Media, 2013
3. Aggarwal, R.S. "Quantitative Aptitude", Revised Edition 2016, Reprint 2018, S.Chand & Co Ltd., New Delhi
4. Arihant Publications," Quantitative Aptitude Quantum CAT ", Sarvesh Kumar Verma

REFERENCES

1. Interact English Lab Manual for Undergraduate Students. OrientBlackSwan: Hyderabad, 2016
2. Raman, Meenakshi and Sangeetha Sharma. Professional Communication. Oxford University Press: Oxford, 2014.
3. Arun Sharma "How to Prepare for Quantitative Aptitude for the CAT " , McGraw Hill Education; Eighth edition 2018
4. Pearson Publication, "A Complete Manual for the CAT", 2018
5. https://learnenglish.britishcouncil.org/general-english/magazine
6. https://blog.lingoda.com/en/10-news-sites-to-practice-your-english-reading-skills
7. https://testbook.com/aptitude-practice/
8. http://www.allindiaexams.in/online-test/online-aptitude-test/all

EVALUATION PATTERN	
Evaluation of Laboratory Observation, Record and Test	**End Semester Examination**
100	100
60	40
TOTAL : 100	

M.h.
(HoD/English)

SEMESTER VI

		L	T	P	C
21BT601	**PRESICION MEDICINE**	**3**	**0**	**0**	**3**

Course Objectives

- To explore the possibilities, promises, and pitfalls of precision medicine, using real-world examples.
- To bridge the gap between basic and translational research and its practical clinical applications, which will help prepare any student interested in research or health professions careers.
- To provide students with knowledge about prolonging health and treating disease that will empower them to make shared informed decisions with their physicians.

Course Outcomes

At the end of the course, learners will be able to

- CO1: Explain how the HGP has advanced technology in biomedical research.
- CO2: Understand how the diversity of life evolves over time by processes of genetic change leading to health implications.
- CO3: Describe recent advances in disease risk prediction, molecular diagnosis and progression of diseases, and targeted therapies for individuals.
- CO4: Understand how to translate research findings and technology into healthcare delivery that benefits the general public.
- CO5: Discuss the ethical, legal, and social implications of health privacy and policy laws for precision medicine
- CO6: Critically evaluate primary and secondary precision medicine research

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2					2									
2	2					2									
3	2				2	2									
4	2				2	2									
5	2				2	2									
6	2				2	2									

3 - High, 2 - Medium, 1 – Low

UNIT I INTRODUCTION TO PRECISION MEDICINE **9**

Overview on Precision Medicine, the Human Genome, and Human Genomic Variation. Pharmacogenome: Whole Genome Sequencing (WGS). Epigenome: DNA Methylation, Histone Modifications and Chromatin Remodeling Factors. Transcriptome. Proteome. Metabolome. Microbiome.

UNIT II MEDICAL MOLECULAR GENETICS **9**

Human genetics/genomics, including pedigree analysis, non-Mendelian genetics, cytogenetics, polymorphism analysis, physical mapping and the human genome, mutation analysis and pathogenesis, genomic imprinting, viral and non-viral gene therapy.

UNIT III APPLICATIONS OF PRECISION MEDICINE **9**

Applications of precision medicine in diagnosis and treatment considerations of concepts in monogenic diseases and complex diseases. Important concepts include susceptibility genomics, diagnostic approaches, laboratory testing, and treatment considerations for genomic medicine. Diseases include cystic fibrosis, monogenic diabetes, Marfan syndrome, Huntington's disease, as well as cardiovascular, metabolic, neurologic, mental health disorders and addiction, and others.

UNIT IV CLINICAL APPLICATIONS OF PRECISION MEDICINE: PRECISION ONCOLOGY **9**

Cancer marker analysis; Approaches and technologies in diagnosing or treating cancer, including the genetics of cancer, targeted cancer treatments, somatic testing, current and future research and clinical trends, and

other information on precision oncology

UNIT V AI FOR PRECISION MEDICINE 9

Practicing precision medicine with intelligently integrative clinical and multi-omics data analysis, Human gene and disease associations for clinical-genomics and precision medicine, Robotic surgery, Use robot to monitor effectiveness of treatment.

TOTAL: 45 HOURS

TEXT BOOKS

1. Genomic and Precision Medicine, 3rd Edition, Geoffrey Ginsburg and Huntington Willard, 2016

REFERENCES

1. The Language of Life: DNA and the Revolution in Personalized Medicine, Francis S. Collins, 2010

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

21BT602 **BIOLOGICAL DATA ANALYSIS** **L T P C**
3 0 0 3

Course Objectives

- To introduce the concept of massive data mining from biological experiments.
- To identify basic experimental design principles in solving biological questions.
- To develop and test hypothesis statistically using data using R – programming.

Course Outcomes

At the end of the course, learners will be able to

- C01: Provide optimal solution and statistics to biological problems
- C02: Apply and interpret the biological data through fundamental statistical analysis
- C03: Apply and interpret biological data related with hypothesis testing
- C04: Explore and infer biological data using visualization
- C05: Understand and apply R-programming for biological data analysis
- C06: Understand and apply the biological annotation for macromolecules

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3			3	3					2	3		3		3
2	3			3	3										
3	3			3	3										
4	3			3	3										
5	3			3	3										
6	3			3	3					3		2	3		3

3 - High, 2 - Medium, 1 – Low

UNIT I INTRODUCTION TO BIOSTATISTICAL ANALYSIS 9

Statistical methods in the context of biological research – Data exploration and Analysis - Arithmetic mean, standard deviation, coefficient of variation, standard error of mean, correlation analysis; regression analysis [Problems alone should be solved]

UNIT II HYPOTHESIS TESTING 9

Introduction to general concepts; characteristics - Type I and II error; Student's t-test, chi-square test, One Way ANOVA (Kruskal–Wallis H test), Mann–Whitney U test; Wilcoxon signed-rank test.

UNIT III DATA EXPLORATION 9

Data visualization and summary statistics – variable types, exploring categorical variable – Relative frequency and percentage, Bar graph, Pie chart; Exploring numerical variables – Histogram, Mean and median, Variance and Standard deviation, quintiles, Box plots; Data Pre-processing – Outliers, data transformation.

UNIT IV BIOLOGICAL DATA ANALYSIS USING R PROGRAMMING 9

Overview – Variable, Data types, Operators, Useful Function, Data frames, working with images and strings, Library functions.

UNIT V BIOINFORMATICS: MINING THE MASSIVE DATA FROM HIGH THROUGHPUT GENOMICS EXPERIMENTS 9

Introduction – Sequence alignment, Genome sequencing - Nanopore and illumina sequencing, gene annotation, RNA folding – RNA hybrid, protein structure prediction - Secondary structure information; Microarray analysis, proteomics, Protein-Protein Interaction..

TOTAL: 45 HOURS

TEXT BOOKS

1. O'Brien, C. M. (2013). Biostatistics with R: An Introduction to Statistics Through Biological Data by Babak Shahbaba. International Statistical Review, 81(3), 472-473.

REFERENCES

1. Sanghamitra, B., Ujjwal, M., & TL, W. J. (Eds.). (2007). Analysis of biological data: a soft computing approach (Vol. 3). World Scientific.

2. McDonald, J. H. (2009). Handbook of biological statistics (Vol. 2, pp. 173-181). Baltimore, MD: sparky house publishing.

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

21BT621 **IMMUNOLOGY**

L	T	P	C
3	0	2	4

Course Objectives

- To enable the students
- To gain an in-sight into the cells and effectors of the immune system and mechanisms of immunity.
- To learn the concept of antigen-antibody interactions and demonstrate the techniques for their evaluation.

Course Outcomes

At the end of the course, learners will be able to

- CO1: Comprehend the general concepts of the immune system and elaborate the cells and organs of the immune system.
- CO2 Analyse and evaluate the organs of the immune system.
- CO3: Demonstrate and evaluate various antigen-antibody interactions and techniques.
- CO4: Apply the concept of cell mediated immunity and complement system.
- CO5: Illustrate the mechanisms behind hypersensitivity and concept of transplantation
- CO6: know the techniques of vaccine development
-

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	1	3	2	1	3						2	1	2	2
2	1	2	3	3	1	2						3	1	3	3
3	1	3	3	2	1	3						2	1	2	2
4	1	2	2	2	1	2						2	1	2	2
5	1	3	3	2	1	3						3	2	3	3
6	3	3	3	2	2	3	2	1	1	1	3	3	3	3	3

3 - High, 2 - Medium, 1 – Low

UNIT I IMMUNE SYSTEM **9**

Introduction and an overview of immunology, History of immunology, Types of Immunity - Innate and acquired immunity, Cell mediated and humoral immunity; Design of immune system- recognition & response. Organs of the immune system: Lymphoid organs - primary and secondary.

UNIT II CELLS OF IMMUNE SYSTEM **9**

Granulocytes and Agranulocytes, T and B Lymphocytes, NK cells, macrophage and dendritic cells their structure, characteristics, function and their identification. Haematopoiesis, extravasation, phagocytosis.

UNIT III HUMORAL SYSTEM **9**

Molecular nature and function of; Antigens, epitopes, haptens; Adjuvants. Antibody – structure, Classes, Antibody diversity. Antigen Antibody reactions; Neutralization, Opsonization. Complement system.

UNIT IV ADAPTIVE IMMUNITY - RECOGNITION, RESPONSES & REGULATION **9**

Major histocompatibility complex; antigen processing and presentation, T-Cell activation and the cellular immune response. Cytokines.

UNIT V CLINICAL IMMUNOLOGY **9**

Immunity to infections: immunity to virus, prokaryotic (Bacteria), & eukaryotic pathogens (parasites & fungi); Transplantation, graft rejection Immunosuppression –Immune Dysfunction: Autoimmunity, Allergy, Hypersensitivity& Immunodeficiency, Diagnostics; Haemagglutination, ELISA, Immunofluorescence & Immunohistochemistry. Therapeutics and prophylactics; Abzymes, Monoclonal Antibody production, Chimeric & humanized antibodies. Vaccines, anti-vaccination movement and its impact.

List of Experiments (15)

1. Blood Grouping

2. Differential Leukocyte count
3. Total Leukocyte count
4. Widal test
5. Single radial immunodiffusion
6. Ouchterlony double immunodiffusion
7. Rocket immunoelectrophoresis
8. Counter current immunoelectrophoresis
9. ELISA-Dot and plate.

Western blotting

TOTAL: 60 HOURS

TEXT BOOKS

1. Kuby immunology by Jenni Punt, Sharon Stranfor, Patricia Jones and Judith A Owen, WH Freeman; 8th ed. 2018 edition

REFERENCES

1. Fundamental Immunology by William E Paul, Lippincott Williams and Wilkins; 7th edition (2012)

EVALUATION PATTERN							
Continuous Internal Assessment						**End Semester Examination**	
Assessment I*		**Assessment II***		**Assessment III***		Theory Examinations	Practical Examinations
Theory	Lab	Theory	Lab	Theory	Lab		
50	50	50	50	50	50	100	100
Theory : 25 % Laboratory : 25 %						35 %	15 %
50						50	
TOTAL = 100							

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course for Theory

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

21EN601 **CAREER ENHANCEMENT PROGRAM – IV** **L T P C**
1 1 0 1

Course Objectives

- To develop strategies to improve students writing skills
- To learn to different types of documents used for business writing
- To Understand relevance & need of quantitative methods for making business decisions
- To demonstrate a sound knowledge of fundamentals of statistics and statistical techniques
- To apply quantitative methods to solve a variety of decision making problems.

Course Outcomes

At the end of the course, learners will be able to

- CO1: Able to participate in formal / informal conversations
- CO2: Speak in different contexts confidently and accurately
- CO3: Ability to understand relevance & need of quantitative methods for making business decisions
- CO4: Able to solve the real time problems statistically.
- CO5: Apply height and distance concept in application skills
- CO6: Study the AP, GP & HP data Interpretations

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1		3	3				2	1		3	3		2		2
2		3	3				2	1		3	2		2		2
3		3	2				2	1		3	3		2		2
4		3	2				3	1		3	3		2		3
5		3	3				2	1		3	2		2		2
6		3	2				2	1		3	3		2		2

3 - High, 2 - Medium, 1 – Low

UNIT I **6**

Applied Language Skills : Active Vocabulary - Writing Personal experiences - Process Description

Quants: Time & Work - Pipes & Cisterns - using fractions, percentages & negative work.

UNIT II **6**

Applied Language Skills : Writing notices , business letters and reports(Minutes & Project)

Quants: Permutation & Combination - Probability - arrangements - selections - chances.

UNIT III **6**

Applied Language Skills : Resume and cover letter writing - Visumes - Practice- Preparation of Applied Language Skills : Feasibility Report, Progressive report - Evaluation report

Quants: Geometry - Mensuration Concepts - Area & Volume - 2D & 3D.

UNIT IV **6**

Applied Language Skills : Book review- Article writing - Writing mails - Letter to the editor

Quants: Trigonometry - Basic concepts - Heights & Distance and its applications.

UNIT V **6**

Applied Language Skills : Taking up certificate test in reading

Quants: Sequence & Series - Progressions - AP, GP & HP - Data Interpretations - Data Sufficiency.

TOTAL: 30 HOURS

TEXTBOOKS

1. Chris Anderson, TED Talks: The official TED guide to public speaking: Tips and tricks for giving unforgettable speeches and presentations The Newyork Times Paperback, 2018
2. by Kerry Patterson, Joseph Grenny,and Ron Mcmillan, Crucial Conversations Tools for Talking When Stakes Are High, McGraw Education, 2017
3. Quantitative Aptitude for Competitive Examinations - R S Aggarwal
4. A Modern Approach to Verbal & Non-Verbal Reasoning by R.S. Aggarwal

REFERENCES

1. Interact English Lab Manual for Undergraduate Students. OrientBlackSwan: Hyderabad, 2016
2. Raman, Meenakshi and Sangeetha Sharma. Professional Communication. Oxford University Press: Oxford, 2014.
3. Arun Sharma "How to Prepare for Quantitative Aptitude for the CAT " , McGraw Hill Education; Eighth edition 2018
4. Pearson Publication, "A Complete Manual for the CAT", 2018
5. https://www.ted.com/talks
6. https://www.toastmasters.org/
7. https://testbook.com/aptitude-practice/
8. http://www.allindiaexams.in/online-test/online-aptitude-test/all

EVALUATION PATTERN	
Evaluation of Laboratory Observation, Record and Test	**End Semester Examination**
100	100
60	40
TOTAL : 100	

M.h.
(HoD/English)

21BT612 **MINI PROJECT**

L	T	P	C
0	0	3	2

Course Objectives

To enable learners of Engineering and Technology develop their basic communication skills in English.
To emphasize specially the development of speaking skills amongst learners of Engineering and Technology.
To ensure that learners use the electronic media such as internet and supplement the learning materials used in the classroom.
To inculcate the habit of reading and writing leading to effective and efficient communication.

Course Outcomes

At the end of the course, learners will be able to
CO1 identify technically and economically feasible problems of social relevance
CO2 plan and build the project team with assigned responsibilities
CO3 identify and survey the relevant literature for getting exposed to related solutions
CO4 analyse, design and develop adaptable and reusable solutions of minimal complexity by using modern tools
CO5 implement and test solutions to trace against the user requirements
CO6 deploy and support the solutions for better manageability and provide scope of improvability

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	1		2	2	2	2	2	2	1	1	1	1
2	3	3	3	3	2	2	2	2	2	2	2	1	2	2	2
3	3	3	3	3	2	2	2	2	2	2	2	1	2	2	2
4	3	3	3	3	2	2	2	2	2	2	2	1	2	2	2
5	3	3	3	3	2	2	2	2	2	2	2	1	2	2	2
6	3	3	3	3	2	2	2	2	2	2	2	1	2	2	2

The students are assigned project work related to product / process development, solution to the technical problems in industry and current research at national and international level. The student is required to submit a report at the end of semester based on the findings. The evaluation is made as per the Regulations of University.

EVALUATION PATTERN	
Evaluation of Laboratory Observation, Record and Test	**End Semester Examination**
100	100
60	40
TOTAL : 100	

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

SEMESTER VII

21MG701 PRINCIPLES OF MANAGEMENT AND PROFESSIONAL ETHICS

L	T	P	C
3	0	0	3

Course Objectives

The course aims to provide the students

- To enable the students to study the evolution of Management, to study the functions and principles of management and to learn the application of the principles in an organization .

Course Outcomes

At the end of the course, learners will be able to

CO1: (Understand) Explain the management concepts, evolution of management and contemporary management thoughts and issues

CO2: (Analyze) Analyze steps in planning, decision making and structure of organization

CO3: (Apply) Apply motivational theories and leadership qualities

CO4: (Apply) Apply human values in engineering ethics

CO5: (Understand) Explain safety, Rights and responsibilities of employee and employer

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1						2	2		2	2	3	2			3
2	2	2				2	2		3	3	3	2			3
3						2	2		3	3	3	2			3
4						3	3	3	3	3	2	2			3
5						2	2	2	2	3	2	2			3

3 - High, 2 - Medium, 1 – Low

UNIT I MANAGEMENT CONCEPTS **10**

Management – Definition – Importance – Functions – Skills required for managers - Roles and functions of managers – Science and Art of Management –Management and Administration-Evolution of Classical, Behavioural and Contemporary management thoughts

UNIT II PLANNING and ORGANISATION **9**

Nature & Purpose – Steps involved in Planning – Forms of Planning – Types of plans – Plans at Individual, Department and Organization level - Managing by Objectives. Forecasting – Purpose – Steps and techniques. Decision-making – Steps in decision making-Nature and Purpose of Organizing - Types of Business Organization - Formal and informal organization – Organization Chart – Structure and Process – Strategies of Departmentation– Line and Staff authority –Benefits and Limitations. Centralization Vs De-Centralization and Delegation of Authority. Staffing – Manpower Planning –Recruitment – Selection – Placement – Induction.

UNIT III DIRECTING AND CONTROLLING **9**

Nature & Purpose – Manager Vs. Leader - Motivation - Theories and Techniques of Motivation. Leadership – Styles and theories of Leadership. Communication – Process – Types – Barriers – Improving effectiveness in Communication. Controlling – Nature – Significance – Tools and Techniques- Corporate Governance Social responsibilities – Ethics in business – Recent issues. American approach to Management, Japanese approach to Management, Chinese approach to Management and Indian approach to Management

UNIT IV HUMAN VALUES AND ENGINEERING ETHICS **9**

Definition, Moral issues, Human values -Types of inquiry- Morality and issues of morality- Kohlberg and Gilligan's theories-consensus and controversy- Professional and professionalism-moral reasoning and ethical theories- virtues, professional responsibility, integrity, self-respect, duty ethics, ethical rights, self-interest, moral obligations-Engineering as social experimentation- codes of ethics

UNIT V RIGHTS, RESPONSIBILITY OF ENGINEERS AND GLOBAL ISSUES 8

Safety and risk – assessment of safety and risk-Collegiality and loyalty – respect for authority – collective bargaining – confidentiality – conflicts of interest – occupational crime – professional rights – employee rights – Intellectual Property Rights (IPR) – discrimination - Multinational Corporations – Environmental ethics – computer ethics – weapons development- –Engineers as trend setters for global values.

TOTAL: 45 HOURS

TEXT BOOKS

1. Tripathy PC And Reddy PN, “Principles of Management”, Tata McGraw-Hill, 9th Edition, 2018.
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, “Engineering Ethics”, Prentice Hall of India, New Delhi, 2018.

REFERENCES

1. Dinkar Pagare, “Principles of Management”, Sultan Chand & Sons, 2017.
2. Stephen A. Robbins & David A. Decenzo & Mary Coulter, “Fundamentals of Management”, 9th Edition, Pearson Education, 2017.
3. Harold Koontz & Heinz Weihrich, “Essentials of Management – An International perspective”, 10th edition. Tata McGraw-Hill, 2019.
4. Mike Martin and Roland Schinzinger, “Ethics in Engineering”. (2015) McGraw-Hill, New York

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

21BT701	DOWNSTREAM PROCESSING	L	T	P	C
		4	0	0	4

Course Objectives

To enable the students

- To provide the students with the purposes of formulation activities.
- To develop bioengineering skills for the production of biochemical product using integrated downstream
- processes.
- To impart interconnection between biology, engineering, and physical sciences.
- To analyse processes involved in production, separation, membrane separation, purification of chemicals,
- food, biofuels and pharmaceuticals using biological agents.
- To provide the techniques of drying, lyophilization processes for final product.

Course Outcomes

At the end of the course, learners will be able to

- CO1:Apply the knowledge of various Cell disruption methods and stabilization of bioproducts
- C02:Evaluate the removal of insoluble through centrifugation and filtration
- C03:Understand and analyse the different methods used for product isolation
- C04:Apply the various purification techniques using chromatography
- C05:Identify the methods used for stabilization of bioproducts
- C06:Study the crystallization process in final product formulation.

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2								3				2		3
2	3	3		2	3					2		2	3		3
3	3	2	3							3			3		2
4				3	3				2				2		2
5	3	3		2									3		2
6															
6	2								3				2		3

3 - High, 2 - Medium, 1 – Low

UNIT I INTRODUCTION **9**

Introduction to downstream processing, principles, characteristics of bio-molecules and bioprocesses. Cell disruption for product release – mechanical, enzymatic and chemical methods. Pre treatment and stabilisation of bio-products.

UNIT II PHYSICAL METHODS OF SEPARATION **9**

Unit operations for solid-liquid separation - filtration and centrifugation.

UNIT III ISOLATION OF PRODUCTS **9**

Adsorption, liquid-liquid extraction, aqueous two-phase extraction, membrane separation – ultrafiltration and reverse osmosis, dialysis, precipitation of proteins by different methods.

UNIT IV PRODUCT PURIFICATION **9**

Chromatography – principles, instruments and practice, adsorption, reverse phase, ion exchange, size exclusion, hydrophobic interaction, bio-affinity and pseudo affinity chromatographic techniques.

UNIT V FINAL PRODUCT FORMULATION AND FINISHING OPERATIONS **9**

Crystallization, drying and lyophilization in final product formulation.

TOTAL: 45 HOURS

TEXT BOOKS

1. Belter, P.A., E.L. Cussler and Wei-Houhu “Bioseparations – Downstream Processing for Biotechnology”,

John Wiley, 1988.
2. Sivasankar, B. “Bioseparations: Principles and Techniques”. PHI, 2005.
3. Asenjo, Juan A. “Separation Processes in Biotechnology”. CRC / Taylor & Francis, 1990.

REFERENCES

1. Ghosh, Raja “Principles of Bioseparations Engineering”. World Scientific, 2006.

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

21BT702 MOLECULAR PATHOGENESIS & DISEASE DIAGNOSIS

L	T	P	C
3	0	0	3

Course Objectives

- To familiarize students about pathogen and zoonotic diseases
- To attain fundamental knowledge on host defense mechanism and host pathogen interaction
- To explain the methods involved in diagnosis of diseases.

Course Outcomes

At the end of the course, learners will be able to

- CO1 : Analyze various pathogens and zoonotic diseases
- CO2 : Analyze host defense mechanisms against pathogens
- CO3 : Apply virulence factors and toxins in pathogenicity
- CO4 : Organize host pathogen interaction
- CO5 : Evaluate modern approaches of disease diagnosis
- CO6 : Understand the pathogenicity of various organisms

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1		3	1			2							1		
2		3	1			2							1	2	
3		3	1			2								2	
4		3	2			1								3	
5		2	1		3	1								1	
6		1	1			2								2	

3 – High, 2 – Medium, 1 – Low

UNIT I PATHOGEN AND ZOONOTIC DISEASES **9**

Pathogens; Attributes and component of microbial pathogenicity; Pathogen types and mode of entry; Robert Koch postulates; General disease symptoms; Microbial Zoonosis and diseases- HUS, MRSA, Leptospirosis, Salmonellosis; Swine flu (H1N1), Avian flu (H5N1).

UNIT II HOST DEFENSE MECHANISM AGAINST PATHOGENS **9**

Host natural defense mechanism - humoral and cellular defense mechanisms; Components of host surface defense systems- skin, mucosa, eye, mouth, respiratory tract; Components of systemic defense- tissues and blood; Complements and inflammation process.

UNIT III VIRULENCE FACTOR AND TOXIN **9**

Virulence factors; Endo and exo toxins; Colonizing and invasion virulence factors; E. coli pathogens - ETEC, EPEC, EIEC, EHEC, EAEC; Salmonella enterica toxin; Shigella toxin; Vibrio cholerae toxin; Clostridial toxins- C. perfringens, C. botulinum

UNIT IV HOST-PATHOGEN INTERACTION **9**

Virulence gene and their regulation; Virulence assays; Cytopathic vs cytotoxic effects; Criteria and tests in identifying virulence factors; Serotyping

UNIT V DISEASE DIAGNOSIS **9**

Influenza virus; Diagnosis of disease using immunological methods-EIA, ELISA, Ouchterlony double diffusion, Immunobloting; Diagnosis of disease using molecular methods- PCR, Hybridization, DNA sequencing.

TOTAL: 45 HOURS

TEXT BOOKS

1. K. Talaro and A. Talaro, Foundations in Microbiology, W.C. Brown Publishers, 2006.
2. C.A. Janeway and P. T. Travers, Immunobiology, Blackwell J Scientific Publishers, 2004
3. Iglewski B.H and Clark V.L -Molecular basis of Bacterial Pathogenesis, Academic Press, 1990

REFERENCES

1. Peter Williams, Julian Ketley & George Salmond, Methods in Microbiology: Bacterial

Pathogenesis, Vol. 27, Academic Press, 1998

2. C.L. Gyles, F.P. John, G. Songer and C. O. Theon, Pathogenesis of Bacterial Infections in Animals, Blackwell Publishers, 2010.
3. Paul Digard, Anthony Nash and R. E. Randall, Molecular Pathogenesis of Virus Infections, Cambridge University Press, 2005

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

21BT703 WASTE MANAGEMENT AND UPCYCLING

L	T	P	C
3	0	0	3

COURSE OBJECTIVE:

- To understand the basic concept of waste and its sustainable management.
- To inculcate knowledge and skills in the collection, transport, treatment, disposal and recycling process for solid and liquid wastes.
- To acquire knowledge on how waste can be converted to wealth in a sustainable way.

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Categories different types of wastes and develop concepts in the field of waste management.
CO2: Relate the characteristics features of different wastes and influencing factors
CO3: Analyze suitable techniques to transport and disposal of wastes.
CO4: Compare among various waste processing technologies
CO5: Formulate treatment process of wastewater and sludge disposal.
CO6: Develop sustainable technologies for waste conversion into value-added products

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	1												
2	2	1	3												1
3	1		2		3		2	2							2
4		1	3			2									1
5				3	2		2	2							2
6	1	2	2		3									2	

3 - High, 2 - Medium, 1 – Low

UNIT I CLASSIFICATION OF WASTES AND IT'S MANAGEMENT 9

Types and sources of solid and hazardous wastes; Need for solid and hazardous waste management; Salient features of Indian legislations on management and handling of municipal solid wastes, nuclear wastes, electronic wastes, plastics and fly ash; Financing and public private participation for waste management; Induction of 5R's in waste management-Refuse, reduce, reuse, repurpose, recycle.

UNIT II WASTE CHARACTERIZATION AND SOURCE REDUCTION 9

Waste generation rates and variation; composition, physical, chemical and biological properties of solid wastes; Hazardous characteristics-TCLP tests; Waste sampling and characterization plan; Source reduction of wastes, waste exchange, extended producer responsibility; Collection of municipal solid wastes, Handling and segregation of wastes at source-storage.

UNIT III TRANSPORT AND DISPOSAL OF WASTES 9

Transfer stations optimizing waste allocation; Compatibility, storage, labelling and handling of hazardous waste; Hazardous waste manifests and transport; Waste disposal options; Disposal in landfills, landfill classification, types and methods; Site selection; Design and operation of sanitary landfills, secure landfills and landfill bioreactors; Leachate and landfill gas management; Landfill closure and environmental monitoring.

UNIT IV WASTE PROCESSING TECHNOLOGIES 9

Material separation and processing technologies; Biological and chemical conversion technologies; Methods and controls of composting; Thermal conversion technologies and energy recovery; Incineration, solidification and stabilization of hazardous wastes; Treatment of biomedical wastes; Health considerations in the context of operation of facilities, handling of materials and impact of outputs on the environment.

UNIT V SUSTAINABLE TECHNOLOGIES FOR WASTE CONVERSION INTO VALUE-ADDED PRODUCTS 9

Waste biomass into bioenergy, Liquid form of biofuels-Bioethanol, Gaseous form of biofuelsBiohydrogen; Conversion of waste into nanoparticles, Application of waste nanomaterials into the environmental sectors; Textile waste upcycling; Upcycling of chicken wastes into fibers; Circular bioeconomy.

TOTAL: 45 HOURS

TEXTBOOKS

1. M.J. Rogoff, “Solid Waste Recycling and Processing” Elsevier, 2nd Edition, 2013.
2. Jonathan W. C. Wong; Rao Y. Surampalli; Tian C. Zhang; Rajeshwar D. Tyagi; and A. Selvam “Sustainable Solid Waste Management, ASCE, First edition, 2016.

REFERENCES

1. A.Virginia, “Industrial wastewater management, treatment & disposal”, Water Environment Federation, 3rd Edition, 2008.
2. O.P. Gupta, “Elements of Solid & Hazardous Waste Management”, Khanna Publishing House, New Delhi, 2019.

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

21BT711 **PROJECT PHASE I**

L	T	P	C
0	0	3	2

Course Objectives

- To enable learners of Engineering and Technology develop their basic communication skills in English.
- To emphasize specially the development of speaking skills amongst learners of Engineering and Technology.
- To ensure that learners use the electronic media such as internet and supplement the learning materials used in the classroom.
- To inculcate the habit of reading and writing leading to effective and efficient communication.

Course Outcomes

At the end of the course, learners will be able to

CO1 :Identify technically and economically feasible problems of social relevance

CO2 :Plan and build the project team with assigned responsibilities

CO3 :Identify and survey the relevant literature for getting exposed to related solutions

CO4 :Analyse, design and develop adaptable and reusable solutions of minimal complexity by using modern tools

CO5 :Implement and test solutions to trace against the user requirements

CO6 :Deploy and support the solutions for better manageability and provide scope of improvability

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	1		2	2	2	2	2	2	1	1	1	1
2	3	3	3	3	2	2	2	2	2	2	2	1	2	2	2
3	3	3	3	3	2	2	2	2	2	2	2	1	2	2	2
4	3	3	3	3	2	2	2	2	2	2	2	1	2	2	2
5	3	3	3	3	2	2	2	2	2	2	2	1	2	2	2
6	3	3	3	3	2	2	2	2	2	2	2	1	2	2	2

The students are assigned project work related to product / process development, solution to the technical problems in industry and current research at national and international level. The student is required to submit a report at the end of semester based on the findings. The evaluation is made as per the Regulations of University.

EVALUATION PATTERN	
Evaluation of Laboratory Observation, Record and Test	**End Semester Examination**
100	100
60	40
TOTAL : 100	

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

SEMESTER-VIII

		L	T	P	C
21BT811	**PROJECT PHASE II**	**0**	**0**	**4**	**8**

Course Objectives

To enable learners of Engineering and Technology develop their basic communication skills in English.
To emphasize specially the development of speaking skills amongst learners of Engineering and Technology.
To ensure that learners use the electronic media such as internet and supplement the learning materials used in the classroom.
To inculcate the habit of reading and writing leading to effective and efficient communication.

Course Outcomes

At the end of the course, learners will be able to
CO1 identify technically and economically feasible problems of social relevance
CO2 plan and build the project team with assigned responsibilities
CO3 identify and survey the relevant literature for getting exposed to related solutions
CO4 analyse, design and develop adaptable and reusable solutions of minimal complexity by using modern tools
CO5 implement and test solutions to trace against the user requirements
CO6 deploy and support the solutions for better manageability and provide scope of improvability

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	1		2	2	2	2	2	2	1	1	1	1
2	3	3	3	3	2	2	2	2	2	2	2	1	2	2	2
3	3	3	3	3	2	2	2	2	2	2	2	1	2	2	2
4	3	3	3	3	2	2	2	2	2	2	2	1	2	2	2
5	3	3	3	3	2	2	2	2	2	2	2	1	2	2	2
6	3	3	3	3	2	2	2	2	2	2	2	1	2	2	2

The students are assigned project work related to product / process development, solution to the technical problems in industry and current research at national and international level. The student is required to submit a report at the end of semester based on the findings. The evaluation is made as per the Regulations of University.

EVALUATION PATTERN	
Evaluation of Laboratory Observation, Record and Test	**End Semester Examination**
100	100
60	40
TOTAL : 100	

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

LIST OF PROFESSIONAL ELECTIVE COURSES : VERTICALS

VERTICAL - I (Biosciences)							
S.No.	**Course Code**	**Course Title**	**Category**	**L**	**T**	**P**	**C**
THEORY							
1	21PBT01	Biosensors	PE	3	0	0	3
2	21PBT02	Bio-Nanotechnology	PE	3	0	0	3
3	21PBT03	Protein structures and Engineering	PE	3	0	0	3
4	21PBT04	Bioengineered Materials	PE	3	0	0	3
5	21PBT05	Stem cell Technology	PE	3	0	0	3
6	21PBT06	Modern Bioanalytical Techniques	PE	3	0	0	3
7	21PBT07	Forensic Science	PE	3	0	0	3
8	21PBT08	Biopolymers	PE	3	0	0	3

21PBT01 **BIOSENSORS**

L	T	P	C
3	0	0	3

Course Objectives

- To ensure the strong knowledge in protein architecture through a detailed study of protein structure.
- To realize the structure-functional relationships of proteins

Prerequisite

- Basic Fundamental knowledge of chemistry and biochemistry

Course Outcomes

- Upon completion of this course, students will be able to
- Describe how bio specific interaction is used for various applications.
- Compare different techniques with emphasis on selectivity and sensitivity.
- Demonstrate knowledge of the general principles of sampling and manipulation of data generated by biosensors.
- Apply the knowledge to identify the various types of analytical methods.
- Design a system component or process to meet desired needs within realistic constraints.
- Recognize different types of transducers, and their application in biosensor design.

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1		2	1	2										
2		2	2	1	3										
3	2	1	2	2											
4		2	1	3	2										
5			2	1	3							1			
6		2	1	3	2										

3 - High, 2 - Medium, 1 – Low

UNIT I FUNDAMENTALS OF BIOSENSOR **9**

Biosensors as functional analogs of chemoreceptors, structure and function of transducers, qualitative and quantitative sensors, sensor parameters, transduction methods-optical, calorimetric, electrochemical and piezoelectric sensors Supports and support modifications-synthetic polymers, carbon material supports, metal supports, bifunctional crosslinkers.

UNIT II METABOLIC SENSORS **9**

Methods of enzyme immobilization-adsorption, gel entrapment, covalent coupling, crosslinking immobilization effects in biosensors, characterisation of immobilized enzymes in biosensors, effectiveness factor, enzyme loading test, Metabolic sensors-glucose, ascorbic acid, lactate sensors, determination of alcohols, sensors for phenols and amines, coupled enzyme reactors, sequence electrodes for nucleic acid , enzyme sensor for inhibitors

UNIT III AFFINITY SENSORS AND REAGENTLESS SENSOR **9**

Affinity sensors based on small ligands, immunosensors, immunoassay-RIA, ELISA and TELISA, piezoelectric immunosensors, optical immunosensors, electrochemical immunoassay, Biocompatibility of sensors, biomimetic sensors, bioconjugated silica nanoparticles for bioanalysis.

UNIT IV NOVEL BIOSENSOR **9**

Surface dielectric enhancement- gold nanoparticles enhanced surface plasmon resonance,magnetic biosensors and biochips, quantum dot based biosensors, DNA and protein conformational changes, optical and magnetic sensors, micro and nanocantilevers, electrochemical QCM,MEMS,PCR microchamber array chip system,Detection of target DNA on a single chip.

UNIT V APPLICATIONS OF BIOSENSORS **9**

Biosensors and diabetes management, Microfabricated biosensors and point-of-care diagnostics systems, Noninvasive biosensors in clinical analysis; Surface plasmon resonance and evanescent wave biosensors, Biosensor in cancer and HIV early diagnosis.

TOTAL: 45 HOURS

TEXT BOOKS

1. Frieder Schelfer and Florian Schubert Biosensors Elsevier Science Publications 1992
2. Challa Kumar Nanomaterials for Biosensors Wiley-VCH Verlag GMBH, Germany 2007.
3. Floriner-Gabriel Banica Chemical sensors and Biosensors-Fundamentals and Applications, John-Wiley & Sons Ltd, 2012.

REFERENCES

1. P. N. Bartlett (Ed.) Bioelectrochemistry- Fundamentals, Experimental techniques and applications, John Wiley & Sons, England 2008.
2. Nalwa (Ed.) Encyclopedia of Nanoscience and Nanotechnology 1 Vol. 5, 2004.

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

21PBT02 **BIO-NANOTECHNOLOGY**

L	T	P	C
3	0	0	3

Course Objectives

- To ensure the strong knowledge in protein architecture through a detailed study of protein structure.
- To realize the structure-functional relationships of proteins

Prerequisite

- Basic Fundamental knowledge of chemistry and biochemistry

Course Outcomes

After completion of this course, the students should be able

- To recognize the nanoscale processes and nanomaterials
- To relate the structural and functional principles
- To develop the protein based nanomaterials
- To construct the DNA based nanomaterials
- To apply the theoretical knowledge for the development of nanomedicine and nanosensors
- To develop the nanomaterials based process and products

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	2	1	1	1	2	2	1	2	2	2	2	1	2
2	2	-	1	2	-	-	1	1	2	1	-	-	2	-	1
3	3	3	3	3	3	3	3	3	3	3	2	3	3	3	3
4	2	2	3	2	2	1	2	2	2	2	2	2	2	2	1
5	3	1	2	1	2	2	2	2	2	3	1	2	3	2	3
6	3	3	3	3	3	2	3	2	3	2	3	3	3	3	3

3 - High, 2 - Medium, 1 – Low

UNIT I NANOSCALE PROCESSES AND NANOMATERIALS **9**

Overview of nanoscale processes and characterization of nanomaterials – Physicochemical properties of nanomaterials – Concepts in nanotechnology – Natural nanomaterials –Types of Nanomaterials (Quantum dots, Nanoparticles, Nanocrystals, Dendrimers, Polymeric nanoparticles, Buckyballs, Nanotubes)–Synthesis and assembly of nanoparticles and nanostructures using bio- derived templates.

UNIT II STRUCTURAL AND FUNCTIONAL PRINCIPLES OF BIONANOTECHNOLOGY **9**

Biomolecular structure and stability – Protein folding – Self-assembly – Self-organization – Information-Driven nanoassembly – Biomaterials – Biomolecular motors – Traffic across membranes – Biomolecular sensing – Self-replication – Machine-phase bionanotechnology.

UNIT III PROTEIN-BASED NANOTECHNOLOGY **9**

Overview of protein nanotechnology – Nanotechnology with S-Layer protein – Engineerednanopores — Bacteriorhodopsin and its potential — Protein assisted synthesis of metal nanoparticles – Synthesis of protein-based nanoparticles – Protein nanopaticle-hybrids – Covalentand non-covalent protein nanoparticle conjugates – Protein-carbon nanotube conjugates.

UNIT IV DNA-BASED NANOTECHNOLOGY **9**

DNA-based nanostructures – Biomimetic fabrication of DNA based metallic nanowires and networks – Self assembling DNA structures – DNA-nanoparticle conjugates – DNA-carbon nanotube conjugates – DNA templated electronics – DNA nanostructures for mechanics and computing — DNA nanomachine.

UNIT V APPLICATIONS OF NANOTECHNOLOGY **9**

Promising nanobiotechnologies for applications in medicine –Liposomes in nanomedicine — Therapeutic applications of nanomedicine – Nano-Sized carriers for drug delivery and drug carrier systems – Protein and peptide nanoparticles, DNA based nan oparticles, Lipid matrix nanoparticles for drug delivery — Nanobiosensors for imaging and diagnosis.

TOTAL: 45 HOURS

TEXT BOOKS

1. Niemeyer, C.M. and Mirkin, C.A., “Nanobiotechnology: Concepts, Applications andPerspectives”, Wiley-

VCH, 2006.
2. Goodsell, D.S., "Bionanotechnology", John Wiley and Sons, 2004.

REFERENCES

1. Shoseyov, O. and Levy I., "Nanobiotechnology: Bioinspired Devices and Materials of theFuture", Humana Press, 2008.
2. Gazit, E., and Mitraki, A., "Plenty of Room for Biology at the Bottom: An Introduction to Bionanotechnology", Imperial College Press, 2013
3. Jesus M. de la Fuente and Grazu, V., "Nanobiotechnology: Inorganic Nanoparticles Vs Organic Nanoparticles" Elsevier, 2012.

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

21PBT03	PROTEIN STRUCTURES AND ENGINEERING	L	T	P	C
		3	0	0	3

Course Objectives

- To ensure the strong knowledge in protein architecture through a detailed study of protein structure.
- To realize the structure-functional relationships of proteins

Prerequisite

- Basic Fundamental knowledge of chemistry and biochemistry

Course Outcomes

At the end of the course, learners will be able to

- CO1 : Understand the basic protein structure and various interactions affecting it.
- CO2 : Elucidate the structure function relationship of proteins.
- CO3 : Understand the basics of post translational modification and peptide analysis
- CO4 : Understand the protein databases and use appropriate tools to predict the structure of proteins
- CO5 : Appraise different protein design strategies used to design completely new proteins tailored to specific tasks
- CO6: Understand the various application of protein engineering.

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1		2	1	2										
2		2	2	1	3										
3	2	1	2	2											
4		2	1	3	2										
5			2	1	3							1			
6		2	1	3	2										

3 - High, 2 - Medium, 1 – Low

UNIT I INTRODUCTION TO PROTEIN STRUCTURE 9

Primary structure (peptide bonds, polypeptide chains), secondary structure, alpha helix, β sheets, β turns & loops/coil; Ramachandran plots), tertiary structure (classification - globular (myoglobin) membrane (bacteriorhodopsin) & fibrous (collagen)), quaternary structure. Amino acids and its properties (size, solubility, charge, pKa), Different interactions in protein (ionic, hydrophobic, hydrogen bonding, covalent, vander wall, co-ordinate bonds), Protein folding, molten globule structure, characterization of folding pathways.

UNIT II STRUCTURE-FUNCTION RELATIONSHIP 9

DNA-binding proteins: prokaryotic transcription factors, Helix-turn-Helix motif in DNA binding, Trp repressor, Eukaryotic transcription factors, Zn fingers, helix-turn helix motifs in homeodomain, Leucine zippers, Membrane proteins: General characteristics, Transmembrane segments, prediction, bacteriorhodopsin and Photosynthetic reaction center Immunoglobulins: IgG Light chain and heavy chain architecture, Abzymes & Enzymes: Serine proteases

UNIT III POST TRANSLATIONAL MODIFICATION AND PEPTIDE ANALYSIS 9

Post translational modification- modification at N-terminus and C-terminus, Glycosylation; Determination of amino acid composition, peptide sequencing - automated edman method & mass-spectrometry, peptide synthesis, peptide mapping.

UNIT IV PROTEIN STRUCTURE PREDICTION 9

Databases for protein sequence and structure, Protein sequence analysis: sequence alignment, programs for sequence alignment, amino acid properties for sequence analysis. Overview on protein structure analysis, Secondary structure prediction-tools used, 3D Structure prediction-Homology modelling, threading and Ab initio methods.

UNIT V PROTEIN ENGINEERING AND APPLICATIONS 9

Strategies for protein engineering, Random and site-directed mutagenesis, Various PCR based strategies, Role of low fidelity enzymes in protein engineering, Gene shuffling and Directed evolution of proteins, Protein backbone changes, Antibody engineering, de novoprotein design.

Case Study : Engineering Blood clotting Factor VIII for Hemophilia Gene Therapy

TOTAL: 45 HOURS

TEXT BOOKS

1. Carl Branden & John Tooze, 'Introduction to Protein Structure' Second Edition, Garland Publishing.
2. Gary Walsh, Protein- Biochemistry & Biotechnology, Wiley, 2019
3. Michael Gromiha, 'Protein Bioinformatics", Academic press, 2004
4. Lilia A, Protein Engineering in Industrial Biotechnology, Harwood publishers, 2005
5. Rangwala & Karypis, 'Introduction to Protein Structure Prediction', Wiley series, 2010

REFERENCES

1. Park S. J. and Cochran J. R., Protein Engineering and Design, 1st Edn., CRC, 2009. Oxford, UK
2. Gregory A. Petsko and Dagmar Ringe—Protein Structure and Function, second Edition, Oxford University Press USA, 2004
3. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3615458/

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

21PBT04 **BIOENGINEERED MATERIALS** **L T P C**
3 0 0 3

Course Objectives

- Summarize the classification of biomaterial, their bulk and surface properties and characterization to prepare the students to find a place in biomedical field
- Interpret the various manufacturing processes and testing, cost, sterilization, packaging and regulatory issues of biomaterials.
- Motivate and facilitate students to undertake projects and research work in Biomaterials

Course Outcomes

At the end of the course, learners will be able to

- CO1: Understand the fundamental principals in biomedical engineering, material science and chemistry, and how they contribute to biomaterial development and performance.
- CO2: Apply the knowledge of different characterization techniques in biomaterial fabrication
- CO3: Apply the math, science, and engineering knowledge gained in the course to biomaterial selection and design.
- CO4: Analyze the need of tissue replacement implants in organ regeneration
- CO5: Critically review the need of different tissue replacement substitutes in regenerative medicine
- CO6: Study about the blood interfacing implants and joint replacements.

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2	1	2										2	
2	2	3	2	3		2								2	
3	2	3	2	2										1	
4	2	2	1	2				2						2	
5	2	3	2	3										1	
6	2	3	2	3										1	

3 - High, 2 - Medium, 1 – Low

UNIT I INTRODUCTION **9**

Basic concepts: General overview of components in the human body used to construct tissue. Implantable materials: temporary or permanent implants, biodegradable materials, cell substrates, tailored tissue.

UNIT II CLASSIFICATION OF BIOMATERIALS **9**

Metals: different types, properties and interaction with the tissue, Polymers: classification and properties, Ceramics: Types, properties and interactions with the tissue, Composites: matrix and reinforcing agents/fillers and properties

UNIT III BIOMATERIAL CHARACTERIZATION **9**

Bulk Characterization: XRD, FT-IR, SEM, X-ray (EDX), DSC, TGA, AFM, Surface modifications, Sterilization of biomedical implants. Cell-biomaterial interactions: ECM components, cellular interaction with non-cellular substrates

UNIT IV BIOMATERIAL COMPATIBILITY **9**

Biocompatibility: blood and tissue compatibility; degradation of biomaterials in biological environment, toxicity tests, sensitization, carcinogenicity, mutagenicity and special tests; In vitro and In vivo testing, implant associated infections.

UNIT V BIOMATERIALS IN MEDICINE **9**

Tissue replacements, wound dressings and sutures, surgical tapes, adhesives and sealants, percutaneous and skin implants, maxillofacial augmentation, blood interfacing implants, hard tissue replacement implants, internal fracture fixation devices, Joint replacements, implants for bone regeneration, Artificial heart, prosthetic cardiac valves

TOTAL: 45 HOURS

TEXT BOOKS

1. D. Shi , Ed., Biomaterials and Tissue Engineering, Berlin, New York: Springer, 2004
2. B. Joon Park, D.B. Joseph and Boca Ration, Biomaterials: principles and applications, CRC, press, 2003

REFERENCES

1. L. Hench and J. Jones, Biomaterials, Artificial Organs and Tissue Engineering, Woodhead Publishing in Materials, 2002.
2. Ratner, B. D., et al, (eds.), Biomaterials Science: An Introduction to Materials in Medicine, Academic Press, 2004

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

21PBT05 **STEM CELL TECHNOLOGY** **L T P C**
3 0 0 3

Course Objectives

- To gain knowledge on the basics of stem cells and their origin
- To learn the methods of stem cell identification and various sources
- To give way to the therapeutic treatment using stem cells

Course Outcomes

At the end of the course, learners will be able to

- CO1: Compare the characteristics of different types of stem cells and their origin
- CO2: Analyze the differentiation process of premature stem cells
- CO3: Compare the characteristic features of Embryonic and adult stem cells
- CO4: Evaluate the methods of stem cell identification and various sources
- CO5: Study of haematopoietic cell development.
- CO6: Implement the therapeutic applications of stem cells in human diseases

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1			2		1							1		
2	2			2		2				1	2				2
3	2			2	2	2				2	2		2		2
4	2			1	2					1	1		1		2
5	1			1	1	1				2	2		1		
6	1			2	2	1				2	2		1		2

3 - High, 2 - Medium, 1 – Low

UNIT I INTRODUCTION TO STEM CELL **9**

Introduction to stem cells; Stem cell niche - embroyonic stem cells, hematepoitic stem cells, bone marrow stem cells, germline stem cells, cancer stem cells, neural stem cells, adult stem cells, muscle and cardiac stem cell; Properties potency and self renewal Epigenetics

UNIT II DIFFERENTIATION OF STEM CELLS **9**

Differentiation status of cells - Primordial germ cell, Skin cell, Gastrointestinal cells; Embryonic stem cell differentiation as a model to study haematopoetic cell development. Endothelial cell development

UNIT III GENERATION OF STEM CELLS **9**

Testing and generation of embryonic stem cells; testing for adult stem cells and differentiation.
Animal models of regeneration

UNIT IV MANIPULATION OF EMBRYONIC STEM CELLS **9**

Integration of transgenes into a defined locus in human embryonic stem cells; Genetic manipulation of embryonic stem cells; Genetic manipulation through DNA delivery by electroporation, , chemical-based reagents and viruses Nucleofection

UNIT V APPLICATIONS OF STEM CELLS **9**

Uses of Stem cells; Human stem cells; Renewal of stem cells; Stem cells and Tissue engineering;
Embryonic stem cells and Gene therapy; Therapeutic Cloning

TOTAL: 45 HOURS

TEXT BOOKS

1. MD. Steward Sell, Stem cells, Human Press Inc., 2004
2. Ariff Bongso and Eng Hin Lee, Stem cells, World Scientific Publication Co. Pvt. Ltd., 2005.
3. Robert Paul Lanza, Essentials of stem cell biology, Academic Press, 2006

REFERENCES

1. Harvey F. Lodish, Arnold Berk and Chris A. Kaiser, Molecular cell Biology, W. H. Freeman and Co., 2008

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

21PBT06 **MODERN ANALYTICAL TECHNIQUES** **L T P C**
3 0 0 3

Course Objectives

- To study the various analytical techniques used in Biotechnology.

Course Outcomes

At the end of the course, learners will be able to

- CO1: Understand and apply principles of Spectroscopy
- CO2: Understand the various diffraction laws and techniques
- CO3: Apply chromatographic and electrophoretic techniques to separate, purify and quantify molecules
- CO4: Understand and apply the various microscopic techniques.
- CO5: Analyze different types of electrodes and electroanalytical techniques for sensing and quantifying analytes
- CO6: Apply various analytical techniques for interpretation in Biotechnology

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1										2		
2	3	2	3	2	2								2		
3	3	2	2	1	2								2		
4	3	3	3	2	2								2		
5	3	1	2	1	1								1		
6	3	2											2		

3 - High, 2 - Medium, 1 – Low

UNIT I SPECTROSCOPY STUDY OF CHEMICAL COMPOUNDS AND BIOMOLECULES 9

Electromagnetic radiations and interactions with matters: Electromagnetic spectrum. Quantisation of energy, Electronic, vibrational and rotational spectroscopy. Franck–Condon principle, Jablonski diagram, radiative, nonradiative pathways, fluorescence and phosphorescence. Absorption of radiation, BeerLambert's law, deviation of Beer-Lambert's equation and its limitations. Principals, instrumentation, sampling and application of few spectroscopic techniques: UV-Visible spectroscopy, Fluorescence spectroscopy, IR/Raman spectroscopy, NMR Spectroscopy and Mass spectroscopy.

UNIT II DIFFRACTION TECHNIQUE 9

Introduction to lattice and lattice systems, Bragg's plane, miller indices, point groups and space groups Principle of diffraction and X-ray diffraction: X-rays production, X- ray spectra, Bragg's law and intensity of X-rays, Mosley's law, powdered XRD, percentage crystallinity, single crystal XRD, macromolecular XRD (protein crystallization, data collection and structure solution).

UNIT III CHROMATOGRAPHY 9

Classification of chromatographic techniques and their principles, Theory of chromatography, band broadening, rate and plate theory factors responsible for separation. Column chromatography, TLC, Paper chromatography. Liquid Chromatography and HPLC: Instrumentation, pumps, solvent delivery system, isocratic and gradient programming modes, sample introduction system, columns, detectors, reversed phase and normal phase chromatography. Gas Chromatography: Instrumentation, carrier gas supply, injectors, columns, packed and capillary columns, column oven and temperature programming, different detectors. Introduction to hyphenated techniques in chromatography, GC-MS and LC-MS.

UNIT IV MICROSCOPY 9

Microscopy with light and electrons – Electrons and their interaction with the specimen – Electron, diffraction – Instrument, specimen preparation and application of TEM and SEM – Fluorescence microscopy – Laser confocal microscopy – Phase contrast – Video microscopy – Scanning probe microscopy.

UNIT V ELECTROPHORETIC TECHNIQUES 9

Principle, equipment and process, Agarose gel electrophoresis, horizontal and vertical gel electrophoresis, electrophoresis techniques, Isoelectric focusing, capillary electrophoresis and application of electrophoresis in analysing macromolecules..

TOTAL: 45 HOURS

TEXT BOOKS

1. D. Campbell, Biological spectroscopy (Benjamin/Cummings Pub. Co, Menlo Park, Calif, (1984), Biophysical techniques series. 2. K. Wilson, J. M. Walker, Eds., Principles and techniques of biochemistry and molecular biology (Cambridge University Press, Cambridge, UK : New York, 7th ed., 2009)
2. R. F. Boyer, Biochemistry laboratory: modern theory and techniques (Prentice Hall, Boston, 2nd ed., 2012).
3. R. Katoch, Analytical techniques in biochemistry and molecular biology (Springer, New York, 2011).
4. D. L. Spector, R. D. Goldman, Eds., Basic methods in microscopy: protocols and concepts from cells: a laboratory manual (Cold Spring Harbor Laboratory Press, Cold Spring Harbor, N.Y, 2006).
5. R. L. Switzer, Experimental biochemistry (W. H. Freeman and Co, New York, 3rd ed., 1999).
6. Chandler, D. and Roberso, R.W., "Bioimaging: Current Techniques in Light & Electron Microscopy", Jones and Bartlett publishers, 2008.

REFERENCES

1. R. F. Boyer, Modern experimental biochemistry (Benjamin Cummings, San Francisco, 3rd ed., 2000).
2. J. R. Lakowicz, Principles of fluorescence spectroscopy (Springer, New York, 2006;
3. B. Fultz, Transmission electron microscopy and diffractometry of materials (Springer, Berlin ; New York, 2nd ed., 2002).
4. D. B. Williams, C. B. Carter, Transmission electron microscopy a textbook for materials science (Springer, New York, 2009
5. R. M. Silverstein, Spectrometric identification of organic compounds (John Wiley & Sons, Hoboken, NJ, 7th ed., 2005).
6. D. Harvey, Modern analytical chemistry (McGraw-Hill, Boston, 2000).
7. Pavia, D.L., Lampman, G.M., Kriz, G.S. and Vyvyan, J.R., "Introduction to Spectroscopy", 4th Edition, Brooks/Cole Cengage Learning, 2008.

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

21PBT07 **FORENSIC SCIENCE** **L T P C**
3 0 0 3

Course Objectives

- To prepare students for entry-level positions in the fields of forensic technology
- To create deeper understanding in forensic science
- To render knowledge of how to perform research in interdisciplinary fields like forensic studies

Course Outcomes

At the end of the course, learners will be able to

- CO1 : Explain the forensic science and crime investigation process
- CO2 : Apply the principles and operation of analytical instruments in forensic analysis
- CO3 : Analyze various biological samples for forensic studies
- CO4 : Analyze the non-biological samples and characterize
- CO5 : Implement forensic examination in different levels and documentation
- CO6 : Understand the pattern of biological samples for forensic studies

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1		2	3	1								2		
2	2	2	1	2	1								1		
3	2		1	2	1								2		
4	1	2	2	2	3								1		
5	1			2											
6	1			2	1								1		

3 – High, 2 – Medium, 1 – Low

UNIT I BASICS OF FORENSIC SCIENCE **9**

History and Development; Crime Scene Management and Investigation- Collection, preservation, packing and forwarding of physical and trace evidence for analysis; Legal and Court procedure pertaining to Expert Testimony

UNIT II ANALYTICAL INSTRUMENTATION **9**

Microscopy-Polarising, Fluorescent and Electron microscopes; Spectrophotometry- UV, Visible, IR atomic absorption; Chromatographic techniques (TLC, GLC, HPLC); Electrophoresis (Gel and Immunoelectrophoresis.)

UNIT III ANALYSIS OF BIOLOGICAL SAMPLES **9**

Fresh Blood-Grouping and typing of fresh blood samples; Analysis of stains of blood and allied body fluids for their groups; Cases of disputed paternity and maternity problems; DNA profiling; Identification of hair, determination of species origin, sex, site and individual identification from hair; Examination and identification of saliva, Urine and Faecal matter.

UNIT IV CHARACTERIZATION OF NON BIOLOGICAL SAMPLE **9**

Physical analysis - soil, glass, paints, lacquers, cement, inks, paper, tool marks, tyre marks, shoe prints, forensic examination of vehicles in cases of accident; Identification of individuals from bodily features; Examination and identification of deceased from skeletal remains

UNIT V FORENSIC EXAMINATION **9**

Preliminary examination of documents-Identification of hand writing, signatures and detection of forgeries; Reproduction of documents (photographic , mechanical) and their examination; Physical and chemical erasures, obliterations, additions, alterations, indentations, secret writings and charred documents; Inks, papers and their scientific examinations including instrumental analysis

TOTAL: 45 HOURS

TEXT BOOKS

1. William G. Eckert,Introduction to Forensic Sciences, 2nd Ed. New York: CRC press, 2000.

2. S.H.James, and J.J. Nordby, Forensic Science An Introduction to Scientific and Investigative Techniques. London: CRC Press, 2003

REFERENCES

1. B. D Alberts Bray, J. Lewis, K. Roberts and J.D. Watson. Molecular Biology of Cell., 2nd ed. New York: Garland Publishing, 1989
2. Simon, Ball. Environment Law: The Law and Policy Relating to Protection of Environment. Delhi: Universal Law Publishing, 1991

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

21PBT08 **BIOPOLYMERS** **L T P C**
3 0 0 3

Course Objectives

- To know what are biopolymers, their classification and potential applications
- To expose how biopolymers help in the development of the next generation of materials, products, and processes
- To facilitate the students to undertake research work both for improving /modifying their functional properties and to develop new products and processes

Course Outcomes

At the end of the course, learners will be able to

CO1: Classify biopolymers based on the properties and structure and characterize them
CO2: Compare nucleic acid, proteins and polysaccharides and their synthesis and use
CO3: Analyze the synthesis and compare the uses of polyesters and polyisoprenoids
CO4: Generate synthetic biodegradable polymers for various applications
CO5: Produce animal and plant fibers for textile and composite applications
CO6: Study about bio compositions and applications.

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2		2		3	2								3	
2	2	3		3		3								2	
3	1	3		2	3									2	
4	2	3		2	2									3	
5	2		1	2			3							1	

3 - High, 2 - Medium, 1 – Low

UNIT I CLASSIFICATION AND STRUCTURE 9

Biopolymer/bio-macromolecule-definition and history, different methods of classification, structure, formation, modification-blending, grafting -properties, characterization- molecular weight, glass transition , amorphous and crystalline behavior, mechanical properties, thermal, bio and photodegradation and applications, Confirmations and Dynamics of biopolymers

UNIT II POLYNUCLEOTIDES, POLYAMIDES AND POLYSACCHARIDES 9

Polynucleotides- DNA, RNA, protein- chemical synthesis-Collagen, casein, pectin, albumin and polysaccharides-synthesis/biosynthesis, structure and applications of important members under each class

UNIT III POLYESTER, POLYISOPRENOIDS AND POLYPHOSPHATES 9

Poly(hydroxyalkanoates), cutan, cutin, poly(hydroxyl butyrate-co-hydroxy valerate), polyisoprenoids and polyphosphate-Structure, synthesis and specific uses with example

UNIT IV SYNTHETIC BIOPOLYMERS AND POLYMER HYDROGELS 9

Synthetic biodegradable polymers-Introduction, applications, and chemical synthesis of important members, biopolymer membrane preparation, characterization and copolymers of lactic, glycolic acid etc, poly (alpha amino acids), polyethylene glycol, polycaprolactone

UNIT V NATURAL FIBERS AND THEIR COMPOSITES 9

Silk, wool, flax, jute, linen, cotton, sisal, bamboo, pineapple leaf and oil palm fibers, kenaf, and industrial hemp, properties, applications, property improvement by biochemical treatment. Wood a composite material, Biocomposites- formation, properties and applications

TOTAL: 45 HOURS

TEXT BOOKS

1. R.M. Johnson, R. M. Mwaikambo, L. Y., Tucker, N. Biopolymers, Rapra Technology 2003
2. 2. Richard Wool., and Susan Sun, X (Eds)., Biobased polymers and composites, Academic Press 2005

REFERENCES

1. Alexander Steinbucghel (Ed.)Encyclopedia of Biopolymers, Vols.1-10, Wiley-VCH 2004
2. Platt K., Biodegradable polymers, Rapra Technology 2006
3. Biopolymers(New Materials for Sustainable Films and Coatings), Wiley, 2011

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

VERTICAL - II (Bioprocess Technology)							
S.No.	**Course Code**	**Course Title**	**Category**	**L**	**T**	**P**	**C**
THEORY							
1	21PBT09	Bioprocess Control and Instrumentation	PE	3	0	0	3
2	21PBT10	Sustainable Bioprocess Development	PE	3	0	0	3
3	21PBT11	Industrial Food Processing	PE	3	0	0	3
4	21PBT12	Bioreactors Design and Scaleup Process	PE	3	0	0	3
5	21PBT13	Bioprocess Modelling and Simulation	PE	3	0	0	3
6	21PBT14	Bioreactors consideration for Recombinant Products	PE	3	0	0	3
7	21PBT15	Bioprocess Calculations	PE	3	0	0	3
8	21PBT16	Separation Techniques	PE	3	0	0	3

21PBT09 BIOPROCESS INSTRUMENTATION AND CONTROL

L	T	P	C
3	0	0	3

Course Objectives

To enable the students

- To introduce dynamic response of open and closed loop systems, control loop components and stability of control systems along with instrumentation.

Course Outcomes

At the end of the course, learners will be able to

CO1 Understand the principles of bioprocess instrumentation and process control

CO2 Apply the knowledge of instrumentations in biochemical engineering systems

CO3 Analyze the open loop systems

CO4 Analyze the closed loop systems

CO5 Evaluate the frequency responses of closed loop

CO6 Understand the importance of various advanced control systems

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2	1												
2	2	3	3										1		
3	2	2	3										1		
4	2	3	3										1		
5	2	3	3		3								1		
6	2	2	1		2										

3 - High, 2 - Medium, 1 – Low

UNIT I INSTRUMENTATION **9**

Principles of measurements and classification of process instruments, measurement of temperature, pressure, fluid flow, liquid weight and weight flow rate, viscosity, pH, concentration,electrical and thermal conductivity, humidity of gases.

UNIT II OPEN LOOP SYSTEMS **9**

Laplace transformation, application to solve ODEs. Open-loop systems, first order systems and their transient response for standard input functions, first order systems in series, linearization and its application in process control, second order systems and their dynamics; transportation lag.

UNIT III CLOSED LOOP SYSTEMS **9**

Closed loop control systems, development of block diagram for feed-back control systems servo and regulatory problems, transfer function for controllers and final control element, principles of pneumatic and electronic controllers, transient response of closed-loop control systems and their stability

UNIT IV FREQUENCY RESPONSE **9**

Introduction to frequency response of closed-loop systems, control system design by frequency response techniques, Bode diagram, stability criterion, tuning of controller settings

UNIT V ADVANCED CONTROL SYSTEMS **9**

Introduction to advanced control systems, cascade control, feed forward control, Smith predictor controller, control of distillation towers and heat exchangers, introduction to computer control of chemical processes

TOTAL : 45 HOURS

TEXT BOOKS

1. Stephanopoulos, G., “Chemical Process Control“, Prentice Hall of India, 2003.
2. Coughnowr, D., “ Process Systems Analysis and Control “,. 3rd ed., McGraw Hill, 2008.

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

21PBT10 SUSTAINABLE BIOPROCESS DEVELOPMENT

L	T	P	C
3	0	0	3

Course Objectives

- To impart knowledge on design and operation of fermentation processes with all its prerequisites.
- To familiar the students with the basics of microbial kinetics and reactor design
- To develop bioengineering skills for the production of value added product using integrated biochemical processes

Course Outcomes

At the end of the course, learners will be able to

- CO1. Develop growth model based on the microbial characteristics
- CO2. Understand working procedure of bioprocess industries
- CO3. Analyze the diversity and nature of bio-products
- CO4. Evaluate enzyme reaction and its kinetics
- CO5. Understand different configurations of bioreactors
- CO6. Understand the sustainability assessment methods

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1															
2															
3															
4															
5															
6															

3 - High, 2 - Medium, 1 – Low

UNIT I BIOPROCESS AND NATURE OF BIO-PRODUCTS 9

Microbial diversity, Major products of biological processing, Component parts of fermentation process, Concept of Upstream, downstream processing and scale up.

UNIT II BIOREACTOR DESIGN AND SUSTAINABILITY ASSESSMENT 9

Mixing, Mixing Equipment, Flow pattern, Mechanism of Mixing, Power requirement for mixing, Bioreactor Configurations (Different Bioreactors), Membrane bioreactor. Sustainability, Economic Assessment-Capital-Cost Estimation, Operating-Cost Estimation, Profitability Assessment, Environmental Assessment, case study.

UNIT III MODELING AND SIMULATION OF BIOPROCESSES 9

Microbial growth model, Problem Structuring, Process Analysis, and Process Scheme, leudeking-piret models, Models with growth inhibitors, oxygen transfer model, volumetric mass transfer coefficient, Uncertainty Analysis- Sensitivity Analysis, error analysis, Application-cellulase based catalysis process.

UNIT IV REACTOR OPERATION 9

Batch Operation of a Mixed Reactor, Fed-Batch Operation of a Mixed Reactor, Continuous Operation of a Mixed Reactor, Chemostat Operation, Operation of Plug-Flow reactor

UNIT V ADVANCED BIOPROCESSING 9

Bioprocess Consideration in plant cell cultures, Bioprocess Consideration in animal cell cultures, Industrial Bioprocess, Advanced Membrane bioreactor to facilitate both upstream and downstream processing simultaneously.

TOTAL: 45 HOURS

TEXT BOOKS

1. Heinzle E, Biwer AP and Cooney CL, “Development of Sustainable Bioprocesses Modeling and Assessment” 2006 John Wiley & Sons, Ltd.

REFERENCES

1. Shuler, M.L. and Kargi,F. " Bioprocess Engineering - Basic concepts" Prentice Hall of India Pvt. Ltd.,2nd edition, 2015.
2. Peter F. Stanbury, Stephen J. Hall & Whitaker. A, "Principles of Fermentation Technology",
3. Butterworth – Heinemann an Imprint of Elsevier India Pvt.Ltd., 2nd edition, 2005.
4. Pauline M. Doran, Bioprocess Engineering Principles, Elsevier Science & Technology Books, 2nd edition, 1995

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

21PBT11 **INDUSTRIAL FOOD PROCESSING**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To know about the constituents and additives present in the food.
- To gain knowledge about the microorganisms, which spoil food and food borne diseases.
- To know different techniques used for the preservation of foods.

Prerequisite

- Knowledge of Microbiology required

COURSE OUTCOMES:

- Understand the basic concepts of food constituents present in Food and microorganisms involved in food processing
- Apply the principles and methods involved in the processing of different foods.
- Able to understand various food processing additives
- Understand different principles and food preservation techniques.
- Apply the knowledge of unit operations in modern food processing in industries
- Familiar with the food borne diseases and factors involved in food spoilage

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	3	2	2	2	2	2	2	2	2	2	2	2	2
2	3	3	2	3	2	2	3	2	2	3	2	2	3	3	2
3	2	3	2	3	3	2	3	2	2	3	2	2	3	2	3
4	2	3	3	3	3	2	2	2	2	2	3	3	3	2	3
5	2	3	2	3	3	2	2	-	2	-	2	2	3	3	3
6	3	2	3	3	3	3	3	2	2	-	3	2	2	2	3

3 - High, 2 - Medium, 1 – Low

UNIT I FOOD ENERGY AND LAWS **9**

Constituents of food –carbohydrates, lipids, proteins, water, vitamins and minerals, dietary sources, role and functional properties in food, contribution to organoleptic and textural characteristics. National food legislation, other food legislations/authorities and their role- essential commodities act, ISI mark of BIS and agmark,food and agricultureal organization (FAO), worldhealth organization(WHO), codex joint FAO/WHOexpert committee on food additives(JECFA),world trade organization(WTO),International organization for standardization(ISO) Food safety and quality management systems.

UNIT II FOOD ADDITIVES **9**

Classification, intentional and non-intentional additives, functional role in food processing andpreservation; food colourants-natural and artificial; food flavours; enzymes as food processing aids.

UNIT III MICROORGANISMS ASSOCIATED WITH FOOD **9**

Bacteria, yeasts and molds- sources, types and species of importance in food processing and preservation; fermented foods and food chemicals, single cell protein.

UNIT IV FOOD BORNE DISEASES **9**

Classification — food infections-bacterial and other types; food Intoxications and Poisionings bacterial and non bacterial ; food spoilage- factors responsible for spoilage, spoilage of vegetable, fruit, meat, poultry, beverage and other food products.

UNIT V FOOD PRESERVATION **9**

Principles involved in the use of sterilization, pasteurization and blanching, thermal death curves of microorganisms, canning, frozen storage-freezing characteristics of foods, microbial activity at low temperatures, factors affecting quality of foods in frozen storage; irradiation preservation of foods.

TOTAL: 45 HOURS

TEXT BOOKS

1. T.P.Coultate-Food-The Chemistry of its Components, 2nd edition. Royal society,London, 1992.
2. B.Sivasanker-Food processing and preservation, Prentice-Hall of IndiaPvt.Ltd.New Delhi, 2002.
3.George JB. Basic Food Microbiology, CBS Publishers & Distributors, 1987.

REFERENCES

1. W.C.Frazier and D.C.Westhoff-Food Microbiology, 4th Ed.,McGraw-Hill book Co.,New York.
2. J.M.Jay-Modern Food Microbiology, CBS Pub.New Delhi,1987.

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

21PBT12 BIOREACTOR DESIGN AND SCALE UP PROCESS

L	T	P	C
3	0	0	3

Course Objectives

- To acquire the knowledge on design, performance, stability analysis of bioreactors
- To learn about the bioreactors scale up methods.

Course Outcomes

Upon completion of this course, students will be able to

- CO1: Design and analyze the performance of bioreactors.
- CO2: Scale up the bioreactors based on various criteria.
- CO3: Clearly understand the monitoring and control of bioprocess.
- CO4: Perform modeling and simulations of bioprocess using software.
- CO5: Understand the immobilized enzyme kinetics and apply for enzyme bioreactor design.
- CO6: Apply the bioreactor design and scale up process in designing a Bioreactor

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	3	2	2							2	2		
2	2		2	2	2								2		
3	2	2		2	2										
4	2	1		2											
5	2	2	2	2	2							2	2		
6	2	2	2	2											

3 - High, 2 - Medium, 1 – Low

UNIT I BASIC BIOREACTOR CONCEPTS **9**

Bioreactor Operation – Batch operation, semi-continuous and fed-batch operation, Continuous Operation – Chemostat, turbidostat – Microbiological reactors, enzyme reactors – Tank-type, Column-type biological reactors – Case studies – Continuous Fermentation with Biomass Recycle, Tanks-in-series, Tubular plug flow bioreactors.

UNIT II AERATION AND AGITATION IN BIOPROCESS SYSTEMS **9**

Mass transfer in agitated tanks; Power requirement for mixing; Agitation rate studies – Mixing time and residence time distribution; Bioreactor Geometry — Reactor, impeller, sparger and baffle design; shear damage, bubble damage, methods of minimizing cell damage. Case Studies for Aeration and Agitation;

UNIT III SELECTION AND DESIGN OF BIOPROCESS EQUIPMENT **9**

Materials of construction for bioprocess plants – Design considerations for maintaining sterility ofprocess streams processing equipments, selection, specification — Design of heat and mass transfer equipment used in bioprocess industries.

UNIT IV BIOREACTOR SCALE-UP AND SCALE-DOWN **9**

Scale-up Techniques: — Scale up by geometric similitude. constant power consumption per volume, constant mixing time, constant impeller tip speed, constant volumetric mass transfer co- efficient; Scale–down Related Aspects; Case Studies in Bioreactor Scaleup and Scale-down Aspects

UNIT V CASE STUDIES **9**

Requirements, design and operation of bioreactor for microbial, plant cell and animal cell.

TOTAL: 45 HOURS

TEXT BOOKS

1. Michael L. Shuler, Fikret Kargi, Matthew De Lisa,.Bioprocess Engineering, 3rd Edition,Prentice Hal, 2017
2. Pauline Doran, Bioprocess Engineering Calculation, 2nd Edition, Blackwell Scientific Publications,2012
3. James M. Lee, Biochemical Engineering, Prentice Hall, 1992

REFERENCES

1. James E. Bailey and David F. Ollis, Biochemical Engineering Fundamentals, McGraw Hill 1986.
2. S.Liu, Bioprocess Engineering: Kinetics, Biosystems, Sustainability, and Reactor Design,Elsevier, 2016
3. Octave Levenspiel, Chemical Reaction Engineering, Wiley 2016.

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

21PBT13 BIOPROCESS MODELLING AND SIMULATION

L	T	P	C
3	0	0	3

Course Objectives

To enable the students

- To introduce the importance of modelling and simulation in bioprocess
- To expose students to mathematical model for modelling a bioprocess
- To create models and simulate bioprocess for improving the quality of process

Course Outcomes

At the end of the course, learners will be able to

CO1 Understand the principles of bioprocess modeling and simulation

CO2 Apply the knowledge of mathematical models in biochemical engineering systems

CO3 Analyze the modelling for reactors

CO4 Analyze the modelling for fermenters

CO5 Evaluate the application of Superpro Designer, MATLAB and SIMULINK in the bioprocess Systems

CO6 Undestand the importance of simulation in process modelling

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2	1												
2	2	3	3										1		
3	2	2	3										1		
4	2	3	3										1		
5	2	3	3		3								1		
6	2	2	1		2										

3 - High, 2 - Medium, 1 – Low

UNIT I INTRODUCTION TO MODELING AND SIMULATION **9**

Basic principles of Modeling, definition of Modeling and simulation, Fundamental laws Continuity equation, energy equation, equation of motion, transport equation, equation of state, Phase and chemical equilibrium, chemical kinetics, Model building, application of mathematical modeling, scope of coverage

UNIT II MODELS FOR BIOCHEMICALENGINEERING SYSTEMS **9**

Models based on Mass, component, energy and force balance: Batch reactors, PFR, CSTR, Gravity flow systems, Reactors in series, Concept of Heated tanks

UNIT III MODELING OF REACTORS **9**

Modeling of fermentation Batch reactor, Fed batch reactor, Modeling a continuous culture: Chemostat, Chemostat with recycles, substrate limited growth in Chemostat

UNIT IV MODELING OF FERMENTERS **9**

Modeling of suspended growth reactors, activated sludge systems, theory onagitated and sparged bioreactor, tower-aerobic and anaerobic bioreactors

UNIT V SUPERPRO DESIGNER, MATLAB AND SIMULINK: APPLICATION INBIOPROCESS SYSTEMS **9**

Introduction to SuperPro Designer for Material and Energy Balance with andwithout reaction. Solving problems using MATLAB by numerical integration, Euler and fourth order RungeKutta methods. Simulation - Simulation of gravity flow tank - Simulation of CSTR in series.

TOTAL : 45 HOURS

TEXT BOOKS

1. Luben W.L. Process Modelling Simulation and Control for Chemical Engineers, McGraw Hill, International New York, 1990

2. Franks RGE. Mathematical Modeling in Chemical Engineering, John Wiley and Sons, Inc., New York, 2004
3. Biquette W.B. Process Dynamics - Modeling analysis with simulation, Prentice Hall; 1 edition January 15, 1998
4. William J. Palm. Introduction to Matlab 7 for Engineers, III, McGraw Hill 2005
5. Kenneth J. Beers. Numerical Methods for Chemical Engineering Applications in MATLAB, Massachusetts Institute of Technology, Cambridge University press 2007 edition

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

21PBT14 BIOREACTOR CONSIDERATIONS FOR RECOMBINANT PRODUCTS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To expose students to application of recombinant DNA technology in biotechnological research.
- To train students in strategizing research methodologies employing genetic engineering techniques.

COURSE OUTCOMES

Upon completion of this course the student will be able to

- CO1. To acquire skills on techniques of isolation of gene of interest and construction ofrecombinant DNA.
- CO2. To apply techniques for production of pharmaceuticals, growth hormones, vaccines, gene therapy in expression system.
- CO3. To apply rDNA technology in evolving plants for resistance to pest and disease, toleranceto herbicides and abiotic factors.
- CO4. To identify problems associated with production of recombinant proteins and protein purification and devising strategies to overcome problem.
- CO5. To acquire knowledge on environmental applications of genetic engineering through bioremediation.
- CO6. To identify the methods for selection of recombinants and to express recombinant protein in E. coli and eukaryotes.

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	2	3	1	-	1	-	2	2	2	2	3	3	3
2	3	3	2	3	2	1	3	1	1	-	1	3	2	2	3
3	3	3	3	2	2	1	-	2	1	2	1	1	3	3	2
4	2	2	3	3	2	-	3	-	2	1	1	2	3	2	3
5	3	3	3	2	2	1	3	3	3	1	2	3	3	3	2
6	3	3	3	3	2	3	3	-	2	1	3	2	3	3	3

3 - High, 2 - Medium, 1 – Low

UNIT I GENETICALLY ENGINEERED ORGANISMS 9

Different host vector systems, Guidelines for choosing Host Vector systems, Process constraints – Genetic instability, considerations in plasmid design, Regulatory constraints, principles and implementation of containment, good industrial large-scale practice (GILSP).

UNIT II CONSIDERATIONS FOR ANIMAL CELL CULTURES 9

Structure and biochemistry of animal cells - Methods Used for the cultivation of animal cells - Bioreactor considerations for animal cell culture - Products of animal cell cultures, economics of animal cell tissue cultures.

UNIT III CONSIDERATIONS FOR PLANT CELL CULTURES 9

Overview of plant cell cultures - Plant cells in culture compared to microbes - Bioreactor considerations for plant cell culture - Bioreactors for suspension cultures - Reactors using cell immobilization - Bioreactors for organized tissues, economics of plant cell tissue cultures

UNIT IV DOWNSTREAM PROCESSING CONSIDERATIONS 9

Release of protein from Biological Host, genetic approaches to facilitate protein purification, Solid- Liquid separation, extraction of Recombinant protein, Avoidance of proteolysis from extracts, membranes for protein isolation and purification, Chromatographic techniques, Removal of detergent from protein fractions, precipitation of proteins, protein crystallization for large scale bio separation.

UNIT V **SAFETY CONSIDERATIONS ASSOCIATED WITH AGRICULTURAL AND ENVIRONMENTAL APLLICATIONS** **9**

Risk assessment methods, safety considerations, Application of rDNA organism in the environment, Survival, multiplication and/or dissemination in the environment, Interactions with species or biological systems, effects on the environment, evaluating environmental risks of rDNA organisms released from industrial applications.

TOTAL: 45 HOURS

TEXT BOOKS

1. Michael L. Shuler, Fikret Kargi, Matthew De Lisa,.Bioprocess Engineering, 3rdEdition,Prentice Hal, 2017
2. Bailey J.A and Ollis D.F., "Biochemical Engineering Fundamentals", McGraw Hill (New York), 2nd Edition, 2010.
3. Cutler, P. ed., 2004. Protein purification protocols (Vol. 244). Springer Science & BusinessMedia.
4. Perry R H ,"Perry's Chemical Engineers' Handbook", McGraw-Hill, 8th Edition, 2008.

REFERENCES

1. Pörtner, R. and Barradas, O.B.J.P., 2007. Animal cell biotechnology. Methods and Protocols, 2nd. Edition. Humana.
2. Slater, A., Scott, N. and Fowler, M., 2008. Plant biotechnology: the genetic manipulation ofplants. OUP Oxford.
3. Pörtner, R. and Barradas, O.B.J.P., 2007. Animal cell biotechnology. Methods and Protocols, 2nd. Edition. Humana.
4. Slater, A., Scott, N. and Fowler, M., 2008. Plant biotechnology: the genetic manipulation ofplants. OUP Oxford.

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

21PBT15 **BIOPROCESS CALCULATIONS** **L T P C**
3 0 0 3

Course Objectives

The main objective of this course is to

- Analyze stoichiometric calculations in industrial applications
- Recall humidity and solubility.
- Investigate the chemical reactions among different states of matter.
- Categorize steady and unsteady state processes.

Course Outcomes

Upon completion of this course, students will be able to

- CO1: Present an overview of industrial chemical Bioprocesses.
- CO2: Develop a fundamental understanding of the basic principles of chemical engineering processes and calculations.
- CO3: Establish mathematical methodologies for the computation of material balances and energy Balances without chemical reactions
- CO4: Establish mathematical methodologies for the computation of material balances and energy Balances with chemical reactions
- CO5: Understand the basic laws of heat transfer & to develop solutions for the problem involving steady state & transient heat conduction in simple geometries.
- CO6: Calculate heat transfer by conduction, convection & thermal radiation realistic cases.

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1					2									
2	2	2	2												
3	2	2	2												
4	2	2													
5	1	3	2	1											
6	2	2	2	2											

3 - High, 2 - Medium, 1 – Low

UNIT I BASIC CHEMICAL CALCULATIONS 9

rvation of mass and energy -Unit and its conversion: basic laws- stoichiometric calculations - Gases, Vapours, Liquids and Solids: Ideal gas law calculations, real gas relationships, vapour pressure and liquids, saturation, partial saturation - vapour-liquid equilibria

UNIT II HUMIDITY AND SOLUBILITY 9

Humidity - Percentage Humidity, Relative Humidity, Molal Humidity, Cox Chart- saturation – vaporization - condensation - wet and dry bulb thermometry Solubility and Crystallisation, Dissolution – solubility of gases.

UNIT III MATERIAL BALANCES WITHOUT CHEMICAL REACTIONS 9

Overall and component material balances process flow sheet- Material balance without chemical reactions- Steady state and unsteady state- Recycle, bypass and purge

UNIT IV MATERIAL BALANCES WITH CHEMICAL REACTIONS 9

Material balance for steady and unsteady state processes with chemical reactions, multiple subsystems; Recycle, bypass and purge; Degrees of freedom-NTU- problems in Biotechnology industrial applications.

UNIT V ENERGY AND COMBUSTION BALANCE 9

Energy balance – laws - heat capacity calculations-gas-liquid-fuel, enthalpy calculations- combustion calculations: fuel and flue gas analysis, air fuel ratio, theoretical oxygen, percentage excess air, limiting and excess reactant

TOTAL: 45 HOURS

TEXT BOOKS

1. B. I. Bhatt and S. M. Vora, "Stoichiometry", 5th Edn., Tata McGraw Hill Publishers, 1996
2. V.Venkataramani and N.Anantharaman,.Process Calculations Prentice Hall of India,Ltd, N.Delhi.2011

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

21PBT16 **SEPARATION TECHNIQUES**

L	T	P	C
3	0	0	3

Course Objectives

- To understand Principles of separation methods used in the process industry.
- To appreciate different equipments developed for separation.

Course Outcomes

Upon completion of this course, students will be able to

- CO1. Understand the size reduction techniques and its characterization properties.
- CO2. Apply the fluids and solid separation methods.
- CO3. Demonstrate various filtration techniques
- CO4. Understand the various membranes used for separation
- CO5. Apply the knowledge of drying and crystallization of the products
- CO6. Compare all the separation process and use necessary methods to process the products.

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2						2								
2	2	2		2			2								
3	2	2		3			2								
4	2						2								
5	2		2				2								
6	2						2								

3 - High, 2 - Medium, 1 – Low

UNIT I SIZE REDUCTION **9**

Characterisation of solid particles – Mixing of solids – equipments – storage of solids – size reduction of solids – Crushing, grinding Cutting-Power requirements-equipments-size enlargement.

UNIT II FLUID – SOLID SEPARATION **9**

Separation of solids & suspension from gas medium-screening- settling- Principles and equipments-classification-clarification.

UNIT III FILTRATION **9**

Filtration – Principles –Equipments-Centrifugal filtration-Principles- equipments – Centrifugal separation of immiscible liquids.

UNIT IV MEMBRANE SEPARATION **9**

Cross flow filtration- Membranes –Ultrafiltration-Microfiltration-Concentration Polarisation - operation and equipments.

UNIT V DRYING & CRYSTALLISATION **9**

Principles of Drying – Drying equipments Principles of Crystallisation- crystallization equipments.

TOTAL: 45 HOURS

TEXT BOOKS

1. Geankoplis, C.J. “Transport Processes and Separation Process Principles”, 4th Edition, Prentice Hall, 2003.

2. McCabe W.L., Smith J.C. “Unit Operations in Chemical Engineering”, 7th Edition, McGraw – Hill Int., 2001,

REFERENCES

1. Richardson, J.E. etal., “Coulson & Richardson’s Chemical Engineering” Vol.2 (Praticle Technology & Separation Processes”) 5th Edition, Butterworth – Heinemann / Elsevier, 2003.

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

VERTICAL - III (Medical Biotechnology)							
S.No.	**Course Code**	**Course Title**	**Category**	**L**	**T**	**P**	**C**
THEORY							
1	21PBT17	Human Genetics	PE	3	0	0	3
2	21PBT18	Cancer Biology	PE	3	0	0	3
3	21PBT19	Biopharmaceuticals and Biosimilars	PE	3	0	0	3
4	21PBT20	Tissue Engineering	PE	3	0	0	3
5	21PBT21	Molecular Therapeutics and Diagnostics	PE	3	0	0	3
6	21PBT22	Biomedical Engineering	PE	3	0	0	3
7	21PBT23	Medical Biotechnology	PE	3	0	0	3
8	21PBT24	Vaccine Biotechnology	PE	3	0	0	3

21PBT17 **HUMAN GENETICS**

L	T	P	C
3	0	0	3

OBJECTIVES

- To discuss the patterns of inheritance and its relevance in disease and therapy
- To describe various genetic laws, learn the chromosome structure function and understand methodologies for cytogenetic applications.

COURSE OUTCOMES

Upon completion of the course, students will be able to

- Understand the concept of Mendelian and non-Mendelian genetics.
- Know the concepts of complex traits inheritance and mechanism of sex determination.
- Discuss clearly about the chromosomal pathologies.
- Describe the principles behind DNA fingerprinting methodologies using molecular markersRFLP, RAPD, STRP, and SNP's.
- Applying the genetic technologies knowledge in industries related to pharmaceuticals, biotechnology, and diagnostic clinics.
- To bring awareness to human society on various genetic disorders, its inheritance patternsand to develop the methods, and techniques of fighting against the diseases.

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
2	1	2						1		2	2	3		2	
2	2	2					2	2		3	2	2	2	2	
3				2						1	1	2		3	
2	3		2	3	1	1	2	3		2	3	3	2	1	2
3	2	3	2	3	3	2	3	3	1	3	2	3	3	2	3
3		3	2	3	2	2	2	3	1	2	2	2	3	3	2

3 - High, 2 - Medium, 1 – Low

UNIT I INTRODUCTION **9**

History of genetics — Mendel's principles and experiments, segregation, multiple alleles — Independent Assortments, Genotypic interactions, epistasis and Sex chromosomes, Sex determination, Dosage compensation, sex linkage and pedigree analysis

UNIT II COMPLEX TRAITS **9**

Approaches to analysis of complex traits- 'Nature vs nurture', role of family and shared environment, monozygotic and dizygotic twins and adoption studies — Polygenic inheritance of continuous (quantitative) traits and discontinuous {dichotomous) traits — Genetic susceptibility incomplex traits - Estimation of genetic components of multifactorial traits: emperic risk, heritability, coefficient of relationship, application of Baye's theorem.

UNIT III HUMAN CYTOGENETICS **9**

Origins and developments in the study of human cytogenetics - Chromosome banding — Human chromosomal pathologies: Numerical and Structural aberrations and their common syndromes –Human karyotype: banding patterns, ideogram, nomenclature of banding — Nomenclature of aberrant karyotypes.

UNIT IV APPLIED GENETICS **9**

Genetic linkage and gene mapping – Genetic polymorphism, RFLP, SNP, STRP – Physical mapping of the human genome – Transcriptional mapping – Molecular techniques in human chromosome analysis (FISH, GISH, CGH, SKY).

UNIT V CLINICAL GENETICS **9**

Genetic basis of syndromes and disorders – Monogenic diseases: Cystic fibrosis, Marfan syndrome – Inborn errors of metabolism: Phenylketonuria, Mucopolysaccharidosis, Galactosemia - Syndromes due to triplet nucleotide expansion: Muscle genetic disorders, Sickle cell anemia,Thalassemias, Colour Blindness, Retinitis pigmentosa.

TOTAL: 45 HOURS

TEXT BOOKS

1. Michael Goldberg, Janice Fischer, Leroy Hood and Leland Hartwell, "Genetics: FromGenes to Genomes", 7th Edition. McGraw Hill Education, 2020.
2. Tom Strachan & Andrew Read, "Human molecular genetics" 4th Edition, Taylor & FrancisGroup, Garland Science, 2011.
3. Anthony Griffiths; John Doebley; Catherine Peichel; David A. Wassarman, "Introduction to Genetic Analysis", 12th Edition. Macmillan Learning, 2020.

REFERENCES

1. Benjamin A. Pierce, "Genetics: A Conceptual Approach", 7th Edition, Macmillan Learning,2020.
2. William S Klug, Michael Cummings, Charlotte A. Spencer, Michael A Palladino & DarrellKillian, "Concepts of Genetics", 12th Edition, Pearson, 2019.
3. D. Peter Snustad, Michael J. Simmons, "Principles of Genetics", 7th Edition, published by Wiley, 2015.

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

21PBT18 **CANCER BIOLOGY**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

The goal of this course is to enable the students to

- Understand the basics of cancer and cancerous cells
- Discuss the significance of carcinogenesis in the development of cancer
- Interpret the role of oncogenes and their growth factors
- Make understanding on process of cancer metastasis and their dysregulation factors
- Gain knowledge on the advancement in cancer treatment
- Design the novel drugs to treat cancer or to reduce the effect of carcinogenesis

COURSE OUTCOMES (CO):

- CO1. Explain the development and proliferation of cancer with specific causes
- CO2. Describe the influence of carcinogenesis in the cancer development
- CO3. Identify the pathways and therapeutic targets of cancer
- CO4. Outline the steps involved in metastasis and tumour cell invasion
- CO5. Develop novel drugs and technologies for the treatment of cancer
- CO6. Summarize the microenvironment of cancer cells and their attack on immune cells

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	-	3	-	3	-	1	-	2	-	2	1	1	-	-
2	3	1	2	1	3	-	1	-	3	-	2	2	2	-	-
3	2	2	2	-	2	1	2	-	2	-	1	2	3	3	-
4	2	2	2	-	2	-	2	-	-	-	1	2	2	-	-
5	3	3	3	3	3	2	1	2	3	-	3	3	3	3	1
6	2	2	3	2	2	-	2	2	3	-	2	2	2	2	1

3 - High, 2 - Medium, 1 – Low

UNIT I FUNDAMENTALS OF CANCER BIOLOGY **9**

Mitosis, Regulation of cell cycle, check points, cell proliferation, apoptosis; Signal transduction pathways, receptor tyrosine kinases (RTKs), RAS signalling. Causes of cancer - Infection, Radiation, Ionising radiation, Ultraviolet radiation, magnetic fields, Tobacco, Alcohol, Tea and coffee, Stress; defective apoptotic pathways leading to cancer.

UNIT II INTRODUCTION TO CANCER **9**

Mutations that cause changes in signal molecules, effects on receptor, signal switches, modulation of cell cycle in cancer; Mechanism of spread. Different forms of cancers, Signal targets and cancer, activation of kinases; Oncogenes, identification of oncogenes, mechanism of oncogene activation, retroviruses and oncogenes, detection of oncogenes.

UNIT III MOLECULAR BIOLOGY OF CANCER **9**

Oncogenes/proto oncogene activity; tumor suppressor genes - pRb, p53, APC, BRCA paradigms; Telomerases, Principles of Cancer Metastasis: three step theory of invasion, proteinases and tumour cell invasion; Angiogenesis.

UNIT IV CANCER PREVENTION AND DIAGNOSIS **9**

Chemotherapy, radiation therapy; Cancer detection: tumour imaging and molecular imaging, Proteomics, Metabolomics, Gene expression profiling, Protein imaging, Nanotubes, graphene and nanocells, advances in cancer detection.

UNIT V ADVANCES IN CANCER THERAPY **9**

Theory of carcinogenesis, Chemical carcinogenesis, metabolism of carcinogenesis, principles of physical carcinogenesis, x-ray radiation, mechanisms of radiation carcinogenesis, Life style and its consequences for cancer.

TOTAL: 45 HOURS

TEXT BOOKS

1. Weinberg, R.A. "The Biology of Cancer" Garland Science, 2007
2. McDonald, F etal., "Molecular Biology of Cancer" IInd Edition. Taylor & Francis, 2004.
3. Pezzella, F., Tavassoli, M., & Kerr, D. J. (Eds.). (2019). Oxford textbook of cancer biology. Oxford University Press.
4. Pelengaris, S., & Khan, M. (Eds.). (2013). The molecular biology of cancer: A bridge from bench to bedside.
5. Hejmadi, M. (2014). Introduction to cancer biology. Bookboon.

REFERENCES

1. King, Roger J.B. "Cancer Biology" Addison Wesley Longman, 1996.
2. Ruddon, Raymond W. "Cancer Biology" IIIrd Edition . Oxford University Press, 1995
3. Margaret A. Knowles, Peter J Selby, An Introduction to Cellular and Molecular Biology of Cancer, 4th Edition, Oxford Medical Publication, 1991.
4. https://oncouasd.files.wordpress.com/2014/09/cancer-principles-and-practice-of-oncology-6e.pdf
5. https://archive.org/details/biologyofcancera00burc.
6. http://csbl.bmb.uga.edu/mirrors/JLU/DragonStar2017/download/introduction-to-cancer-biology.pdf

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

21PBT19 **BIOPHARMACEUTICALS AND BIOSIMILARS**

L	T	P	C
3	0	0	3

Course Objectives

- To provide strong foundation and advanced information on biopharmaceutical aspects in relation to drug development.
- To impart the knowledge of the various dosage forms and its implications in pharmaceutical technology.

Course Outcomes

Upon completion of the course, students will be able to

- CO1. Comprehend the factors influencing the bioavailability and bioequivalence of drugs Grasp the current regulatory acts and safety norms of the modern pharmaceutical industries.
- CO2. Recognize the formulation concepts and evaluate different dosage forms to meet out the compendial requirements.
- CO3. Acquired knowledge on novel drug delivery systems and their applications in therapeutic fields.
- CO4. Understand the design and analysis of biosimilar drugs.
- CO5. Demonstrate knowledge and understanding of current topical biopharmaceuticals.
- CO6. Understand the aspects of newly emerging biopharmaceuticals

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	-	-	2	-	-	-	-	-	-	1	2	2	-	-
2	-	-	2	2	2	3	1	2	3	-	2	2	3	-	-
3	1	3	1	2	-		-	-	2	-	2	2	2	3	2
4	2	1	3	1	2	--	2	-	2	-	2	3	2	2	3
5	1	2	1	2	2	1	-	-	3	-	3	3	3	3	3
6	3	-	2	2	3	2	2	1	3	-	3	3	3	3	3

3 - High, 2 - Medium, 1 – Low

UNIT I INTRODUCTION **9**

Drug sources – Discovery and Development phases – Drugs and Cosmetics Act and regulatory aspects – Role of patents in the drug industry – Biopharmaceutical classification system – Drug Target — Drug metabolism — Pharmacokinetics — Pharmacodynamics — Bioavailability — Bioequivalence – Toxicity studies – Pharmacogenomics.

UNIT II DOSAGE FORMS **9**

Classification of dosage forms – Excipients – Formulation – Tablets, Capsules, Emulsion, Suspension, Lotion, Liniments, Ointments, Cream, Paste, Suppositories, Parenterals – Pressurized dosage forms — Packaging techniques.

UNIT III ADVANCED DRUG DELIVERY SYSTEMS **9**

Controlled release dosage forms – Rationale – Principle and factor influencing – Design and Fabrication – Microencapsulation – Liposomes – Niosomes – Transdermal drug delivery – Ocular,Vaginal and Uterine controlled release.

UNIT IV BIOSIMILARS **9**

Biosimilar medicine – Importance – INN nomenclature system – Key trends in biosimilar product development – Production of biosimilar products – Difficulties with biosimilar drugs – Non clinicaland clinical study – Regulation and approval process – Future prospects.

UNIT V CASE STUDIES ON BIOPHARMACEUTICALS **9**

Erythropoietin – Insulin – Somatotropin – Interleukin – Interferon – GMCSF – Blood clotting Factors – Tissue plasminogen activator – Monoclonal antibodies and engineered antibodies.

TOTAL: 45 HOURS

TEXT BOOKS

1. Crommelin Dwan J.A., Robert D. Sindelar and Bernd Meibohm, "PharmaceuticalBiotechnology: Fundamentals and application", Springer, 4th Edition, 2013.
2. Gary Walsh, "Pharmaceutical Biotechnology-Concepts and Application", John Wiley andSons Publishers, 1st Edition, 2007.
3. Shein-Chung Chow, "Biosimilars: Design and Analysis of Follow-on Biologics", CRC Press,3rd Edition, 2013.

REFERENCES

1. James Swarbrick, "Encyclopedia of Pharmaceutical Technology", CRC Press, 4th Edition, 2013.Shayne Cox Gad, "Pharmaceutical Manufacturing Handbook: Production and Processes", Wiley, 2nd Edition, 2011.

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

21PBT20 **TISSUE ENGINEERING**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To enable the students
- To learn the fundamentals of tissue engineering and tissue repairing
- To acquire knowledge on clinical applications of tissue engineering
- To understand the basic concept behind tissue engineering focusing on the stem cells
- To study the biomaterials and its applications

COURSE OUTCOMES:

Upon completion of this course, the students would get

- CO1. To understand the importance and scope of tissue engineering.
- CO2. Ability to understand the components of the tissue architecture
- CO3. Opportunity to get familiarized with the stem cell characteristics and their relevance in
- CO4. medicine Awareness about the properties and broad applications of biomaterials
- CO5. Overall exposure to the role of tissue engineering and stem cell therapy
- CO6. To know the role of tissue engineering in implants

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2		1	1	1										
2	1		2	2	1										
3		2	1	2	3										
4			2	1	2		2								
5	1		2	2	1										
6	2			2		2									

3 - High, 2 - Medium, 1 – Low

UNIT I INTRODUCTION **9**

Introduction to tissue engineering: Basic definition; current scope of development; use in therapeutics, cells as therapeutic agents, cell numbers and growth rates, measurement of cell characteristics morphology, number viability, motility and functions. Measurement of tissue characteristics, appearance, cellular component, ECM component, mechanical measurements and physical properties.

UNIT II TISSUE ARCHITECTURE **9**

Tissue types and Tissue components, Tissue repair, Engineering wound healing and sequence of events. Basic wound healing Applications of growth factors: VEGF/angiogenesis, Basic properties, Cell-Matrix& Cell-Cell Interactions, telomeres and Self-renewal, Control of cell migration in tissue engineering.

UNIT III BIOMATERIALS **9**

Biomaterials: Properties of biomaterials, Surface, bulk, mechanical and biological properties. Scaffolds & tissue engineering, Types of biomaterials, biological and synthetic materials, Biopolymers, Applications of biomaterials, Modifications of Biomaterials, Role of Nanotechnology.

UNIT IV BASIC BIOLOGY OF STEM CELLS **9**

Stem Cells: Introduction, hematopoietic differentiation pathway Potency and plasticity of stem cells,sources, embryonic stem cells, hematopoietic and mesenchymal stem cells, Stem Cell markers, FACS analysis, Differentiation, Stem cell systems- Liver, neuronal stem cells, Types & sources of stem cell with characteristics: embryonic, adult, haematopoetic, fetal, cord blood, placenta, bone marrow, primordial germ cells, cancer stem cells induced pleuripotent stem cells.

UNIT V CLINICAL APPLICATIONS **9**

Stem cell therapy, Molecular therapy, In vitro organogenesis, Neurodegenrative diseases, spinal cord injury, heart disease, diabetes, burns and skin ulcers, muscular dystrophy, orthopedic applications, Stem cells and Gene therapy Physiological models, tissue engineered therapies, product characterization, components, safety, efficacy. Preservation –freezing and drying. Patent protection and regulation of of tissue-engineered products, ethical issues.

TOTAL: 45 HOURS

TEXT BOOKS

1. Bernhard O.Palsson, Sangeeta N.Bhatia, "Tissue Engineering" Pearson Publishers 2009.
2. Meyer, U.; Meyer, Th.; Handschel, J.; Wiesmann, H.P. .Fundamentals of Tissue Engineering and Regenerative Medicine.2009.

REFERENCES

1. Bernard N. Kennedy (editor). Stem cell transplantation, Tissue engineering, and cancer applications, Nova Science Publishers, 2008.
2. Raphael Gorodetsky, Richard Schäfer.Stem cell-based tissue repair. RSC Publishing, 2011.
3. R. Lanza, I. Weissman, J. Thomson, and R. Pedersen, Handbook of Stem Cells, Two
4. Volume, Volume 1-2: Volume 1-Embryonic Stem Cells; Volume 2-Adult & Fetal Stem Cells, Academic Press, 2004.
5. R. Lanza, J. Gearhart, B. Hogan, D. Melton, R. Pedersen, E. .l Thomas, J. Thomson, I. W.Gearhart, Essential of Stem Cell Biology, Elsevier Academic Press, 2nd Edition , 2009.
6. J. J. Mao, G. Vunjak-Novakovic et al (Eds), Translational Approaches In Tissue Engineering & Regenrative Medicine" Artech House, INC Publications, 2008.
7. Naggy N. Habib, M.Y. Levicar, , L. G. Jiao,.and N. Fisk, Stem Cell Repair and Regeneration, volume-2, Imperial College Press, 2007.

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

21PBT21 MOLECULAR THERAPEUTICS AND DIAGNOSTICS

L	T	P	C
3	0	0	3

Course Objectives

- To understand the concepts of molecular diagnosis and therapeutics
- To apply the knowledge of molecular techniques in clinical diagnosis

Course Outcomes

Upon completion of this course, students will be able to

- CO1. Identify the role and importance of molecular diagnostics in genetic and acquired diseases
- CO2. Demonstrate knowledge and principle in molecular techniques for diagnosis and monitoring of genetic and acquired diseases
- CO3. Identify limitation in molecular diagnostics strategy and ethical issue in molecular diagnostics strategy
- CO4. Apply knowledge in molecular techniques for development of diagnostic kit based on patients and disease specific information and parameters
- CO5. Understand the concept of targeted therapy
- C06. Apply the molecular techniques for clinical diagnostics.

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	1	1				1								
2		2	2			1									
3		2		2	1										
4					2		1								
5		2	1	1	2										
6		2		2	2										

3 - High, 2 - Medium, 1 – Low

UNIT I INTRODUCTION TO MOLECULAR DIAGNOSTICS 9

History of diagnostics, Diseases- infectious, physiological and metabolic errors, genetic basis of diseases, inherited diseases. Infection — mode of transmission in infections, factors predisposing to microbial pathogenicity, types of infectious diseases- bacterial, viral, fungal, protozoans and other parasites; general approach to clinical specimens, Sample collection- method of collection, transport and processing of samples

UNIT II TRADITIONAL DISEASE DIAGNOSIS METHODS AND TOOLS 9

Diagnosis of infection caused by Streptococcus, Coliforms, Salmonella, Shigella, Vibrio, and Mycobacterium., Diagnosis of major fungal infections: Dermetophytoses, Candidiosis and Aspergillosis. · Diagnosis of DNA and RNA viruses- Pox viruses, Adenoviruses, Rhabdo Viruses, Hepatitis Viruses and · Retroviruses. · Diagnosis of Protozoan diseases: Amoebiosis, Malaria, Trypnosomiosis, Leishmaniasis.

UNIT III DIAGNOSIS AND TREATMENT OF COMMON DISEASES 9

Atherosclerosis, ischemic heart disease and cerebrovascular disease; coagulation system and hypertension; metabolic syndrome and diabetes mellitus; asthma, allergy and inflammatory diseases of the lung; gastrointestinal system, including inflammatory bowel diseases.

UNIT IV TARGETED THERAPY 9

Objective and types of targeted therapy, working mode of targeted therapy against cancer — by immunotherapy, by cell signaling interruption, by angiogenesis inhibitors, monoclonal antibody therapy, by apoptosis, hormone therapy for prostate cancer and hormone therapy for breast cancer; side effects of cancer treatment and drawbacks of targeted therapy. Targeted drug delivery — active and passive targeting, drug delivery vehicles

UNIT V TECHNIQUES IN MOLECULAR AND CLINICAL DIAGNOSTICS 9

PCR-based methods for mutation detection, alternative methods for mutation detection and DNA sequencing for disease association, microarray approaches for gene expression analysis, methods for analysis of DNA methylation; clinical diagnostic technologies: flow cytometry, medical cytogenetics, fluorescence *in situ*

hybridization, immunohistochemistry and laser capture microdissection (FFPE).

TOTAL: 45 HOURS

TEXT BOOKS

1. Molecular Diagnostics by Harald Seitz Sarah Schumacher, Springer 2013 Ed.
2. Fundamentals of Molecular Diagnostics by David E. Bruns, Edward.R, Ashwood, Carl A.Burtis, Elsevier Health Sciences 2007

REFERENCES

1. Molecular Diagnostics: Fundamentals, Methods and Clinical Applications by LelaBuckingham, F. A. Davis Company 2019
2. Molecular Cancer Therapeutics: Strategies for Drug Discovery and Development, by George C. Prendergast, Wiley & Sons, Inc. 20043.
3. Molecular and Cellular Therapeutics by David Whitehouse, Ralph Rapley, Wiley & Sons, Ltd.2012

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

21PBT22	BIOMEDICAL ENGINEERING	L	T	P	C
		3	0	0	3

Course Objectives

- To identify the real-life problems of biomedical engineering.
- To develop the healthcare information system for remote access

COURSE OUTCOMES

Upon completion of this course, students will be able to

- CO1. Identify, analyse and solve the real-life problems by applying principles of biomedical engineering.
- CO2. Design, develop and specify the mathematical model to understand the inter relationamong various physiological systems.
- CO3. Demonstrate various applications of engineering and physiological subsystems in designingand developing human body systems.
- CO4. Apply the knowledge to identify the various types of analytical and diagnostic equipment used in biomedical engineering
- CO5. Design a system component or process to meet desired needs within realistic constraints.
- CO6.Develop healthcare information system for automation and remote access.

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	2	3	2	-	3	-	-	-	1	1	3	2	3
2	2	1	3	2	3	2	2	1	-	-	-	-	2	2	1
3	2	2	3	3	3	-	3	2	-	-	-	2	3	2	2
4	1	2	2	1	2	1	1	-	-	-	-	-	1	1	2
5	-	3	2	2	2	-	2	1	-	-		-	2	-	3
6	3	3	3	2	3	1	2	-	-	-	-	-	2	3	3

3 - High, 2 - Medium, 1 – Low

UNIT I HUMAN BODY SUBSYSTEM AND TRANSDUCERS 9

Brief description of muscular, cardiovascular and respiratory systems; their electrical, mechanical and chemical activities. Principles and classification of transducers for Bio-medical applications. Electrode theory, different types of electrodes; Selection criteria for transducers and electrodes.

UNIT II NON-ELECTRICAL PARAMETERS MEASUREMENT 9

Measurement of blood pressure - Cardiac output - Heart rate - Heart sound - Pulmonary function measurements – spirometer – Blood Gas analyzers, pH of blood – Measurement of blood pCO2,pO2.

UNIT III ELECTRICAL PARAMETERS MEASUREMENT AND ELECTRICAL SAFETY 9

ECG — EEG — EMG — ERG — Lead systems and recording methods — Typical waveforms -Electrical safety in medical environment, shock hazards – leakage current - Instruments for checking safety parameters of biomedical equipment.

UNIT IV IMAGING MODALITIES AND BIO-TELEMETRY 9

Diagnostic X-rays - Computer tomography – MRI – Ultrasonography – Endoscopy – Thermography-Different types of biotelemetry systems.

UNIT V LIFE ASSISTING AND THERAPEUTIC DEVICES 9

Pacemakers – Defibrillators – Ventilators – Nerve and muscle stimulators - Heart Lung machine –Dialyzers - Diathermy — Lithotripsy.

TOTAL: 45 HOURS

TEXT BOOKS

1. Leslie Cromwell, Biomedical Instrumentation and Measurement, Prentice Hall of India, NewDelhi, 2007.
2. Joseph J.carr and John M. Brown, Introduction to Biomedical Equipment Technology, JohnWiley and sons, New York, 4th Edition, 2012.
3. Khandpur R.S, Handbook of Biomedical Instrumentation, Tata McGraw-Hill, New Delhi, 2ndEdition, 2003.

REFERENCES

1. John G. Webster, Medical Instrumentation Application and Design, John Wiley and sons,New York, 1998.
2. Duane Knudson, Fundamentals of Biomechanics, Springer, 2nd Edition, 2007.
3. Suh, Sang, Gurupur, Varadraj P., Tanik, Murat M., Health Care Systems, Technology andTechniques, Springer, 1st Edition, 2011.
4. Ed. Joseph D. Bronzino, The Biomedical Engineering Hand Book, Third Edition, BocaRaton, CRC Press LLC, 2006
5. M. Arumugam, 'Bio-Medical Instrumentation', Anuradha Agencies, 2003

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

21PBT23 **MEDICAL BIOTECHNOLOGY**

L	T	P	C
3	0	0	3

Course Objectives

- To understand the classification, diagnosis and therapy of pathogenic infections.
- To understand the concepts of stem cells and tissue engineering.
- To learn the importance of recombinant products and growth factors

Course Outcomes

Upon completion of this course, students will be able to

- CO 1 : Understand the classification, diagnosis and therapy for pathogenic infections.
- CO 2 : Exhibit knowledge on recent trends in diagnosis of various disorders.
- CO 3 : Learn the production of monoclonal antibodies as diagnostic tools and therapeutic agents.
- CO 4 : Exhibit knowledge on stem cells, tissue engineering and gene products.
- CO 5 : Learn the types, preparation and testing of vaccines, recombinant products and growth factors
- CO 6 : Apply the knowledge of various biotechnological techniques in Medical diagnostics and therapeutics

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	1					1						1		
2		2	1	2		1							2		
3		2	2		2								2		
4				1	2								2		
5		2	2	2	2	1	1						2		
6	1	2													

3 - High, 2 - Medium, 1 – Low

UNIT I MEDICALLY IMPORTANT INFECTIOUS ORGANISMS **9**

Classification of pathogenic microbes; Leptospira, Brucella, Bacillus anthraces; Medical Parasitology: Amoebiasis, Cryptoporidiosis, Giardiasis, Malaria, Toxoplasmosis; Viruses: Adenoviruses, Retroviruses; Medical Mycology: Superfical Mycoses, Subcutaneous Mycoses, Systemic Mycoses

UNIT II DIAGNOSTICS **9**

Prenatal diagnosis: Invasive techniques - Amniocentesis, Fetoscopy; Non-invasive techniques – Ultrasonography, X-ray, Diagnosis using protein and enzyme markers, DNA/RNA based diagnosis; Hepatitis, HIV - CD 4 receptor; Microarray technology in cancer diagnosis.

UNIT III MODERN ADVANCES IN THERAPY **9**

Monoclonal Antibodies: Production, Target drug delivery using monoclonal antibodies; Gene Therapy: types, vectors used in gene therapy; Immunotherapy in cancer; Application of nano biosystems in diagnosis and therapy.

UNIT IV STEM CELL AND TISSUE ENGINEERING **9**

Embryonic and adult stem cells: Totipotent, pluripotent and multipotent cells: Testing and generation of embryonic stem cells; Potential uses of stem cells: cell based therapies and clinical applications. Biomaterials: Characterization, Host reactions, Extracellular matrix, Scaffolds, Artificial organs, Applications.

UNIT V PHARMACEUTICAL BIOTECHNOLOGY **9**

Vaccines- Preparation and testing, standardization and storage study; New generation of vaccines: Hepatitis, AIDS, Malaria; Minicells as vaccine; Production of recombinant pharmaceutical products–Biotechnologically derived products (therapeutic proteins): Interferons, Interleukins, Insulin, Growth Hormones; Recombinant coagulation factors and thrombolytic agents, Somatostatin, Somatotropin, Ketopeptide.

TOTAL: 45 HOURS

TEXT BOOKS

1. Judit Pongracz, Mary Keen, “Medical Biotechnology”, Elsevier Health Sciences, 2009.
2. Bernard R. Glick, Terry L. Delovitch, Cheryl L. Patten, “Medical Biotechnology”, ASM Press, Washington DC, 2014

REFERENCES

1. Albert Sasson , “Medical biotechnology: achievements, prospects and perceptions”, United Nations University Press, 2005.
2. Yuan Kun Lee, “Microbial biotechnology: principles and applications”, World Scientific, Edition 2006.

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

21PBT24 **VACCINE TECHNOLOGY** **L T P C**
3 0 0 3

Course Objectives

- To study the various forms of vaccines
- To learn the techniques of vaccine production and their delivery methods
- To give an exposure on the regulatory and biosafety measures of vaccine

Course Outcomes

At the end of the course, learners will be able to

- CO1 : Apply the principle of vaccination for immunization processes
- CO2 : Attribute the types of vaccines and their applications
- CO3 : Evaluate vaccine purification, preservation and formulation techniques
- CO4 : Determine the advanced methods of vaccine delivery
- CO5 : Relate the quality measures and regulatory issues concerned with vaccine production
- CO6: Study the quality assurance in vaccine production.

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1												
2		1	2	3										2	
3				3	2									1	
4				2	3										1
5			2			3									1
6			2			3									1

3 - High, 2 - Medium, 1 – Low

UNIT I INTRODUCTION **9**

Vaccines - definition, History of vaccine development, requirements for immunity, Basics of immunization- Epitopes, linear and conformational epitopes, characterisation and location of APC, MHC and immunogenicity; immunization programs and role of WHO in immunization programs

UNIT II TYPES AND METHODS OF APPLICATION **9**

Active and passive immunization; Viral/bacterial/parasite vaccine differences, methods of vaccine preparation - Live, killed, attenuated, sub unit vaccines; Vaccine technology- Role and properties of adjuvants, recombinant DNA and protein based vaccines, plant-based vaccines, edible vaccines, reverse vaccinology, combination vaccines, therapeutic vaccines; Peptide vaccines, conjugate vaccines; Cell based vaccines. Uses of nanoparticles in vaccine application. Reverse Vaccinology

UNIT III TECHNIQUES IN VACCINE PRODUCTION **9**

Purification, preservation and formulation techniques. Commercial production of DPT, TT, polio, rabies and hepatitis vaccines.

UNIT IV DELIVERY METHODS **9**

Needle free Vaccine delivery, ISCOMS, Adjuvant delivery systems, Intranasal and inhaled vaccine delivery, liquid jet and solid dose injectors, development of gene-based vectors.

UNIT V REGULATORY AND BIOSAFETY MEASURES **9**

Quality assurance in vaccine production. Regulatory issues - Environmental concerns with the use of recombinant vaccines - Disease security and biosecurity principles and OIE guidelines.

TOTAL: 45 PERIODS

TEXT BOOKS

1. P. Ramadass, Animal Biotechnology - Recent concepts and Developments, MJP Publications, 2008.
2. 2. T. J. Kindt, R. A. Goldsby, B. A. Osborne and J. Kuby, Kuby Immunology, W.H. Freeman & company, 2007.
3. S. A. Plotkin, W. A. Orenstein and P. A. Offit, Vaccines, W B Saunders Company, 2012.

REFERENCES

1. Cheryl Barton, Advances in Vaccine Technology and Delivery, Espicom Business Intelligence, 2009.
2. Ronald W. Ellis, New Vaccine Technologies, Landes Bioscience, 2001.

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

VERTICAL - IV (Biochemical Engineering)							
S.No.	**Course Code**	**Course Title**	**Category**	**L**	**T**	**P**	**C**
THEORY							
1	21PBT25	Mass Transfer Operations	PE	3	0	0	3
2	21PBT26	Transfer Phenomena in Biological System	PE	3	0	0	3
3	21PBT27	Bioenergy and Biofuels	PE	3	0	0	3
4	21PBT28	Bioremediation Technology	PE	3	0	0	3
5	21PBT29	Chemical Reaction Engineering	PE	3	0	0	3
6	21PBT30	Petroleum Biotechnology	PE	3	0	0	3
7	21PBT31	Process Calculation & Heat Transfer	PE	3	0	0	3
8	21PBT32	Computational Methods for Biochemical Engineering	PE	3	0	0	3

21PBT25 **MASS TRANSFER OPERATIONS**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To define the principles of adsorption, absorption, leaching and drying extraction, distillation crystallization operations.
- To begin the concept of membrane separation process and develop skills of the students inthe area of mass transfer operations with emphasis on separation and purification of products.

COURSE OUTCOMES:

After completion of this course, the students will be able to:

- To recognize and apply analogies among momentum, heat and mass transfer in varioustypes of mass transfer operations.
- To investigate gas -liquid, vapour-liquid, solid-liquid and liquid-liquid equilibrium in mass transfer operations
- To employ the engineering correlations of diffusion and mass transfer coefficients to modela separation process
- To demonstrate a multi-stage equilibrium separation process.
- To apply the knowledge on downstream processing
- To attain the desired products by mass transfer operations

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2			2			3	2		1	2		3		
2	2		3		3			3			3		2	2	
3	3				3	2	2	2	1		2		3	2	2
4			3		2		2			2		1	2		
5	2		3				3	2			2	2		2	
6	2		2	2	2		2	3			2	2	2	2	2

3 - High, 2 - Medium, 1 – Low

UNIT I DIFFUSION AND MASS TRANSFER **9**

Molecular diffusion in fluids and solids; Interphase Mass Transfer; Mass Transfer coefficients; Analogies in Transport Phenomenon.

UNIT II GAS LIQUID OPERATIONS **9**

Principles of gas absorption; Single and Multi-component absorption; Absorption with Chemical Reaction; Design principles of absorbers; Industrial absorbers; HTU, NTU concepts.

UNIT III VAPOUR LIQUID OPERATIONS **9**

V-L Equilibria; Simple, Steam and Flash Distillation; Continuous distillation; McCABE-THIELE & ONCHON-SAVARIT Principles; Industrial distillation equipments, HETP, HTU and NTU concepts.

UNIT IV EXTRACTION OPERATIONS **9**

L-L equilibria, Staged and continuous extraction, Solid-liquid equilibria, Leaching Principles.

UNIT V SOLID FLUID OPERATIONS **9**

Adsorption equilibria – Batch and fixed bed adsorption; Drying-Mechanism-Drying curves- Time ofDrying; Batch and continuous dryers.

TOTAL: 45 HOURS

TEXT BOOKS

1. Treybal R.E. Mass Transfer Operations.IIIrd edition. Mcgraw Hill, 2017.
2. Kiran D.Patil Principles of Mass transfer Operations , 6th edition, Nirali Prakashanpublisher, 2017

REFERENCES

1. Binay K. Dutta Principles of Mass Transfer and Separation Processes, Prentice Hall India publisher,2006
2. Geankoplis C.J. Transport Processes and Unit Operations. IIIrd edition, Prentice Hall ofIndia, 1993.

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

21PBT26 TRANSPORT PHENOMENA IN BIOLOGICAL SYSTEM

L	T	P	C
3	0	0	3

Course Objectives

To impart knowledge about individual and simultaneous momentum, heat and mass transfer, model development along with appropriate boundary conditions.

COURSE OUTCOMES:

Upon completion of this course the student will be able to

- Employ shell balance equations to obtain desired profiles for velocity, temperature andconcentration.
- Reduce and solve the appropriate equations of change to obtain desired profiles forvelocity, temperature and concentration.
- Reduce and solve appropriate macroscopic balances for conservation of momentum,energy and mass.
- Utilize information obtained from solutions of the balance equations to obtain engineeringquantities of interest.
- Recognize and apply analogies among momentum, heat and mass transfer.
- Appreciate relevance of transport principles in diverse applications of chemical, biological,and materials science and engineering.

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2			2			3	2		1	2		3		
2	2		3		3			3			3		2	2	
3	3				3	2	2	2	1		2		3	2	2
4			3		2		2			2		1	2		
5	2		3				3	2			2	2		2	
6	2		2	2	2		2	3			2	2	2	2	2

3 - High, 2 - Medium, 1 – Low

UNIT I TRANSPORT PHENOMENA BY MOLECULAR MOTION 9

Vectors/Tensors, Newton's law of viscosity, Newtonian & Non-Newtonian fluids, rheological models, Temperature, pressure and composition dependence of viscosity, Kinetic theory of viscosity, Fourier's law of heat conduction, Temperature, pressure and composition dependence of thermal conductivity, Kinetic theory of thermal conductivity, Fick's law of diffusion, Temperature, pressure and composition dependence of diffusivity, Kinetic theory of diffusivity.

UNIT II MOMENTUM TRANSPORT 9

Shell Momentum balances, boundary conditions, velocity profiles, average velocity, momentum flux at the surfaces, of Newtonian and non-Newtonian for flow of a falling film, flow through circular tube, slits, flow through an Annulus, Adjacent flow of two Immiscible fluids. Equations of Change (Isothermal), equation of continuity, equation of motion, equation of energy (isothermal) theirapplications in fluid flow problems.

UNIT III HEAT TRANSPORT 9

Shell energy balances, boundary conditions, temperature profiles, average temperature, energy fluxes at surfaces for different types of heat sources such as electrical, nuclear viscous and chemical, Equations of change (non-isothermal), equation of motion for forced and free convection, equation of energy (non-isothermal).

UNIT IV MASS TRANSPORT 9

Shell mass balances, boundary conditions, concentration profiles, average concentration, massflux at surfaces for Diffusion through stagnant gas film, Diffusion with homogeneous and heterogeneous chemical reaction, Diffusion in to a falling liquid film, Diffusion and chemical reaction in porous catalyst and the effectiveness factor, equation of continuity for binary mixtures, equation of change to set up diffusion problems for simultaneous heat and mass transfer.

UNIT V TRANSPORT IN TURBULENT AND BOUNDARY LAYER FLOW 9

Turbulence phenomena; phenomenological relations for transfer fluxes; time smoothed equationsof change and their applications for turbulent flow in pipes; boundary layer theory; laminar and turbulent hydrodynamics thermal and concentration boundary layer and their thicknesses; analysis of flow over flat surface. Introduction

to macroscopic balances for isothermal flow systems, non isothermal systems and multi component systems.

TOTAL: 45 HOURS

TEXT BOOKS

1. R. B. Bird, W.E. Stewart, E.W. Lightfoot, Transport Phenomena, Revised 2nd Edition, John Wiley, 2021
2. Robert, S Brodkey, Harry C. Hershey, "Transport Phenomena A Unified Approach", BrodkeyPublishing 2003.

REFERENCES

1. C. J. Geankoplis, Transport Processes and Separation Process Principles,Pearson publishers., 4th Edition, 2013
2. C. O. Bennett, J. O. Myers, Momentum, Heat and Mass Transfer, 2nd International StudentEdition Mc-Graw Hill, 1983.
3. R. Welty, R.W. Wilson, and C.W.Wicks, Rorer G.E, Wilson R.W. "Fundamentals of Momentum Heat and Mass Transfer", 5th Edition, John Wiley, New York, 2007.

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

21PBT27 **BIOENERGY AND BIOFUEL**

L	T	P	C
3	0	0	3

Course Objectives

- This course will be focussed on achievement, acquisition of knowledge and enhancement of comprehension of information regarding bioenergy and biofuel technologies and their sustainable applications.

COURSE OUTCOMES

Upon completion of this course, students will be able to

- CO1. Determine the important properties of biomass.
- CO2. Produce solutions to real world problems related to bioenergy.
- CO3. Analyse bioenergy systems and their potential in future energy supply.
- CO4. Use of biomass an inexpensive feedstock as sustainable and renewable energy.
- CO5. Replace fossil-based products with biodiesel.
- CO6. Source other alternate energy such as bio hydrogen and bio refinery.

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	3	3	2	2	-	3	-	-	-	1	1	2	3	2
2	2	3	3	3	3	-	2	1	-	-	-	-	2	2	1
3	3	3	3	3	3	-	2	2	-	-	2	-	2	3	1
4	3	2	2	2	2	-	1	-	-	-	-	-	1	1	3
5	2	2	2	2	2	-	-	-	-	-	-		-	2	2
6	3	3	2	3	3	1	1	-	-	-	-	-	3	2	3

3 - High, 2 - Medium, 1 – Low

UNIT I INTRODUCTION **9**

Cellulosic Biomass availability and its contents. Lignocellulose as a chemical resource. Physical and chemical pretreatment of lignocellulosic biomass. Cellulases and lignin degrading enzymes.

UNIT II ETHANOL **9**

Ethanol as transportation fuel and additive; bioethanol production from carbohydrates; engineering strains for ethanol production from variety of carbon sources to improved productivity.

UNIT III BIODIESEL **9**

Chemistry and Production Processes; Vegetable oils and chemically processed biofuels; Biodiesel composition and production processes; Biodiesel economics; Energetics of biodiesel production and effects on greenhouse gas emissions Expanding biodiesel production.

UNIT IV OTHER BIOFUELS **9**

Biodiesel from microalgae and microbes; biohydrogen production; biorefinery concepts-Biobutanol,Biopropanol, bioglycerol –Principles,materials and feedstocks-Process technologies and techniques-Advantages and Limitations.

UNIT V APPLICATIONS OF BIOFUELS **9**

Life cycle environmental impacts of biofuels and co products — Environmental sustainability of biofuels – Energy security and supply,Economic sustainability of biofuels.

TOTAL: 45 HOURS

TEXT BOOKS

1. Gupta. V. K. and TUOHY. M. g. Biofuel Technologies, Springer, 2013.
2. Luque, R., Campelo, J.and Clark, J. Handbook of biofuels production, WoodheadPublishing Limited 2011.
3. Moheimani, N. R., Boer, M, P, M, K, Parisa A. and Bahri, Biofuel and Biorefinery Technologies, Volume 2, Springer, 2015.

REFERENCES

1. Lee, Sunggyu; Shah, Y.T. "Biofuels and Bioenergy". CRC / Taylor & Francis, 2013.
2. Eckert, C, A. and Trinh, C, T. Biotechnology for Biofuel Production and Optimization, Elsevier, 2016.
3. Bernardes, M, A, D, S. Biofuel production — recent developments and prospects, InTech, 2011.

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

21PBT28 **BIOREMEDIATION TECHNOLOGY** **L T P C**
3 0 0 3

Course Objectives

- To develop fundamental understanding of problems in environment and preservation
- To expose students to ways of pollution and control methods
- To create deeper understanding of Bioremediation and its application

Course Outcomes

At the end of the course, learners will be able to

- CO1 : Understand the importance of Environmental Biotechnology
- CO2 : Apply the knowledge in solving environmental problems
- CO3 : Analyze the nature of environmental drawbacks
- CO4 : Evaluate the role of biotechnology in nuclear waste management
- CO5 : Evaluate the technology for heavy metal reduction in environment
- CO6: understand the importance of bioremediation and biodegradation

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1			1			1	1	1							
2			2			2	2	2							2
3			3			1	3	1							1
4			1			1	1	2							2
5			2			3	2	3							
6			2			2	2	2							

3 - High, 2 - Medium, 1 – Low

UNIT I INTRODUCTION **9**

Introduction to Bioremediation: Types of Bioremediation, Factors affection Bioremediation .Bioremediation Mechanisms.Limitations of Bioremediations. Microbes for Bioremediation :Essential Chararcteristics of Microbes for Bioremediation, Microbial Adapadation for Adverse conditions. Microbes involved in Bioremediation. Metabolic process involved in bioremediation. Bioremediation Techniques : Insitu & Exsitu bioremediation techniques. Phytoremediation

UNIT II SPECIFIC BIOREMEDIATION TECHNOLOGIES **9**

Application, specific advantages and disadvantages of specific bioremediation technologies - land farming, prepared beds, biopiles, composting, bioventing, biosparging, pump and treat method, constructed wet lands, use of bioreactors for bioremediation

UNIT III MOLECULAR TECHNIQUES IN BIOREMEDIATION **9**

Bioremediation of phenols, chlorinated phenols, chlorinated aliphatic compounds, heterocyclic compounds, cyanides, dyes; Rhizoremediation: a beneficial plant-microbe interaction; Molecular techniques in bioremediation- Enhanced biodegradation through pathway engineering; Biodegradation of polyhalogenated compounds by genetically engineered bacteria

UNIT IV NUCLEAR WASTE BIOREMEDIATION **9**

Spent fuel characterisation, storage and disposal; Partitioning, transmutation and conditioning; Measurement of Radioactivity in the environment; Basic actinide research

UNIT V HEAVY METAL AND OIL SPILL BIOREMEDIATION **9**

Heavy metal pollution & sources; Microbial interactions with heavy metals - resistance &tolerance ;Microbial transformation; Accumulation and concentration of metals. Biosorption of heavy metals by microbial biomass and secondary metabolites Ã¢?? Biosurfactants. Advantages of biosurfactants over chemical surfactants.; Biotechnology and oil spills; Improved oil recovery

TOTAL: 45 HOURS

TEXT BOOKS

1. Bruce E. Rittmann, Perry L. McCarty, Environmental Biotechnology: Principles and Applications, McGraw-Hill, 2001

2. Phillip L. Buckingham , Jeffrey C. Evans, Hazardous Waste Management, Waveland Pr Inc; Reissue edition 1, 2010
3. S. K. Agarwal, Environmental Biotechnology, APH Publishing, 2000
4. Martin Alexander, Biodegradation & Bioremediation, Academic press, 1999
5. Karrely D., Chakrabarty K., Omen G.S, Biotechnology and Biodegradation, Portfolio Pub. Co., 1990.
6. P. Rajendran, P. Guansekaran, Microbial Bioremediation, Mjp Publishers, 2011

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

21PBT29 **CHEMICAL REACTION ENGINEERING** **L T P C**
3 0 0 3

Course Objectives

To enable the students

- Understand types of reactors and find rate constants for different reactions.
- Enable students to calculate selectivity, reactivity, and yield for mixed reactions
- Understand principles of reaction kinetics and rate equations.
- Examine how far real reactors deviate from ideal.

Course Outcomes

At the end of the course, learners will be able to

- CO1: Apply the principles of reaction kinetics, formulate rate equations and analyse the batch reactor data
- CO2: Solve problems involving conversion and space time for different types of reactors
- CO3: Analyze the experimental kinetic data
- CO4: Evaluate selectivity, reactivity and yield for parallel and mixed reactions
- CO5: Examine how far real reactors deviate from the ideal
- CO6: Apply the chemical formula for the research purposes

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1			2									1			
2		1					2								
3	1													1	
4			1							2			1		
5															1
6	2					2			3		3		2	2	
6	2					2			3		3		2	2	

3 - High, 2 - Medium, 1 – Low

UNIT I REACTION KINETICS **9**

Reactions: Classifications, order and molecularity, rate equation, rate constant; Concentration and temperature dependence, Activation energy; Search for reaction mechanism; Methods of analyzing batch reactor data: Integral and differential; Analysis of total pressure data obtained in constant volume system, Reaction kinetics of enzymatic reactions.

UNIT II IDEAL REACTOR **9**

Performance equations: batch, plug flow and mixed flow reactors; Space time and Space velocity; Size comparison of single reactors, multiple reactor systems, Recycle reactor and autocatalytic reactions, Reactors for bioprocess industries.

UNIT III NON-IDEAL REACTORS **9**

RTD: Reasons for non-ideality in reactors, RTD function and measurement, RTD in plug flow and mixed flow reactor, Conversion in non ideal flow, relation among E,F and C curve, non - ideal flow models: tank-in-series and dispersion models, Non-ideal models for bioreactors.

UNIT IV HETEROGENEOUS REACTING SYSTEM **9**

Heterogeneous reacting system: Introduction, Ideal contacting patterns, Solid catalysed reactions: Surface kinetics and pore resistance; Kinetics of non catalytic fluid particle systems: Progressive conversion model and shrinking core model; Determination of rate controlling step, Rate controlling step in adsorption.

UNIT V INDUSTRIAL REACTORS **9**

Reactors to carry out G/L reactions on solid catalysts - Trickle bed, slurry, three phase fluidized bed, fluid-fluid and fluid-particle reactors, Multiphase bioreactors.

TOTAL: 45 HOURS

TEXT BOOKS

1. Octave Levenspiel. Chemical Reaction Engineering., 3rd edition, Wiley.2014
2. Fogler, H. Scott. Elements of Chemical Reaction Engineering. PHI learning private limited, 1999
3. Nauman, E. Bruce. Chemical Reactor Design, Optimization, and Scaleup. John Wiley & Sons, 2008

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

21PBT30 **PETROLEUM BIOTECHNOLOGY**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To impart the knowledge about biotransformation in petroleum industries.
- To provide a core foundation for the analysis and design of Bio refineries.

COURSE OUTCOMES:

Upon completion of this course, the student would be able

- To demonstrate an ability to apply various process parameters.
- To conduct an experimental investigation in order to determine biotransformation process.
- To apply bioprocess and biochemical principles in petroleum refineries.
- To maintain a suitable environment to obtain quantitative qualitative outputs.
- To design an equipment for bio-based products to achieve production and yield Specifications in petroleum industries.
- To apply various methods to recovery, refining and remediation in the uses of petroleum and petroleum products.

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2			2			3	2		1	2		3		
2	2		3		3			3			3		2	2	
3	3				3	2	2	2	1		2		3	2	2
4			3		2		2			2		1	2		
5	2		3				3	2			2	2		2	
6	2		2	2	2		2	3			2	2	2	2	2

3 - High, 2 - Medium, 1 – Low

UNIT I INTRODUCTION TO PETROLEUM BIOTECHNOLOGY **9**

Introduction: Petroleum microbiology, principles of biotechnology, Biotransformation of petroleum constituents, Alkane derivatives, Aromatic hydrocarbon derivatives, Factors affecting biotransformation, Reservoir character, Temperature and Pressure effects.

UNIT II MICROBIAL ENHANCED AND BIO UPGRADING OIL RECOVERY **9**

Oil Recovery: Primary, secondary and Tertiary process. Mechanism and effects-permeability, wettability, Biological demulsification of crude oil, Bio desulfurization, Biodemetallization, Biodearomatization. Bio degrading microorganisms-Aerobic and anaerobic biotransformation, Biotransformation of Asphalts. Case studies and challenges.

UNIT III BIO CATALYTIC DESULFURISATION AND DENITROGENATION **9**

Desulfurization-Hydro desulfurization, Adsorptive desulfurization, Oxidative desulfurization. Crudeoil and its fractions-Enzymatic oxidation of organosulfur compounds, Immobilization. Nano biocatalytic desulfurization. Hydro and Thermal denitrogenation, Biocatalytic denitrogenation. Case studies and challenges.

UNIT IV BIOREMEDATION **9**

Kinetics of petroleum biotransformation in soil: Indigenous and augmented microbial population, pollutant type and concentration, soil characteristics studies- soil type, Degree of weathering, nutrient concentration, moisture content, temperature, soil interactions with macro and microorganisms, aeration, acidity-alkalinity, heavy metals, surfactants. Oil spill remediation methods, factors influencing rates of oil spill remediation, bioremediation technology for marine oil spill. Case studies and challenges.

UNIT V THE FUTURE OF PETROLEUM BIOTECHNOLOGY **9**

Biorefining, technology potential, biorefinery products and by products, petroleum nanobiotechnology-modern applications for sustainable future. Challenges and prospects in biotechnology.

TOTAL: 45 HOURS

REFERENCES

1. James G.Speight, Nour Shafik El-Gendy “Introduction to petroleum biotechnology” Elsevier Gulf Professional Publishin-2017

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

21PBT31 **PROCESS CALCULATION & HEAT TRANSFER**

L	T	P	C
3	0	0	3

Course Objectives

- To develop skills of the students in the area of chemical engineering with emphasis in stoichiometry.
- To understand the basic laws of heat transfer and to develop solutions for the problems involving steady state and transient heat conduction in simple geometries.
- To obtain numerical solutions for radiation heat transfer problems and to analyze the heat transfer efficiencies of any engineering systems involving heat exchange.

Course Outcomes

Upon completion of this course, students will be able to

- CO1: Present an overview of industrial chemical Bioprocesses.
- CO2: Develop a fundamental understanding of the basic principles of chemical engineering processes and calculations.
- CO3: Establish mathematical methodologies for the computation of material balances and energy balances.
- CO4: Understand the basic laws of heat transfer & to develop solutions for the problem involving steady state & transient heat conduction in simple geometries.
- CO5: Calculate heat transfer by conduction, convection & thermal radiation realistic cases.
- CO6: Understand the heat transfer equipment's and its application.

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1					1	2	1	1	1	1	1	3	3	
2	2	2	3						2	2		2	3	3	
3	2	2	2	1					1	1		1	1	1	
4	2	2		3			1	1	2	1	2	3	3	3	
5	1	3	3	2	1		1	2				3	3	3	
6	1	3	3	2	1		1	2				3	3	3	

3 - High, 2 - Medium, 1 – Low

UNIT I OVERVIEW OF PROCESS INDUSTRY **9**

Systems of units - fundamental and derived quantities, unit conversion, composition conversionatomic weight, molecular weight, equivalent weight, molar concept, mole percent, weight percent, volume percent, molarity, molality, normality etc., Basics of unit operations and unit processes involved in biotechnology industries and its applications.

UNIT II MATERIAL BALANCES **9**

Overall and component balances; material balances without and with chemical reactions; degrees of freedom; steady and unsteady state; unit operations; recycle and by pass; humidity calculations.

UNIT III ENERGY BALANCE **9**

Fundamentals of energy balance calculations–concepts of heat capacity, latent heat, sensible heat, vapor pressure and internal energy – energy balance with and without chemical reactions.

UNIT IV CONDUCTION AND CONVECTION **9**

Introduction – Conduction – Basic concepts of conduction in solids, liquids and gases – One and two dimensional heat conduction – Critical and optimum insulation thickness. Introduction to unsteady state heat transfer. Principles of convection – Equations of forced and free convection.

UNIT V RADIATION AND HEATEXCHANGERS **9**

Basic laws of heat transfer by radiation – black body and gray body concepts – solar radiations – combined heat transfer coefficients by convection and radiation. Heat Transfer equipment – Double pipe, Shell & tube and Plate type heat exchanger

TOTAL: 45 HOURS

TEXT BOOKS

1. Bhatt B.I and Vora S.M. “Stoichiometry”, Tata McGraw-Hill, New Delhi, 4th Edition. 2004
2. Incropera F.P. “Fundamentals of Heat and Mass Transfer”, John Wiley, 7th edition. 2011.

REFERENCES

1. Yunus Cengel, “Heat and Mass Transfer – Fundamentals & Applications”, McGraw-Hill, 5th edition, 2015.
2. K.V. Narayanan, B.Lakshmikutty, “Stoichiometry and Process calculations”, Prentice hall of India, 2nd edition. 2017

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

21PBT32 COMPUTATIONAL METHODS FOR BIOCHEMICAL ENGINEERING

L	T	P	C
3	0	0	3

Course Objectives

- To ensure the strong knowledge in biochemical models
- To understand the formulation, modelling of Biochemical processes

Course Outcomes

Upon completion of this course, students will be able to

- CO1. Understand the formulations of Physical problems
- CO2. Understand the formulations of finite difference methods
- CO3. Understand the concepts of probability
- CO4. Apply the knowledge to mathematics in designing computational models
- CO5. Understand the concepts of Data analysis in chemical engineering
- CO6. Apply the data analysis concepts in graphical representation.

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2	2		2							2	2	2	2
2	2	3	2		2							2	2	2	2
3	3	3	2		2							2	3	2	3
4	3	3	2		2							2	3	2	3
5	3	3	2		2							2	3	2	3
6	2	2	2		2							2	2	2	2

3 - High, 2 - Medium, 1 – Low

UNIT I MATHEMATICAL FORMULATION OF THE PHYSICAL PROBLEM 9

Formulation of the differential Equation: Application of law of conservation of Mass, Momentum and Energy.

UNIT II MATHEMATICAL FORMULATION OF FINITE DIFFERENCE EQUATION 9

Finite difference methods in analysis of stage wise processes, numerical solution of partial differential equation.

UNIT III PROBABILITY THEORY 9

Handling stochastic phenomena, groundwork for statistics. Vectors and matrices: applied to population dynamics, quantitative genetics and statistics.

UNIT IV DYNAMICAL SYSTEMS 9

Techniques to analyse models of population growth, reaction kinetics, etc.

UNIT V DATA ANALYSIS 9

Application in data processing, Statistical analysis of data, Regression. Analysis of variance, Interpolation, Graphical representations of various Chemical Engineering problem both in laboratory exercise and core subjects such as Mechanical operation, Reaction Engineering, Distillation etc.,

TOTAL: 45 HOURS

TEXT BOOKS

1. Applied Mathematics in Chemical Engineering, Mickley, H.S., Sherwood, T.K., and Reed, C.E., McGraw Hill, N.Y.
2. Mathematical models in biology. L. Edelstein-Keshet McGraw-Hill Education, ISBN 0075549506.

REFERENCES

1. Calculus for biology and medicine ,C. Neuhauser. Prentice Hall, ISBN 0131234412.
2. Mathematical techniques by D. W. Jordan & P. Smith. Oxford University Press, ISBN 0199249725.
3. Dynamic models in biology by S. P. Ellner & J. Guckenheimer. Princeton University Press, ISBN-10: 0691125899

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

VERTICAL - V (Animal Biotechnology)							
S.No.	**Course Code**	**Course Title**	**Category**	**L**	**T**	**P**	**C**
THEORY							
1	21PBT33	Fundamentals of Animal Biotechnology	PE	3	0	0	3
2	21PBT34	Animal Health and Nutrition	PE	3	0	0	3
3	21PBT35	Animal Physiology and Metabolism	PE	3	0	0	3
4	21PBT36	Animal Cell Culture Technology	PE	3	0	0	3
5	21PBT37	Advances in Animal Biotechnology	PE	3	0	0	3
6	21PBT38	Biotechniques in Animal Breeding	PE	3	0	0	3
7	21PBT39	Animal Genomics	PE	3	0	0	3
8	21PBT40	Developmental Biotechnology	PE	3	0	0	3

21PBT33 FUNDAMENTALS OF ANIMAL BIOTECHNOLOGY

L	T	P	C
3	0	0	3

COURSE OBJECTIVE:

- To provide the fundamentals of animal cell culture, details of the diseases and therapy
- To offer the knowledge about the micromanipulation and transgenic animals

COURSE OUTCOMES:

Upon completion of this subject the student will be able to

- CO1. Understand the origin and evolution of life
- CO2. Understand the animal diversity and natural selection in animals
- CO3. Understand the structural organisation of animal cell and techniques in cell culture
- CO4. Know the concepts of micromanipulation technology
- CO5. Understand the transgenic animal technology
- CO6. Understand and apply the various cell culture techniques

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	3												3	1
2						2		3							
3	2	3	2											2	2
4	2	2	2			1		2						3	2
5	3	2	2			1	2	2						3	1
6	2	3	2			1	2	2						3	2

3 - High, 2 - Medium, 1 – Low

UNIT I ORIGIN AND EVOLUTION OF LIFE **9**

Theories of the origin of life, early earth, modern self-assembly theories, Oparin Haldane theory of chemical evolution, The Miller Urey experiment, Organic evolution, Development of evolution theory, Darwin's theory, Origin and evolution of human being.

UNIT II ANIMAL DIVERSITY **9**

Basis of classification, levels of organization (Symmetry, diploblastic and triploblastic organization),Coelom, segmentation, Notochord. The nature of natural selection, Examples of natural selection, levels of selection, selection of organisms and groups, species selection.

UNIT III STRUCTURAL ORGANIZATION AND CELL CULTURE TECHNIQUES **9**

Animals Tissues: Epithelial Tissue, connective Tissue, Muscle Tissue, Neural Tissue. Culturing of cells, primary and secondary cell lines, Cell culture-Scaling up of animal cell culture- monolayer culture, suspension culture;

UNIT IV MICROMANIPULATION OF EMBRYOS **9**

What is micromanipulation technology; equipments used in micromanipulation; enrichment of x and y bearing sperms from semen samples of animals; artificial insemination and germ cell manipulations; in vitro fertilization and embryo transfer; micromanipulation technology and breeding of farm animals.

UNIT V TRANSGENIC ANIMALS **9**

Concepts of transgenic animal technology; strategies for the production of transgenic animals and their importance in biotechnology; stem cell cultures in the production of transgenic animals.

TOTAL: 45 PERIODS

REFERENCES

1. Sue Dallas, Emily Jewell. Animal Biology and Care Wiley-Blackwell; 3rd edition.
2. Franklin Shull A, George R. Larue, Alexander G. Ruthven. Principles of animal biology. Mc GrawHill agricultural and Biological publications.
3. Ranga M.M. Animal Biotechnology. Agrobios India Limited, 2002
4. Ramadass P, Meera Rani S. Text Book Of Animal Biotechnology. Akshara Printers, 1997.

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

21PBT34 **ANIMAL HEALTH AND NUTRITION**

L	T	P	C
3	0	0	3

COURSE OBJECTIVE:

To provide the basic nutritional requirements for laboratory animals

To gain knowledge about the animal health management and its behavior

COURSE OUTCOMES:

Upon completion of this subject the student will be able to

- CO1. Understand the basic nutritional requirements
- CO2. Know the various diseases and its management.
- CO3. Understand about the various animal disease disgnosis
- CO4.Know the concepts of animal vaccines and therapeutic methods
- CO5. Understand the behavior of animal on experiments
- CO6. Apply various knowledge of animal health and nutrition in experimental research.

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1												2			2
2	2											2			2
3	2	3										2			2
4	2											2			2
5	2											2			2
6	2	2													2

3 - High, 2 - Medium, 1 – Low

UNIT I BASIC NUTRITIONAL REQUIREMENTS AND FEEDING 9

Nutritional requirements for rat, Mice, guinea pigs, rabbit. Types of diets: Natural, semi synthetic and synthetic. Feeding of water, nutrition's to kids, young adults, mature adults. Significance of carbohydrates, lipids, proteins, major minerals, trace minerals, fat soluble vitamins, water soluble vitamins.

UNIT II ANIMAL HEALTH AND DISEASE MANAGEMENT 9

Bacterial and viral diseases in animals like rat, Mice, guinea pigs, rabbit, monkeys and horse-Type of diseases, Symptoms, causative agent, colonization and disease transmission. Control of parasites.

UNIT III ANIMAL DISEASE DIAGNOSIS 9

Monoclonal antibodies and their use in diagnosis; Antigen-antibody based diagnostic assays including radioimmunoassay and enzyme immunoassays; Immunoblotting; Nucleic acid based diagnostic methods including nucleic acid probe hybridization; Restriction endonuclease analysis; PCR, Real time PCR; Nucleic acid sequencing; Probiotics.

UNIT IV ANIMAL VACCINES AND THERAPEUTICS 9

Introduction to the concept of vaccines; Conventional methods of vaccine production; Recombinantapproaches to vaccine production; Recombinant cytokines and their use in the treatment of animal infections; monoclonal antibodies in therapy; gene therapy for animal diseases.

UNIT V ANIMAL BEHAVIOR IN EXPERIMENTAL RESEARCH 9

Types of behavior, Behavioral observation of Mice, guinea pigs, rabbit. neuroscience research, chicken welfare, Spatial behavior, rat social behavior, zebrafish studies. Live stock and wild life summary data sheet.

TOTAL: 45 PERIODS

REFERENCES

1. Ranga M.M. Animal Biotechnology. Agrobios India Limited, 2002
2. Ramadass P, Meera Rani S. Text Book Of Animal Biotechnology. Akshara Printers, 1997.
3. Zipser, B.; Schleking, A.; Kaiser, S.; Sachser, N. (2014). Effects of domestication of biobehavioural profiles: a comparison of domestic guinea pigs and wild cavies from early to late adolescence. Frontiers in Zoology, 11, 30.
4. Boix, J.; von Hieber, D.; Connor, B. (2018). Gait Analysis for Early Detection of Motor Symptoms in the 6-OHDA Rat Model of Parkinson's Disease. Frontiers in Behavioral Neuroscience, 12, 39.

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

21PBT35 ANIMAL PHYSIOLOGY AND METABOLISM

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To gain knowledge about the animal physiology
- To understand the concept of various system
- To know the nutrient transport and metabolism

COURSE OUTCOMES

Upon completion of this subject the student will be able to

- CO1. Understand the basics of animal physiology
- CO2. Know the operations of Blood and Circulatory System
- CO3. Understand the functions of Respiratory and Digestive System
- CO4. Understand the nutrient transport and metabolism
- CO5. Learn the micromanipulation technique
- CO6. Apply the micromanipulation techniques in breeding farm animals

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1												2			
2												2			
3												2			
4												2			
5	2			2								2			
6	2	2		2								2			2

3 - High, 2 - Medium, 1 – Low

UNIT I INTRODUCTION TO ANIMAL PHYSIOLOGY 9

The various physiological organ-•-systems and their importance to the integrative functions of the animal body. The concept of homeostasis, including set point, negative and positive feedback loops, and compensatory responses. Body fluid and its dynamics. Transport of through biological membranes.

UNIT II BLOOD AND CIRCULATORY SYSTEM 9

Composition of blood, structure & functioning of its constitutes. Blood coagulation and anti--coagulants. Hemoglobin and its polymorphism. Anaemias. Sreticule-•-endothelial System. Body defense mechanism and immunogenesis. Structure andfunctions of the cardiovascular system, including the mechanical and electrical properties of cardiac muscle function. Excitation--contraction coupling in cardiac muscle. Reflex regulation of blood pressure.

UNIT III RESPIRATORY SYSTEM AND DIGESTIVE SYSTEM 9

Respiration:Structure and functions of the respiratory system,Structure and functions of smooth muscle,including excitation-•-contraction coupling in smooth muscle.Digestion:Structure, function and physiology of digestive system. Control of motility and secretion ofalimentary canal and reflexes in the control of digestive functions. Control of rumen motility.Digestion in ruminant and monogastric animals.

UNIT IV NUTRIENT TRANSPORT AND ENERGY METABOLISM 9

Food, energy, ATP,carbohydrates, lipids, proteins, major minerals, trace minerals, fat solublevitamins, water soluble vitamins, metabolic disorders, comparative nutrition, nutrigenomics, endocrinology, ruminology.

UNIT V MICROMANIPULATION OF EMBRYOS AND REPRODUCTION 9

What is micromanipulation technology; equipments used in micromanipulation; enrichment of x and y bearing sperms from semen samples of animals; artificial insemination and germ cell manipulations; in vitro fertilization and embryo transfer; micromanipulation technology and breeding of farm animals.

TOTAL: 45 PERIODS

REFERENCES

1. Schmidt-•-Nielsen, Animal Physiology, Cambridge University Press.
2. Christopher D. Moyes and Patricia M. Schulte, Principles of Animal Physiology, PearsonPress.
3. Arthur C. Guyton and John E. Hall, Textbook of Medical Physiology, W.B. Saunders

Company.
4. William S. Hoar, General and Comparative Animal Physiology, Prentice Hall, India
5. Animal Physiology, Richard W, Gordon A and Margaret A. Sinauer Associates, USA
6. Ranga M.M. Animal Biotechnology. Agrobios India Limited, 2002
7. Ramadass P, Meera Rani S. Text Book Of Animal Biotechnology. Akshara Printers, 1997.

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

21PBT36 **ANIMAL CELL CULTURE TECHNOLOGY**

L	T	P	C
3	0	0	3

COURSE OBJECTIVE:

- To know the basic requirements of animal cell culture laboratory
- To understand the cell culture media, types and reactors
- To understand the applications of cell culture

COURSE OUTCOME:

Upon completion of this subject the student will be able to

- CO1. Understand the basic requirements of lab facility
- CO2. Know the various types of media and its preparation
- CO3. Understand the bioreactor and growth of cells
- CO4. Learn the role of genetic engineering in animal cell culture
- CO5. Understand the valuable products from animal cell
- C06. Apply the knowledge of cell culture technology in production of valuable products

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1											2			
2	2														
3	2				2										2
4	2				2										2
5	2				2										2
6	2	2			2										2

3 - High, 2 - Medium, 1 – Low

UNIT I **BASIC REQUIREMENTS OF LAB FACILITY** **9**

Safety: biosafety levels, SDS, safety equipments, personal protective equipments, safe laboratory practices.cell culture equipments: basic equipments - centrifuge, Inverted microscope, confocal microscope, flow cytometer, Hemocytometer, cell culture vessels, bioreactors. Cell culture laboratory: Aseptic work area, Cell culture hood, Incubator, cryostorage,cell counter, aseptic technique, Maintenance of nutrients, prevention of cross contamination.

UNIT II **MEDIA PREPARATION AND TYPES** **9**

Media components-Serum, tissue extracts, growth factors, hormones, carrier proteins, lipids, vitamins, additive, detergents. Types: natural media, synthetic media, chemically defined andserum free media — advantages, disadvantages, BSS, CMRL, Eagle's, RPMI, animalcell cultures, their maintenance and preservation;

UNIT III **BIOREACTORS AND GROWTH OF CELLS** **9**

Bioreactor process control, stirred animal cell culture, Air-lift fermentor, hemostat/Turbidostat;Culturing: various types of cultures suspension cultures,continuous flow cultures, immobilized cultures; somatic cell fusion; growth of cells.

UNIT IV **GENETIC ENGINEERING OF ANIMAL CELL** **9**

Gene therapy-prospects and problems, Recent advancements in Gene therapy; Knock out mice and mice model for human genetic disorder; Baculo virus in biocontrol; Enzymes technology, Somatic manipulation of DNA, Nucleic acid hybridization and probes in diagnosis- preparation of probes, evaluation and applications.Recent advancements in diagnostic tool development and its diagnostic procedure

UNIT V **PRODUCTS FROM ANIMAL CELL** **9**

Enzymes – asperagenase, collagenase, urokinase, pepsin, hyaluronidase. Hormones- leutinizing hormones, FSH, chronic. Vaccines - FMD, measles and mumps, rubella, rabies monoclonal antibodies, interferons, plasminogen activator.

TOTAL: 45 PERIODS

REFERENCES

1. Watson, J.D., Gilman, M., WitowskiJ. and Zoller, M. Recombinant DNA, 3rd ed., ScientificAmerican Books, 2007

2. Glick, B.R. and Pasternack, J.J. Molecular Biotechnology, 3rd ed., ASM Press, 2003
3. Lewin, B. Genes VIII , Pearson Prentice Hall, 2004.
4. Davis J.M. Basic Cell Culture: A Practical Approach, IRL Press, 2nd ed., 2002
5. Freshney R.I. Animal Cell Culture- a practical approach, 6th ed., 2010

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

21PBT37 **ADVANCES IN ANIMAL BIOTECHNOLOGY**

L	T	P	C
3	0	0	3

Course Objectives

- To educate the students about the scope, regulatory issues and commercially available products produced using of animal biotechnology.
- To provide depth knowledge about the available viral vectors that can be used to create recombinant DNA for gene therapy purposes so that they can undertake research/project work related to biopharming.
- To teach the importance of cell culture study for invitro study purposes and for scaling up the products at commercial level.
- To educate the principle behind invitro fertilization and biopharming in order to create transgenic animal of commercial importance.

COURSE OUTCOME:

After completion of the course the students will be able to:

- CO1. Understand the scope, regulatory issues and commercially available products produced using of animal biotechnology.
- CO2. Gain knowledge about the available viral vectors that can be used to create recombinant DNA for gene therapy purposes so that they can undertake research/project work related to biopharming.
- CO3. Understand the importance of cell culture study for invitro study purposes and for scaling up the products at commercial level.
- CO4. Gain knowledge in creating recombinant products for gene therapy purpose and the importance of molecular probe which is an important tool for medical and forensic studies.
- CO5. Understand the principle behind invitro fertilization and biopharming in order to create transgenic animal of commercial importance.
- CO6. Apply various advances in Animal Biotechnology

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1															
2	2														
3	2				2										
4	2				2										
5	2				2										
6	2	2			2										

3 - High, 2 - Medium, 1 – Low

UNIT I **BASICS OF ANIMAL BIOTECHNOLOGY** **9**

Scope of Animal Biotechnology, Animal Biotechnology for production of regulatory proteins, bloodproducts, vaccines, hormones and other therapeutic proteins.

UNIT II **MOLECULAR BIOLOGY** **9**

Biology of animal viral vectors- SV40, adeno virus, retrovirus, vaccinia virus, herpes virus, adenoassociated virus and baculo virus. Applications of commercially available viral vectors and their prosand cons.

UNIT III CELL CULTURE TECHNOLOGY IN ANIMAL SCIENCE **9**

Culturing of cells, primary and secondary cell lines, Cell culture-Scaling up of animal cell culture- monolayer culture, suspension culture; Various bio-reactors used for animal cell culture-Roller bottleculture; Bioreactor process control, stirred animal cell culture, Air-lift fermentor, hemostat/Turbidostat;High technology vaccines; Hybridoma technology; Cell lines and their applications

UNIT IV **GENETIC ENGINEERING APPLICATIONS IN ANIMAL SCIENCE** **9**

Gene therapy-prospects and problems, Recent advancements in Gene therapy; Knock out mice andmice model

for human genetic disorder; Baculo virus in biocontrol; Enzymes technology, Somaticmanipulation of DNA, Nucleic acid hybridization and probes in diagnosis- preparation of probes,evaluation and applications.Recent advancements in diagnostic tool development and its diagnosticprocedure

UNIT V ADVANCEMENTS AND APPLICATIONS IN ANIMAL BIOTECHNOLOGY 9

Rumen manipulation- probiotics embryo transfer technology, invitro fertilization, transgenesis- methods of transferring genes into animal oocytes, eggs, embryos andspecific tissues byphysical,chemical and biological methods; Biopharming –Transgenic animals (case study : Mice,Cows, Pigs,Sheep, Goat, Birds and Insects); Artificial insemination and embryo transfer.

TOTAL: 45 PERIODS

REFERENCES

1. Watson, J.D., Gilman, M., WitowskiJ. and Zoller, M. Recombinant DNA, 3rd ed., ScientificAmericanBooks, 2007
2. Glick, B.R. and Pasternack, J.J. Molecular Biotechnology, 3rd ed., ASM Press, 2003
3. Lewin, B. Genes VIII , Pearson Prentice Hall, 2004.
4.. Davis J.M. Basic Cell Culture: A Practical Approach, IRL Press, 2nd ed., 200

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

21PBT38 BIO-TECHNIQUES IN ANIMAL BREEDING

L	T	P	C
3	0	0	3

COURSE OBJECTIVE:

- To educate the students about the basic tools requirement for cell culture and micromanipulation
- To provide depth knowledge about micromanipulation and application.
- To teach the importance of stem cell mediated production and guidelines.

COURSE OUTCOME:

Upon completion of the course the student will able to

- CO1. Understand the concept of basic tools requirement for cell culture and micromanipulation
- CO2. Gain knowledge on micromanipulation and its application
- CO3. Know the concept of stem cells and ES cell of transgenic animals.
- CO4. Understand the research importance in transgenic animals.
- CO5. Gain knowledge on ethical CPCSEA guidelines
- CO6. Apply the ethical guidelines and maintain records for animal breeding application

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2				2										
2	2				2										
3	2				2										
4		2													
5								2				2			
6								2				2			

3 - High, 2 - Medium, 1 – Low

UNIT I BASIC TOOLS REQUIREMENTS FOR CELL CULTURE AND MICROMANIPULATION 9

Biosafety levels, safety equipments, personal protective equipments, safe laboratory practices. cell culture equipments: basic equipments - centrifuge, Inverted microscope, confocal microscope, flow cytometer, Hemocytometer, cell culture vessels, bioreactors. Cell culture laboratory: Aseptic work area, Cell culture hood, Incubator, cryostorage,cell counter, aseptic technique, Maintenance of nutrients, prevention of cross contamination. Micromanipulation tools: micromanipulator, pipette puller, pipette grinder, holding pipette,

UNIT II MICROMANIPULATION AND ITS APPLICATION 9

Enrichment of x and y bearing sperms from semen samples of animals; artificial insemination and germ cell manipulations; in vitro fertilization and embryo transfer; micromanipulation technology andbreeding of farm animals.

UNIT III STEM CELLS AND TRANSGENIC ANIMALS 9

Stem cells – sources, types, uses, ES cells, pluripotent stem cells, adult stem cell, epithelial stemcell, bone marrow and hematopoietic, neural stem cell, transgenic techniques, Stem cell mediated transgenic animals

UNIT IV TRANSGENIC ANIMALS IN RESEARCH 9

Ethics of transgenic technology, Dolly (transgenic sheep), Transgenic mice, rat, sheep, goat,rabbit, pig, fish, cow- case studies.

UNIT V ETHICAL GUIDELINES ON ANIMAL BREEDING 9

Justification on research, care and housing of laboratory animals, acquisition of laboratory animals,experimental procedure, CPCSEA guidelines. Animal integrity and ethical limits to breeding. Animal welfare issues. Record Maintenance as per guidelines.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Frieder Schelfer and Florian Schubert Biosensors Elsevier Science Publications 1992

2. Challa Kumar Nanomaterials for Biosensors Wiley-VCH Verlag GMBH, Germany 2007.

3. Floriner-Gabriel Banica Chemical sensors and Biosensors-Fundamentals and Applications, John-Wiley & Sons Ltd, 2012.

REFERENCES

1. Watson, J.D., Gilman, M., WitowskiJ. and Zoller, M. Recombinant DNA, 3rd ed., ScientificAmerican Books, 2007
2. Glick, B.R. and Pasternack, J.J. Molecular Biotechnology, 3rd ed., ASM Press, 2003
3. Lewin, B. Genes VIII , Pearson Prentice Hall, 2004.

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

21PBT39 **ANIMAL GENOMICS**

L	T	P	C
3	0	0	3

Course Objectives

- To ensure the strong knowledge in animal genomics
- To understand the techniques of gene therapy and its application in various industry

Course Outcomes

Upon completion of this course, students will be able to

- CO1. Understand the concept of Animal Gene and Genomes
- CO2. Understand the Genetic markers in Animals.
- CO3. Know the concepts of Bioinformatics in animal genomics
- CO4. Understand the concepts of Gene Therapy.
- CO5. Know the issues and policies in animal genomics
- CO6. Apply various policies of genomics during experimental studies.

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1														
2	2				3										2
3	2				2										2
4	2				2										2
5												2			
6												2			

3 - High, 2 - Medium, 1 – Low

UNIT I GENE AND GENOME **9**

Chromosome structure and organization -Gene structure and organization- Eukaryotic gene, Prokaryotic gene- Anatomy of the eukaryotic genome- The Human Genome Project- Genomics and it's types- Mapping genomes- Regulation of gene expression -Regulation of gene expression in eukaryotes- Role of genomics in animal improvement.

UNIT II GENETIC MARKERS USED IN ANIMAL GENOMICS **9**

Quantitative and molecular genetics-Molecular markers-Restriction fragment length polymorphism (RFLP), Random amplified polymorphic DNA (RAPD),Amplified fragment length polymorphism (AFLP),Microsatellites,Minisatellites,ingle nucleotide polymorphisms (SNPs)-Allozyme markers-Mitochondrial DNA (mtDNA), Functions and uses of mtDNA,Maternal transmission,Heteroplasmy,Recombination, Applications of mtDNA markers- DNA barcoding markers,Animal identification by DNA barcoding-Marker assisted selection (MAS)

UNIT III BIOINFORMATICS IN ANIMAL GENOMICS **9**

Need for bioinformatics in animal genomics- Genomic bioinformatics processes- DNA sequencing(First generation sequencing, Second generation sequencing, Third-generation sequencing, Fourth- generation sequencing)- Technologies to assess gene expression- Differential display, Microarrays - Tools for genomic data manipulation- Animal genomes available in NCBI.

UNIT IV GENE THERAPY **9**

Genes- Gene therapy- Use of gene therapy- Types of gene therapy: somatic and germline- Types of vectors- Techniques of gene therapy-History of human gene therapy-CRISPR gene editing-Gene therapy in animals

UNIT V ISSUES AND POLICIES IN ANIMAL GENOMICS **9**

Global (transcontinental) scenario in transgenic animal research: issues and policies- Genomics vis-a-vis Indian policy and regulations: current deliberations - Mechanism of implementation of biosafety guidelines in India- Assessment of environmental risk- Hazards associated with the inserted gene/element.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Frieder Schelfer and Florian Schubert Biosensors Elsevier Science Publications 1992
2. Challa Kumar Nanomaterials for Biosensors Wiley-VCH Verlag GMBH, Germany 2007.

3. Floriner-Gabriel Banica Chemical sensors and Biosensors-Fundamentals and Applications, John-Wiley & Sons Ltd, 2012.

REFERENCES

1. P. N. Bartlett (Ed.) Bioelectrochemistry- Fundamentals, Experimental techniques and applications, John Wiley & Sons, England 2008.

2. Nalwa (Ed.) Encyclopedia of Nanoscience and Nanotechnology 1 Vol. 5, 2004.

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

21PBT40 **DEVELOPMENTAL BIOLOGY**

L	T	P	C
3	0	0	3

Course Objectives

- To ensure the strong knowledge in Developmental Biology
- To Understand the various stages in Development Biology

Course Outcomes

Upon completion of this course, students will be able to

- CO1. Understand the concepts of Developmental Biology
- CO2. Understand the early embryonic develoment.
- CO3. Know the embryonic development in later stages
- CO4. Understand the theories of post embryonic development.
- CO5. Understand and Apply the implications of Developmental Biology
- CO6. Understand the effects of embryonic development biology

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1												2			
2												2			
3												2			
4												2			
5	2											2			
6	2											2			

3 - High, 2 - Medium, 1 – Low

UNIT I INTRODUCTION **9**

Historical perspective and basic concepts: Phases of development, Cell-Cell interaction, Pattern formation, Differentiation and growth, Differential gene expression, Cytoplasmic determinants and asymmetric cell division

UNIT II EARLY EMBRYONIC DEVELOPMENT **9**

Gametogenesis, Spermatogenesis, Oogenesis; Types of eggs, Egg membranes; Fertilization (External and Internal): Changes in gametes, Blocks to polyspermy; Planes and patterns of cleavage; Types of Blastula; Fate maps (including Techniques); Early development of frog and chick up to gastrulation; Embryonic induction and organizers

UNIT III LATE EMBRYONIC DEVELOPMENT **9**

Fate of Germ Layers; Extra-embryonic membranes in birds; Implantation of embryo in humans, Placenta (Structure, types and functions of placenta)

UNIT IV POST EMBRYONIC DEVELOPMENT **9**

Metamorphosis: Changes in amphibians and insects; Regeneration: Modes of regeneration, epimorphosis, morphallaxis and compensatory regeneration (with one example each); Ageing: Concepts and Theories

UNIT V IMPLICATIONS OF DEVELOPMENTAL BIOLOGY **9**

Teratogenesis: Teratogenic agents and their effects on embryonic development; In vitro fertilization, Stem cell (ESC), Amniocentesis

TOTAL: 45 PERIODS

TEXT BOOKS

1. Gilbert, S. F. (2010). Developmental Biology, IX Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA
2. Balinsky B. I. and Fabian B. C. (1981). An Introduction to Embryology, V Edition, International Thompson Computer Press
3. Carlson, R. F. Patten's Foundations of Embryology Kalthoff (2008). Analysis of Biological Development, II Edition, McGraw-Hill Publishers
4. Lewis Wolpert (2002). Principles of Development. II Edition, Oxford University Press

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

VERTICAL - VI (Computational Biotechnology)							
S.No.	**Course Code**	**Course Title**	**Category**	**L**	**T**	**P**	**C**
THEORY							
1	21PBT41	Programming for Bioinformatics Applications	PE	3	0	0	3
2	21PBT42	Fundamentals of Algorithms for Bioinformatics	PE	3	0	0	3
3	21PBT43	Molecular Modelling	PE	3	0	0	3
4	21PBT44	Computer Aided Drug Design	PE	3	0	0	3
5	21PBT45	Metabolomics and Metabolic Engineering	PE	3	0	0	3
6	21PBT46	Data Mining and Machine Learning Techniques for Bioinformatics	PE	3	0	0	3
7	21PBT47	Bio-python	PE	3	0	0	3
8	21PBT48	Genomics and Proteomics	PE	3	0	0	3

21PBT41 PROGRAMMING FOR BIOINFORMATICS APPLICATIONS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To improve the programming skills and database development of the student.
- To introduce the fundamentals of Perl programming language to the student.
- To familiarize with Perl modules and to write scripts for manipulating/processing genomicand proteomic data

COURSE OUTCOMES

Upon completion of this course,Students will be able to

- CO1. Understand the basics of Linux operating system and the SQL for database creation andmanagement.
- CO2. Use the Perl data types to construct programs in Perl.
- CO3. Understand various operators and its usage.
- CO4. Understand the expression of various characters in Perl.
- CO5. Apply the knowledge of Perl in Biotechnological Applications
- CO6. Know the importance of Bio-Perl

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1		2		2		1						2		
2	1							2		2				2	
3	1		2	1								3			
4		1				2		2			3			2	
5							2				2				2
6	1		2	1								3			

3 - High, 2 - Medium, 1 – Low

UNIT I INTRODUCTION **9**

Introduction to Operating systems, Linux commands, File transfer protocols FTP and telnet, Data life cycle, Database management system models. Structured Query Language (SQL) - Data Definition Language (DDL), Data Manipulation Language (DML) and Query by example.PL/SQL - Stored procedure, Database triggers; Relational Data Base Management system.

UNIT II PERL PROGRAMMING **9**

Perl overview, variables and data types, control Structure, loops- while loop, for loop, until loop,File handles - opening and closing files, reading and writing file handles, Library Functions: String specific functions, User defined functions.

UNIT III OPERATORS **9**

Arithmetic Operators, Assignment Operators, Logical operators, Equality Operators, Increment and Decrement Operators, String Concatenation and Repetition, Operators precedence and Associativity, Conditional Operators, Logical Operators, Operators for manipulating arrays, Operators for Manipulating hashes.

UNIT IV REGULAR EXPRESSIONS **9**

Simple characters, * special character, . character, | character, Grouping with ()s, anchor characters, pattern matching, regular expression shortcuts, defining subroutines, returning values, using arguments, inheritance in Perl, polymorphism in Perl.

UNIT V APPLICATIONS OF PERL IN BIOINFORMATICS **9**

Concatenating DNA Fragments, Transcription: DNA to RNA, Reading Protein Files, Finding Motifs, Simulating DNA, Generating Random DNA, Analysing DNA, Translating DNA to Proteins, Reading DNA from Files in FASTA format, Separating Sequence and Annotation, Parsing Annotation,Parsing PDB files, Parsing BLAST output, Bio-perl .

TOTAL: 45 HOURS

TEXT BOOKS

1. James Tisdall, “Beginning Perl for Bioinformatics”, O’Reilly & Associates, 2001
2. James Tisdall, “Mastering Perl for Bioinformatics”, O’Reilly, 2003.
3. Elmasri and Navathe. 2006. Fundamentals of Database Systems. Addison Wesley.

REFERENCES

1. Cynthia Gibas& Per Jambeck, “Developing Bioinformatics Computer Skills”, O’Reilly & Associates, 2000.
2. Rex A. Dawyer, “Genomic Perl”, Cambridge University Press 3. Learning Perl, 3rd Edition , Author: Randal L. Schwartz and Tom Phoenix, O’Reilly

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

21PBT42 FUNDAMENTALS OF ALGORITHMS FOR BIOINFORMATICS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To study various Algorithm design techniques and applying it in bioinformatics.
- To understand the algorithms such as Dynamic programming, HMM and ANN in Biological applications.

COURSE OUTCOMES:

Upon completion of this course,
Students will be able to

- CO1. Understand the basics of algorithms used in Bioinformatics.
- CO2. Apply dynamic programming in sequence analysis.
- CO3. Analyze the macromolecules using HMM.
- CO4. Understand the concepts of ANN and other related algorithms
- CO5. Apply and Understant DNA related algorithms
- CO6. Understand the applications of various algorithm in Biotechnology

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1		1				2									
2			3		2	3									1
3			2		3	3									1
4		3	2			2								1	1
5			2		2	3								2	
6	1				1									2	

3 - High, 2 - Medium, 1 – Low

UNIT I INTRODUCTION TO ALGORITHMS **9**

Algorithms-Complexity of algorithms and running time, Polynomial, NP complete problems,Recursion, Linear, Exhaustive search, Branch and Bound, divide and conquer algorithms,Travelling sales man problem, sorting.

UNIT II DYNAMIC PROGRAMMING AND SEQUENCE BASED ALGORITHMS **9**

Dynamic programming Principles and its uses. Local and Global alignment principles, Finding longest common subsequences, Heuristics second generation alignment tools for database searching : (Blast, FASTA, ClustalW), Statistical and Similarity based methods for gene prediction, Models of evolution.

UNIT III EXACT MATCH AND HIDDEN MARKOV MODELS **9**

Knuth-Morris- Pratt and Boyer-Moore algorithm for exact match and graph and maximumlikelihood algorithm, Hidden Markov Model: Forward and Backward Algorithms, Most probablestate path: Viterbi algorithm, Parameter Estimation for HMMs:-Baum-Welch Algorithm, EMAlgorithm, Applications of profile HMMs for multiple alignment of proteins and for finding genesin the DNA.

UNIT IV ARTIFICIAL NEURAL NETWORKS **9**

Introduction to Artificial Neural Networks (ANN): A Simple Neuron, Firing rule,Network layers, Architectures of Artificial Neural Network: Feed-Forward networks,Feed-Back networks, Perceptrons, Pattern recognition problems, Back PropagationAlgorithm, Applications of Neural Networks.

UNIT V DNA AND RNA RELATED ALGORITHMS **9**

Restriction enzyme mapping algorithms: algorithms for partial digest- double digest problem, Motif finding, Finding regulatory motifs in DNA, DNA computing, Genome alignment, Suffix Trees, RNA secondary structure prediction: Base pair maximisation and the Nussinov folding algorithm, Energy minimization and the Zuker folding algorithm, Design of covariance models, Application of RNA Fold.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Dan Gusfield- Algorthims on Strings, Trees and Sequences : Computer Science and Computational Biology (1997) Cambridge University Press. ISBN-10: 0521585198.

2. Horowitz, S. Sahini, and Rajasekharan : Fundamentals of Computer Algorithms , Galgotia Publications.

REFERENCES

1. Neil C.JonesandPavel .A Pevzner An introduction to BioinformaticsAlgorthims.(computational Molecular Biology) (2004) MIT press. ISBN-10: 0262101068.
2. R. Durbin, S.Eddy, A.Krogh, G.Mitchison Biological sequence analysis : Probabilisticmodels of Proteins and Nucleic acids (2005) Cambridge University Press 0521540798
3. Michael.S.Waterman Introduction to Computational Biology : Maps, Sequences andGenomes . Waterman. Edition 2 (2012) Chapman and Hall/ CRC Press ISBN:1439861315

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

21PBT43 **MOLECULAR MODELING** **L T P C**
3 0 0 3

COURSE OBJECTIVES

The course aims to

- Understand the molecular behaviour of proteins, nucleic acids and small molecules in the biological system.
- Explain the principles involved in molecular modelling

COURSE OUTCOMES

At the end of the course the students will be able to

- CO1. Understand the behaviour of Small and macro molecules in biological system.
- CO2. Understand the concepts of classical mechanics
- CO3. Understand the mechanism of Statistical mechanics
- CO4. Understand the behaviour of molecules using quantum mechanics
- CO5. Simulate the biomolecules using molecular modelling softwares.
- CO6. Assess and utilize various softwares and tools which utilizes quantum and molecular mechanics principles.

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3		2	1										2	
2	2		2	1	3									2	
3	2		2	2	3									3	
4	1		2	1	3									3	
5	1		2	1	3									1	
6	1	2			3								1	2	

3 - High, 2 - Medium, 1 – Low

UNIT I INTRODUCTION TO CLASSICAL MECHANICS 9

Newtons laws of motion – time intervals- algorithms

UNIT II INTRODUCTION TO STATISTICAL MECHANICS 9

Boltzman's Equation – Ensembles – Distribution law for non interacting molecules – Statistical mechanics of fluids.

UNIT III QUANTUM MECHANICS 9

Photoelectric effect – De Broglies hypothesis – Uncertainity principle – Schrodingers time independent equation – particle in a one -dimensional box.

UNIT IV GROMOS , GROMACS, AMBER & DOCK 9

Various forcefields for proteins and nucleic acids – Molecular mechanics – Molecular dynamics– Molecular dynamics simulations in water and organic solvents.

UNIT V GAUSSIAN 9

Preparing input files – job types – model chemistries – basis sets – molecule specifications running Gaussian – examples.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Leach, Andrew R. " Molecular Modelling : Principles and Applications" IInd Edition, Pearson, 2010.
2. Cohen, N.C. " Guide Book on Molecular Modeling in Drug Design" Academic Press/ Elsevier, 1996.

REFERENCES

1. Statistical Mechanics ; D. McQuarrie, Narosa, University Science Books; 1st edition 2000
2. Quantum Mechanics; D. McQuarrie, Narosa, 1999.
3. GROMOS Handbook www.gromacs.org

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

21PBT44 **COMPUTER AIDED DRUG DESIGN**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

The objective of this course is to

- Find a chemical compound that can fit to a specific cavity on a protein target both geometrically and chemically.
- To know the informatics approaches to the prediction of chemical properties of new drugs
- To present the appropriate tools for such a modelling, ranging from electronic Structure
- Methods, Molecular modelling, Structure Activity Relationships in drug design, QSAR,
- Molecular docking and Molecular dynamics

COURSE OUTCOMES:

The students will be able to

- CO1. Gain knowledge about fundamental concepts, challenges, and rich opportunities in developing and applying algorithms for structural bioinformatics and healthcare.
- CO2. Interpret and practice the fundamental concepts of Molecular Modeling and Computer aided Drug Design.
- CO3. Develop practical skills in computational approaches to analyse, predict, and engineer biomolecules and biomolecular systems.
- CO4. Find a chemical compound that can fit to a specific cavity on a protein target both geometrically and chemically.
- CO5. Present the appropriate tools for such a modelling, ranging from electronic Structure methods, Molecular modelling, Structure Activity Relationships in drug design, QSAR, Molecular docking and Molecular dynamics
- CO6. Apply the fundamental tools in techniques like docking, modelling, electronic structure methods which leads to new drug target design.

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3		2	1										2	
2	2		2	1	3									2	
3	2		2	2	3									3	
4	1		2	1	3									3	
5	1		2	1	3									1	
6	1	2			3								1	2	

3 - High, 2 - Medium, 1 – Low

UNIT I ELECTRONIC STRUCTURE METHODS **9**

Quantum chemical methods semi-empirical and ab initio methods. Conformational analysis, energy minimization, predicting the mechanism of organic reactions using electronic structure methods.

UNIT II MOLECULAR MODELING **9**

Bioactive vs. global minimum conformations. Automated methods of conformational search. Advantages and limitations of available software. Molecular graphics. Computer methodologies behind molecular modeling including artificial intelligence methods.

UNIT III STRUCTURE ACTIVITY RELATIONSHIPS IN DRUG DESIGN **9**

Qualitative versus quantitative approaches advantages and disadvantages. Random screening, Non-random screening, rational approaches to lead discovery. Homologation, chain branching, ring-chain transformations. Insights into molecular recognition phenomenon. Structure based drug design, ligand based drug design.

UNIT IV QSAR: ELECTRONIC EFFECTS 9

Hammett equation, lipophilicity effects. Hansch equation, steric effects. Taft equation. Experimental and theoretical approaches for the determination of physicochemical parameters, parameter inter-dependence: Regression analysis, Descriptor calculation. The importance of biological data in the correct form; 2D QSAR; 3D-QSAR examples of CoMFA and CoMSIA.

UNIT V MOLECULAR DOCKING 9

Rigid docking, flexible docking, manual docking. Advantages and disadvantages of Flex-X, Flex- S, Autodock and Dock softwares, with successful examples. Dynamics of drugs, biomolecules, drug receptor complexes, Monte Carlo simulations and Molecular dynamics in performing conformational search and docking.

TOTAL: 45 HOURS

TEXT BOOKS

1. Andrew R. Leach, Molecular Modelling Principle and Application, 2nd Edition, Prentice Hall, England,2001.
2. Richard B. Silverman, Mark W. Holladay, Organic Chemistry of Drug Design and Drug
3. Action, 3rd Edition, Academic Press, USA, 2014.
4. Paul S. Charifson, Practical Applications of computer aided drug design, 1st Edition, Marcel Dekker, New York, 1997.
5. J. M. Goodman, Chemical Applications of Molecular Modelling, The Royal Society of Chemistry, Cambridge, 1998.

REFERENCES

1. Donald J. Abraham, Burger's Medicinal Chemistry and Drug Discovery, Vol V, 6th Edition, John Wiley and Sons, Inc., 2003.
2. John B. Taylor and David J. Triggle, Comprehensive Medicinal Chemistry II, Vol IV, Elsevier Science, 2006.
3. Graham L. Patrick, An Introduction to Medicinal Chemistry, 5th Edition, Oxford University Press, UK, 2013.
4. David. C. Young, Computational Drug Design – A Guide for Computational and Medicinal Chemists, John Wiley and Sons Ltd, Hoboken, United States, 2009.
5. Alan Hinchliffe, Molecular Modelling for Beginners, 2nd Edition, Wiley, United University of California, 2008.

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

21PBT45 METABOLOMICS AND METABOLIC ENGINEERING

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To provide the fundamental knowledge on upcoming field of Metabolomics and the Metabolic engineering in post genomic era.
- To introduce the redesign of metabolism to enable cells to produce new products.

COURSE OUTCOMES:

Upon completion of this course,
Students will be able to

- CO1. Understand the concept of Metabolome and Metabolomics.
- CO2. Apply the Bioinformatics tools in metabolomics.
- CO3. Understand the fundamentals of Metabolic engineering.
- CO4. Analyze the metabolic pathways using flux control.
- CO5. Understand the application of Metabolic Networks
- CO6. Apply the concepts of Metabolic Networks for Biological Applications

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3				2									1	
2	2		2		2									2	
3	1		2		2									1	
4			2	2	2	3	2	2						2	
5				2	2	3	2	2							
6	1				2								2	1	1

3 - High, 2 - Medium, 1 – Low

UNIT I INTRODUCTION TO METABOLOMICS **9**

Role of metabolomics in systems biology –application of metabolomics- Analytical methods in metabolomics – Data standards– Databases for Chemical, Spectral and Biological Data – Reconstruction of dynamic metabolic network model- examples- study of metabolome of a simple organism like *E.coli*.

UNIT II BIOINFORMATICS IN METABOLOMICS **9**

Online databases and pipelines for metabolomics – GC-MS based metabolomics – Computational methods to compute and integrate metabolic data-software for metabolomics- metabolomics and medical sciences

UNIT III INTRODUCTION TO METABOLIC ENGINEERING **9**

Metabolic engineering: introduction, mass balance, black box, metabolic flux analysis, stochiometry, Principles of metabolic engineering, Importance of metabolic engineering-comprehensive models for cellular reactions-material balances & data consistency- metabolic pathway synthesis.

UNIT IV METABOLIC FLUX ANALYSIS **9**

Flux balance analysis, flux balance methods, group based flux balance, metabolic control analysis: overview, control coefficients, methods of measuring control. Flux analysis of networks- top down approach, bottom up approach.

UNIT V METABOLIC NETWORKS AND APPLICATIONS **9**

Kinetic model of metabolic networks-Systems metabolic engineering of *E.coli.* Applications of Metabolomics to biology: examples and case studies, Metabolome informatics, data integration and mining.

TOTAL: 45 HOURS

TEXT BOOKS

1. Jens Hřiriis Nielsen, Michael C. Jewett, “Metabolomics: A Powerful Tool in Systems Biology”, Springer, 2007.
2. Dr. ChristophWittmann, Sang Yup. Lee, “Systems Metabolic Engineering”, Springer 2012.

3. Gregory N. Stephanopoulos, “Metabolic Engineering- Principles and Methodologies”, Academic press, First Edition, 1998.
4. Sang Yup Lee, E. Terry Papoutsakis, “Metabolic engineering”, CRC Press, 1999.’

REFERENCES

1. Tomita M., T. Nishioka, “Metabolomics:The Frontier of Systems Biology”, Springer, 2003.
2. Gregory N. Stephanopoulos, “Metabolic Engineering: Principles and Methodologies”,Academic press, First Edition, 1998.
3. Wolfram Weckwerth, “Metabolomics: Methods And Protocols”, Humana Press, 2007.
4. Cortassa S. “An Introduction to Metabolic and Cellular Engineering”, World scientific public company Ltd., 2002.

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

21PBT46	DATA MINING AND MACHINE LEARNING TECHNIQUES FOR BIOINFORMATICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To learn various data mining techniques used to analyses huge biological data to find the hidden patterns.
- To familiarize students with a new rapidly evolving filed of machine learning and mining

COURSE OUTCOMES

Upon completion of this course,
Students will be able to

- CO1. Know the basic notions and terminology used in Machine learning and Data mining.
- CO2. Understand fundamental principles of modern data analysis.
- CO3. Understand the applications of Machine learning in biological data processing and visualization.
- CO4. Understand the applications of data mining in biological data processing and visualization.
- CO5. Understand the importance of data mining in Biotechnological applications
- CO6. Apply the concepts of data mining for data analysis in Biotechnology.

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3			3	3					2	3		3		3
2	3			3	3										
3	3			3	3										
4	3			3	3										
5	3			3	3										
6	3			3	3					3		2	3		3

3 - High, 2 - Medium, 1 – Low

UNIT I OVERVIEW OF MACHINE LEARNING TECHNIQUES 9

Supervised and unsupervised techniques. Empirical Risk Minimization, Structural Risk Minimization; Measuring the accuracy of learned hypotheses. Comparing learning algorithms: cross-validation, learning curves, and statistical hypothesis testing.

UNIT II MACHINE LEARNING TECHNIQUES 9

Classification: Decision tree, Bayesian, Rule based classification, ANN, SVM, HMM; Case based reasoning and Applications in Bioinformatics. Clustering: Partition Methods, Hierarchical methods, Density based methods, Grid based clustering, Model based clustering, clustering of high dimensional data, constraints based clustering, Analysis of MD trajectories, Protein Array data Analysis.

UNIT III INTRODUCTION TO DATA MINING 9

Introduction to Data mining, Data mining Functionalities, Classification of Data mining Systems, Data Mining Task Primitives, Integration of Data mining systems, Major issues of Data mining.

UNIT IV DATA PREPROCSSING AND VISUALIZATION 9

Overview of data preprocessing, Data cleaning, Data integration, Data reduction, Data transformation and discretization, Visualization- Visualizing a single attributes, Visualizing pair of attributes, Visualizing several attributes, Visualizing results of machine learning.

UNIT V APPLICATIONS OF DATA MINING 9

Application of Data Mining in Biodata analysis: DNA/protein sequence Analysis, Genome analysis, Protein Structure Analysis, Pathway analysis, microarray data analysis, annotation, gene ontology, gene mapping. Biological data mining tools: Entrez, Blast, sequence retrieval system (SRS).

TOTAL: 45 HOURS

TEXT BOOKS

1. Witten, H. I., Frank, E. and Hall, M. A. 2011. Data Mining: Practical Machine Learning Tools and Techniques.
2. Hastie, T., Tibshirani, R., Friedman, J. H. 2009. The Elements of Statistical Learning: Data Mining Interface and Prediction.

3. Clarke, S. B., Fokoue, E. and Zhang, H. H. 2009 Principles and Theory for Data Mining and Machine Learning.

REFERENCES

1. Data Mining: Concepts and Techniques by Jiawei Han and MichelineKamber, 2000
2. Data Mining Techniques, A. K. Pujari, UniversityPress, Hyderabad, 2006
3. Data mining in bioinformatics by Wang et al, Springer-Verlag, 2005

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

		L	T	P	C
21PBT47	BIOPYTHON	2	0	0	2

COURSE OBJECTIVES

- To enable the students
- To learn about basic of biopython.
- To develop Python programs for sequence manipulation.
- To develop Python programs for structure manipulation.
- To study the concepts of molecular docking.
- To visualize the molecular interactions after molecular docking.

COURSE OUTCOMES

C01: At the end of the course, learners will be able to:
C02: Demonstrate skills in safe operation of laboratory equipment
C03: Analyse experimental data and observed phenomena
C04: Communicate experimental findings through formal written reports
C05: Further understand the engineering principles of each unit operations
C06: Work as part of a team in a mature and professional manner
students would learn the implement of docking in various fields

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1		2		1		1				1		2		
2	1			2						2				2	
3	1		2	1			2		2			3			
4		1				2		2			3			2	
5							2				2				2
6			2											2	

3 - High, 2 - Medium, 1 – Low

UNIT I BASICS OF BIOINFORMATICS AND BIOPYTHON 9

Introduction to Bioinformatics, Concepts in Bioinformatics – types of biological data, DNA, RNA, protein sequences database, protein structure database, sequence alignment. Introduction to biopython, downloading and installing biopython package

UNIT II SEQUENCE PROCESSING WITH BIOPYTHON 9

Working with sequences, Parsing sequence file formats – FASTA and GENBANK, Connecting with biological databases, Sequence objects, Sequence annotation objects, Sequence input/output, NCBI's BLAST using biopython

UNIT III STRUCTURE PROCESSING WITH BIOPYTHON 9

Going 3D- the PDB module, Reading and writing crystal structure file, structure representation, Disorder, Heteroresidues, navigating through a structure object, Analyzing structures, Common problems in PDB files, Accessing the PDB.

UNIT IV INTRODUCTION TO MOLECULAR DOCKING 9

Basics of molecular docking – theory, function and applications, Chemo informatics and small molecule databases – PUBCHEM, Zinc and drug databases, Tools for molecular docking – softwares available, free wares, commercial software packages.

UNIT V DOCKING SIMULATION AND VISUALIZATION 9

Collection and preparation of input files for molecular docking – Receptor and ligand preparation for molecular docking, Energy minimization concept, Auto grid and running autodock in Vina, Binding affinity and ranking of binding poses, visualization tools and intermolecular interactions – H bonds, Hydrophobic and van der waal interactions.

TOTAL: 45 HOURS

TEXT BOOKS

1. Jeff Chang and Brad Chapman, "Biopython tutorinal and cookbook", Biopython documentation,2013, 1nd edition.

2. Walter Azevedo Jr, "Docking screens for drug discovery", 1st Edition, Springer New York, 2019

REFERENCE

1. Arthur Lesk, "Introduction to Bioinformatics", 4th Edition, Oxford University Press, 2014

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

21PBT48 **GENOMICS AND PROTEOMICS**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To understand the background of genomes and proteomes used in providing new insights in biotechnology tools
- To explore the genome and protein sequence analysis and determination.
- To formulate genome-related hypothesis and design an experimental plan for testing and analysis.

COURSE OUTCOMES

At the end of the course, learners will be able to

- CO1 : Understand the importance of genomes and proteomes
- CO2 : Apply the knowledge in genomic approaches for Biotechnology applications
- CO3 : Apply the knowledge in proteomic approaches for Biotechnology applications
- CO4: Study of chromatographic techniques.
- CO5 : Analyze the advanced genome-proteome based concepts
- CO6 : Evaluate genome and proteomic approaches in systems biology and other medical applications

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1										1		
2	2	2	1										2		
3	2	2	1										1		
4	3	2	1										2		
5	3	2	2												
6		1	2	1									1	2	

3 – High, 2 – Medium, 1 – Low

UNIT I INTRODUCTION **9**

Introduction to genomes, transcriptomes and proteomes; Organisation and structure of genomes; DNA sequencing methods; Recombinant DNA technology; Human genome project; Overview of Protein structure; Introduction to omics: Genomics, Proteomics, Transcriptomics, Metabolomics, Fluxomics

UNIT II GENOMICS **9**

Introduction and scope of genomics, Next generation sequencing methods, Genetic Mapping, Physical Mapping, Integration of mapping methods, Gene variation and Single Nucleotide Polymorphisms (SNPs), Expressed sequenced tags (ESTs), Gene-disease association, Polymorphism, Social, Legal and Ethical Implications of Human Genome Research

UNIT III PROTEOMICS **9**

Introduction and scope of proteomics, Protein separation techniques: ion-exchange, size-exclusion and affinity chromatography techniques, Polyacrylamide gel electrophoresis, Isoelectric focusing (IEF), Two dimensional PAGE for proteome analysis, Introduction to mass spectrometry, Protein sequencing, Protein modifications and proteomics

UNIT IV ADVANCED PROTEOMICS AND GEMOMICS **9**

Comparative genomics, Functional genomics, Structural genomics, Personal Genomics, Protein engineering, DNA and Protein chips, Functional proteomics, Quantitative proteomics, Structural proteomics, DNA Protein interactions, Protein Protein interactions, HTP Analysis

UNIT V APPLICATIONS OF GENOMICS AND PROTEOMICS **9**

Systems and Synthetic biology, Genomics based drug design, Predictive Medicine, Cytogenomics, Clinical and biomedical application of proteomics, Applications of proteome analysis to drug

TOTAL: 45 HOURS

TEXT BOOKS

1. T.A. Brown, Genomes 3, Garland Science, 2007.
2. D.C. Libeler, Introduction to Proteomics: Tools for the New Biology, Humana Press, 2006

3. Arthur M. Lesk, Introduction to Protein Science- Architecture, Function and Genomics, Oxford University Press, 2004.

REFERENCES

1. Peter Sudbery, Human Molecular genetics, Benjamin-Cummings Publishing Company, 2010
2. S. R Pennington, and M.J. Dunn, Proteomics: from Protein Sequence to Function First, Viva Books Private Limited, 2002
3. S.B Primrose and R.M Twyman, Principles of Genome Analysis and Genomics, Blackwell Publishing Co., 2005

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

VERTICAL - VII (Quality and Regulatory Affairs)							
S.No.	**Course Code**	**Course Title**	**Category**	**L**	**T**	**P**	**C**
THEORY							
1	21PBT49	Clinical trials and healthcare policies in Biotechnology	PE	3	0	0	3
2	21PBT50	Biotechnological Products and its Validation	PE	3	0	0	3
3	21PBT51	Quality Assurance and Quality control in Biotechnology	PE	2	1	0	3
4	21PBT52	Entrepreneurship and patent design	PE	3	0	0	3
5	21PBT53	Intellectual Property Rights in Biotechnology	PE	3	0	0	3
6	21PBT54	Biosafety and Hazard Management	PE	3	0	0	3
7	21PBT55	Biostatistics	PE	3	0	0	3
8	21PBT56	Biological Data Analysis	PE	3	0	0	3

21PBT49 CLINICAL TRIALS AND HEALTH CARE POLICIES IN BIOTECHNOLOGY

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To highlight the epidemiologic methods, study design, protocol preparation
- To gain knowledge in the basic bio-statistical techniques involved in clinical research.
- To describe the principles involved in ethical, legal and regulatory issues in clinical trials

COURSE OUTCOMES:

The student will be able to

- CO1: Explain key concepts in the design of clinical trials
- CO2: To know the regulations of clinical trials.
- CO3: To understand Project management in clinical trials.
- CO4: To design consent and data protection.
- CO5: To understand quality assurance and governance.
- CO6: To apply the quality control guidance to management studies.

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1					1	2	2	2	2		2	3	1	
2	1	2				1	2	2	2	2		2	3	1	
3	3	1				2	3	2	2	2		2	3	3	
4	2	1					3	2	2	2		2	3	1	
5	2		2			3	2	2	1	2		2	3	1	
6	2		2			3	1	1	1			1	1	2	

3 - High, 2 - Medium, 1 – Low

UNIT I REQUIREMENTS IN CLINICAL RESEARCH **9**

Good clinical practice (ICH GCP E6), Clinical trial materials (Documentation, Investigational drugs, logistical materials)

UNIT II TYPES AND DESIGNS IN CLINICAL RESEARCH AND SAFETY MONITORING IN CLINICAL TRIALS **9**

Types of research designs based on Controlling Method (Experimental, Quasi experimental, and Observational methods) Randomization techniques (Simple randomization, restricted randomization, blocking method and stratification),Time Sequences (Prospective and Retrospective), Sampling methods (Cohort study, case Control study and cross sectional study), Health outcome measures (Clinical & Physiological, Humanistic and economic)

UNIT III CLINICAL TRIAL STUDY AND GOVERNING REGULATIONS **9**

Roles and responsibilities of: Investigator, Study Coordinator, Sponsor, Monitor, Contract Research Organization, Site management Organizations Guidelines to the preparation of following documents: Protocols, Investigator's Brochure, Informed Consent Form, Case report forms, Contracts and agreements, Trial Master File preparation and maintenance, Investigator Site File, Pharmacy File, Dairy Cards

UNIT IV OVERVIEW TO UNDERSTANDING THE HEALTHCARE SYSTEM **9**

HEALTH CARE SYSTEM COMPONENTS, Elements of a Health Care System, The Role and Financing Methods of Third-Party Payers, The Production of Medical Services, An Overview of the U.S. Health Care System, Production of Health Services and Provider Choice in the United States.

UNIT V HEALTH CARE POLICIES **9**

Health care policy- overview- Private health care sectors, Health policy and planning.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Guidance for Industry on Submission of Clinical Trial Application for Evaluating Safety and Efficacy by CDSCO (Central Drug Standard Control Organisation)

2. Textbook of Clinical Trials edited by David Machin, Simon Day and Sylvan Green, March 2005, John Wiley and Sons.
3. Santerre, Rexford E. Health economics. 2009.
4. Griffin(1992) :Bhat.R1993 The private-public mix in health care in India *Health Policy and Planning.*

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

21PBT50 BIOTECHNOLOGICAL PRODUCTS AND ITS VALIDATION

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the process validation and quality assurance of biotechnological products
- To understand the various equipment validation

COURSE OUTCOMES:

The students will be able to

- CO1. Understand the Process validation and Quality assurance process
- CO2. Understand and validate the pharmaceutical products
- CO3. Understand and validate the Food Nutraceuticals and cosmetics products
- CO4. Understand and validate various medical devices
- CO5. Understand the process validation in Biotechnological process
- CO6. Understand and apply the general considerations for process equipments

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1								2							
2		2	2					2							
3		2	2					2							
4		2	2					2							
5		2	2					2							
6		2	2					2							

3 - High, 2 - Medium, 1 – Low

UNIT I INTRODUCTION **9**

Process validation and quality assurance: a) Installation Qualification (IQ), Operational Qualification (OQ) and Performance Qualification (PQ) for laboratory instruments. b) Methods of validation and calibration of equipments c) Documentation: importance and significance d) Current Good Manufacturing Practices (cGMP) and Current Good Laboratory Practices (cGLP).

UNIT II VALIDATION OF PHARMACEUTICAL PRODUCTION **9**

Introduction to Pharmaceutical Validation, Scope & merits of Validation, Validation and calibration of Master plan, ICH & WHO guidelines for calibration and validation of equipments, Validation of specific dosage form, Types of validation. Government regulation, Manufacturing Process Model, URS, DQ, IQ, OQ & P.Q. of facilities, Analytical method validation

UNIT III VALIDATION OF FOOD NEUTRACEUTICALS AND COSMETICS **9**

Microbiological quality control for Nutraceuticals.

UNIT IV VALIDATION OF MEDICAL DEVICES **9**

Validation and Verification of Medical device Physical and Mechanical Testing of medical device, Chemical Testing of Medical Device materials, Biological Testing of Medical Devices.

UNIT V BIOTECHNOLOGY PROCESS AND EQUIPMENT VALIDATION **9**

Process validation, General considerations for process equipments, Regulatory requirements for process validation, Documentation, Analytical methods.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Pharmaceutical Process Validation; By Fra. R. Berry and Robert A. Nash
2. Analytical Method validation and Instrument Performance Verification by Churg Chan, Heiman Lam, Y.C. Lee, Yue. Zhang, Wiley Inter Science.
3. Book: Leachables and Extractables Handbook: Safety Evaluation, Qualification, and Best Practices Applied to Inhalation Drug Products, Douglas J. Ball, Daniel L. Norwood, Cheryl L. M. Stults and Lee M. Nagao,

4. Book: Medical Device 1st edition, Seeram Ramakrishna Lingling Tian Charlene Wang Susan Liao Wee Eong Teo, Woodhead Publishing, Hardcover ISBN: 9780081002896.
5. Book: Biomaterials, Medical Devices and Combination Products: Biocompatibility Testing and Safety Assessment, Shayne Cox Gad, Samanta Gad-McDonald, CRC Press
6. Fermentation Microbiology and Biotechnology by M. El-Mansi and C.Bryce
7. Process Validation: General Principles and Practices-FDA Guidelines

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

21PBT51 QUALITY ASSURANCE AND QUALITY CONTROL IN BIOTECHNOLOGY

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- The student shall be able to understand the scope of quality certifications.
- Appreciate the importance of documentation.
- The cGMP aspects in a pharmaceutical industry.
- To understand the responsibilities of QA & QC departments in biotechnology industries

COURSE OUTCOMES:

The students will be able to

- CO1. Understand the various aspects of quality control and quality assurance aspects of various biotechnological industries.
- CO2. Understand and apply the quality assurance and control in clinical trials
- CO3. Understand and apply the quality assurance in pharmaceutical industries
- CO4. Understand and apply the quality system regulations and quality control of medical devices.
- CO5. Understand the Quality of various biological products
- CO6. Know the important aspects like cGMP, QC tests, documentation, quality certifications, GLP and regulatory affairs.

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1		2						2				2			2
2		2						2				2			2
3		2						2				2			2
4		2						2				2			2
5		2						2				2			2
6		2						2				2			2

3 - High, 2 - Medium, 1 – Low

UNIT I INTRODUCTION **9**

Quality Assurance , Quality Control , Role of Quality Assurance**,** QA testing, Role of Quality Control, Test for quality control, Quality assurance – Quality control – Practice of cGMP- Overview of ICH Guidelines - QSEM, with special emphasis on Q-series guidelines. Good Laboratory Practices: Scope of GLP, Definitions, Quality assurance unit, protocol for conduct of non clinical testing, control on animal house, , scope of quality certifications - responsibilities of QA & QC departments, Analysis of raw materials, finished products, packaging materials, in process quality control (IPQC), Developing specification (ICH Q6 and Q3)

UNIT II QUALITY ASSURANCE AND QUALITY CONTROL IN CLINICAL TRIALS **9**

Audit criteria, Audit process, Responsibilities of stakeholders in audit process, Audit follow-up and documentation, Audit resolution and Preparing for FDA inspections, Fraud and misconduct management - Clinical Trial Data Management- Standard Operating Procedures, Data management plan, CRF & Data base design considerations, Study set-up, Data entry, CRF tracking and corrections, Central lab, IVRS, source data. Data cleaning, managing laboratory and ADR data, Data transfer and database lock, Quality Control and Quality Assurance in CDM, Data mining and warehousing

UNIT III QUALITY ASSURANCE AND QUALITY CONTROL IN PHARMACEUTICAL INDUSTRIES **9**

Schedule M – USFDA- Quality audit and self inspections SOPs – Documentation – Loan license auditing – Common technical documentation (CTD) – Drug master file (DMF).

UNIT IV QUALITY SYSTEM REGULATIONS AND QUALITY CONTROL OF MEDICAL DEVICES **9**

Quality System Requirements 21 CFR Part 820, Labeling requirements 21 CFR Part 801, Post marketing surveillance of MD and Unique Device Identification (UDI), Quality System requirements and clinical evaluation and investigation. IMDRF study groups and guidance documents, ISO 13485, Quality Risk Management of

Medical Devices: ISO 1497-

UNIT V QUALITY IN FOOD, NUTRACEUTICALS, BIOLOGICAL AND COSMETIC PRODUCTS **9**

WHO guidelines on nutrition. NSF International: Its Role in the Dietary Supplements and Nutraceuticals Industries, NSF Certification, NSF Standards for Food And Dietary Supplements. Good Manufacturing Practices for Nutraceuticals, Quality, safety and legislation for herbal products in India, USA and European Union, Analysis of Cosmetics, Toxicity screening and test methods: Quality control and toxicity studies as per Drug and Cosmetics Act, Analysis of Food additives- milk constituents and milk products- Pesticide analysis

TOTAL: 45 PERIODS

TEXT BOOKS

1. Willig, H., Tuckeman, M.M. and Hitchings, W.S., "Good Manufacturing Practices for Pharmaceuticals", 5th Edition, Marcel Dekker Drugs and the Pharmaceutical Sciences, by CRC Press, New York, 2000.
2. Medical Product Regulatory Affairs: Pharmaceuticals, Diagnostics, Medical Devices by John J. Tobin and Gary Walsh
3. P.P.Sharma. Cosmetics - Formulation, Manufacturing & Quality Control, Vandana Publications, New Delhi

REFERENCES

1. Mindy J. Allport-Settle, Current Good Manufacturing Practices: Pharmaceutical, Biologics, and Medical Device Regulations and Guidance Documents Concise Reference, Pharmalogika Inc., USA, 2009.

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

21PBT52 **ENTREPRENEURSHIP AND PATENT DESIGN**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- Student will be able to develop entrepreneurial skills and writing of business plan market strategies.
- They will gain knowledge on patent filing and design.

COURSE OUTCOMES:

The students will be able to

- CO1. Know about the entrepreneurial role.
- CO2. Develop a business
- CO3. Understand the importance of Marketing plan
- CO4. Understand the various operations in the Business
- CO5. Understand the importance of patents and licensing
- CO6. Apply various plans for the development of a Business

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1		2						2			2	2			
2		2						2			2	2			
3		2						2			2	2			
4		2						2			2	2			
5		2						2			2	2			
6		2						2			2	2			

3 - High, 2 - Medium, 1 – Low

UNIT I ENTREPRENEUR **9**

Entrepreneurial motivation – dynamics of motivation. Entrepreneurial competency –Concepts. Developing Entrepreneurial competencies - requirements and understanding the process of entrepreneurship development, self-awareness, interpersonal skills, creativity, assertiveness, achievement, factors affecting entrepreneur role.

UNIT II BUSINESS PLAN, MARKETING PLAN **9**

Develop a Business Plan

UNIT III MARKETING PLAN **9**

Choose Your Location and Set Up for Business, Market Your Business, Hire and Manage a Staff

UNIT IV OPERATIONS MANAGEMENT **9**

Finance, Protect and Insure Your Business, Record Keeping and Accounting, Financial Management.

UNIT V PATENTS **9**

Patents – objectives and benefits of patent, Trademarks, copyright, Geographic indicators, Concept, features of patent, Inventive step, Specification, Types of patent application, process E-filling, Examination of patent, Grant of patent, Revocation, Equitable Assignments, Licences, Licensing of related patents, patent agents, Registration of patent agents.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Hisrich, R.D. and Peters, M.P. (1995): Entrepreneurship – Starting, Developing and Managing a New Enterprise, Richard D., Inwin, INC, USA.
2. Entrepreneurship Ideas in Action—South-Western, 2000.
3. Catherine J. Holland, “Intellectual property: Patents, Trademarks, Copyrights, Trade Secrets”, Entrepreneur Press, 2007.
4. David Hunt, Long Nguyen, Matthew Rodgers, “Patent searching: tools & techniques”, Wiley, 2007.
5. The Institute of Company Secretaries of India, Statutory body under an Act of parliament, “Professional Programme Intellectual Property Rights, Law and practice”, September 2013.

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

21PBT53 INTELLECTUAL PROPERTY RIGHTS IN BIOTECHNOLOGY

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand and apply for intellectual Property rights

COURSE OUTCOMES:

At the end of the course, learners will be able to

- CO1 Understand the basics of IPR
- CO2 Understand the aspects of registration of IPR
- CO3. Understand the International treaties and conventions on IPR
- CO4. Understand the laws of IPR and Digital innovations
- CO5. Understand the Enforcement of IPRS
- CO6. Ability to manage Intellectual Property portfolio to enhance the value of the firm.

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2					3	3			2			3	2	3
2	2					3	3			2			3	2	3
3	2					3	3			2			3		3
4	2					3	3			2			3		3
5	2					3	3			2			3		3
6	2					3	3			2			3	2	3

3 - High, 2 - Medium, 1 – Low

UNIT I INTRODUCTION **9**

Introduction to IPRs, Basic concepts and need for Intellectual Property - IPR in India and Abroad – Genesis and Development – the way from WTO to WIPO –TRIPS, Nature of Intellectual Property, Industrial Property, technological Research, Inventions and Innovations – Important examples of IPR.

UNIT II REGISTRATION OF IPRs **9**

Meaning and practical aspects of registration of CopyRights, Trademarks, Patents, Geographical Indications, Trade Secrets and Industrial Design registration in India and Abroad

UNIT III AGREEMENTS AND LEGISLATIONS **9**

International Treaties and Conventions on IPRs, TRIPS Agreement, PCT Agreement, Patent Act of India, Patent Amendment Act, Design Act, Trademark Act, Geographical Indication Act.

UNIT IV DIGITAL PRODUCTS AND LAW **9**

Digital Innovations and Developments as Knowledge Assets – IP Laws, Cyber Law and Digital Content Protection – Unfair Competition – Meaning and Relationship between Unfair Competition and IP Laws – Case Studies.

UNIT V ENFORCEMENT OF IPRs **9**

Infringement of IPRs, Enforcement Measures, Emerging issues – Case Studies.

TOTAL: 45 PERIODS

TEXT BOOKS

1. V. Scople Vinod, Managing Intellectual Property, Prentice Hall of India pvt Ltd, 2012
2. S. V. Satakar, “Intellectual Property Rights and Copy Rights, Ess Ess Publications, New Delhi, 2002.

REFERENCES

1. Deborah E. Bouchoux, “Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets”, Cengage Learning, Third Edition, 2012.
2. Prabuddha Ganguli, ”Intellectual Property Rights: Unleashing the Knowledge Economy”, McGraw Hill Education, 2011.
3. Edited by Derek Bosworth and Elizabeth Webster, The Management of Intellectual Property, Edward Elgar Publishing Ltd., 2013.

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

21PBT54 **BIOSAFETY AND HAZARD MANAGEMENT**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- Students learn about implementation of safety procedures, risk analysis and assessment, hazard identification.

COURSE OUTCOMES:

At the end of the course, learners will be able to

- CO1 Understand the need for safety in industries
- CO2 Understand the importance of quality checks
- CO3. Understand the overall risks in the industries and emergency planning
- CO4. Apply the Safety audits in the Industries
- CO5. Understand the hazardous operations and recommendations
- CO6. Ability to manage the Hazards and maintain the Biosafety

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2					3	3			2			3	2	3
2	2					3	3			2			3	2	3
3	2					3	3			2			3		3
4	2					3	3			2			3		3
5	2					3	3			2			3		3
6	2					3	3			2			3	2	3

3 - High, 2 - Medium, 1 – Low

UNIT I INTRODUCTION **9**

Need for safety in industries; Safety Programmes – components and realization; Potential hazards – extreme operating conditions, toxic chemicals; safe handling.

UNIT II QUALITY CHECKS **9**

Implementation of safety procedures – periodic inspection and replacement; Accidents – identification and prevention; promotion of industrial safety.

UNIT III RISK ANALYSIS **9**

Overall risk analysis--emergency planning-on site & off site emergency planning, risk management ISO 14000, EMS models case studies. Quantitative risk assessment – rapid and comprehensive risk analysis; Risk due to Radiation, explosion due to over pressure, jet fire-fire ball.

UNIT IV SAFETY AUDITS **9**

Hazard identification safety audits, checklist, what if analysis, vulnerability models event tree analysis fault tree analysis, Hazan past accident analysis Fixborough-Mexico-Madras- Vizag Bopal analysis.

UNIT V HAZARDOUS OPERATIONS **9**

Hazop-guide words, parameters, derivation-causes-consequences-recommendation-coarse Hazop study-case studies-pumping system-reactor-mass transfer system.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Fawatt, H.H. and Wood, W.S., “Safety and Accident Prevention in Chemical Operation“, Wiley Interscience, 1965.
2. Marcel, V.C., Major Chemical Hazard- Ellis Harwood Ltd., Chi Chester, UK, 1987.
3. Skeleton, B., Process Safety Analysis: An introduction, Institution of chemical Engineers, U.K., 1997.
4. Hyatt, N., Guidelines for process hazards analysis, hazards identification & risk analysis, Dyadem Press, 2004.

REFERENCES

1. Handley, W., “Industrial Safety Hand Book “, 2nd Edn., McGraw-Hill Book Company,1969.

2. Heinrich, H.W. Dan Peterson, P.E. and Rood, N., "Industrial Accident Prevention", McGraw-Hill Book Co., 1980.
3. Chemical Process Safety: Fundamentals with Applications, Daniel A. Crowl, J.F. Louvar, Prentice Hall, NJ, 1990.
4. Taylor, J.R., Risk analysis for process plant, pipelines and transport, Chapman and Hall, London, 1994

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

21PBT55 **BIOSTATISTICS**

L	T	P	C
3	0	0	3

Course Objectives

- To introduce the techniques used in statistical & regression analysis.
- To compare the various parameters used in statistical significance

Course Outcomes

Upon completion of this course, students will be able to

- CO1. Classify common statistical tests and tools.
- CO2: Distinguish between p-values and confidence intervals as measures of statistical significance.
- CO3: Interpret commonly used regression analysis.
- CO4: Explain the data tables and its interpretations in community health.
- CO5: Evaluate commonly used statistical and epidemiologic measures.
- CO6: Understand the concepts of Meta Analysis

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2	2		2							2			
2	2	2	2		2							2			
3	2	2	2		2							2			
4					2	2	2	2			2	2			
5					2	2	2	2			2	2			
6					2	2	2	2			2	2			

3 - High, 2 - Medium, 1 – Low

UNIT I INTRODUCTION TO BIOSTATISTICS **9**

Biostatistics - Statistical problems in Biomedical research– Basic concepts: Population, Samples and Variables - Basic probability, likelihood & odds, distribution variability.

UNIT II STATISTICAL PARAMETERS **9**

Statistical parameters p-values, computation and level chi square test and distribution.

UNIT III REGRESSION ANALYSIS **9**

Regression – Linear regression – Multiple linear regression – Multiple colinearity, Determining Best regression – Nonlinear regression – Logistic regression – Poison regression.

UNIT IV INTERPRETING DATA **9**

Life table: Interpreting life tables clinical trails, epidemical reading and interpreting of epidemical studies, application in community health.

UNIT V META ANALYSIS **9**

META analysis for research activities, purpose and reading of META analysis, Forest graph, Funnel plots, Radial plots, L'Abbe plots, Criticisms of Meta analysis.

TOTAL: 45 HOURS

TEXT BOOKS

1. Joseph A. Ingel finger, Frederick Mosteller, Lawrence A. Thibodeau, James H. Ware 'Biostatistics in Clinical Medicine', Singapore, 3rd Edition, 1994.
2. Gerald van Belle, Lloyd D. Fisher, Patrick J. Heagerty, Thomas Lumley, 'Biostatistics: A Methodology For the Health Sciences', John Wiley & Sons, 2004.

REFERENCES

1. Julien I.E. Hoffman, 'Biostatistics for Medical and Biomedical Practitioners', Elsevier Press, 2015.
2. James F. Jekel, 'Epidemiology, Biostatistics, and Preventive Medicine', Elsevier Health Sciences, 2007.
3. Ray M. Merrill, 'Fundamentals of Epidemiology and Biostatistics, Jones & Bartlett Learning, 2013.

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

21PBT56 TOTAL QUALITY MANAGEMENT FOR BIOTECHNOLOGISTS

L	T	P	C
3	0	0	3

Course Objectives

- The course aims to develop skills of the Students in various total quality management Principles, tools and quality systems in the Biotechnology industries.
- To understand the TQM tools for continuous process improvement of ISO and Quality systems

Course Outcomes

At the end of the course, learners will be able to

CO1. discuss various dimensions of product and service quality

CO2. apply the TQM principles for quality improvement in organization

CO3. distinguish various TQM tools and techniques used in manufacturing and service sectors

CO4. use QFD tool to design and develop a new product as per customer requirements

CO5. explain various ISO standards and quality systems practiced in various sector

CO6. summarize the basic concepts in total quality management relevant to manufacturing and service sectors

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1				2		2		2			2				
2									2		2				
3				2							2				
4				2		2			2		2		2	2	
5							2								
6			2						2		2				

UNIT I INTRODUCTION **9**

Introduction - Need for quality - Evolution of quality - Definition of quality - Dimensions of product and service quality - Basic concepts of TQM – TQM Framework - Contributions of Quality Gurus – Barriers to TQM – Cost of Quality.

UNIT II TQM PRINCIPLES **9**

Quality statements - Customer focus –Customer orientation, Customer satisfaction, Customer complaints, Customer retention - Continuous process improvement – PDCA cycle, 5s, Kaizen- Supplier partnership – Partnering, Supplier selection, Supplier Rating.

UNIT III TQM TOOLS & TECHNIQUES I **9**

The seven traditional tools of quality – New management tools – Six-sigma: Concepts, methodology, applications to manufacturing, service sector including IT – Bench marking – Reason to bench mark, Bench marking process – FMEA – Stages, Types.

UNIT IV TQM TOOLS & TECHNIQUES II **9**

Quality circles – Quality Function Deployment (QFD) – Taguchi quality loss function – TPM – Concepts, improvement needs – Performance measures - BPR.

UNIT V QUALITY SYSTEMS **9**

Need for ISO 9000- ISO 9000-2000 Quality System – Elements, Documentation, Quality auditing- QS 9000 – ISO 14000 – Concepts, Requirements and Benefits – Quality Council – Leadership, Employee involvement – Motivation, Empowerment, Team and Teamwork, Recognition and Reward.

TOTAL: 45 HOURS

TEXT BOOKS

- Dale H.Besterfiled, et al., “Total Quality Management”, Pearson Education Asia, Third Incubator Shaker 1 Spectrophotometer 2 Laminar Flow Chamber Glassware, Chemicals, Media 2 as required Edition, Indian Reprint , 2006.

REFERENCES

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", (6th Edition), South-Western (Thomson Learning), 2005.
2. Oakland, J.S. "TQM – Text with Cases", Butterworth – Heinemann Ltd., Oxford, Third Edition , 2003.
3. Suganthi,L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006 .
4. Janakiraman,B and Gopal, R.K, "Total Quality Management – Text and Cases",Prentice Hall (India) Pvt. Ltd., 2006.

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

VERTICAL - VIII(Agro Biotechnology)							
S.No.	**Course Code**	**Course Title**	**Category**	**L**	**T**	**P**	**C**
THEORY							
1	21PBT57	Plant anatomy	PE	3	0	0	3
2	21PBT58	Therapeutics application of phytochemicals	PE	3	0	0	3
3	21PBT59	Biofertilizer production and Mushroom cultivation	PE	2	1	0	3
4	21PBT60	Biotechnological Approach in Crop Improvement	PE	3	0	0	3
5	21PBT61	Advance Techniques in Agro forestry	PE	3	0	0	3
6	21PBT62	Plant Tissue Culture and Transformation Techniques	PE	3	0	0	3
7	21PBT63	Plant Physiology	PE	3	0	0	3
8	21PBT64	Plant Pathology	PE	3	0	0	3

21PBT57 **PLANT ANATOMY**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To become familiar and to understand the plant cell, tissues, and internal structures of stem, root and leave.
- To learn the importance of plant anatomy in plant production systems

COURSE OUTCOMES

Upon completion of this course, students will be able to

- CO1. Recall or remember the informations including basic and advanced in relation with plant anatomy and embryology.
- CO2. Understand the various concepts of plant development and reproduction.
- CO3. Apply their idea on sectioning and dissection of plants to demonstrate various stages of plant development.
- CO4. Analyze the effect of plant stresses on anatomical structures and reproduction in plants.
- CO5. Learn the structures, functions and roles of apical vs lateral meristems in monocot and dicot plant growth
- CO6. Study the function and organization of woody stems derived from secondary growth in dicot and monocot plants

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1		1		1			1		1	1					
2		1		1		1	2		1	1					
3		1		2		1	1	1	1	3					
4		1		1		1	1	1	1						
5		2		1			1		2						
6		1		2			1	1	2	2					

3 - High, 2 - Medium, 1 – Low

UNIT I PLANT CELL STRUCTURE **9**

Plant cell structure and tissues Plant cell structure –nature of plant cell wall. Tissue and tissue systems - meristematic tissue, permanent tissue and secretary cells.

UNIT II MORPHOLOGICAL CHARACTERS OF PLANT CELL **9**

Morphogenesis and Differentiation Morphogenesis in plants -Differentiation of stem, root and leaf - Vascular bundles and Vascular cambium.

UNIT III CELLULAR ORGANIZATION OF MERISTEMS **9**

Organization of meristems Meristems – types of meristems: apical, intercalary and lateral; primary meristem and secondary meristem. Apical meristems – theories on organization of meristems – apical cell theory, Tunica-Corpus theory and histogen theory.

UNIT IV ANATOMY OF STEM AND ROOT **9**

Structure of Dicot stem–primary and secondary structure; Structure of Monocot stem; Nodal anatomy. Structure of Dicot root–primary and secondary structure; Structure of monocot root .

UNIT V ANATOMY OF LEAF AND ANOMALOUS **9**

Secondary growth Leaf anatomy–dorsiventral and isobilateral; Stomatal types Anomalous secondary growth –Bignonia, Aristolochia, Boerhaavia (dicot stem)Dracaena(monocot stem).

TOTAL: 45 PERIODS

TEXT BOOKS

1. Vashishta, P.C. 1997. Plant Anatomy, Pradeep Publications. 2. Fahn, A.1992. Plant Anatomy. Pergamon Press

REFERENCES

1.Esau, K. 1990. Plant Anatomy. Wiley Eastern Pvt Ltd New Delhi.

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

21PBT58 THERAPEUTIC APPLIATION OF PHYTOCHEMICALS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- The main objective is to provide an overview of the plant derived natural products for their occurrence, sources, basic chemistry and therapeutic applications.

COURSE OUTCOMES

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

- CO1. Recall or remember the cultivation, collection and processing of plant derived drugs.
- CO2. Understand the various medicinal values of phytochemicals
- CO3. Apply the knowledge to process the plant materials for phytochemical extraction
- CO4. Analyze or identify the various phytochemicals by qualitative screening.
- CO5. Understand the importance of all phytochemicals and application
- CO6. Evaluate the plant derived drugs using various methods.

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1			1	1		2									
2			1	1		1									
3			1	2		3									
4			1	1		1									
5			2	1		1									
6			1	1		1									

3 - High, 2 - Medium, 1 – Low

UNIT I INTRODUCTION PLANT NATURAL PRODUCTS **9**

History- general significance- classification- list of floral sources- general detection, extraction and characterization procedures.

UNIT II GLYCOSIDES AND FLAVONOIDS GLYCOSIDES **9**

Classification, therapeutic value, chemical properties & tests for identification. Flavonoids: Sources, classification, biogenesis, extraction, isolation, identification and therapeutic applications.

UNIT III ANTHOCYANINS AND COUMARINS ANTHOCYANINS **9**

Sources, classification, extraction, isolation, identification and therapeutic applications. Coumarins: Sources, classification, biosynthesis - furanocoumrarins and pyranocoumarins: pharmacological properties and photo-toxicity.

UNIT IV LIGNANS, TERPENES, VOLATILE OILS, SAPONINS LIGNANS AND NEOLIGNANS: **9**

Classification, naturalsources and pharmacological applications. Terpenes: Classification, biosynthesis, origin of 5-carbons isoprene unit, head to tail coupling and tail-totail coupling of isoprene units - Volatile Oils: Classifications, sources, medicinal and non-medicinal uses - Saponins : Sources, classification, physical and biological properties.

UNIT V CAROTENOIDS AND ALKALOIDS CAROTENOIDS **9**

Sources, biogenesis, classification and therapeutic values. Alkaloids: Classification, distribution in nature, localization, nomenclature, physico -chemical properties, extraction, detection, isolation, purification, biosynthetic origin and pharmacological activities.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Agarwal, O. P. 2002. Organic chemistry–Chemistry of organic natural products. Vol. II. Goel publishing house ,Meerut.
2. Farooqui, A. A. and Sreeraman, B. S. 2001. Cultvation of medicinal and aromatic crops. Universities Press. 160
3. Harborne, J. B. 1998. Phytochemical methods –a guide to modern techniques of plant analysis 3 rd edition, Chapman and Hall.

4. Yesodha, D., Geetha, S and Radhakrishnan, V. 1997. Allied Biochemistry. Morgan publications, Chennai.

REFERENCES

1. Gurdeep Chatwal, 1980. Organic chemistry of natural productis. Vol. I.Himalaya Publishing house.
2. Kalsi, P. S. and Jagtap, S., 2012. Pharmaceutical medicinal and natural product chemistry. N.K. Mehra for Narosa Publishing House Pvt. Ltd. New Delhi.

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

21PBT59 BIO-FERTILIZER PRODUCTION AND MUSHROOM CULTIVATION

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- Understand the basic concepts, principles, potentials and limitations of mushroom cultivation and vermiculture techniques
- Apply the active compounds of mushroom for developing a solution for health care problems Develop mushroom cultivation and vermiculture skills for entrepreneurial activity

Course Outcomes

At the end of the course, learners will be able to

- CO1: Apply the active compounds of mushroom in food and pharmaceutical industry
- CO2: Knowledge on different harvesting technology
- CO3: Implement the cultivation techniques for mushroom production
- CO4: Apply post-harvest technology to preserve the quality of the product
- CO5: Evaluate the significance of earthworms in increasing the soil fertility
- CO6: Execute the techniques of vermicomposting for large scale production and marketing

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1		1				2									
2			3		2	3									1
3			2		3	3									1
4		3	2			2								1	1
5			2		2	3								2	
6	1				1									2	

3 - High, 2 - Medium, 1 – Low

UNIT I MUSHROOM BIOLOGY MORPHOLOGY **9**

Classification: edible and poisonous mushrooms. Life cycle of Basidiomycetes fungi Breeding and Genetic improvement of mushroom strains. Medicinal and Nutritional value of mushrooms.

UNIT II MUSHROOM CULTIVATION TECHNIQUES **9**

Cultivation conditions for tropical and temperate countries. Isolation, spawn production, growth media, spawn running and harvesting of mushrooms (Volvariella spp., Pleurotus spp., Agaricus spp., Calocybe spp., and Lentinus spp). Diseases / contamination; Post Harvest Technology: Freezing, drying, freeze drying and canning.

UNIT III ECONOMICS OF MUSHROOM CULTIVATION **9**

Economics of the production of oyster mushroom, milky mushroom and paddy straw mushroom cultivation : Infrastructure facilities, expenditure on fixed assets, plant and machinery, cost of the project, recurring expenditure , interest and depreciation of the expenditure, cost of production and profit. Entrepreneurship in mushroom cultivation.

UNIT IV COMPOSTING TECHNIQUE INTRODUCTION **9**

History of composting – compost - composting processes - microbiology of composting fate of pathogens - ingredients in composting - various methods of composting: vermi- composting and home composting-steps in composting.

UNIT V BIO-FERTILIZERS AND THEIR PRODUCTION **9**

Introduction - Types: Microbes as biofertilizer, Green manure, importance of macronutrients ;Biofertilizers vs Chemical fertilizers; Nitrogen fixers – types and examples; Phosphate solubilizers – role of bacteria and Mycorrhizae -Mass cultivation and Application of the following biofertilizers: i)Rhizobium ii)Azospirillum iv) Cyanobacteria v) Mycorrhizae Quality control; Challenges and opportunities; Biofertilizer Entrepreneurship

TOTAL: 45 HOURS

TEXT BOOKS

1. Nita Bahl, 2002. Hand Book on Mushroom Cultivation. 4th Edition, Vijay Primlani for Oxford &IBH Publishing Co., Press, New York, New Delhi.

2. Biswas, S, Datta, M and Nagachan, S.V. 2012. Mushrooms- A manual for cultivation. PHI Learning Private Limited, New Delhi.
3. Krishnamoorthy, 1999. Hand Book of Mushroom Cultivation. TNAU Publications, Coimbatore, TN, India.
4. SubbaRao, N. S., 1988, Biofertilizers in agriculture. Oxford & IBH Publishing Company, New Delhi.
5. SubbaRao, N. S., 1977, Soil microorganisms and Plant Growth. Oxford & IBH Publishing Company, New Delhi.
6. SubbaRao, N. S., 1998, Biofertilizers in agriculture and forestry. India Book House Ltd. New Delhi.

REFERENCES

1. Chang, T.S. and Hayes, W.A. 1978. The Biology and Cultivation of Edible Mushrooms. Academic Press, New York.
2. M.C. Nair, C. Gokulapalan and Lulu Das, 1997. Topics on Mushroom Cultivation. Scientific Publishers, Jodhpur, India.

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

21PBT60 BIOTECHNOLOGICAL APPROACH IN CROP IMPROVEMENT

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- The crops produced need to increase with ever increasing population. Conventional methods for crop improvement are not able to deliver fully. Therefore, high use of throughput technologies is need of the hour.
- This course is intended to give some idea to students how crop plants can be improved quantitatively and qualitatively using biotechnological approaches. Students are able to understand plant genome organization. To acquaint students with recent techniques for crop improvement Application of molecular markers for crop improvement

COURSE OUTCOMES:

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

- CO1. Understand the genomic organization of plants
- CO2. Understand and apply various Biotechnological approach for crop improvement
- CO3. Understand the role of Molecular Markers in crop improvement
- CO4. Apply the concepts of Molecular Markers in the improvement of crops.
- CO5. Understand the concept of Transgenic plants
- CO6. Understand the production of transgenic plants for field crops

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2														
2	2		2		2										
3	2		2		2										
4	2		2		2										
5	2		2		2										
6	2		2		2										

3 - High, 2 - Medium, 1 – Low

UNIT I PLANT GENOME ORGANIZATION 9

Features of plant chromosomes: centromere, telomere, euchromatin, heterochromatin and nucleolus organizing region (NOR); karyotype (asymmetric and symmetric). C-value paradox, range of interspecific and intraspecific variation, origin of quantitative DNA variation. Estimation of various components of higher-plant genome: highly repetitive sequences, middle repetitive sequences, and unique DNA sequences. Rice and maize genome sequencing projects; cereal genome databases.

UNIT II BIOTECHNOLOGICAL APPROACH FOR CROP IMPROVEMENT 9

Biotechnological approaches for disease resistance, protection against fungal pathogens and drought tolerance. Modification of crop-plant nutritional content (vitamins, amino acids and lipids). Modification of crop-plant taste and appearance (sweetness, starch and preventing discoloration). Polyploidy: induction of polyploidy by artificial methods; role of polyploidy in crop improvement.

UNIT III MOLECULAR MARKERS AND CROP IMPROVEMENT 9

Types of molecular markers used in analyzing genetic diversity for crop improvement; molecular mapping and tagging of agronomically important traits. Molecular cytogenetic markers: FISH and GISH, their application in crop improvement. Transposable elements: mechanism of action and their role in crop improvement. Quantitative trait loci (QTL) mapping: introduction, types of mapping populations; role in crop improvement.

UNIT IV APPLICATION OF MOLECULAR MARKERS 9

Construction of molecular maps (using F2, DH, RILs); gene tagging using bulked segregant analysis (BSA) and near isogenic lines (NILs); QTL analysis; map-based cloning of genes; elementary idea of marker-assisted selection (MAS) in plant breeding.

UNIT V PRODUCTION OF TRANSGENIC PLANTS IN VARIOUS FIELD CROPS 9

Cotton, wheat, maize, rice, soybean, oilseeds, sugarcane etc. Commercial releases. Biotechnology applications in male sterility/hybrid breeding, molecular farming. MOs and related issues (risk and regulations); GMO; International regulations, biosafety issues of GMOs; Regulatory procedures in major countries including India, ethical, legal and social issues; Intellectual property rights. Bioinformatics & Bioinformatics tools. Nanotechnology and its applications in crop improvement programmes.

TOTAL: 45 HOURS

TEXT BOOKS

1. Abelson, P. H. (1984). Biotechnology and Biological Frontiers. American Association for the Advancement of Science, Washington, U.S.A.
2. Ammirato, P. V., Evans, P. V., Evans, D. A., Sharp, W. R. and Yamada, Y. (Eds.) (1984). Handbook of Plant Cell Culture. Vols. 1, 2 & 3. MacMillan Publishing Co, New York.
3. Dodds, J. H. and Roberts, L. W. (1985). Experiments in Plant Tissue Culture. Cambridge University Press, Cambridge.
4. Mantell, S. H. and Smith, H. (Eds.) (1983). Plant Biotechnology. Cambridge University Press, Cambridge.
5. Swaminathan, M. S. (1991). Biotechnology in Agriculture – A dialogue. MacMillan India, New Delhi.
6. Gupta, P. K. (2004). Biotechnology and Genomics. Rastogi Publications, Meerut
7. Kung, S. and Arntzen, C. J. (Eds.). (1989). Plant Biotechnology. Butterworth, Boston.
8. Grierson D (Ed.). (1991). Plant Genetic Engineering: Plant Biotechnology Series, Volume I. Blockie, Glasgow, London.

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

21PBT61 ADVANCE TECHQNIQUES IN AGRO FORESTRY

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To introduce the students to the essential basics of phytogeography and forestry of India

COURSE OUTCOMES

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

- CO1. Understand the concept of Silviculture and its importance in agro-forestry
- CO2. Understand the method of Measuring, Management and utilization of Forest.
- CO3. Understand and apply the concepts of tree improvement
- CO4. Know the concepts of wood and non-wood products in forest
- CO5. Analyze the importance of forest in Climate change
- CO6. Apply the knowledge of agro-forestry in saving the forest and climate change

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1		2					2					2			
2		2					2					2			
3		2					2					2			
4		2					2					2			
5		2					2					2			
6		2					2					2			

3 - High, 2 - Medium, 1 – Low

UNIT I SILVICULTURE **9**

General silvicultural principles; ecological and physiological factors influencing vegetation; natural and artificial regeneration of forests; nursery techniques; seed technology collection, storage, pre-treatment and germination; establishment and tendings. Silvicultural systems-clear felling, uniform, shafter-wood, selection, coppice and conversion systems. Social forestry-objectives, scope, necessity; agro-forestry; extension forestry: recreation forestry; people's participation.

UNIT II FOREST MENSURATION, MANAGEMENT AND UTILIZATION **9**

Methods of measuring-diameter, girth, height and volume of trees; form factor; volume estimation of stand: sampling methods; yield calculation; current annual increment; mean annual increment; sample plots; yield and stand tables; scope and objectives of forest inventory; aerial survey and remote-sensing techniques. Forest management-objectives and principles; techniques; sustained yield relation; normal forest; growing stock; regulation of yield-methods of application; working plans-preparation and control. Forest utilisation: Logging and extraction techniques and principles; transport, storage and sale. Minor and major forest product : definition and scope. Collection, processing and disposal of minor and major forest products.

UNIT III ADVANCES IN TREE IMPROVEMENT **9**

Mendelian concepts as applied to forest trees. Cytological and chromosomal systems of forest trees. Cytoplasmic inheritance in trees. Colchiploid and mutation breeding for forest trees. Physiological basis of tree improvement. Pollution responses of trees. Pollen handling and hybridization techniques in forest trees. Tissue culture of trees. Indirect selection for improvement of desired traits, molecular markers. Juvenile traits and their role in genetic evaluation in tree improvement programmes.

UNIT IV ADVANCES IN WOOD AND NON-WOOD FOREST PRODUCTS **9**

Mechanics of wood and wood composites, Application of orthotropic and non-linear constitutive relations, Laminate theory and failure criterion in the prediction of mechanical properties of solid woods; Wood-polymer, Hybrid composite processing. Methods of extraction, chemistry, processing, import and export potential of gums, resins, tannins, dyes, essential oils, fixed oils, cutch and katha, drugs, spices, poisons, insecticides, pesticides, wild edible fruits etc.

UNIT V CLIMATE CHANGE AND FORESTRY **9**

Climate change and implications for sustainable forest management. Impact of climate change on Indian forest - Adaptation of forest trees to climate change – Potential for adaptation – Evolutionary mechanisms – The challenge of climate change for forest management – Different concepts of adaptation to climate change – Case studies on the management of certain tree species in India.

TOTAL: 45 PERIODS

TEXT BOOKS

1. McManus B. Collins and Fred M White, 1981. Elementary Forestry. Reston Publishing Company, Inc., Reston, Virginia.
2. MacDonald, G.2003. Biogeography: Introduction to Space, Time and Life. John Wiley & Sons, Inc.
3. Sagreiya, K.P.,1967.Forestsand Forestry. National Book Trust, India.

REFERENCES

1. Dwivedi, A.P.,1993.A Text Book of Silviculture.International Book Distributors, Dehra Dun.
2. Lal, J.B., 2003. TropicalSilviculture: NewImperatives: NewSystems, International Book Distributors, Dehra Dun.
3. Longman, K.A. and Jenik, J., 1987. Tropical forest and its Environment: ELBS, 2nd edn. London.
4. Shanmughavel, P., 2003: Techniques in Forestry, Pointer, Jaipur.
5. Simmons, I. G. 1979. Biogeography: Natural and Cultural. Edward Arnold Ltd.
6. Tiwari, K.M. and Singh, R.V., 1984. Social Forestry Plantations. Oxford & IBH Publishing Co., New Delhi

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

21PBT62 PLANT TISSUE CULTURE AND TRANSFORMATION TECHNIQUES

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To Understand the basic principles of plant tissue culture
- To Understand the methods in biotechnology

COURSE OUTCOMES:

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

- CO1. Understand the concept of Plant Tissue Culture
- CO2. Understand the techniques of plant tissue culture.
- CO3. Understand the concepts of organ culture
- CO4. Understand and apply the concepts of tissue culture in forest trees.
- CO5. Understand the importance of Transformation in tissue culture techniques.
- CO6. Know about the agrobacterium and its importance

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2				2	2						2			
2	2				2	2						2			
3	2				2	2						2			
4	2				2	2						2			
5	2				2	2						2			
6	2				2	2						2			

3 - High, 2 - Medium, 1 – Low

UNIT I INTRODUCTION TO PLANT TISSUE CULTURE **9**

History of plant tissue culture research - basic principles of plant tissue callus culture, meristem culture, organ culture, Totipotency of cells, differentiation and dedifferentiation. Methodology - sterilization (physical and chemical methods), culture media, Murashige and Skoog's (MS medium), phytohormones, medium for micro-propagation/clonal propagation of ornamental and horticulturally important plants, Callus subculture maintenance, growth measurements, morphogenesis

UNIT II PLANT TISSUE CULTURE **9**

Endosperm culture – Embryo culture -culture requirements – applications, embryo rescue technique. Production of secondary metabolites. Cryopreservation; Germ plasm conservation

UNIT III ORGAN CULTURE **9**

Anther, Embryo & Meristem culture. Organogenesis, somatic embryogenesis and artificial seeds. Somatic Hybridization: Isolation, fusion and protoplast culture. Somoclonal Variation & cryopreservation.

UNIT IV TISSUE CULTURE IN FOREST TREES **9**

In vitro propagation via enhanced release of auxiliary buds. Somatic organogenesis and somatic embryo genesis, leaf diseases, embryoid and synthetic seed production. Haploid culture and production of homodiploids, Protoplast isolation, culture and regeneration

UNIT V TRANSFORMATION TECHNIQUES **9**

Genetic transformation techniques in plants: Gene transfer methods in plants – Direct DNA transfer methods, Agro bacterium mediated nuclear transformation. Ti and Ri plasmids, binary & cointegrated vector systems; genetic markers; reporter genes; genetic transformation techniques for overcoming biotic and abiotic stress. Green house and green home technology. Arid and semiarid technology

TOTAL: 45 HOURS

TEXT BOOKS

1. Botany-Plant tissue culture and its biotechnological applications, by B. R. C. Murthy & V. S. T. Sai, Venkateswara Publications, Gu

REFERENCES

1) Pullaiah. T. and M.V.Subba Rao. 2009. Plant Tissue culture. Scientific Publishers, New Delhi.
2) Bhojwani, S.S. and Razdan, M.K., (1996). Plant Tissue Culture: Theory and Practice. Elsevier Science Amsterdam. The Netherlands.
3) Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.
4) Bhojwani, S.S. and Bhatnagar, S.P. (2011). The Embryology of Angiosperms. VikasPublicationHouse Pvt. Ltd., New Delhi. 5th edition.
5) Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics. John Wiley and Sons, U.K. 5th edition.
6) Stewart, C.N. Jr. (2008). Plant Biotechnology & Genetics: Principles, Techniques and Applications. John Wiley & Sons Inc. U.S.A.

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

21PBT63 **PLANT PHYSIOLOGY**

L	T	P	C
3	0	0	3

Course Objectives

The main objectives of this course are to:

- Learn physiological mechanisms underlying plant metabolism.
- Know the energy production and its utilization in plants.
- Be familiar with the phytohormones and its metabolism in plants generating plant growth.
- Study about the movements in plants.
- Know the various responses of plants against stress and its mechanism of resistance.

Course Outcomes

- On the successful completion of the course, student will be able to
- CO1. Understand the various steps involved in the basic functioning of plant growth and the nutritive value of food
- CO2. Understand the various hormones and its functioning in plants, plant movements and also the photobiology
- CO3. Expand knowledge about application of various mechanisms such as channel or transport proteins involved in nutrient uptake in plants
- CO4. Able to identify the plant stress based on its responses and anti-oxidative defense.
- CO5. Validate the plant physiological scientific hypothesis by using various experiments
- CO6. Gain awareness about the various process involved in the energy production in plants and metabolic pathways

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1			1		2		2								
2			2							3					
3			1			2			2						
4			1				2	3							
5			1		2										
6			1					2							

3 - High, 2 - Medium, 1 – Low

UNIT I PLANT WATER RELATIONS AND MINERAL NUTRITION **9**

Solute transport: Properties of water, Diffusion, Osmosis and Water potential. Translocation of water and solutes through cells, xylem and phloem. Mechanisms of loading and unloading of photo-assimilates. Transpiration and Stomatal movement

UNIT II PHOTOSYNTHESIS AND RESPIRATION **9**

Photosynthesis: Principles of light absorption, energy transfer and electron transfer; CO2 fixation - C3, C4 and CAM pathway, ATP synthesis. Respiration: Glycolysis, TCA cycle and Photorespiration.

UNIT III BIOENERGETICS **9**

Laws of thermodynamics, Concepts of free energy, Oxidation Reduction reaction. Mitochondrial electron transport and ATP cycle. Electron transport inhibitors.

UNIT IV PLANT HORMONES & NITROGEN METABOLISM **9**

Plant Hormones: Biosynthesis and transport of Auxins, Gibberellins, Ethylene and Abscisic acid. Nitrogen metabolism: Nitrogen cycle, Biological Nitrogen fixation. Photobiology and photomorphogenesis: Functions of Phytochrome, Photoperiodism and Biological clocks. Plant Movements

UNIT V STRESS PHYSIOLOGY **9**

Physiological responses of plants to biotic (insects and pathogens) and abiotic stresses (water, temperature and salt). Mechanism of resistance to biotic stress and tolerance to abiotic stress. Free Radicals and Antioxidants.

TOTAL: 45 HOURS

TEXT BOOKS

1. Hopkins W. G. and Hüner, N. P. A. 2008. Introduction to Plant Physiology. 4th ed. John Wiley & Sons, Inc., New York, USA.
2. Jain, V.K. 2000. Fundamentals of Plant Physiology. 5th ed. S. Chand & Co Ltd; New Delhi
3. Lincoln T, Eduardo Z, Ian Max M, and Angus M. 2018. Fundamentals of Plant Physiology. Sinauer Associates Inc., US
4. Pandey, N. S. and Pandey, P. 2016. Textbook of Plant Physiology. Daya Publishing House, New Delhi.
5. Pandey, S.N. and Sinha, B.K. 2010. Plant Physiology, Vikas Publishing, New Delhi
6. Taiz, L., Zeiger, E., Møller, I.M. and Murphy, A. 2015. Plant Physiology and Development 6 th Edition. Sinauer Associates, Sunderland, CT
7. Voet, D., Voet, J.G. and Pratt, C.W. 2013. Principles of Biochemistry, 4th ed. Wiley

REFERENCES

1. Buchanan, B.B., Gruissem, W. and Jones, R.L. , Biochemistry and Molecular Biology of Plants, 2015, John Wiley and Sons Ltd., UK.
2. Davies, P. J. 2010. Plant Hormones: Biosynthesis, Signal Transduction, Action. 3rd ed. Springer, Dordrecht.
3. Hopkins, W.G. 2006. Photosynthesis and Respiration. Chelsea House Publishers, NY.
4. Mengel, K., Kirkby, E.A., Kosegarten, H. and Appel, T. 2001. Principles of Plant Nutrition. Springer, Dordrecht.
5. Russell, L. J., Helen, O., Howard, T. and Susan, W. 2012. The Molecular Life of Plants. American Society of Plant Biologists and Wiley-Blackwell, US

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.

21PBT64 **PLANT PATHOLOGY**

L	T	P	C
3	0	0	3

Course Objectives

The main objectives of this course are to:

- Provide students with the latest information in the field of plant pathology.
- Explain the theoretical basis of disease control and development of pesticides

Course Outcomes

Upon completion of this course, students will be able to

- CO1. Understand the concepts of Plant Pathology
- CO2. Understand the various pathogens responsible for plant disease
- CO3. Know the techniques for studying plant disease
- CO4. Acquire knowledge about the principles of plant disease control.
- CO5. Understand the concepts of Biological control of plant pathogens
- CO6. Apply the concepts of Biological control in development of Biopesticides

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1											2			2
2	1											2			2
3	1											2			2
4	2											2			2
5	1											2			2
6	1											2			2

3 - High, 2 - Medium, 1 – Low

UNIT I INTRODUCTION **9**

Plant Pathology, Definition of plant disease, Pathogen and plant disease, Classification of plant disease, Disease classified according to major casual agents, Plant diseases, Economic importance of plant diseases.

UNIT II DISEASE INCITING ORGANISMS **9**

Animate pathogens, Fungi, Bacteria, Mycoplasma, Algae, Phanerogamic parasites, Nematodes, Viral pathogens, Viruses, Synergism of virus, Plant virus and Inanimate pathogens.

UNIT III METHODS OF STUDYING PLANT DISEASES **9**

Macroscopic study, Microscopic study, Koch's postulates, Culture techniques, Preparation of Culture tubes, Media Preparation, Inoculation, Isolation, Pure culture, Pathogenicity of leaf-spotting fungi, Parasitism of obligate parasites, Methods in bacteriology, Techniques required in introductory bacteriology.

UNIT IV PRINCIPLES OF PLANT DISEASE CONTROL **9**

Exclusion of the parasite, Eradication of the parasite, Improved culture practices, Biological Control, Direct protection, Use of fungicides, Fumigants, Antibiotics, Growth regulators, Systemic fungicides, Breeding for disease resistance, Breeding programme, Specific control measures.

UNIT V BIOPESTICIDES IN DISEASE MANAGEMENT **9**

Introduction, Biological control of plant pathogens, Biocontrol of insect pests, Biological control of weeds.

TOTAL: 45 HOURS

TEXT BOOKS

1. B.P. Pandey, Plant Pathology – Pathogen and Plant Disease, 2021, S. Chand and Company Ltd.
2. Singh, R.S. 2018. Introduction to Principles of Plant Pathology, 4th ed. Scientific International, Bengaluru, India.
3. Sullia, S.B. and Shantharam, S. 1998. General Microbiology, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi
4. Vasanthakumari, R. 2016. Textbook of Microbiology. 3rd Edition, Wolters Kluwer (India) Pvt., Ltd., Gurgaon.

EVALUATION PATTERN				
Assessment I*	**Assessment II***	**Assessment III***	**Total Internal Assessment Marks**	**End Semester Examination**
50	50	50	150	100
TOTAL			**40**	**60**

*Written Test and Assignment/Seminar/Group Discussions / Technical presentation can also be provided. Course coordinator can choose any one or two components based on the nature of the course.

HOD, Department of Bio Technology
Sri Shakthi Institute of Engineering
And Technology,
Coimbatore - 641 062. TN,India.