SRI SHAKTHI
INSTITUTE OF ENGINEERING AND TECHNOLOGY,
(AUTONOMOUS)
L&T BYPASS ROAD, COIMBATORE - 62

National Assessment & Accreditation Council

DEPARTMENT OF BIOTECHNOLOGY

CURRICULUM AND SYLLABI
B.Tech in Biotechnology

REGULATION 2019

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.

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B. Tech. BIOTECHNOLOGY
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CHOICE BASED CREDIT SYSTEM

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

PROGRAMME SPECIFIC 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

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MAPPING OF **COURSE OUTCOMES** WITH PROGRAMME **OUTCOMES**

A broad relation between the **Course Outcomes** and Programme **Outcomes** is given in the following 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 Biotechnology	✓	✓					✓					
	Applied Physics for Biosciences	✓	✓								✓		
	Computational Thinking and Problem Solving	✓	✓	✓	✓								✓
	Introduction to Biotechnology	✓	✓		✓	✓			✓	✓			
	Introduction to Biotechnology Laboratory	✓	✓		✓	✓				✓			
	Engineering Exploration I	✓	✓	✓	✓		✓		✓	✓		✓	
	Crop Production Laboratory I	✓	✓										
	Communicative English Laboratory									✓	✓		✓
	Applied Physics for Biosciences Laboratory	✓	✓										
	Computational Thinking and Problem Solving Lab	✓	✓	✓					✓	✓	✓		
	Language-Tamil. Language- Malayalam										✓		
II	English for Engineers									✓	✓		✓
	English for Engineers Laboratory									✓	✓		✓
	Laplace transform and advanced calculus for Biotechnology	✓	✓										
	Chemistry for Biotechnology	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓
	Chemistry for Biotechnology Laboratory	✓	✓	✓	✓	✓	✓	✓		✓	✓		✓
	C Programming	✓	✓		✓	✓	✓	✓		✓	✓		
	C Programming Laboratory	✓	✓		✓		✓	✓		✓	✓		
	Cell Biology	✓	✓	✓	✓	✓	✓	✓					✓
	Cell Biology Laboratory	✓	✓		✓								✓
	Microbiology	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓
	Microbiology laboratory	✓	✓	✓						✓			✓
	Engineering Exploration II	✓	✓	✓	✓		✓		✓	✓		✓	
III	Environmental Science for Biotechnology	✓	✓				✓	✓			✓		
	Environmental Science for Biotechnology Laboratory	✓	✓										
	Transforms and numerical methods for Biotechnology	✓	✓										
	Transforms and numerical methods for Biotechnology Laboratory	✓											
	Python Programming	✓	✓	✓	✓	✓							
	Python Programming Laboratory	✓	✓	✓	✓	✓							
	Career Enhancement Program-I									✓	✓		✓
	Unit Operation and Unit Principles	✓	✓	✓	✓	✓							
	Unit Operation and Unit Principles Laboratory	✓	✓		✓		✓					✓	
	Biochemistry	✓	✓	✓	✓	✓	✓	✓					✓
	Enzyme technology and Biotransformation	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓
	Engineering Exploration III	✓	✓	✓	✓		✓		✓	✓		✓	
	Bio organic chemistry Laboratory	✓	✓	✓	✓	✓	✓	✓		✓	✓		✓
	Enzyme technology Laboratory	✓	✓	✓	✓	✓	✓		✓			✓	✓
IV	Probability and Statistics for Biotechnology	✓	✓	✓	✓	✓						✓	✓

	Probability and Statistics for Biotechnology Laboratory	✓	✓	✓	✓	✓							
	Applied Thermodynamics for Biotechnologists	✓	✓	✓	✓	✓				✓	✓		
	Applied Thermodynamics for Biotechnologists Laboratory	✓	✓	✓		✓		✓		✓	✓		
	Plant Biotechnology	✓	✓	✓	✓		✓	✓				✓	✓
	Plant Biotechnology Laboratory		✓		✓	✓							
	Biopython and Molecular Docking	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Biopython and Molecular Docking Laboratory	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Molecular Biology	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓
	Biomolecular Sciences Laboratory	✓	✓		✓	✓				✓			
	Basic Industrial Biotechnology	✓	✓	✓	✓	✓	✓	✓				✓	✓
	Basic Industrial Biotechnology Laboratory	✓	✓		✓	✓				✓			
	Engineering Exploration IV	✓	✓	✓	✓		✓		✓	✓		✓	
	Career Enhancement Program-II-Personality Development II									✓	✓		✓
V	Transport Phenomena	✓	✓	✓				✓			✓		✓
	Principles of Genetic Engineering	✓	✓	✓	✓		✓					✓	✓
	Bioprocess Engineering	✓	✓	✓	✓	✓				✓	✓	✓	✓
	Bioinformatics	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Professional Elective I												
	Professional Elective II												
	Transport Phenomena Laboratory	✓	✓	✓	✓		✓	✓				✓	✓
	Principles of Genetic Engineering Laboratory	✓	✓	✓	✓						✓		
	Bioprocess Engineering Laboratory	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓
	Bioinformatics Laboratory	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓
	Engineering Exploration V	✓	✓	✓	✓		✓		✓	✓		✓	
	Career Enhancement Program - III									✓	✓		✓
VI	Applied Chemical Reaction Engineering	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓
	Immunology	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Biological Data Analysis	✓			✓	✓					✓	✓	✓
	Nano biotechnology	✓	✓	✓	✓	✓	✓	✓					✓
	Bioentrepreneurship	✓	✓	✓				✓	✓	✓	✓	✓	✓
	Open Elective I												
	Engineering Exploration VI	✓	✓	✓	✓		✓		✓	✓		✓	
	Applied Chemical Reaction Engineering Laboratory	✓	✓	✓		✓						✓	✓
	Immunology Laboratory	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓
	Biological Data Analysis Laboratory	✓			✓	✓					✓	✓	✓
	Career Enhancement Program IV									✓	✓		✓
VII	Downstream Processing	✓	✓	✓	✓	✓				✓	✓		✓
	Cancer Biology	✓	✓		✓	✓		✓					
	Project Phase I	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Open Elective II												
VIII	Project Phase II	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

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SEMESTER I								
SL. NO	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
THEORY								
1	U19ENTL101T	Communicative English	HS	4	2	0	2	2
2	U19MATH103	Matrices and calculus for Biotechnology	BS	4	3	1	0	4
3	U19PHTL102T	Applied Physics for Biosciences	BS	4	2	0	2	2
4	U19CSTL101T	Computational Thinking and Problem Solving	ES	4	3	0	2	3
5	U19BTTL101T	Introduction to Biotechnology	PC	4	3	0	2	3
6	U19LATH101, U19LATH102	Language-Tamil. Language-Malayalam	HS	4	2	0	0	2
PRACTICALS								
7	U19CCEX101	Engineering Exploration I	EEC	3	1	0	2	2
8	U19AEPC101	Crop Production Laboratory I	BS	3	0	0	4	2
9	U19ENTL101L	Communicative English Laboratory	HS	2	0	0	2	1
10	U19PHTL102L	Applied Physics for Biosciences Laboratory	BS	2	0	0	2	1
11	U19CSTL101L	Computational Thinking and Problem Solving Laboratory	ES	2	0	0	2	1
12	U19BTTL101L	Introduction to Biotechnology Laboratory	PC	2	0	0	2	1
		TOTAL		**38**	**16**	**1**	**22**	**24**

SEMESTER II								
SL. NO	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
THEORY								
1	U19ENTL202T	English for Engineers	HS	4	2	0	0	2
2	U19MATH212	Laplace transform and advanced calculus for Biotechnology	BS	4	3	1	0	4
3	U19CHTL202T	Chemistry for Biotechnology	BS	5	3	0	0	3
4	U19CSTL203T	C Programming	ES	4	3	0	0	3
5	U19BTTL202T	Cell Biology	PC	4	3	0	0	3
6	U19BTTL203T	Microbiology	PC	4	3	0	0	3
PRACTICALS								
7	U19CCEX202	Engineering Exploration II	EEC	3	1	0	2	2
8	U19ENTL202L	English for Engineers Laboratory	HS	2	0	0	2	1
9	U19CHTL202L	Chemistry for Biotechnology Laboratory	BS	2	0	0	2	1
10	U19CSTL203L	C Programming Laboratory	ES	2	0	0	2	1
11	U19BTTL202L	Cell Biology Laboratory	PC	2	0	0	2	1
12	U19BTTL203L	Microbiology Laboratory	PC	2	0	0	2	1
		TOTAL		**38**	**18**	**1**	**12**	**25**

SEMESTER III								
SL. NO	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
THEORY								
1	U19BTTL304T	Environmental Science for Biotechnology	PC	4	2	0	0	2
2	U19MATL301T	Transforms and numerical methods for Biotechnology	BS	5	3	0	0	3
3	U19BTTL305T	Unit Operation and Unit Principles	ES	4	2	0	0	2
4	U19BTTH301T	Biochemistry	PC	3	3	0	0	3
5	U19BTTH302T	Enzyme technology and Biotransformation	PC	3	3	0	0	3
6	U19ITTL302T	Python Programming	ES	3	2	0	0	2
PRACTICALS								
7	U19CCEX303	Engineering Exploration III	EEC	3	0	0	2	1
8	U19CCLC301	Career Enhancement Program-I	EEC	2	0	0	2	1
9	U19BTLC301L	Bio organic chemistry Laboratory	PC	4	0	0	4	2
10	U19BTLC302L	Enzyme technology Laboratory	PC	4	0	0	4	2
11	U19BTTL304L	Environmental Science for Biotechnology Laboratory	PC	2	0	0	2	1
12	U19MATL301L	Transforms and numerical methods for Biotechnology Laboratory	BS	2	0	0	2	1
13	U19BTTL305L	Unit Operation and Unit Principles Laboratory	ES	2	0	0	2	1
14	U19ITTL302L	Python Programming Laboratory	ES	2	0	0	2	1
		TOTAL		**43**	**15**	**0**	**20**	**25**

SEMESTER IV								
SL. NO	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
THEORY								
1	U19MATL403T	Probability and Statistics for Biotechnology	BS	4	2	0	0	2
2	U19BTTL406T	Applied Thermodynamics for Biotechnologists	ES	4	2	0	0	2
3	U19BTTL407T	Plant Biotechnology	PC	4	3	0	0	3
4	U19BTTL408T	Bio python and Molecular Docking	ES	4	2	0	0	2
5	U19BTTH403T	Molecular Biology	PC	3	3	0	0	3
6	U19BTTL409T	Basic Industrial Biotechnology	PC	3	3	0	0	3
PRACTICALS								
7	U19CCEX404	Engineering Exploration IV	EEC	3	0	0	2	2
8	U19CCLC402	Career Enhancement Program-II	EEC	2	0	0	2	1
9	U19BTLC403L	Bimolecular Sciences Laboratory	PC	4	0	0	4	2
10	U19MATL403L	Probability and Statistics for Biotechnology Laboratory	BS	2	0	0	2	1
11	U19BTTL406L	Applied Thermodynamics for Biotechnologists Laboratory	ES	2	0	0	2	1
12	U19BTTL407L	Plant Biotechnology Laboratory	PC	2	0	0	2	1
13	U19BTTL408L	Biopython and Molecular Docking Laboratory	ES	2	0	0	2	1
14	U19BTTL409L	Basic Industrial Biotechnology Laboratory	PC	2	0	0	2	1
		TOTAL		**37**	**14**	**0**	**18**	**25**

SEMESTER V								
SL. NO	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
THEORY								
1	U19BTTL510T	Transport Phenomena	ES	4	3	0	0	3
2	U19BTTL511T	Principles of Genetic Engineering	PC	3	3	0	0	3
3	U19BTTL512T	Bioprocess Engineering	PC	3	3	0	0	3
4	U19BTTL513T	Bioinformatics	PC	3	3	0	0	3
5	U19BTPE001	Protein Structures and Engineering	PE	3	3	0	0	3
6	U19BTPE002	Marine Biotechnology	PE	3	3	0	0	3
PRACTICALS								
7	U19CCEX505	Engineering Exploration V	EEC	3	1	0	2	1
8	U19CCLC503	Career Enhancement Program - III	EEC	2	1	0	0	1
9	U19BTTL510L	Transport Phenomena Laboratory	ES	2	0	0	2	1
10	U19BTTL511L	Principles of Genetic Engineering Laboratory	PC	2	0	0	2	1
11	U19BTTL512L	Bioprocess Engineering Laboratory	PC	2	0	0	2	1
12	U19BTTL513L	Bioinformatics Laboratory	PC	2	0	0	2	1
		TOTAL		**32**	**20**	**0**	**12**	**24**

SEMESTER VI								
SL. NO	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
THEORY								
1	U19BTTL614T	Applied Chemical Reaction Engineering	ES	4	3	0	0	3
2	U19BTTL615T	Immunology	PC	3	3	0	0	3
3	U19BTTL616T	Biological Data Analysis	PC	3	2	0	0	2
4	U19BTPE003	Nanobiotechnology	PE	3	3	0	0	3
5	U19BTPE004	Bioentrepreneurship	PE	3	3	0	0	3
6	U19FTOE002	Food preservation Techniques	OE	3	3	0	0	3
PRACTICALS								
7	U19CCLC604	Career Enhancement Program-IV	EEC	2	1	0	0	1
8	U19BTTL614L	Applied Chemical Reaction Engineering Laboratory	ES	2	0	0	2	1
9	U19BTTL615L	ImmunologyLaboratory	PC	2	0	0	2	1
10	U19BTTL616L	Biological Data AnalysisLaboratory	PC	2	0	0	2	1
11	U19BTPR601	Mini Project	EEC	4	0	0	3	2
		TOTAL		**31**	**18**	**0**	**9**	**23**

SEMESTER VII								
SL. NO	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
THEORY								
1	U19BTTH704	Downstream Processing	PC	4	4	0	0	4
2	U19BTPE012	Cancer Biology	PE	4	3	0	0	3
3	U19FTOE003	Beverage Technology	OE	3	3	0	0	3
PRACTICALS								
4	U19BTPR702	Project Phase I	EEC	4	0	0	3	2
			TOTAL	**15**	**10**	**0**	**3**	**12**

SEMESTER VIII								
SL. NO	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
THEORY								
1	U19BTPR803	Project Phase II	EEC	4	0	0	12	8

HUMANITIES AND SOCIAL SCIENCES (HS)

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
I	U19ENTL101T	Communicative English	HS	4	2	0	2	2
I	U19ENTL101L	Communicative English Laboratory	HS	2	0	0	2	1
I	U19LATH101, U19LATH102	Language-Tamil. Language-Malayalam	HS	2	2	0	0	2
II	U19ENTL202T	English for Engineers	HS	4	2	0	0	2
II	U19ENTL202L	English for Engineers Laboratory	HS	2	0	0	2	1

BASIC SCIENCES (BS)

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
I	U19MATH103	Matrices and calculus for Biotechnology	BS	4	3	1	0	4
I	U19PHTL103T	Applied Physics for Biosciences	BS	4	2	0	2	2
I	U19PHTL103L	Applied Physics for Biosciences Laboratory	BS	2	0	0	2	1
I	U19AEPC101	Crop Production Laboratory I	BS	3	0	0	4	2
II	U19MATH212	Laplace transform and advanced calculus for Biotechnology	BS	4	3	1	0	4
II	U19CHTL202T	Chemistry for Biotechnology	BS	5	3	0	0	3
II	U19CHTL202L	Chemistry for Biotechnology Laboratory	BS	2	0	0	2	1
III	U19MATL301T	Transforms and numerical methods for Biotechnology	BS	5	3	0	0	3
III	U19MATL301L	Transforms and numerical methods for Biotechnology Laboratory	BS	2	0	0	2	1
IV	U19MATL403T	Probability and Statistics for Biotechnology	BS	4	2	0	0	2

IV	U19MATL403L	Probability and Statistics for Biotechnology Laboratory	BS	2	0	0	2	1

ENGINEERING SCIENCES (ES)

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
I	U19CSTL101T	Computational Thinking and Problem Solving	ES	4	3	0	2	3
I	U19CSTL101L	Computational Thinking and Problem Solving Laboratory	ES	2	0	0	2	1
II	U19CSTL203T	C Programming	ES	4	3	0	0	3
II	U19CSTL203L	C Programming Laboratory	ES	2	0	0	2	1
III	U19BTTL305T	Unit Operation and Unit Principles	ES	4	2	0	0	2
III	U19BTTL305L	Unit Operation and Unit Principles Laboratory	ES	2	0	0	2	1
III	U19ITTL302T	Python Programming	ES	3	2	0	0	2
III	U19ITTL302L	Python Programming Laboratory	ES	2	0	0	2	1
IV	U19BTTL406T	Applied Thermodynamics for Biotechnologists	ES	4	2	0	0	2
IV	U19BTTL406L	Applied Thermodynamics for Biotechnologists Laboratory	ES	2	0	0	2	1
IV	U19BTTL408T	Biopython and Molecular Docking	ES	4	2	0	0	2
IV	U19BTTL408L	Biopython and Molecular Docking Laboratory	ES	2	0	0	2	1
V	U19BTTL510T	Transport Phenomena	ES	4	3	0	0	3
V	U19BTTL510L	Transport Phenomena Laboratory	ES	2	0	0	2	1
VI	U19BTTL613T	Applied Chemical Reaction Engineering	ES	5	3	0	0	3
VI	U19BTTL613L	Applied Chemical Reaction Engineering Laboratory	ES	2	0	0	2	1

PROFESSIONAL CORE (PC)

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
I	U19BTTL101T	Introduction to Biotechnology	PC	4	3	0	2	3
I	U19BTTL101L	Introduction to Biotechnology Laboratory	PC	2	0	0	2	1
II	U19BTTL202T	Cell Biology	PC	4	3	0	0	3
II	U19BTTL202L	Cell Biology	PC	2	0	0	2	1
II	U19BTTL203T	Microbiology	PC	4	3	0	0	3
II	U19BTTL203L	Microbiology Laboratory	PC	2	0	0	2	1
III	U19BTTL304T	Environmental Science for Biotechnology	PC	4	2	0	0	2
III	U19BTTL304L	Environmental Science for Biotechnology Laboratory	PC	2	0	0	2	1
III	U19BTTH301T	Biochemistry	PC	3	3	0	0	3
III	U19BTTH302T	Enzyme technology and Biotransformation	PC	3	3	0	0	3
III	U19BTLC301L	Bio organic chemistry Laboratory	PC	4	0	0	4	2
III	U19BTLC302L	Enzyme technology Laboratory	PC	4	0	0	4	2
IV	U19BTTL407T	Plant Biotechnology	PC	4	3	0	0	3
IV	U19BTTL407L	Plant Biotechnology Laboratory	PC	2	0	0	2	1
IV	U19BTTH403T	Molecular Biology	PC	3	3	0	0	3
IV	U19BTTL409T	Basic Industrial Biotechnology	PC	3	3	0	0	3
IV	U19BTTL409L	Basic Industrial Biotechnology Laboratory	PC	2	0	0	2	1
IV	U19BTLC403L	Biomolecular Sciences Laboratory	PC	4	0	0	4	2
V	U19BTTL511T	Principles of Genetic Engineering	PC	3	3	0	0	3
V	U19BTTL511L	Principles of Genetic Engineering Laboratory	PC	2	0	0	2	1
V	U19BTTL512T	Bioprocess Engineering	PC	3	3	0	0	3
V	U19BTTL512L	Bioprocess Engineering Laboratory	PC	2	0	0	2	1
V	U19BTTL513T	Bioinformatics	PC	3	3	0	0	3
V	U19BTTL513L	Bioinformatics Laboratory	PC	2	0	0	2	1
VI	U19BTTL614T	Immunology	PC	3	3	0	0	3
VI	U19BTTL614L	Immunology Laboratory	PC	2	0	0	2	1
VI	U19BTTL615T	Biological Data Analysis	PC	3	2	0	0	2
VI	U19BTTL615L	Biological Data Analysis Laboratory	PC	2	0	0	2	1
VII	U19BTTH704	Downstream Processing	PC	4	4	0	0	4

PROFESSIONAL ELECTIVES (PE)

(This can be based on the department as few department the elective starts from fourth semester. Please prepare this based on the curriculum)

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	U19BTPE001	Protein Structures and Engineering	PE	4	3	0	0	3
2	U19BTPE002	Marine Biotechnology	PE	4	3	0	0	3
3	U19BTPE003	Nanobiotechnology	PE	4	3	0	0	3
4	U19BTPE004	Bioentrepreneurship	PE	4	3	0	0	3
5	U19BTPE005	Research Methodology	PE	4	3	0	0	3
6	U19BTPE006	Total Quality Management	PE	4	3	0	0	3
7	U19BTPE007	Food Science and Technology	PE	4	3	0	0	3
8	U19BTPE008	Industrial biosafety and bioethics	PE	4	3	0	0	3
9	U19BTPE009	Metabolic Engineering	PE	4	3	0	0	3
10	U19BTPE010	Fermentation technology	PE	4	3	0	0	3
11	U19BTPE011	Biomaterials	PE	4	3	0	0	3
12	U19BTPE012	Cancer Biology	PE	4	3	0	0	3
13	U19BTPE013	Lifestyle Diseases	PE	4	3	0	0	3
14	U19BTPE014	Bioprocess plant design and economics	PE	4	3	0	0	3
15	U19BTPE015	Bioenergy	PE	4	3	0	0	3
16	U19BTPE016	Structural Biology	PE	4	3	0	0	3
17	U19BTPE017	Systems Biology	PE	4	3	0	0	3
18	U19BTPE018	Stem Cell Technology	PE	4	3	0	0	3
19	U19BTPE019	Bioremediation Technology	PE	4	3	0	0	3
20	U19BTPE020	Bioorganic Chemistry	PE	4	3	0	0	3
21	U19BTPE021	Biological spectroscopy	PE	4	3	0	0	3
22	U19BTPE022	Bioprocess modelling and simulation	PE	4	3	0	0	3
23	U19BTPE023	Bioprocess Instrumentation and Control	PE	4	3	0	0	3
24	U19BTPE024	Pharmaceutical Biotechnology	PE	4	3	0	0	3

OPEN ELECTIVES (OE)

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	U19BTOE001	Basics of Bioinformatics	OE	4	3	0	0	3
	U19BTOE002	Introduction to Bioenergy and Biofuels	OE	4	3	0	0	3

	U19FTOE002	Food preservation Techniques	OE	4	3	0	0	3
2	U19BTOE004	Industrial Waste Management	OE	4	3	0	0	3
	U19BTOE003	Analytical methods and Instrumentation	OE	4	3	0	0	3
	U19FTOE003	Beverages Technology	OE	4	3	0	0	3

*The elective list for all the semester to be tabulated

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
I	U19CCEX101	Engineering Exploration I	EEC	3	1	0	2	2
II	U19CCEX202	Engineering Exploration II	EEC	3	1	0	2	2
III	U19CCEX303	Engineering Exploration III	EEC	3	0	0	2	1
III	U19CCLC301	Career Enhancement Program-I	EEC	2	0	0	2	1
IV	U19CCEX404	Engineering Exploration IV	EEC	3	0	0	2	2
IV	U19CCLC402	Career Enhancement Program-II-Personality Development II	EEC	2	0	0	2	1
V	U19CCEX505	Engineering Exploration V	EEC	3	1	0	2	1
V	U19CCLC503	Career Enhancement Program – III	EEC	1	1	0	1	1
VI	U19CCLC604	Career Enhancement Program – IV	EEC	1	1	0	1	1
VI	U19BTPR601	Mini Project	EEC	5	0	0	3	2
VII	U19BTPR702	Project Phase I	EEC	2	0	0	3	2
VIII	U19BTPR803	Project Phase II	EEC	4	0	0	12	8

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	4.82%
2	BS	10	8	4	3					25	15.06%
3	ES	3	4	6	6	4	4			27	16.27%
4	PC	4	8	13	13	13	7	4		62	37.35%
5	PE					6	6	3		15	9.03%
6	OE						3	3		6	3.61%
7	EEC	2	2	2	3	2	2	2	8	23	13.86%
TOTAL										166	100%

SEMESTER I

U19ENTL101T	COMMUNICATIVE ENGLISH	L	T	P	C
		2	0	2	2

Course Objectives

- To enhance learners' listening skills so as to help them to comprehend conversations and lectures in diverse contexts.
- To develop the speaking skills of learners with fluency and appropriacy in order to express their ideas, views and opinions in varied formal and informal contexts and social situations.
- To inculcate the habit of reading using different types of reading strategies for understanding contextual situations.
- To develop the learners to write various writing forms effectively and coherently in an appropriate style.
- To develop linguistic competence and performance to express ideas effectively and appropriately in different contexts.

Course Outcomes

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

C01: Listen and comprehend technical and non-technical spoken experts critically and functionally.

C02: Write different forms of writing effectively and apparently and create advance level of writing in English.

C03: Read different genres of text, analyzing and interpreting it by guessing the meaning from the context and employ it for new ideas, to learn and present.

C04: Speak fluently using the appropriate vocabulary, modulation, articulation and pronunciation.

C05: Familiarize the soft skills needed for the employability and gaining functional understanding of the language.

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			2
2								1	2	3		2			2
3						2		2	3	3		2			2
4							3	2	1	3		3			3
5						3	3	3	3	3		3			3

3 - High, 2 - Medium, 1 – Low

UNIT I INTRODUCTION TO BUSINESS COMMUNICATION 6

Parts of Speech - Jumbled words - Making mild Suggestions / offers / invitations - Discourse Markers - Letter writing (Request / Complaint / Thanking) .

UNIT II EXTENDED WRITING 6

Seeking advice / Information politely - Root words - Present Tense - Reading Comprehension (MCQ) - Paragraph writing.

UNIT III READING COMPREHENSION 6

Past Tense - Phrasal Verbs - Jargon - Making polite requests - Reading and comprehending newspaper articles - Hints Development.

UNIT IV EXTENDED GRAMMAR CONCEPTS 6

Future Tense - Determiners - Making enquiries / requests indirectly and politely - Indicating Preference - Reading Comprehension (Short questions) - Constructing conversations (Formal and Informal).

UNIT V TECHNICAL COMMUNICATION 6

Pointing out mistakes and unpleasant things politely - Asking yes or no type questions and wh-questions indirectly and politely - Misspelled words - Cloze reading - Picture Description – Jumbled sentences.

TOTAL: 30 HOURS

TEXT BOOKS

1. Means, L. Thomas and Elaine Langlois. English & Communication for Colleges. Cengage Learning ,USA: 2007.
2. Redston, Chris & Gillies Cunningham. Face2Face (Pre-intermediate Student's Book). Cambridge University Press, New Delhi: 2005.

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. Meenakshi Raman and Sangeeta Sharma. Technical Communication. Oxford University Press. 2018.

WEB RESOURCES

1. http://www.bbc.co.uk/worldservice/learningenglish/language/
2. http://www.bbc.co.uk/learningenglish/english/features/pronunciation/introduction
3. http://toefl.uobabylon.edu.iq/papers/itp_2015_1817487.pdf

M.h.
(HoD/English)

U19ENTL101L **COMMUNICATIVE ENGLISH LABORATORY**

L	T	P	C
0	0	2	1

COURSE OBJECTIVES

The course aims to provide the students

- To enhance learners' listening skills so as to help them to comprehend conversations and lectures in diverse contexts.
- To develop the speaking skills of learners with fluency and appropriacy in order to express their ideas, views and opinions in varied formal and informal contexts and social situations.
- To inculcate the habit of reading using different types of reading strategies for understanding contextual situations.
- To develop the learners to write various writing forms effectively and coherently in an appropriate style.
- To develop linguistic competence and performance to express ideas effectively and appropriatelyin Different contexts.

Course Outcomes

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

C01: Take up all international examinations such as IELTS and TOEFL

C02: Make Presentations and participate in group discussion

C03: Speak fluently using the appropriate vocabulary, modulation, articulation and pronunciation.

C04: Develop felicity of expression and familiarity with technology enabled communication

C05: Familiarize the soft skills needed for the employability and gaining functional understanding of the language.

Course Articulation Matrix

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

3 - High, 2 - Medium, 1 – Low

LAB COMPONENTS

1. Organs of Speech
2. Pronunciation – Vowels
3. Pronunciation – Diphthongs
4. Pronunciation – Consonants
5. Word Transcription
6. Pronunciation tips
7. Word stress
8. Intonation
9. News/ Video clips
10. Conversation
11. Self-introduction (Video Recording)
12. Ted Talks (comprehension and questions)

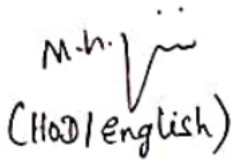
Total: 30 Hours

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.



U19MATH103 **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 wildly used in Bio technology studies.

Course Outcomes

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

C01: Diagonalize symmetric matrices and similar matrices using Eigen values and Eigen vectors.

C02: Explain gradients, potential functions, and directional derivatives of functions of several variables

C03: Compute line, surface and volume integral using Gauss divergence, Green's and stoke's theorem.

C04: Discuss analytic functions in heat and fluid flow.

C05: Extend the concept of contour integrals in evaluating Real integrals.

C06: Understand the importance of matrix and calculus in microarray technologies

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	
6	2	1											2		2

3 - High, 2 - Medium, 1 – Low

UNIT I MATRICES **9+3**

Consistency of linear system of equations – Rouche's theorem– Linear transformations – Vectors – Linear dependence – Eigen values and Eigen vectors of a real matrix – Properties of Eigen values and Eigen vectors (excluding proof) – Applications of Matrices in Bio Technology

UNIT II DIAGONALIZATIONOFAREALSYMMETRICMATRICES **8+3**

Cayley - Hamilton theorem (excluding proof) – Orthogonal matrix – Diagonalization of matrices– Reduction of a Quadratic form to Canonical form by orthogonal transformation – Applications of Diagonalization of real symmetric matrices in Bio Technology.

UNIT III DIFFERENTIAL CALCULUS AND ITS GEOMETRICAL APPLICATIONS **9+3**

Derivatives-Curvature-Radius of curvature in Cartesian and Parametric forms-Simple problems-Centre of curvature -Circle of curvature-Involutes and Evolutes of Parabola-Applications of Differential Calculus in Bio Technology.

UNIT IV INTEGRAL CALCULUS AND MULTIPLE INTEGRALS **9+4**

Definite and Indefinite integrals - Substitution rule - Integration by parts - Double integrals – Area enclosed by a plane curves - Triple integrals in Cartesian coordinates - Applications of Integrals in Bio Technology.

UNIT V ORDINARY DIFFERENTIAL EQUATIONS **9+3**

Higher order linear differential equations with constant coefficients - Cauchy'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.

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

U19PHTL102T **APPLIED PHYSICS FOR BIOSCIENCES**

L	T	P	C
2	0	2	2

Course Objectives

- To understand the difference between classical and quantum free electron theory, and able to know concept of holes
- To enrich the understanding of charge carriers in semiconducting materials and devices
- To ensure the physical properties of materials like superconductor and magnetic materials
- To ensure the electrical behavior of dielectric materials and to bring the awareness about synthesis of new materials and their applications in engineering and technology
- To learn the nanotechnology with applications and different characteristic methods for nano materials.

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 magnetic materials and super conducting materials

CO4.Know the concept of dielectric phenomenon.

CO5.Understand principle of Nano-sciences

C06. Implementation of nano friendly product

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

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 paramagnetism- Application

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
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

REFERENCES

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.

WEB RESOURCES

1. http://ocw.mit.edu/courses/#physics
2. http://nptel.ac.in/courses/115106090

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U19CSTL101T	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.

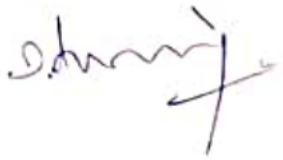
TOTAL: 45 HOURS

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.



U19BTTL101T **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

C06: Students would learn about basic structures and functions of cells.

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		2		1					2					1	
5	1							1							
6		2			1				2					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.

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And Technology,
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U19LATH101 **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

U19LATH102 **MALAYALAM**

L	T	P	C
2	0	0	2

Course Objectives

- The course aims to provide the students,
- To enhance reading and writing skills for better understanding of the main contextual ideas
- To comprehend communication using Malayalam.
- To inculcate the ability of reading and writing skills of the learners and express their views and ideas using the appropriate vocabulary and phrases.

Course Outcomes

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

CO1. Read and understand the contextual ideas of Malayalam literature.

CO2. Analyse and expand ideas using the language.

CO3. Speak and express views and ideas using appropriate vocabulary and phrases

CO4. Apply communicative strategy in writing letters.

C05: 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		

3 - High, 2 - Medium, 1 – Low

THEORY COMPONENT CONTENTS

UNIT I **WRITING** **6**

Writing- letters, swaraksharangal, vyanjanaksharangal, Error-free Malayalam: 1. Language; 2. Clarity of expression; 3. Punctuation.

UNIT II **LETTER WRITING** **6**

Formal (applications, letter to editor of a Newspaper, commercial correspondence, complaints) and informal letters.

UNIT III **READING SECTION** **6**

Comprehension of unseen prose passages

UNIT IV **EXPANSION OF IDEAS** **6**

Proverbs, poems and philosophical statements.

UNIT V **CRITICAL APPRECIATION OF LITERARY WORKS** **6**

(Books and Films). Literary & Cultural figures of Kerala and about their literary contributions.

TOTAL: 30 HOURS

TEXTBOOKS

1. John D Kunnathu, Lissy J Kunnathu, Learn Basic Malayalam In Six Weeks: With Daily Worksheets & Answer Key; CreateSpace Independent Publishing Platform (June 22, 2015).

WEB RESOURCES

1. https://e-resources.saraswatihouse.com

U19LATH103 **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

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

M.h.
(HOD/English)

U19CCEX101	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

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U19AEPC101 **CROP PRODUCTION-I LABORATORY**

L	T	P	C
0	0	4	2

Course Objectives

- To introduce the students to principles of field crops production and to introduce the production practices of crops.
- To delineate the role of agricultural and irrigation engineers in relation to various crop production practices.
- To equip the students with necessary theoretical and practical knowhow on basic principles of cropping and acquaint them with the cultivation practice of few important crops of Tamil Nadu..

Course Outcomes

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

CO1 : Knowledge on crop selection, production and management.

CO2 : Able to understand the importance of crop water management

C03 :Understand the cultivation practices for some of the important crops in Tamil Nadu

C04: Good knowledge in the fileld preparation of crops including systems of tillage

C05: Sound understanding of the production practices of vegetable crops

C06: Students will gain good knowledge in the production of agricultural and horticultural crops

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

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

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Coimbatore - 641 062, Tamilnadu, India.

U19PHTL102L	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.

Course Outcomes

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

C01: Understand the functioning of various physics laboratory equipment.

C02: Use graphical models to analyze laboratory data.

C03: Use mathematical models as a medium for quantitative reasoning and describing physical Reality

C04: Use mathematical models as a medium for quantitative reasoning and describing physical Reality

C05: Solve problems individually and collaboratively.

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													

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.

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U19CSTL101L 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.

U19BTTL101L **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

C06: Environmental friendly implementation of products

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				2										1	
6		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.

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SEMESTER II

U19ENTL202T	ENGLISH FOR ENGINEERS	L	T	P	C
		2	0	0	2

Course Objectives

The Course prepares students to:

- To develop learners' ability to listen and comprehend talks for the application of language in various context.
- To develop the students' ability to use English accurately, appropriately and fluently in different social and professional situations.
- To comprehend advanced technical passages and to identify the author's purpose and tone.
- To enhance advanced level of writing by organizing ideas and achieving consistency in academic as well as workplace contexts.
- To enhance the technical components of English language for formulating effective and appropriate sentences.

Course Outcomes

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

C01: Communicate with one or many listeners using appropriate communicative strategies.
C02: Speak clearly, confidently and comprehensively using appropriate communicative strategies.
C03: Read different genres of texts adopting various reading strategies.
C04: Understand the form and function of the basic official correspondences and perform a range official support through formal and informal writings.
C05: Comprehend and apply the language learning strategies to read, comprehend, organize and retain written information.

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	3		2		2	
2						2	2	2	2	3		2		2	
3						3	3	1	2	3		3		2	
4						1	1		1	3		1		3	
5						3	3	3	3	3		3		3	

3 - High, 2 - Medium, 1 – Low

UNIT I BASICS OF GRAMMAR 6

Use of the Gerund - Use of the infinite -'Used to' for habitual actions - Degrees of Comparison – Reading Comprehension passage and answering- Essay writing ((Narrative / Descriptive / Expository / Persuasive)- Letter Writing (Suggestions / Apology/ Acceptance).

UNIT II FOCUS ON LANGUAGE DEVELOPMENT 6

Modal verbs (Possibility, ability, Permission, Suggestions and obligations obligation) - Simple Past vs Present Perfect - Subject and verb agreement - Interpreting charts / Graphs / Tables – Instructions.

UNIT III FUNCTIONAL GRAMMAR AND FORMAL WRITING 6

Relative Pronouns for people and things - Future with 'be going to' and 'will' - Personal and impersonal passive - Email writing - Memo writing - Expansion of a Proverb.

UNIT IV EXTENDED WRITING 6

Fixed and Semi-fixed expressions - Wishes and hypotheses - Conditional clauses -Process Description- Notice / Agenda / Minutes of Meeting.

UNIT V TECHNICAL COMMUNICATION 6

Idioms: guessing meaning based on the context - Question Tags - Reported speech - Technical Proposal – Report Writing (Project / Survey). .

TOTAL: 30 HOURS

TEXT BOOKS

1. Redston, Chris & Gillies Cunningham. Face2Face (Upper-intermediate Student's Book). Cambridge University Press, New Delhi: 2005.
2. Daise, Debra &Charl Norloff. Q:Skills for Success Reading and Writing (2nd Edition). Oxford University Press. 2019.
3. Sudharshana N Pand Savitha C. English for Technical Communication. Cambridge University Press. 2018.

WEB RESOURCES

1. https://learnenglish.britishcouncil.org/grammar
2. https://www.kau.edu.sa/Files/0013287/Subjects/academic-writing-handbook-international-students-3rd-ed%20(2).pdf
3. https://owl.purdue.edu/owl/general_writing/academic_writing/essay_writing/descriptive_essays.html

M.h.
(HOD/English)

U19MATH212	LAPLACE TRANSFORMS AND ADVANCED 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 Laplace Transforms, Differential Calculus of several variables, Vector Calculus, Complex Differentiation and Complex Integration which are being wildly used in Bio technology studies

Course Outcomes

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

C01: Compute Eigen values and Eigen vectors of a matrix, diagonalize symmetric matrices and similar matrices

C02: Explain gradients, potential functions, and directional derivatives of functions of several variables.

C03: Compute line, surface and volume integral using Gauss divergence, Green's and stoke's theorem

C04: Discuss analytic functions in heat and fluid flow.

C05: Extend the concept of contour integrals in evaluating Real integrals

C06: Understand the complex integration for Thermodynamics application.

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	
6	2	1			2							2			

3 - High, 2 - Medium, 1 – Low

UNIT I LAPLACE TRANSFORMS AND ADVANCED CALCULUS FOR BIOTECHNOLOGY 9+4

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+3

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+4

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 8+3

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

UNIT V COMPLEX INTEGRATION 8+3

Complex integration – Statements of Cauchy's theorem and Cauchy's integral formula – Laurent's series - Singular points – Residues – Calculation of Residues- Cauchy's Residue theorem (excluding proof) – 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.

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U19CHTL202T **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.
To get the knowledge about the synthesis of biomass.

Course Outcomes

At the end of the course, learners will be able to
C01: Understand the water and its parameters influencing treatment process.
C02: Understanding the manufacturing of various types of fuels.
C03: Understanding the importance of nanomaterials and concepts
C04: Learn about instrumental analysis and chemical components.
C05: Gain knowledge of chemical reaction in fermentation and biomass.
C06: They would learn about biofertilizers.

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

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 BIOTECHNOLOGY **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).

CARAJ]

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U19CSTL203T	C Programming	L	T	P	C
		3	0	0	3

Course Objectives

The course aims to provide the students

- Write modular programs consisting of structure, functions and pointer concepts.
- Use structure variables for data storage and manipulation.
- Develop application using strings.
- Gain knowledge about memory management in C.
- To learn the files and perform file manipulations

Prerequisites : U19CSTL101 – Computer Thinking and Problem Solving

Course Outcomes

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

C01: Explain the syntax for C programming

C02: Associate the programs in 'C' for real world situation

C03: Apply the concepts of Arrays, Strings in 'C' language for user defined problems.

C04: Apply the concept of functions and pointers.

C05: Associate the programs with structure using 'C' language

C06: Discuss to read and write data from/to files in 'C' Programs

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									1		
2	2	1	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 INTRODUCTION: C PROGRAMMING 9

Structure of C program, Comments, Data types, Variables, Tokens: Keyword, Identifier, Constants, Operators, Expression and evaluation, Input and Output statements, Decision making-statements, Iterative statements, Storage Classes: auto, register, static and extern, Preprocessor Directives.

UNIT II ARRAYS AND STRING 9

Introduction to arrays: Declaration, Initialization. One dimensional array Multi-dimensional arrays, Searching: Linear and Binary Search, Sorting: Bubble sort, Selection Sort. Introduction to string, Built in string functions, String manipulation with and without built in functions, Array of strings, Pattern matching application using strings.

UNIT III FUNCTIONS AND POINTERS 9

Introduction to functions, Function prototype, Function definition, Function call, User defined functions and Standard functions (math function), Parameter passing: Call by value, Call by reference, Recursive functions, Passing arrays to functions, Command line arguments. Pointer in C, Importanceof pointer, Types of pointer, Pointer expression and arithmetic, Pointer and array, String as pointer,Pointer to function, Dynamic Memory Allocation

UNIT IV USER DEFINED DATATYPES 8

Structure: Declaration, Accessing structure elements, Array of structure, Nested structure, Pointers to structure, Structure to function, typedef vs #define. Union: Declaration, Accessing union elements, Difference between structure and union, Enum and its uses

UNIT V FILE HANDLING 9

Introduction to file, File Operations: Create, Open: File modes, Read, Write, Move, Close, File Processing: Sequential access and Random access.

TOTAL: 45 HOURS

TEXT BOOKS

1. Programming in C, Ashok N. Kamthane, 2nd Edition, Pearson Education India, 2011
2. Behrouz A. Forouzan and Richard F. Filberg, “Computer Science A Structures Programming Approach using C”, Third Edition, Cengage Learning, 2006.

REFERENCES

1. A first book of ANSI C by Gray J.Brosin 3rd edition Cengage delmer Learning India P.Ltd
2. Pradip Dey, Manas Ghosh, “Programming in C”, second edition, Oxford University Press, 2011.
3. Seyed H Roosta,” Foundations of programming languages design & implementation”, Cengage Learning. 2009.

U19BTTL202T **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 signalling

Course Outcomes

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

C01: List the fundamentals of prokaryotic and eukaryotic cell

C02: understand the specific processes and proteins involved in membrane transport

C03: understand about the intercellular chemical messengers, receptor subclasses and their possible uses in cell signalling

C04: analyse the mechanisms by which different messenger-receptor interactions bring about ling or short-term changes in cell state

C05: integrate the different levels of biological organization, from molecules to cells to organisms

C06: 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	3	2	2			2						3	3		1
2	2	3	2	1	2	2						2	3	2	
3	3	1	2	1	1	3	2					2		2	1
4	2		1		2	2	1								
5	2	1	3	2	2							3			
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

REFERENCES

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

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

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U19BTTL203T **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

C01: Comprehend knowledge about the taxonomical classifications and fundamentals of Microscopy

C02: Recognize the fundamental concepts in the structure and functioning of a microbial cell

C03: Understand the concepts of nutritional requirements for microbial growth and pure culture isolation

C04: Understand the controlling of microbes using physical and chemical methods

C05: Apply and evaluate the antibiotics and antifungal agent to control the microbial species

C06: 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	3	3		3		2	3	3	3	3		2	3	3	
2	3				2							3	3	3	
3	3	3	3	3		2	1		3	3		3	3	3	
4	3	2	2	3		2	2		2	2		2	2	2	
5	2			2		2	2		2	3		2	2	2	
6	2	2	1	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

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U19CCEX202	ENGINEERING EXPLORATION II	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

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

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U19ENTL202L	ENGLISH FOR ENGINEERS LABORATORY	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES

The course aims to provide the students

- To develop learners' ability to listen and comprehend talks for the application of language in various context.
- To develop the students' ability to use English accurately, appropriately and fluently in different social and professional situations.
- To comprehend advanced technical passages and to identify the author's purpose and tone
- To enhance advanced level of writing by organizing ideas and achieving consistency in academic as well as workplace contexts.
- To enhance the technical components of English language for formulating effective and appropriate sentences.

Course Outcomes

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

C01: Take up all conversation and communication if general forum

C02: gain confidence in participating in various discussion

C03: Speak fluently using the appropriate vocabulary, modulation, articulation and pronunciation.

C04: Develop felicity of expression and familiarity with technology enabled communication

C05: Familiarize the soft skills needed for the employability and gaining functional understanding of the language.

Course Articulation Matrix

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

3 - High, 2 - Medium, 1 – Low

LAB COMPONENTS

1. Telephone conversation
2. One Minute Talk (Prepared)
3. Describing a holiday / festivals / special events
4. BBC Hard Talk / NDTV Big Fight
5. Impromptu Speech
6. Story writing
7. Story telling
8. Open ended stories
9. Peacha Kucha
10. Book Review
11. Blog writing
12. TED Talk Presentation

Total: 30 Hours

WEB RESOURCE

1. https://www.ted.com/talks, https://www.toastmasters.org/
2. https://testbook.com/aptitude-practice/
3. http://www.allindiaexams.in/online-test/online-aptitude-test/all

M.h.
(HoD/English)

U19CHTL202L **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.
To equip the students to understand the concept of isolation techniques

Course Outcomes

At the end of the course, learners will be able to
C01: Estimate the amount of substance present in the given solution using potentiometer and conductivity meter.
C02: Examine the total hardness and chemical oxygen demand in the given solution by volumetric analysis method
C03: Apply the use of internal and external indicators and their comparison for redox titrations and mechanisms of iodometric titrations and use of double indicator method in a single titration.
C04: Learn about instrumental analysis and chemical components.
C05: Gain knowledge of mechanism chemical reaction.
C06: They would learn about synthesis and separation techniques.

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					2	1		1	3	2	2
2	2	2	1	1					1			1	3	2	2
3	1	1	1	2	1				2	1		1	3	2	2
4	2	1	2	1					2	1		1	3	2	2
5	2	2	3	2					2	1		1	3	2	2
6	1	1	2			2	2					1	3	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: 30 HOURS

TEXT BOOKS

1. Lab Manual, prepared by Chemistry Department

REFERENCES

1. Vogel's textbook of quantitative chemical analysis (8th edition, 2014).

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U19CSTL203L	C Programming Laboratory	L	T	P	C
		0	0	2	1

Course Objectives

- Write modular programs consisting of structure, functions and pointer concepts.
- Use structure variables for data storage and manipulation.
- Develop application using strings.
- Gain knowledge about memory management in C.
- To learn the files and perform file manipulations

Course Outcomes

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

C01: Explain the syntax for C programming

C02: Associate the programs in 'C' for real world situation

C03: Apply the concepts of Arrays, Strings in 'C' language for user defined problems.

C04: Apply the concept of functions and pointers.

C05: Associate the programs with structure using 'C' language.

C06:Discuss to read and write data from/to files in 'C' Programs.

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									1		
2	2	1	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. Solve some mathematical and scientific problems using functions.
2. Solve problems using arrays.
3. Create a programs using recursive functions.
4. Demonstrate various Predefined String functions.
5. Manipulate string using user defined functions.)
6. Solve problems using pointers.
7. Develop a C program using Enum data type.
8. Design a C program using typedef.
9. Create programs using structures and unions.
10. Develop a C program using Dynamic Memory Allocation.
11. File handling in sequential access.
12. File handling in random access.

TOTAL: 30 HOURS

U19BTTL202L **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 signalling

Course Outcomes

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

C01: demonstrate the basic concepts of sterilization techniques

C02: Interpret the behavior of cells in their microenvironment

C03: demonstrate working principles of microscopy

C04: differentiate the cells by staining techniques

C05: categorize the various stages of mitosis

C06: differentiate the 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	3	1													
2	3	2												2	
3	2	3		1									1	1	
4	3	2													
5	2	1													
6	1											2		1	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 epithelial cells
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

REFERENCES

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.
3. Sadava, D.E. “Cell Biology: Organelle Structure and Function”, Panima Publishing, 2004.
4. Rastogi, S.C. “Cell Biology” IInd Edition, New Age International, 2002.
5. Gardner, E.J., Simmons, M.J., and Snustad. D.P. 2005. Principles of genetics. 8th edition. Wiley India, Nice Printing press, New Delhi.
6. Agarwal V.K., and Verma, P.S. Genetics. Sultan Chand & co. New Delhi. 2004.

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U19BTTL203L **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

C01: discuss how microscopy has revealed the structure and function of microorganisms

C02: demonstrate the methods for isolation, subculture and maintenance of bacterial and fungal specimens

C03: employ the uses of various media and testing protocols with focus on clinical applications

C04: examine the causes and consequences of microbial evolution and the generation od diversity as well as human impacts on adaption

C05: inspect the evidence of bacterial and fungal metabolism

C06: understand the micrometry and different staining techniques

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	3	1											3		
3	2	1												3	
4	3	1											1		
5	2	1							2			2	3	2	
6	2	2	3												

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

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.

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SEMESTER III

U19BTTL304T	ENVIRONMENTAL SCIENCE FOR BIOTECHNOLOGY	L	T	P	C
		2	0	0	2

Course Objectives

To equip the students in understanding various aspects of the environment and how Biotechnology could be applied in finding sustainable solutions to environmental issues.

Course Outcomes

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

C01: Summarize the values, threats, conservation of biodiversity and ecosystems

C02: Discuss the sources, effects, control measures of different types of pollution, and solid waste management

C03: Associate the effects of exploitation of Natural resources on environment

C04: Summarize the water conservation methods and various environmental acts for environmental sustainability

C05: Explain the effect of Human population and role of IT in environment and human health

C06: Discuss scientific, technological, economic and social solutions to environmental problems

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	2					2	3			2					
3	2					2	3			2			2	2	
4							3			2			2		
5	2					2	3			2				2	
6		1				2	3			2					

3 - High, 2 - Medium, 1 – Low

UNIT I MICROBIAL ENVIRONMENT 9

Microbiology of Water -Importance of water; Types of Water; Water born diseases; Microbiology of air-Airborne microorganisms; Soil Microbiology- Layers of Soil; Classification; Scope and Importance of Soil Microbiology; Microbes and Biogeochemical cycles; Role of microbes in biogeochemical cycles - Carbon cycle; Sulphur cycle; Nitrogen cycle and Phosphorus cycle.

UNIT II ECOSYSTEM AND EUTROPHICATION 9

Concept of anecosystem – structure and function of an ecosystem – producers, consumers and decomposers –energy flow in the ecosystem – ecological succession – food chains, food webs and ecologicalpyramids – Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to biodiversity definition: genetic, species andecosystem diversity – biogeographical classification of India – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local levels – India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity. Field study of common plants, insects, birds; Field study of simple ecosystems – pond, river, hill slopes, etc. Eutrophication; Microbial changes induced by organic and inorganic pollutants; role of phosphorus and nitrogen in eutrophication; process and control of eutrophication.

UNIT III MICROBIAL TREATMENT OF WASTE WATER 9

Potability of water - Microbial assessment of water quality; Test of BOD and COD for water analysis. Conventional treatment process; Primary- Sedimentation or settling Principles; Biological waste water treatment-Aerobic suspended-growth; Aerobic attached-growth (TF, RBC, PBR);Anaerobic suspended growth; Anaerobic attached growth; Advanced tertiary process:-Solids removal; Biological nitrogen removal Biological phosphorus removal; Disinfection.

UNIT IV BIOREMEDIATION 9

Introduction of Bioremediation; advantages and applications; Types of bioremediation ;Natural (attenuation) ;Ex-situ and In-situ ;Bioaugmentation and biostimulation ;Solid phase and slurry phase bioremediation; Biological Filtration Processes for Decontamination of Air Stream; Biofiltration; Biotrickling Filtration; Bioscrubbers; Use of microbes for Heavy metal detoxification.

UNIT V BIODEGRADATION 9

Aerobic vs. anaerobic Degradation; Microbial basis of Biodegradation; Biodegradation of Xenobiotics; Microbial degradation of pesticides.

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).

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U19MATL301	TRANSFORMS AND NUMERICAL METHODS FOR BIOTECHNOLOGY	L	T	P	C
		3	0	2	4

Course Objectives

Engineering Mathematics is an essential tool for describing and analysing 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.

Course Outcomes

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

C01: Solve Linear Partial differential equations of first and second order.

C02: Associate the concepts of Fourier series expansion for even and odd functions.

C03: Associate the concepts of Fourier series in solving boundary value problems.

C04: Discuss the Fourier transform, Fourier Sine and Cosine transform techniques.

C05: Discuss the Fourier transform, Fourier Sine and Cosine transform techniques.

C06: Understand the importance of heat equation in biotechnological industries.

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	1	1	
3	2	2	2		2							2	2	2	
4	3	3	2		2							2	2	2	
5	3	3	2		2							2	2	2	
6	2	1													

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**

Fourier series solution in Cartesian Coordinates–Solutions of one-dimensional heat equation – Steady state solution of two-dimensional heat equation –Applications of Boundary value problem in Bio Technology.

UNIT IV INTERPOLATION AND APPROXIMATION **9**

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: Newton's forward and backward difference formulae - Numerical integration using Trapezoidal, Simpson's 1/3 rule – Evaluation of double integrals by Trapezoidal –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.

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U19BTTL305T **UNIT OPERATION AND UNIT PRINCIPLES**

L	T	P	C
2	0	0	2

Course Objectives

To apply knowledge on various unit operations in bioprocess industries

Course Outcomes

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

C01: Ability to understand the basic principle behind various mixers used in chemical Industries

C02: Elaborate the knowledge of basic principles of fluid mechanics

C03: Ability to analyse fluid flow measurements

C04: Ability to perform simultaneous material and energy balances

C05: Elaborate the principles of heat exchangers

C06: students would learn calculation part of unit operations

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													

3 - High, 2 - Medium, 1 – Low

UNIT I FLUID FLOW PHENOMENA **9**

Nature of fluid, Types of Fluid, Fluid properties, Rheological behavior of fluids & Newton's Law of viscosity- Newtonian and non-Newtonian fluid, hydrostatic equilibrium. Pressure measurement devices, Basic equations of fluid flow – Continuity equation, Euler's equation and Bernoulli equation (no derivation). Types of flow – laminar and turbulent; Reynolds experiment; Flow through circular and non-circular conduits – Hagen Poiseuille equation.

UNIT II FLOW MEASUREMENTS & MECHANICAL OPERATIONS **9**

Flow measuring devices: Orifice meter, Venturimeter, Rotameter, Pitot tube, V-notch. Pumps – types of pumps (Centrifugal & Reciprocating pumps), application of Bernoulli's equation for Energy calculations in pumps. Properties and handling of particulate solids, Screening analysis- Types of methods- differential method and cumulative analysis method. Size reduction concept–characteristics of comminuted products, crushing laws, working principle of ball mill. Mixing – types of mixers (ribbon and miller mixer), power number calculation.

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

Units and dimensions conversion -Temperature, Pressure. Properties of gases using 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 and partial pressure. Density of gas mixtures Solutions and their concentrations-problems.

UNIT IV MATERIAL BALANCE FOR NON REACTIVE AND REACTIVE SYSTEMS **9**

Basic concepts involved in material balance calculations. Material balance problems without chemical reactions: mixing, Drying, Evaporation, Distillation and extraction. Material balances for processes with reactions- Limiting reactant, excess reactant, conversion, selectivity, yield and recycle. Chemical equation and stoichiometry- Combustion as special case of material balance with reactions. Analysis of products of combustion, calculation of excess air, theoretical air, excess air.

UNIT V INTRODUCTION TO ENERGY BALANCES **9**

Thermo physics: Heat capacity, Kopp's rule. Sensible heat, latent heat and enthalpy. Energy balance for non-reactive systems. Standard Heat of formation, standard heat of combustion, Hess law, Heat of reaction from heat of formation or combustion. Enthalpy changes in reactions with different temperatures. Application of energy balances. Solving energy balances for evaporator and heat exchanger.

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. 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.

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U19BTTH301T **BIOCHEMISTRY**

L	T	P	C
3	0	0	3

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

C01: Make use of the fundamentals of bio organic chemistry

C02: Distinguish in detail about the elements of atoms, charges and their bonding rules

C03: Classify the various kinetic properties and its types of reaction mechanisms

C04: Determine the various bio organic reactions involved in biosynthesis

C05: Compare the principles of chemical bonding, stereochemistry of bio organic molecules and their catalytic mechanisms

C06: understand the bioorganic reactions and energy transfer

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	2	3	2	1	2	2						2	1	2	
3	3	1	2	1	1	3	2					2	1		
4	2		1		2	2	1								
5	2	1	3	2	2							3		1	
6	3		3	1	3							2			

3 - High, 2 - Medium, 1 – Low

UNIT I BASIC ORGANIC CHEMISTRY 9

Introduction- Important elements in biology, concept of hybridization Shape of water and ammonia molecules Acids and bases, pH, Henderson- Hasselbalch Equation Buffers Important functional groups in organic chemistry, Non-covalent interactions General types of reactions in Biochemistry

UNIT II CARBOHYDRATES 9

Introduction, Sources, Classification into mono, di and polysaccharides. Classification of monosaccharides based on no. of carbon atoms.). aldoses and ketoses, Fischer projections, Haworth structures, Anomers, Epimers, Structure and functions of sugars, Disaccharides, Polysaccharides, Glycoconjugates. Energy metabolism- Glycolysis, TCA cycle and Electron transport cycle

UNIT III AMINO ACIDS AND PROTEINS 9

Introduction, Classification Optical isomerism, chemical properties, Acid-base properties- polyionic nature, zwitter ions, pKa's, pI, Peptide bond formation and properties, Classification of proteins. Levels of protein structure (brief mention of primary, secondary, tertiary & quaternary structures, Denaturation of Proteins. Protein metabolism – Urea cycle.

UNIT IV LIPIDS 9

Lipids: Introduction, sources, Nomenclature Classification, Properties & Functions ,Fatty acids, Triacyl glycerols, Membrane lipids, Steroids, Structure of steroid nucleus, Biological role of Cholesterol, fat solublevitamins, Biological Membranes.

UNIT V NUCLEIC ACIDS 9

Structures of purine and pyrmidine bases Nucleosides, nucleotides, RNA, & DNA Types of RNA Structure of DNA, Watson and Crick model

TOTAL: 45 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 ,Conneticut.
2. Textbook of Biochemistry with clinical correlations. Ed. Thomas M. Devlin. Wiley Liss Publishers

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U19BTTH302T **ENZYME TECHNOLOGY AND BIO TRANSFORMATION** **L T P C**
3 0 0 3

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

C01: gain knowledge on enzyme classification and enzyme reactions

C02: understand the theoretical and practical aspects of enzyme kinetics

C03: comprehend the immobilization process and its application in various industries

C04: carry out enzyme isolation, purification and characterization

C05: design biotransformation reactions and production of novel enzymes.

C06: appraise different enzymes and uses 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	1	2	3	1	3						3	2	1	3
2	3	3	2	3	2							3	3	3	3
3	3	3	3	3	3	3	2		2			3	3	3	3
4	3	3	3	3	3	3	3		2		2	3	3	3	3
5	3	3	3	3	3	3	3		2			3	3	3	3
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; Enzymes in organic solvents; 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: King and Altmann equation; Types of inhibition: Competitive, Uncompetitive, noncompetitive inhibition; Allosteric regulation of enzymes; Monod Changeux Wyman model.

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 **BREWING AND FRUIT INDUSTRIES** **9**

Brewing industry: Process of malting, mashing and brewing, use of exogenous enzymes and process improvement by use of novel enzymes – commercial enzymes used in baking and brewing industry. Process and enzymes involved in wine production. Process involved in fruit juice production – cell wall degrading enzymes in the production of fruit juices with specific reference to apple, mango, guava, banana, lemon and grape fruit.

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

Baking industry: Dough production process, action of additives and processing aids, amylases and proteinases, practical interpretation of enzyme performance (farinograph, extensograph, alveograph), Milk coagulating enzymes, ripening of cheese and control of bitterness in cheese, enzymes (lipase, lysozyme, lactase, catalase) used in cheese manufacture and proceessing of whey. Enzymes (aminopeptidases) involved in debittering of protein hydroxylates. Enzyme modified cheese (ENC) – Altering flavors using

enzymes (lipoxygenase and hydrogen peroxide lyase).

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
5. Edition, Springer, 2003.
6. 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.

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U19ITTL302T **PYTHON PROGRAMMING**

L	T	P	C
2	0	0	2

Course Objectives

To enable the students

To learn about basic Python language syntax and semantics.

To develop Python programs using control statements and immutable Data types.

To develop Python programs using mutable Data types.

To create user defined functions in Python.

To develop Python Programs using Collections Packages.

Course Outcomes

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

C01: Discuss the logical solutions through Flowcharts, Algorithms and Pseudo code

C02: Explain the syntax for python programming constructs.

C03: Compute the flow of the program to obtain the programmatic solution.

C04: Examine the programs with sub problems using 'Python' language.

C05: Compute the compound data using Python lists, tuples, and dictionaries

C06: Apply python programs to read and write data from/to files.

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									1		1
2	2	1	1	1	2								2	2	
3	2	1	1	1	2								1	2	
4	3	2	2	1	3								2	2	
5	2	1	1	1	2								2	2	
6	3	2	2	1	3								1	2	

3 - High, 2 - Medium, 1 – Low

UNIT I BASICS OF PYTHON PROGRAMMING 9

Introduction to Python - Introduction to Python Language – History of Python – Features – Version-Python as Interpreter-Executing a Python Program - Basic structure of a Python Program-python as calculator, values and types (int, float, boolean, string, complex and list), keywords,Variables,Identifiers, expressions, commenting in python(single-line, multi-line, and documentation),Multiline Statements-Reading input from console-Operators(arithmetic, relational, assignment, logical, bitwise, membership and identity), Precedence of operator ,Type Conversion, Command line arguments

UNIT II CONTROL STRUCTURE AND IMMUTABLE DATATYPES 9

Control Structures - Decision making statement, iterative Statements, unconditional statements, pass statement, range()-Using else with loops, Nested Looping Statements. String - mutable Vs immutable types, String Operations- indexing-slicing-Striding, string functions, format function. Tuple - tuple operations and functions, tuple assignment. Pattern Programs.

UNIT III MUTABLE DATA TYPES 9

List - list operations, list slicing, Built-in list functions, Advanced List Processing –List as Array-Stack-Queue, list comprehension Set - set operations-Built-in functions –Set Comprehension. Dictionary - key-value pair, dictionary operations - functions-Nested Dictionary-Yield ()-Dictionary Comprehension.

UNIT IV FUNCTIONS 9

Functions - Python built in functions (python standard library). User Defined Functions -Creating function, invoking functions, types of functions (required arguments, keyword arguments, default arguments and variable length arguments), and recursion. Modules and Packages-importing random, math and time module functions, creating and importing own modules, importing packages, creating own packages, package folder structure.

UNIT V COLLECTIONS 9

Anonymous functions –Lambda, reduce, filter, map .Collections-Counter, Chainmap, Named Tuple, Default dict, Ordered Dict, deque. Files- text files, file modes, reading and writing files. Multithreading - start new thread, the thread module, synchronizing thread, multithreaded priority queue.

TOTAL: 45 HOURS

TEXT BOOKS

1. Guido van Rossum and Fred L. Drake Jr, "An Introduction to Python Revisedand updated for Python 3.2", Network Theory Ltd.,2011, 2nd edition.
2. Mark Summerfield, "Programming in Python 3", 1st Edition, Indian edition published by Dorling Kindersley India Pvt. Ltd.,2009

REFERENCES

1. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", 2nd Edition, O'Reilly,2016
2. Mark Lutz, "Learning Python", 5th Edition, O'Reilly Media,2013.
3. Python Documentation"https://docs.python.org/3.5/".

U19CCEX303	ENGINEERING EXPLORATION III	L	T	P	C
		0	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

2.

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

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

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U19CCLC301 **CAREER ENHANCEMENT PROGRAM – I**

L	T	P	C
0	0	2	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

C01: Listen and comprehend technical and non-technical spoken experts critically and functionally.

C02: Able to use English accurately, appropriately and fluently in different social and professional situations

C03: Able to gain a strong foundation by expanding their logical, numerical and reasoning skills.

C04: Ability to comprehend, work with, and apply general mathematical techniques and models to different situations.

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

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

WEB RESOURCES

1. https://learnenglish.britishcouncil.org/skills/listening
2. https://ieltspolska.pl/wp-content/uploads/2020/05/Listening-paper-assets.pdf
3. https://www.cambridgeenglish.org/learning-english/activities-for-learners/?skill=listening
4. https://testbook.com/aptitude-practice
5. https://www.indiabix.com/aptitude/questions-and-answers/

M.h.
(HoD/English)

U19BTLC301L **BIOCHEMISTRY LABORATORY**

L	T	P	C
0	0	4	2

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

C01: perform quantitative and qualitative analysis of biomolecules.

C02: calculate the solution preparations such as dilution, unit conversion and solutions of different concentrations

C03: perform the separation of solutes using chromatographic techniques

C04: perform molecular analysis of DNA and various enzymatic assays

C05: design, execute and analyse a biochemistry experiment and make its report

C06: perform experiments using safe and good lab practices individually or as a team

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					2	1		1	3	2	2
2	2	2	1	1					1			1	3	2	2
3	1	1	1	2	1				2	1		1	3	2	2
4	2	1	2	1					2	1		1	3	2	2
5	2	2	3	2					2	1		1	3	2	2
6	1	1	2			2	2					1	3	2	2

3 - High, 2 - Medium, 1 – Low

List of Experiments

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: 30 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 ,Conneticut.
2. Textbook of Biochemistry with clinical correlations. Ed. Thomas M. Devlin. Wiley Liss Publishers

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U19BTLC302L **ENZYME TECHNOLOGY LABORATORY**

L	T	P	C
0	0	4	2

Course Objectives

Provide hands-on training on the assay of different enzymes and kinetics
To familiarize the students with solid state fermentation and its applications
To expose the students to the proper handling of fermenters

Course Outcomes

At the end of the course, student will be able to
CO1 : Perform isolation of enzymes from natural sources
CO2 : Demonstrate the production of enzymes
CO3 : Perform partial purification of enzymes
CO4 : Execute the enzyme activity and immobilized enzyme
CO5 Perform the applications of enzymes
CO6 Demonstrate the bioreactor and modes of operation

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	3	2						1		2	3
2	3	2	2	2	2	2						1		2	3
3	3	2	1	2	2	2						1		2	3
4		2	1			1		1							
5		2				1									
6											2	1	2		

3 - High, 2 - Medium, 1 – Low

List of Experiments

1. Standard Maltose Curve
2. Isolation of Alpha/Beta Amylase
3. Determination of enzyme activity
4. Construction of Protein standard curve by Folin's Lowry method and Determination of specific activity of enzyme.
5. Effect of substrate concentration on Enzyme kinetics and determination of Km and Vmax
6. Effect of temperature on Enzyme kinetics
7. Effect of time on Enzyme kinetics
8. Effect of pH on Enzyme kinetics

TOTAL: 30 HOURS

TEXTBOOKS

1. Trevor Palmer, Enzymes (2007); Biochemistry, Biotechnology and Clinical Chemistry, 2nd Edition, Horwood Publishing Limited, United Kingdom.
2. Shanmugham.S and Sathishkumar.T, (2012); Enzyme Technology, 2nd edition, I.K. International Publishing House Pvt. Ltd., New Delhi, India.
3. Nicholas Price and Lewis Stevens, (2009); Fundamentals of Enzymology, 3rd Edition, Oxford University Press, India.

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.

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U19BTTL304L	ENVIRONMENTAL SCIENCE FOR BIOTECHNOLOGY LABORATORY	L	T	P	C
		0	0	2	1

Course Objectives

To equip the students in understanding various aspects of the environment and how Biotechnology could be applied in finding sustainable solutions to environmental issues.

Course Outcomes

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

CO1 : Identify the key concepts in ecosystems management

CO2 : Summarize wastewater characteristics and treatment protocols

CO3 : Construct systems for biotreatment of industrial effluents and solid wastes

CO4 : Review the biodegradation pathways for xenobiotic compounds

CO5 : Apply the concepts in developing environment-friendly bioproducts

CO6 : Understand concepts of biodiversity and IPR related issues

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	2	1											2	1	
4	2	1													
5	2	1											2	2	
6	2	1													

3 - High, 2 - Medium, 1 – Low

List of Experiments

1. Estimation of PH, Color, and Turbidity of water sample
2. Estimation of Cu2+ and Ni2+ by colorimetry/spectrophotometry.
3. Turbidimetric determination of sulphate ions in a water sample
4. Estimation of heavy metals in various samples by AAS.
5. Field visit to river/lake and waste water treatment plants.
6. Sampling techniques: waste water analysis for physico-chemical characteristics such as BOD, COD, CO2, alkalinity, chlorides, and hardness.
7. Vermicomposting: collection, preparation and analysis of composted material for NPK, moisture holding and microbial load.

TOTAL: 30 HOURS

REFERENCE

1. Hurst, C. J., Crawford, R. L., Garland, J. L., & Lipson, D. A. (Eds.). (2007). Manual of environmental microbiology. American Society for Microbiology Press.

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U19MATL301L TRANSFORMS AND NUMERICAL METHODS LABORATORY

L	T	P	C
0	0	2	1

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.

Course Outcomes

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

C01: Understand the water and its parameters influencing treatment process

C02: Understand the manufacturing of various types of fuels.

C03: Understand the importance of nanomaterials and concepts.

C04: Learn about instrumental analysis of chemical compounds.

C05: Gain knowledge of chemical reactions in fermentation and biomass.

C06: Gain knowledge to implement the methodology in lab

Course Articulation Matrix

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

3 - High, 2 - Medium, 1 – Low

List of Experiments

1. Introduction to MATLAB
2. Arithmetic Operators – Addition, Subtraction, Multiplication and Division
3. Matrix Operations- Addition, Multiplication, Transpose and Inverse.
4. Calculate the roots of the polynomials.
5. Solve exponential, trigonometric and logarithmic functions.
6. Solve a system of equations.
7. Evaluate Definite and Indefinite Integrals of the given function.
8. Solve problems using Double Integrals.
9. Solve problems using Trapezoidal rule.
10. Solve problems using Simpson's rule.

TOTAL: 30 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.

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U19BTTL305L	UNIT OPERATION AND UNIT PRINCIPLES LABORATORY	L	T	P	C
		0	0	2	1

Course Objectives

To apply knowledge on various unit operations in bioprocess industries

Course Outcomes

CO1 : Illustrate the importance of fluid flow operations in bioprocess industries

CO2 : Demonstrate the applications of particle flow operations in bioprocess industries

CO3 : Exemplify the significance of heat flow operations in bioprocess industries

CO4 : Demonstrate the impact of mass transfer concepts in bioprocess industries.

CO5: Solve importance of mixing and agitation and scale up.

CO6: Elaborate the principles of filtration, centrifugal and sedimentation.CO5 : Work as part of a team in a mature and professional manner

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	1					2					2		2		
3		2				2					1			2	
4		2		2		2					2				
5		1				2					1		1		
6															

3 - High, 2 - Medium, 1 – Low

List of Experiments

1. Flow through piping networks
2. Frictional losses in piping network and valves.
3. Flow measurement – Venturimeter
4. Flow measurement- Orifice meter.
5. Flow measurement- Rotameter
6. Viscosity measurements
7. Agitation and Mixing operations
8. Sedimentation
9. Ion exchange columns.

TOTAL: 30 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. 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.

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U19ITTL302L	PYTHON PROGRAMMING LABORATORY	L	T	P	C
		0	0	2	1

Objectives

To learn about basic Python language syntax and semantics.
To develop Python programs using control statements and immutable Data types.
To develop Python programs using mutable Data types.
To create user defined functions in Python.
To develop Python Programs using Collections Packages.

Outcomes

At the end of the course, student will be able to
C01: Write, test, and debug simple Python programs
C02: Apply the concept of conditionals and loops in Python programs.
C03: Develop the Python programs step-wise by defining functions and calling them
C04: Use Python lists, tuples, dictionaries for representing compound data.
C05: Read and write data from/to files in Python.
C06: Apply the concept of Pygame.

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	3	2	2	1	3								2	1	
3	3	3	3	2	3								1	2	
4	3	2	2	1	3								2	1	
5	1	1	1	1	1								2	1	
6	3	2	2	1	3								1	2	

3 - High, 2 - Medium, 1 – Low

List of Programs

1. Write a Python program for implementing string concepts with minimum of two functions.
2. Write a Python program involving the usage of dictionaries
3. Write a Python program mentioning the usage of lists and Tuples
4. Write a Python program involving the usage of set.
5. Write a Python program for implementing built-in functions.
6. Write a Python program involving the usage of user defined functions with required arguments.
7. Write a Python program involving the usage of user defined functions with Default arguments
8. Write a Python program to implement reduce functions.
9. Write a Python program for implementing lambda functions.
10. Write a Python program involving collections modules.

TOTAL: 30 HOURS

REFERENCES

1. Allen B. Downey, “Think Python: How to Think Like a Computer Scientist”, 2nd Edition, O’Reilly,2016
2. Mark Lutz, “Learning Python”, 5th Edition, O’Reilly Media,2013.
3. Python Documentation“https://docs.python.org/3.5/”.

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SEMESTER IV

U19MATL403	PROBABILITY AND STATISTICS FOR BIOTECHNOLOGY	L	T	P	C
		2	0	2	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

C01: Characterize standard probability distribution by employing basic techniques and methods of probability mass function and probability density function for discrete and continuous random variables

C02: develop skills to solve problems on correlation and regression

C03: obtain statistical data from experiments and able to analyse the same using statistical test

C04: design experiments using suitable ANOVA techniques and draw conclusions.

C05: use control charts to study, analyse and interpret problems in statistical quality control

C06: Use the concepts of design of experiments in biotechnological research application.

Course Articulation Matrix

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

3 - High, 2 - Medium, 1 – Low

UNIT I RANDOM VARIABLES 6

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

UNIT II TWO DIMENSIONAL RANDOM VARIABLES 6

Two dimensional discrete random variables – Joint distributions – Marginal and conditional distributions – Correlation and Linear regression – Applications of Two dimensional discrete random variables in Bio Technology.

UNIT III TESTING OF HYPOTHESIS 6

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 - Applications of Testing of Hypothesis in Bio Technology.

UNIT IV DESIGN OF EXPERIMENTS 6

Analysis of variance – One way classification – Completely Randomized Design (CRD) – Two-way classification – Randomized Block Design (RBD) – Latin square Design – Applications of Design of Experiments in Bio Technology.

UNIT V STATISTICAL QUALITY CONTROL 6

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.

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U19BTTL406T **APPLIED THERMODYNAMICS FOR BIOTECHNOLOGISTS**

L	T	P	C
2	0	0	2

Course Objectives

To make the students to understand the concepts thermodynamics with examples from bioprocess 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 bioprocess engineering

CO3 : Explain the principles of solution thermodynamics and their applications in bioprocess engineering

CO4 : Explain the principles of phase equilibria problems and their applications in industrial biotechnology

CO5 : Describe the basics principles of chemical reaction equilibria problems and their applications in industrial biotechnology

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	1	1	1	1	2				1				2	1	
2	1	2	2	1	2				1				2	1	
3	1	2	2		1					1			2	1	
4	2	1							1	1					
5	2	1	1												
6		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

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U19BTTL407T **PLANT BIOTECHNOLOGY**

L	T	P	C
3	0	0	3

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

C01: Understand the fundamentals of plant cells, structure and functions market

C02: learn the nitrogen fixation mechanism and significance of viral vectors

C03: Gain the knowledge about the plant tissue culture and transgenic plants

C04: Study the structural functions of genetic material

C05: Use of the gained knowledge for the development of therapeutic product

C06: 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	2	3	2		1	1				2	2	3	2	2
2	2	2	3	2		1	1				2	2	3	2	2
3	2	2	3	2		1	1				2	2	3	2	2
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.

TOTAL: 45 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

REFERENCES

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.

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		L	T	P	C
U19BTTL408T	**BIOPYTHON AND MOLECULAR DOCKING**	**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

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U19BTTH403T **MOLECULAR BIOLOGY**

L	T	P	C
3	0	0	3

Course Objectives

Familiarize students with the cell and molecular biology of both Prokaryotes and Eukaryotes.

Acquire basic fundamental knowledge and explore skills in molecular biology and become aware of the complexity and harmony of the cells.

Emphasize the molecular mechanism of DNA replication, repair, transcription, protein synthesis and gene regulation in various organisms

Course Outcomes

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

C01: Knowledge gained on distinguish between Prokaryotes and Eukaryotes

C02: Describe the basic structure and biochemistry of nucleic acids and proteins and discriminate between them

C03: Identify the principles of DNA replication, transcription and translation and explain how they relate to each other

C04: Discuss clearly about gene organization and mechanisms of control the gene expression in various organisms

C05: Study of protein synthesis and gene regulation in various organisms

C06: 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	3	3	3	3	2	2		2		2	2	3	2	2
2	3	3	3	3	3	2	2		2		2	2	3	2	2
3	3	3	3	3	3	2	2		2		2	2	3	2	2
4	3	3	3	3	3	2	2		2		2	2	3	2	2
5	3	3	3	3	3	2	2		2		2	2	3	2	2
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 of telomeres in eukaryotes. Inhibitors of replication.

UNIT II DNA REPLICATION & REPAIR 9

Overview of Central dogma. Organization of prokaryotic and eukaryotic chromosomes. DNA replication: Meselson & Stahl experiment, bi–directional DNA replication, Okazaki fragments, Proteomics of DNA replication, Fidelity of DNA replication, Inhibitors of DNA replication, Overview of 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 in prokaryotes – initiation, elongation, termination. Transcription in eukaryotes. Post-transcriptional processing – 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.

TOTAL: 45 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.

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U19BTTL409T **BASIC INDUSTRIAL BIOTECHNOLOGY**

L	T	P	C
3	0	0	3

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

C01: Explain the steps involved in the production of bioproducts and methods to improve modern biotechnology

C02: Apply basic biotechnological principles, methods and models to solve biotechnological tasks

C03: Identify and debate the ethical, legal, professional, and social issues in the field of biotechnology

C04: Develop the different strategies for the production of enzymes and other products

C05: Design and deliver useful modern biotechnology products to the Society

C06: Study of bioprocess strategies in plant and animal cell culture

Course Articulation Matrix

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

TOTAL: 45 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.

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U19CCEX404	ENGINEERING EXPLORATION IV	L	T	P	C
		0	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

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

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U19CCLC402 **CAREER ENHANCEMENT PROGRAM– II**

L	T	P	C
0	0	2	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

C01. Participate in formal / informal conversations

C02. Speak in different contexts confidently and accurately

C03. Interpret the given information correctly, determine which mathematical model best describes the data, and apply the model correctly.

C04. Improve analytical and data interpretation 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

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. Aggarwal, R.S. "Quantitative Aptitude", Revised Edition 2016, Reprint 2018, S.Chand& Co Ltd., New Delhi.
3. Analytical Reasoning by M.K Pandey

M.h.
(HoD/English)

U19BTLC403L **BIOMOLECULAR SCIENCES LABORATORY**

L	T	P	C
0	0	4	2

Course Objectives

To enable the students

To familiarize with cell counting and cell separation techniques.

To acquire practical skills related to DNA/ RNA isolation methods

To gain hands-on experience with action of restriction endonucleases and ligase on DNA.

Course Outcomes

CO1 : Demonstrate cell counting and cell separation techniques

CO2 : Carry out DNA isolation from various biological sources.

CO3 : Analyze and interpret DNA data.

CO4 : Separate proteins by SDS-PAGE..

CO5 : Demonstrate bacterial genetics through conjugation experiment

CO6 : Execute Western blotting

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					2	
3	1	3		2	1				1					1	
4															
5															
6															

3 - High, 2 - Medium, 1 – Low

List of Experiments

1. Isolation and analysis of microbial genomic DNA
2. Isolation and analysis of plant genomic DNA
3. Isolation and analysis of human genomic DNA from blood cells
4. Isolation and analysis of RNA from prokaryotic and eukaryotic cells
5. Isolation of Yeast genomic DNA
6. Quantification of DNA and RNA
7. PCR
8. Growth vs DNA concentration
9. Separation of proteins by SDS PAGE
10. Western blotting

TOTAL: 30 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.

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U19MATH403L	PROBABILITY AND STATISTICS FORBIOTECHNOLOGY LABORATORY	L	T	P	C
		0	0	2	1

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.

Course Outcomes

At the end of the course, student 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.

C06: Design experiments using suitable ANOVA techniques and draw conclusions.

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	2	1	2								2	1	
3	1	2	2	2	1								2	1	
4		2													
5			1												
6		1													

3 - High, 2 - Medium, 1 – Low

List of Experiments

1. Introduction of the Statistics toolbox.
2. Find the mean, median and mode of the given data.
3. Create a matrix and compute its variance and standard deviation of each column (or) row.
4. Write a program to find the Covariance between two random variables.
5. Write a program to find the Correlation coefficients between two random variables.
6. Write a program to find an ANOVA table of one way classification.
7. Write a program to find an ANOVA table of two way classification.
8. Write a program to find an ANOVA table of N way classification.
9. Write a program for testing of Hypothesis for Mean and Difference of means for large samples.
10. Write a program for testing of Hypothesis for Mean and Difference of means for small samples.
11. Write a program for testing of Hypothesis for variances of small samples.
12. Create and R control charts for the given data.
13. Create p, c and np Control charts for the given data.

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, 2020.

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U19BTTL406L **APPLIED THERMODYNAMICS FOR BIOTECHNOLOGISTS LABORATORY** **L T P C**
0 0 2 1

Course Objectives

To enable the students

To make the students to understand the concepts thermodynamics with examples from bioprocess industries.

Course Outcomes

At the end of the course, student 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 bioprocess engineering

CO3: Explain the principles of solution thermodynamics and their applications in bioprocess engineering

CO4: Explain the principles of phase equilibria problems and their applications in industrial biotechnology

CO5: Describe the basics principles of chemical reaction equilibria problems and their applications in industrial biotechnology

C06: 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	1	1													1
2		2	1						1					1	2
3		2	1						1						2
4		2	1							1					2
5		2	1						1	1			1	2	2
6					2		1						1	1	

3 - High, 2 - Medium, 1 – Low

List of Experiments

1. Boiling and condensation studies
2. Heat transfer in laminar and turbulent flow
3. Heat transfer by combined natural convection and radiation
4. Gas liquid and liquid reactions
5. Distillation – Simple / Steam / Packed
6. Solution thermodynamics- Determination of ΔG, ΔH and ΔS for dissolution of KNO3 in water.
7. Pressure drop studies – Packed bed
8. Pressure drop studies - Fluidized bed

TOTAL: 30 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

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U19BTTL407L **PLANT BIOTECHNOLOGY LABORATORY** **L T P C**
0 0 2 1

Course Objectives

To enable the students

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, student will be able to

CO1. Understand the structural complexity and diversity of plants

CO2. Explore the principles underlying the tissue culture and gene manipulation

CO3. Realize the principles underlying intermediary metabolism in plants

CO4. Understand the principles underlying breeding and protection

C05: Appreciate the utility of plants as production systems

C06: 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		1		2	2								3	2	3
2		2		3	2								2	2	2
3		2		1	3								1	2	3
4															
5															
6		1													

3 - High, 2 - Medium, 1 – Low

List of Experiments

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: 30 HOURS

TEXTBOOKS

1. Harvey Lodish, Arnold Berk, S.L Zipursky, Paul Matsudaira, David Baltimore and James Danell
2. Molecular Cell Biology, 4thEdition, New York: W.H Freeman and company,2002.
3. Singh, B.D. (2008) Text book of Biotechnology, fourth Edition, Kalyani Publishers, New Delhi.
4. Keshavachandran R and Peter KV (2008). Plant Biotechnology- Methods in tissue culture and gene transfer, University press, Hyderabad, India
5. Brown TA., Genomes 2, 3rd edition Bios Scientific Publishers Ltd, Oxford, 2006.

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U19BTTL408L	BIOPYTHON AND MOLECULAR DOCKING LABORATORY	L	T	P	C
		0	0	2	1

Course Objectives

To enable the students

To learn about basic of biophython.

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

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

CO1 : Demonstrate skills in safe operation of laboratory equipment

CO2 : Analyse experimental data and observed phenomena

CO3 : Communicate experimental findings through formal written reports

CO4 : Further understand the engineering principles of each unit operations.

CO5 : Work as part of a team in a mature and professional manner

C06: 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												

3 - High, 2 - Medium, 1 – Low

List of Experiments

1. Biopython installation and crating simple applications.
2. Biopython – sequence operations
3. Biopython- sequence input/output operations
4. Biopython – Sequence alignment and BLAST
5. Biopython – The PDB module
6. Nucleic acid, protein sequence and structure databases.
7. Chemoinformatics – small molecule databases
8. Drawing small molecules/ligands and .mol file preparation.
9. Molecular docking simulation using Auto dock Vina.
10. Visualization of molecular docking simulation – intermolecular interactions.

TOTAL: 30 HOURS

TEXT BOOK

1. Mitchell L Model. (2007) Bioinformatics programming using python, O'Reilly Media. Inc.
2. Andrew P Beckerman & Owen L Petchey. (2012) Getting started with R: An introduction for Biotechnologist, Oxford Biology.

REFERENCE

1. James D Tisdall. (2002) Beginning PERL for Bioinformatics,O'Reilly Media. Inc.
2. Herbert Schildt. (2018) Java: A beginner's guide (8th edition), McGraw-Hill Education

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U19BTTL409L **BASIC INDUSTRIAL BIOTECHNOLOGY LABORATORY** **L T P C**
0 0 2 1

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, student will be able to

CO1. Illustrate the screening procedures of microbes of industrial importance

CO2. Explain the medium requirements for fermentation processes

CO3. Compare various types of fermentation processes

CO4. Sketch and describe the production of industrially important products

CO5. Discuss the production of microbial enzymes, biofertilizers, biopesticides.

C06: Study of bioprocess strategies in plant and animal cell culture

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					1						
5															
6															

3 - High, 2 - Medium, 1 – Low

List of Experiments

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: 30 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.

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SEMESTER V

		L	T	P	C
U19BTTL510T	**TRANSPORT PHENOMENA**	**3**	**0**	**0**	**3**

Course Objectives

To enable the students

To comprehend and apply the principles and operations of heat transfer

To understand the fundamentals and applications of mass transfer in bioprocess engineering.

Course Outcomes

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

CO1: Outline the modes of heat of transfer

CO2: Design the heat transfer equipment in chemical industries

CO3: Illustrate the principles of diffusion and apply the concepts of interphase mass transfer in bioreactor

CO4: Apply the concept of distillation and drying in bioprocess

CO5: Comprehend the extraction and membrane separation

C06 : operate heat transfer equipment in chemical and biochemical industries

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		1					2								
3	1													1	
4			1							2			1		
5															1
6															

3 - High, 2 - Medium, 1 – Low

UNIT I FUNDAMENTALS OF HEAT TRANSFER 9

Classification of Transport Processes, Conservation Laws, Vector and Tensor Calculus, Modes of heat transfer; Conduction: Fourier's law, Thermal conductivity of biological materials, Conduction through plane wall, hollow cylinder and hollow sphere.

UNIT II HEAT TRANSFER EQUIPMENTS 9

Heat Exchangers: Basic calculations, Heat exchanger types, Design heat exchanger for Food and Bioprocess; LMTD and NTU concepts: Industrial evaporators - types, Methods of operation, Single effect evaporator and its enthalpy calculations.

UNIT III DIFFUSION AND INTERPHASE MASS TRANSFER 9

Modes of mass transfer; Diffusion: Fick's first law, Molecular diffusion in gases, liquids and solids; Interphase mass transfer: Individual and overall mass transfer coefficients, Theories of mass transfer; Mass transfer in bioreactors: Factors affecting oxygen transfer rate.

UNIT IV DISTILLATION AND DRYING 9

Distillation: Overview of vapour-liquid equilibria, Flash, differential, continuous, steam, azeotropic and extractive distillation, Determination of number of stages by McCabe-Thiele method; Drying– theory; classification of dryers; batch drying – Mechanism and time of cross through circulation drying.

UNIT V EXTRACTION AND MEMBRANE SEPARATION 9

Extraction and leaching: Ternary liquid-liquid equilibria, choice of solvents, Single and multistage extraction, Co-current and cross - current extraction. Extraction and leaching equipment's, Solid and liquid membranes; concept of osmosis; reverse osmosis; electro dialysis; ultrafiltration.

TOTAL: 45 HOURS

TEXT BOOK

1. Treybal, R.E., (2017) Mass-transfer operations. McGraw-Hill.
2. Doran, P. M. (2012). Bioprocess engineering principles. Elsevier.
3. Rajput, R.K. (2008) Heat and Mass Transfer, S. Chand and Co.
4. Shuler, Kargi, and DeLisa (2017). Bioprocess Engineering: Basic Concepts. 3rd edition.

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U19BTTL511 T **PRINCIPLES OF GENETIC ENGINEERING**

L	T	P	C
3	0	0	3

Course Objectives

To learn various types of host-vector systems and steps in creating a recombinant DNA molecule
To gain knowledge on various recombinant DNA techniques and their applications.
To understand the genomics techniques.

Course Outcomes

At the end of the course, learners will be able to:
C01: Study the characteristics of cloning and expression vectors based on plasmid and bacteriophage
C02: Aware of how to clone commercially important genes.
C03: Knowledge gained how to produce the commercially important recombinant Proteins
C04: Understand the PCR and its types
C05: Aware of gene and genome sequencing techniques
C06: 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	2	2	3		2					1	2	3	3	2
2	3	2	2	3		2					1	2	3	3	2
3	3	2	2	3		2					1	2	3	3	2
4	3	2	2	3		2					1	2	3	3	2
5	3	2	2	3		2					1	2	3	3	2
6	3	2	2	3		2					1	2	3	3	2

3 - High, 2 - Medium, 1 – Low

UNIT I BASICS OF RECOMBINANT DNA TECHNOLOGY 9

Restriction and modifying enzymes, construction of recombinant DNA molecules, transformation of r-DNA molecules into target host organisms: Calcium chloride mediated, electroporation, microinjection, gene gun, selection methods for recombinants: antibiotic resistance, blue and white selection, GFP and Luciferase based selection. Case study: mode of action of a selection marker

UNIT II CLONING AND EXPRESSION VECTORS 9

Cloning vector; properties of a cloning vector: origin of replication, polylinker region, selectable marker gene; Plasmid Vectors: Lambda phage vectors, phagemid, cosmid, shuttle vector, expression vectors; yeast vectors , Baculoviral based vector, mammalian expression vectors, plant transformation vector; binary vector, high capacity vector;YAC Case study: Latest multipurpose expression vector.

UNIT III GENE CLONING AND APPLICATIONS 9

Construction and screening of genomic and cDNA libraries, over-expression and purification of recombinant His tag fusion proteins using Ni+ column. Blotting techniques: Southern, northern, western blotting, Polymerase Chain Reaction (PCR); DNA fingerprinting using molecular markers: RAPD, RFLP, gene silencing: RNAi and gene knock-out; site directed mutagenesis, Application of genetically modified organisms: medicine, agriculture, Biosafety levels for microbes, plant and animals, safety guidelines and release procedure for GMOs in India. Case study: Use of PCR and RFLP in forensic field.

UNIT IV GENOME MAPPING AND SEQUENCING 9

History and mile stones of human genome project, Genome organization: prokaryote, eukaryote; complexity of genomes; genome mapping: FISH, optical mapping, STS content mapping, Advanced DNA sequencing methods: pyrosequencing, nanopore sequencing, genome sequencing methods: topdown approach, bottom- up approach; genome sequence assembly; comparative study on the genome sequencing methods. Case study: Optical mapping.

UNIT V FUNCTIONAL GENOMICS 9

Differential gene expression analysis; DDRT- PCR, subtractive hybridization, representational display analysis, Serial Analysis of Gene Expression, Microarray: fabrication of cDNA based array, DNA chip;

application microarray in gene expression analysis. Case study: Analysis and interpretation of microarray data.

TOTAL: 45 HOURS

TEXT BOOK

1. Glick B.R.,and PasternickJ.J., Molecular Biotechnology : Principles and Applications of Recombinant DNA, 3rd Edition, ASM press, Eashington (2003).
2. Brown T.A., Genomes 2, Bios Scientific Publishers Ltd, Oxford, 3rd edition,(2006).
3. Primrose S.B., Twyman RM., Principles of Gene Manipulation and Genomics, 7thEdition, Blackwell Science,(2006).

REFERENCE

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

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U19BTTL512T **BIOPROCESS ENGINEERING**

L	T	P	C
3	0	0	3

Course Objectives

To enable the students

To provide the students with the basics of bioreactor engineering.

To develop bioengineering skills for the production of biochemical product using integrated biochemical processes.

To impart interconnection between biology, engineering, and physical sciences.

To analyse processes involved in production of chemicals, food, biofuels and pharmaceuticals using biological agents.

To understand the unit operations and processes for product recovery.

Course Outcomes

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

C01: Apply engineering principles to systems containing biological catalysts to meet the needs of the society.

C02: Apply the knowledge of media for new processes to make bio- products in economically feasible way.

C03: Interpret the sterilization kinetics and types of sterilization during fermentation processes.

C04: Enhance and modify the biological materials to improve its usefulness by finding the optimal formulation materials to facilitate product production

C05: Design and work on chemostat and its kinetics

C06: demonstrate theory, principle, design, application and possible integrations of bioprocessing

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				2	2	2	3		2	3
2	3	3	2	3	3				2	2	2	3	2	2	3
3	3	3	2	3	3				2	2	2	3	2	2	3
4	3	3	2	3	3				2	2	2	3	2	2	3
5	3	3	2	3	3				2	2	2	3	2	2	3
6	3	2	1	3										2	3

3 - High, 2 - Medium, 1 – Low

UNIT I MEDIA AND ITS OPTIMIZATION METHOD **9**

Criteria for good medium; Various carbon, nitrogen, minerals, vitamins and other complex nutrients for fermentation industry; Simple and complex media for microbial, plant and animal cells; oxygen requirements; medium formulation for optimal growth and product formation; Stoichiometric analysis of media . Medium optimization methods: Plackett-Burman design, simplex design and response-surface methodology. Case study: Enzyme production using Plackett-Burman design.

UNIT II STERILIZATION KINETICS **9**

Thermal death kinetics of microorganisms; batch and continuous heat sterilization of liquid media; filter sterilization of liquid media; sterilization of air; design of sterilization equipment for batch and continuous process.

UNIT III FERMENTATION KINETICS **9**

Modes of operation – batch, fed-batch and continuous cultivation, Simple unstructured kinetic models for microbial growth - Monod model; Growth of filamentous organisms and yeast. Product formation kinetics; Leudeking-Piret models, substrate and product inhibition on cell growth and product formation.

UNIT IV TRANSPORT PHENOMENA IN BIOREACTOR AND TYPES OF BIOREACTOR **9**

Aeration and agitation in gas-liquid mass transfer, Oxygen transfer rate (OTR), determination of KLa, Factor affecting in OTR in bioreactor, Mass transfer correlation in Oxygen transfer. Types and industrial applications of bioreactors; Stirred-tank reactor and its ancillaries; Bubble-column reactor; Packed-bed reactor; Fluidized- bed; Air-lift reactor; and Photobioreactor.

Case study: alagal cultivation

UNIT V SCALE-UP OF BIOREACTORS AND NON-IDEAL REACTOR 9

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. Introduction to non- ideal reactors: Residence time distribution (RTD), Reasons for non-ideality in reactors, RTD function and measurement, RTD in plug flow and mixed flow reactor.

TOTAL: 45 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.

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U19BTTL513T **BIOINFORMATICS**

L	T	P	C
3	0	0	3

Course Objectives

To enable the students

To improve the programming skills of the student

To let the students, know the recent evolution in biological science

Course Outcomes

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

C01: introduce the concept of biological sequence alignment and various genome sequence protocols

C02: familiarize with various biological database searches, parameters and algorithm.

C03: apply, interpret and analyze multiple sequence alignments

C04: construct, interpret and access molecular phylogenetic tree prediction

C05: apply, interpret and analyze protein structures prediction algorithms

C06: introduce the concepts of perl programming

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	3	2		2	3	3	3	3	3
2	3	3		2		2	3	2		2	3	3	3	3	3
3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
5	3	3	3	3	3	3	3	3	3	2	3	3	3	3	3
6	3	3	3	3	3	3	3	3	3	2	3	3	3	3	3

3 - High, 2 - Medium, 1 – Low

UNIT I INTRODUCTION **9**

Introduction to Operating systems, Linux commands, File transfer protocols ftp and telnet, Introduction to Bioinformatics and Computational Biology, Biological sequences, Biological databases, Genome specific databases, Data file formats, Data life cycle, Database management system models, Basics of Structured Query Language (SQL).

UNIT II SEQUENCE ALIGNMENT **9**

Sequence Analysis, Pair wise alignment, Dynamic programming algorithms for computing edit distance, string similarity, shotgun DNA sequencing, end space free alignment. Multiple sequence alignment, Algorithms for Multiple sequence alignment, Generating motifs and profiles, Local and Global alignment, Needleman and Wunsch algorithm, Smith Waterman algorithm, BLAST, PSIBLAST and PHIBLAST algorithms.

UNIT III PHYLOGENETIC METHODS **9**

Introduction to phylogenetics, Distance based trees UPGMA trees, Molecular clock theory,Ultrametric trees, Parsimonious trees, Neighbour joining trees, trees based on morphologicaltraits, Bootstrapping. Protein Secondary structure and tertiary structure prediction methods,Homology modeling, abinitio approaches, Threading, Critical Assessment of Structure Prediction,Structural genomics.

UNIT IV PROTEIN STRUCTURE ANALYSIS **9**

Machine learning techniques: Artificial Neural Networks in protein secondary structure prediction, Hidden Markov Models for gene finding, Decision trees, Support Vector Machines. Introduction to Systems Biology and Synthetic Biology, Microarray analysis, DNA computing,Bioinformatics approaches for drug discovery, Applications of informatics techniques in genomics and proteomics: Assembling the genome, STS content mapping for clone contigs, Functional annotation, Peptide mass fingerprinting.

UNIT V PERL PROGRAMMING **9**

Basics of PERL programming for Bioinformatics: Data types: scalars and collections, operators,Program control flow constructs, Library Functions: String specific functions, User defined functions, File handling.

TOTAL: 45 HOURS

TEXT BOOKS

1. Introduction to Bioinformatics by Arthur K. Lesk , Oxford University Press.
2. Algorithms on Strings, Trees and Sequences by Dan Gusfield, Cambridge University Press.

3. Biological Sequence Analysis Probabilistic Models of proteins and nucleic acids by R.Durbin, S.Eddy, A.Krogh, G.Mitchison.
4. Bioinformatics Sequence and Genome Analysis by David W. Mount, Cold Spring Harbor Laboratory Press.
5. Beginning Perl for Bioinformatics: An introduction to Perl for Biologists by James Tindall,O'Reilley Media

REFERENCES

1. Bioinformatics The Machine Learning Approach by Pierre Baldi and Soren Brunak.

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U19CCEX505	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

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

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U19CCLC503 **CAREER ENHANCEMENT PROGRAM – III**

L	T	P	C
1	0	1	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 reasning.

Course Outcomes

At the end of the course, learners will be able to
C01: Enable the development in sharing information about family and friends.
C02: Strengthen general comprehending skills and present lucid skills in free writing.
C03: Understand the basic grammar techniques and utilize it in enhancing language development.
C04: Foster an environment for reading and develop good language skills
C05: Develop flair for any kind of writing with rich vocabulary and proper syntax.
C06: 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	3		
2									2	2		3		3	2
3										2		3	3	3	2
4										2		3			
5										2		3	3		
6									3	3		2			

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.

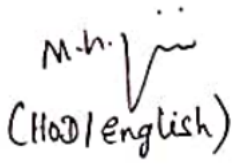
TOTAL: 30 HOURS

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



U19BTTL510 L **TRANSPORT PHENOMENA LABORATORY**

L	T	P	C
0	0	2	1

Course Objectives

To enable the students

To comprehend and apply the principles and operations of heat transfer

To understand the fundamentals and applications of mass transfer in bioprocess engineering.

Course Outcomes

C01: solve the problems related to fluid flow

C02: select various valves and pumps for its application in industries

C03: resolve problems for heat flow by conduction for various geometries

C04: elucidate the convective heat transfer problems

C05: design heat exchanger equipment

C06: operate heat transfer equipment in chemical and biochemical industries

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	3			3
3	3	3	3	3		1	1				2	3			3
4	3	3	3	3		1	1				2	3			3
5	3	3	3	3		1	1				2	3			3
6	3	2	2	1							3	2	3		1

3 - High, 2 - Medium, 1 – Low

List of Experiments

1. Heat transfer calculation in double pipe exchanger
2. Heat transfer calculation in shell and tube heat exchanger
3. Studies on simple distillation
4. Studies on steam distillation
5. Convective drying of food/biological materials
6. Mass transfer studies on rotating disc contactor
7. Liquid membrane separation of bioactive compounds

TOTAL: 30 HOURS

TEXT BOOK

1. Treybal, R.E., (2017) Mass-transfer operations. McGraw-Hill.
2. Doran, P. M. (2012). Bioprocess engineering principles. Elsevier.
3. Rajput, R.K. (2008) Heat and Mass Transfer, S. Chand and Co.
4. Shuler, Kargi, and DeLisa (2017). Bioprocess Engineering: Basic Concepts. 3rd edition.

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U19BTTL511L **PRINCIPLES OF GENETIC ENGINEERING LABORATORY** **L T P C**
0 0 2 1

Course Objectives

To enable the students

To learn various types of host-vector systems and steps in creating a recombinant DNA molecule

To gain knowledge on various recombinant DNA techniques and their applications.

To understand the genomics techniques

Course Outcomes

C01: describe core nucleic acid techniques such as extraction, nucleic acid separations and elution.

C02: illustrate DNA amplification using polymerase chain reaction

C03: classify the methods of nucleic acids characterization, through the application of gene probes

C04: employ gene cloning and screening of recombinants

C05: compare the proteins through SDS-PAGE

C06: employ various hybridization techniques

Course Articulation Matrix

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

3 - High, 2 - Medium, 1 – Low

List of Experiments

1. Preparation of plasmid DNA,
2. Preparation of DNA
3. Agarose gel electrophoresis and Elution of DNA from agarose gels
4. Restriction digestion to prepare foreign gene
5. Cloning by Ligation of foreign DNA into expression vectors
6. Transformation & Selection of recombinants – Blue white screening assay
7. Optimisation of time of inducer for recombinant protein expression
8. Recombinant protein expression profiling by SDS - PAGE
9. Southern blotting
10. PCR and colony lysate amplification for detection

TOTAL: 30 HOURS

TEXT BOOK

1. J. Sambrook, D. Russell, and D. W. Russell, Molecular cloning-A laboratory Manual (A set of Volume 1, 2 and 3), USA: Cold Spring Harbor Laboratory Press

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U19BTTL510L	BIOPROCESS ENGINEERING LABORATORY	L	T	P	C
		0	0	2	1

Course Objectives

To enable the students

Determine the parameters involved in enzyme kinetic

Carryout kinetics of enzyme inhibition

Perform different types of enzyme immobilisation

Evaluate the various parameters involved in growth kinetics

Formulate the optimum media for the growth of microorganisms

Estimate and quantify the distribution and utilization of nutrients by Residence Time Distribution studies

Course Outcomes

CO1: Apply the knowledge of various optimization methods to design the media for fermentation broth

CO2 Evaluate the sterilization kinetics of media and able to design the holding time for batch sterilization

CO3: Develop a suitable mathematical model for batch, fed-batch and continuous fermentation and able to simulate and evaluate the constants for microbial growth

CO4: Understand and analyse the application of various bioreactors and importance of mass transfer effect in bioprocess engineering

CO5: Apply the various scale-up criteria to design the bioreactors

CO6: Identify and provide the solution for non- ideal performance of bioreactor

Course Articulation Matrix

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

3 - High, 2 - Medium, 1 – Low

List of Experiments

1. Batch sterilization Process
2. Calculation of Del factor
3. Estimation of holding time
4. Batch cultivation and evaluation of growth parameters
5. Fed-batch cultivation and evaluation of growth parameters
6. Residence Time Distribution (RTD)
7. Medium optimization by Plackett-Burman design/response surface methodology (RSM) using design expert tool
8. Estimation of KLa – power correlation
9. Estimation of KLa – sulfite oxidation
10. Estimation of KLa – dynamic gassing method
11. Production of microbial metabolites (enzymes / antibiotics) in bioreactor
12. Estimation of overall heat transfer coefficient.

TOTAL: 30 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.

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U19BTTL513L **BIOINFORMATICS LABORATORY** **L T P C**
0 0 2 1

Course Objectives

To enable the students

To improve the programming skills of the student

To let the students, know the recent evolution in biological science.

Course Outcomes

CO1: Use bioinformatics tools with programming skills.

CO2: Apply computational based solutions for biological perspectives.

CO3: Alignment of nucleotide and protein sequences.

CO4: Predict gene and protein structure.

CO5: Construct, interpret and assess the different molecular phylogenetic tree prediction and gene prediction algorithms.

C06: Students would learn different equence Alignnment with application

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	1	2						1	2	2	3
2	3	2	3	1	2	1						2	1	2	3
3	3	2	3	3	2	2						2	2	2	3
4		2				3	2	1			1	3		2	
5							2	1				3		2	
6			2		2									2	

3 - High, 2 - Medium, 1 – Low

List of Experiments

1. Operating systems, Internet browsers and File Editors
2. Biological databases
3. File formats of biological databases – Analysis and Interconversion
4. Retrieval of sequences from biological databases – BLAST and FASTA
5. Pairwise Alignment of sequences
6. Multiple sequence alignment
7. Phylogenetic analyses
8. Gene prediction
9. Prediction of secondary structures of protein
10. Protein structure Visualization (SPDBV)

TOTAL: 30 HOURS

REFERENCES

1. Bioinformatics The Machine Learning Approach by Pierre Baldi and Soren Brunak.

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SEMESTER VI

		L	T	P	C
U19BTTL614T	**APPLIED CHEMICAL REACTION ENGINEERING**	**3**	**0**	**0**	**3**

Course Objectives

To enable the students

To make the students to apply the concepts of reaction mechanism and kinetics for biochemical and microbial reactions

To make the students to design a reactor for biological reactions

Course Outcomes

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

CO1: Elucidate the basic laws on chemical kinetics and its application on different types of reactions

CO2 Apply the various ideal reactors and their design equations

CO3: Elaborate the non-ideal behaviour of reactors

CO4: Conceptualize the basic of heterogeneous reacting systems

CO5: Identify and analyse the various multiphase reactors

CO6: Solve the importance of multiphase rectors

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			3	
2	3	3		2	3					2		2		2	
3	3	2	3							3					
4				3	3	2			2		2			2	
5	3	2		2										3	
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

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U19BTTL615T	IMMUNOLOGY	L	T	P	C
		3	0	0	3

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:

C01:know the immune system and their role in disease protection

C02: profound knowledge in immune dianostic techniques

C03: describe immune adverse reaction and their therapeutic approach

C04: explain the features of immune response against antigens

C05: familiar with transplantation and vaccine biology

C06: 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	3	3	3	2	2	3	2	1	1	1	3	3	3	3	3
2	3	3	3	2	2	3	2	1	1	1	3	3	3	3	3
3	3	3	3	2	2	3	2	1	1	1	3	3	3	3	3
4	3	3	3	2	2	3	2	1	1	1	3	3	3	3	3
5	3	3	3	2	2	3	2	1	1	1	3	3	3	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.

TOTAL: 45 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)

2 Essential clinical immunology by Zabriskie, Cambridge University Press, 1st edition (2009)

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U19BTTL616T	BIOLOGICAL DATA ANALYSIS	L	T	P	C
		2	0	0	2

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.

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U19CCLC604 **CAREER ENHANCEMENT PROGRAM – IV**

L	T	P	C
1	0	1	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
C01: To classify the content material and make effective presentations.
C02: Employ adequate soft skills to successfully execute the job on hand
C03: To respond favorably to the values of others opinion and manage difficult situations in group discussions wisely.
C04: To execute various skills in grooming for any profession.
C05: To display the body language in a very pleasant manner and react to even tough situations with ease.
C06: To perform intelligently during job interviews and be successful

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									3	2		3		3	2
3									2	3		3	3	3	2
4									3	2		3			
5									2	2		3	3		
6									2	3		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.

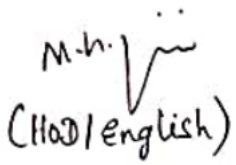
TOTAL: 30 HOURS

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



U19BTTL614L APPLIED CHEMICAL REACTION ENGINEERING LABORATORY L T P C
0 0 2 1

Course Objectives

To enable the students

To make the students to apply the concepts of reaction mechanism and kinetics for biochemical and microbial reactions

To make the students to design a reactor for biological reactions

Course Outcomes

CO1: Elucidate the basic laws on chemical kinetics and its application on different types of reactions

CO2 Apply the various ideal reactors and their design equations

CO3: Elaborate the non-ideal behaviour of reactors

CO4: Conceptualize the basic of heterogeneous reacting systems

CO5: Identify and analyse the various multiphase reactors

CO6: Solve the importance of multiphase rectors

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								1	2	
3	2	2	3		3								2	2	
4															
5															
6		2	2		2						2	3	2	3	3

3 - High, 2 - Medium, 1 – Low

List of Experiments

1. Flow measurement a) Orifice meter
2. Flow measurement b) Venturimeter
3. Flow measurement c) Rotameter
4. Pressure drop in flow through fluidized beds
5. Characteristics of centrifuge pump
6. Plate and frame filter press
7. Filteration in leaf filter
8. Adsorption isotherm

TOTAL: 30 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.

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U19BTTL615L **IMMUNOLOGY LABORATORY** **L T P C**
0 0 2 1

Course Objectives

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

Course Outcomes

C01: design the experiments in immunology research laboratories
C02: ability to handle the animals for immunological research
C03: acquired e ability to rise antiserum against protein antigens by using experimental animals
C04: familiarize with immune diagnostic techniques
C05: to isolate and characterize the lymphocytes
C06: familiarize with various other immunological techniques

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	1	1		3	3	3	3	3
2	3	3	3	2	2		2	1	1		3	3	3	3	3
3	3	3	3	2	2		2	1	1		3	3	3	3	3
4	3	3	3	2	2		2	1	1		3	3	3	3	3
5	3	3	3	2	2		2	1	1		3	3	3	3	3
6	3	3	3	2	2		2	1	1		3	3	3	3	3

3 - High, 2 - Medium, 1 – Low

List of Experiments

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.
10. Western blotting

TOTAL: 30 HOURS

REFERENCES

1 Roitt I, Male, Brostoff. Immunology, Mosby Publ., 2002.
2 Kuby J, Immunology, WH Freeman & Co., 2000.
3 Ashim K. Chakravarthy, Immunology, TataMcGraw-Hill, 1998.

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U19BTTL616L	BIOLOGICAL DATA ANALYSIS LABORATORY	L	T	P	C
		0	0	2	1

Objectives

To enable the students

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.

Outcomes

CO1: Understand and apply the biological annotation for macromolecules; apply and interpret the structural analysis of macromolecules using high throughput experiment.

CO2 Apply and interpret the biological data through fundamental statistical analysis.

CO3: Apply and interpret biological data related with hypothesis testing

CO4: Explore and infer biological data using visualization.

CO5: Understand and apply R-programming for biological data analysis

CO6: Provide optimal solution and statistics to biological problems

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

List of Experiments

1. Introduction to R installation, package management and basic operators
2. Bioconductor tools – Introduction & usage
3. Biological sequences and sequence analysis
4. Basic plot and customized plot using ggplot2
5. R for large biological datasets
6. Descriptive statistics and One-way ANOVA
7. Image analysis using EB Image
8. Case Study: Microarray data analysis using Bioconductor package.

TOTAL: 30 HOURS

REFERENCES

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

2 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.

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

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U19BTPR601 **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.

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SEMESTER VII

		L	T	P	C
U19BTTH704	**DOWNSTREAM PROCESSING**	**4**	**0**	**0**	**4**

Course Objectives

- 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 OUTCOME

CO1:Apply the knowledge of various Cell disruption methods and stabilization of bioproducts
CO2:Evaluate the removal of insoluble through centrifugation and filtration
CO3:Understand and analyse the different methods used for product isolation
CO4:Apply the various purification techniques using chromatography
CO5:Identify the methods used for stabilization of bioproducts
CO6: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															

4 - High, 2 - Medium, 1 – Low

5

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.

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U19BTPR702 **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	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.

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SEMESTER VIII

U19BTPR803	PROJECT PHASE II	L	T	P	C
		0	0	12	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.

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LIST OF PROFESSIONAL ELECTIVES

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	U19BTPE001	Protein Structures and Engineering	PE	4	3	0	0	3
2	U19BTPE002	Marine Biotechnology	PE	4	3	0	0	3
3	U19BTPE003	Nanobiotechnology	PE	4	3	0	0	3
4	U19BTPE004	Bioentrepreneurship	PE	4	3	0	0	3
5	U19BTPE005	Research Methodology	PE	4	3	0	0	3
6	U19BTPE006	Total Quality Management	PE	4	3	0	0	3
7	U19BTPE007	Food Science and Technology	PE	4	3	0	0	3
8	U19BTPE008	Industrial biosafety and bioethics	PE	4	3	0	0	3
9	U19BTPE009	Metabolic Engineering	PE	4	3	0	0	3
10	U19BTPE010	Fermentation technology	PE	4	3	0	0	3
11	U19BTPE011	Biomaterials	PE	4	3	0	0	3
12	U19BTPE012	Cancer Biology	PE	4	3	0	0	3
13	U19BTPE013	Lifestyle Diseases	PE	4	3	0	0	3
14	U19BTPE014	Bioprocess plant design and economics	PE	4	3	0	0	3
15	U19BTPE015	Bioenergy	PE	4	3	0	0	3
16	U19BTPE016	Structural Biology	PE	4	3	0	0	3
17	U19BTPE017	Systems Biology	PE	4	3	0	0	3
18	U19BTPE018	Stem Cell Technology	PE	4	3	0	0	3
19	U19BTPE019	Bioremediation Technology	PE	4	3	0	0	3
20	U19BTPE020	Bioorganic Chemistry	PE	4	3	0	0	3
21	U19BTPE021	Biological spectroscopy	PE	4	3	0	0	3
22	U19BTPE022	Bioprocess modelling and simulation	PE	4	3	0	0	3
23	U19BTPE023	Bioprocess Instrumentation and Control	PE	4	3	0	0	3
24	U19BTPE024	Pharmaceutical Biotechnology	PE	4	3	0	0	3

U19BTPE001 **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
To impart advance knowledge the characteristic properties of proteins and their significance in biological systems

Course Outcomes

At the end of the course, learners will be able to
C01: Identify the importance of protein biomolecules
C02: Analyze the various interactions in protein makeup
C03: Familiar with different levels of protein structure
C04: Study the role of functional proteins in various field of study
C05: Knowledge gained on Immunoglobins and its types
C06: Practice the latest application of protein science in their research

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	3	2	1
2	3	3	2	2	2						2	2	3	2	1
3	3	3	2	2	2						2	2	3	2	1
4	3	3	2	2	2						2	2	3	2	1
5	3	3	2	2	2						2	2	3	2	1
6	3	3	2	2	2						2	2	3	2	1

3 - High, 2 - Medium, 1 – Low

UNIT I INTRODUCTION TO PROTEIN STRUCTURE 9

Primary structure (peptid bonds, polypeptide chains), secondary structure (helices (α, 310, Π) , β sheets, β turns & loops/coil; Ramachandran plots), tertiary structure (fold, domain & motif; classification - globular (myoglobin) membrane (collagen) & fibrous (bacteriorhodopsin)), quaternary structure (protein assembly; globular arrangement; symmetry considerations- cyclic, dihedral & cubic symmetry; helical quaternary structures). 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. Post translation modification (involving amino, carboxyl, hydroxyl, thiol, imidazole groups).

UNIT II PROTEIN STRUCTURE PREDICTION AND DESIGN 9

Strategies for design of novel proteins-strategies for the design of structure and function: computer methods in protein modelling. Protein sequence comparison, multiple sequence alignment, data bank scanning, pattern matching; sequence structure comparison. secondary structure prediction, surfaces & volumes, molecular dynamics simulations, free energy perturbation. Incorporation of Binding Sites into de Novo Proteins, Design of Catalytically Active Proteins.

UNIT III APPROACHES OF PROTEIN ENGINEERING 9

Introduction and scope of Protein Engineering. Different approaches of protein engineering: Random mutagenesis, Mutagenesis by rational design. Effect of mutation on protein structure, stability and folding, phi value analysis. Invitro mutagenesis- principles & variations, invitro chemical mutagenesis, Oligonucleotide based mutagenesis, Cassette Mutagenesis, PCR-based mutagenesis, Types of template, Saturation mutagenesis, Applications of mutagenesis

UNIT IV STRATEGIES FOR THE PRODUCTION OF NOVEL PROTEINS 9

Site and strategies for heterologous expressions: methods for expressing recombinant proteins in yeast, in vitro mutagenesis. Proteolytic processing, Genetic considerations in expression, post translational modifications, Sites of expression. Advantages of using yeast for protein production, Methods for expressing recombinant protein in yeast. Analysis of Yeast Transformants Expressing Heterologous Proteins, Optimization of Protein Production, Recovery and Processing.

UNIT V ANALYSIS AND CHARACTERIZATION OF PROTEINS 9

Protein identification Protein structural and biochemical characterization using NMR (Principles, Types of NMR), FTIR, mass spectrometry, Protein Crystallography- X-Ray Diffraction Pattern, Crystallization of proteins, Phase determination, Electron Density Map Interpretation, Spectroscopic - CD spectrum of proteins, Near-UV Circular Dichroism of Proteins, Raman spectroscopy Calorimetric methods- differential scanning calorimetry- reversible & irreversible transitions.

TOTAL: 45 HOURS

TEXT BOOKS

1. Cleland and Craik, Protein Engineering, Principles and Practice, Vol 7, Springer Netherlands 1998.
2. Paul R Carey, Protein Engineering and Design, 1996, Elsevier publisher.
3. Permington S R , Dunn M J,"Proteomics from Protein sequence to function" , Viva Books Pvt. Ltd., New Delhi, 2002
4. Walsh G, "Proteins Biochemistry and Biotechnology" John Wiley and sons (2003).

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. Koehrer, Caroline, RajBhandary, Uttam L., Protein Engineering, Springer, 2009

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U19BTPE002 **MARINE BIOTECHNOLOGY**

L	T	P	C
3	0	0	3

Course Objectives

To understand the basics of marine environment that sustains life

To let the students, develop applications out of aquatic life and ecology

Course Outcomes

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

C01: learn about different marine ecosystems

C02: identify the flora and fauna of marine environment

C03: aware of the ways and means of protect the environment from various types of pollution

C04: comprehend the importance of marine organisms and produce new marine products

C05: design aquaculture farm with new technology

C06: know the importance of aquafarm design and construction

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	3	2		2	3	3	3	3	3
2	3	3		2		2	3	2		2	3	3	3	3	3
3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
5	3	3	3	3	3	3	3	3	3	2	3	3	3	3	3
6	3	3	3	3	3	3	3	3	3	2	3	3	3	3	3

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

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		L	T	P	C
U19BTPE003	**NANOBIOTECHNOLOGY**	**3**	**0**	**0**	**3**

Course Objectives

To develop the knowledge on nanomaterials synthesis characterization
To gain knowledge in involvement of macromolecules in nanobiotechnology
To study the application in drug delivery and cancer treatment.

Course Outcomes

At the end of the course, learners will be able to:
C01:To develop the knowledge on nanomaterials synthesis characterization
C02: To gain knowledge in involvement of macromolecules in nanobiotechnology
C03: To study the application in drug delivery and cancer treatment.
C04: To study use of nano materials in Biotechnology
C05: Importance of extraction of nanao materials in Biotechnology
C06: Students would learn the application of nanobiotechnology in different fields

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	-	-	1						1	2	
2	1	2	2	3	2								3	2	
3	2	2	1	3	-		2					1		1	3
4	1	1				2	3								3
5	1	2	3	2		3						2			3
6				1										2	

3 - High, 2 - Medium, 1 – Low

UNIT I INTRODUCTION TO NANOBIOTECHNOLOGY 9

Introduction to Nanotechnology and nanobiotechnology: Properties at nanoscale; overview of nanodevices and techniques; General synthesis methods of nanoscale materials; top down and bottom up approaches; Biological approach to self assembly.

UNIT II NANOPARTICLES CHARACTERIZATION TECHNIQUES 9

X-ray diffraction technique; Scanning Electron Microscopy with EDX; Transmission Electron Microscopy including high-resolution imaging; Surface Analysis techniques;: AFM, SPM, STM, SNOM, ESCA, SIMS; Nanoindentation.

UNIT III NANOMATERIALS AND APPLICATIONS 9

Inorganic nanoscale systems for biosystems: nanostructure materials of fullerenes, carbonnanotubes, quantum dots and wires, preparation, properties and applications; Nanopores:applications.

UNIT IV NANOMOLECULES IN BIOSYSTEMS 9

Nanomolecules in biosystems: Proteins, RNA and DNA nanoscale elements for delivery of materials into cells; DNA based artificial nanostructures; proteins as components in nanodevices; Tissue regeneration using anti-inflammatory nanofibres; Polymer nanofibers and applications; polymer nanocontainer; magnetosomes; bacteriorhodopsin: applications; S-layer proteins.

UNIT V APPLICATION OF NANOBIOTECHNOLOGY 9

Nanoscale devices for drug delivery: micelles for drug delivery; targeting; bioimaging; microarray and genome chips; nanobiosensors and nanobiochips; Nanotechnology for cancer diagnosis and treatment; Case study on drug delivery of gold nanoparticles against breast cancer.

TOTAL: 45 HOURS

TEXT BOOKS

1 Niemeyer, C. M., and CA Mirkin, C. A., (2010); NanoBiotechnology II – More concepts, and applications. First edition, Wiley –VCH publications.

2 Rosenthal, S.J. and Wright, D.W., (2010); Nanobiotechnology Protocols, First Edition, Humana Press.
3 Jain, K. K. (2006); NanoBiotechnology in molecular diagnostics –current technique and applications, First edition, Taylor and Francis.

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		L	T	P	C
U19BTPE004	**BIOENTREPRENEURSHIP**	**3**	**0**	**0**	**3**

Course Objectives

To inculcate the entrepreneurship spark among the student community by converting their research ideas into commercial products

To develop the entrepreneurial skill in the field of biotechnology

To study the Business strategy and Technology Transfer

Course Outcomes

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

C01: To inculcate the entrepreneurship spark among the student community by converting their research ideas into commercial products

C02: To develop the entrepreneurial skill in the field of biotechnology

C03: To study the Business strategy and Technology Transfer

C04: Would learn the diffrent strategy for business

C05: Would learn to implement the start up by themself

C06: Would lern different ideas to implement

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	2	2				2	2	2	2	2	2	2	2	2
3	3	3	3				3	3	3	3	3	3	3	3	3
4	2	2	2				2	2	2	2	2	2	2	2	2
5	3	3	3				3	3	3	3	3	3	3	3	3
6		1													

3 - High, 2 - Medium, 1 – Low

UNIT I INTRODUCTION **9**

Entrepreneurship, Definition; Factors necessary for Entrepreneurship, Attributes in an Entrepreneur, Bioentrepreneurship; Indicators of Bio entrepreneurship

UNIT II COMPONENTS OF A BIOTECH COMPANY **9**

Paths for starting new Biotech ventures, History of establishment of pioneer biotechnology companies

UNIT III BIOTECH BUSINESS MODELS **9**

Vertical model, Platform Business Model, Hybrid Model, Service Business Model from Genomics based companies

UNIT IV BUSINESS PLAN **9**

General considerations, Business plan - Dos and donts, How to write Business proposal, Checklist for Business proposal writing

UNIT V BUSINESS STRATEGIES AND TECHNOLOGY TRANSFER **9**

Intellectual property in biotech - Licensing, Accessing University technology, Licensing of Biotechnological invention

TOTAL: 45 HOURS

TEXT BOOKS

1. Holger Patzelt Thomas Brenner, 2008 Handbook of Bioentrepreneurship. Springer Int.,DOI: 10.1007/978-0-387-48345
2. Craig Shimasaki, 2014. Biotechnology EntrepreneurshipStarting, Managing, and Leading Biotech Companies. Elsevier Int. ISBN: 978-0-12-404730-3
3. Vardhaman Mahaveer open university, Kota , Entrepreneurship and small business managementMP-110,
4. Rajeev roy, Entrepreneurship, oxford publications 2nd edition, 2011

REFERENCES

1 S. N. Jogdand, Entrepreneurship and Business of Biotechnology, Himalaya Publishing Home, 2007.
2 R Oliver, The coming biotech age: The business of biomaterials. New York: McGraw Hill, 2000
3 S. Shaleesha. Bioethics, Wisdom educational service, Chennai, 2008.

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U19BTPE005 **RESEARCH METHODOLOGY** **L T P C**
3 0 0 3

Course Objectives

To enable the students

- To understand the statistical tools commonly used in biological research
- To assimilate the concepts of hypothesis testing and its importance in research
- To know the aspects fundamental to research and to understand the methods of research
- To know the nuances of technical writing of scientific documents like thesis and journal articles

Course Outcomes

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

C01: analyse biological data using the best suited statistical tools

C02: draw inferences from the results

C03: ascertain whether a given set of biological data significant or not by applying appropriate hypothesis testing method

C04: devise the research methodology for their dissertation and design a project based on the research problem

C05: compile their results from the dissertation work and integrate the interpretation

C06: conceive the best presentation mode for their results in the form of a thesis and journal article(s)

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				1		3	2	3
2	3		2	1			1				1		2	3	2
3	3		2	2		2	1				2			3	2
4	3		1	2		2	1				2			2	
5	3		1	2		2	1				2		3		2
6	3		1	2		2	1				2		2		

3 - High, 2 - Medium, 1 – Low

UNIT I STATISTICAL SURVEY AND DATA COLLECTION 9

Statistical survey - Organization of a statistical survey, methods of data collection, data representation, diagrammatical and graphical representation of data Sampling fundamentals - need for sampling, properties of an ideal sample, sampling procedures. Self study: Frequency distributions, sampling distributions, standard error

UNIT II MEASURES OF CENTRAL TENDENCY, DEVIATION, CORRELATION AND REGRESSION 9

Measures of central tendency - arithmetic mean, median, mode Measures of deviation - range, quartile deviation, variance, standard deviation Correlation and regression - correlation analysis and regression analysis. Self study : Relationship between mean, median and mode; pros and cons of the measures of central tendency and deviation; applications of correlation and regression

UNIT III PROBABILITY AND HYPOTHESIS TESTING 9

Probability and theoretical distributions - probability definition, types, binomial, Poisson and normal distributions, large and small samples, degrees of freedom Hypothesis testing - Formulation of null and alternate hypotheses, testing the hypothesis, Student's t test, Chi square test and goodness of fit, Analysis of Variance (one way and twoway only), acceptance and rejection of hypothesis.Self study: Simple problems on probability, theoretical distributions, hypothesis testing; importance of hypothesis testing.

UNIT IV RESEARCH METHODOLOGY 9

Research methodology- meaning of research, objectives of research, types of research, research methodology and research designs, single blind and double blind trials Inclusion and exclusion criteria - importance of inclusion and exclusion criteria in animal and human research with special reference to clinical research (elementary concepts only), examples and case studies. Self study: Random block design; importance of single blind and double-blind studies

UNIT V REPORT WRITING 9

Writing a thesis - layout of the thesis, preparing the components of the thesis - hypothesis, abstract, introduction, review of literature, methodology, results, discussion, summary and conclusion, references Writing a journal article - format of an article - journal requirements - differences between the thesis components and article components; abstract preparation - concise presentation, outline of work presented; keywords - list of important technical terms; main article - introduction, materials and methods, results, discussion, presentation of tables, figures and graphs, conclusion, acknowledgement, references, conflicts of interest Avoiding plagiarism - definition of plagiarism, ethical issues, copyright issues. Self study: Different formats of thesis; plagiarism-detection software; ShodhGanga and ShodhGangotri

TOTAL: 45 HOURS

TEXT BOOKS

2 Gupta, S.P. (2010) Statistical methods, Sultan Chand and Sons, New Delhi.
3 Gurimani N (2008) An introduction to Biostatistics, M.J.P. Publishers, Chennai.
4 Banerjee, P.K. (2008) Introduction to Biostatistics, S. Chand and Co., New Delhi.
5 Negi KS, (2018), Methods in Biostatistics, 3ro Ed., AITBS Publishers.
6 Day, R.A. (2006) How to write and publish a scientific paper, Cambridge University Press, UK.

REFERENCES

3 Arumugam, N. (2016) Research Methodology: For Life Sciences, 1st Ed., Saras Publication, and New Delhi.
4 Holmes, D. and Moody, P. (2006) Research Methods For The Biosciences, Oxford University Press, .UK.

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U19BTPE006 **TOTAL QUALITY MANAGEMENT** **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.

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U19BTPE007 **FOOD SCIENCE AND TECHNOLOGY**

L	T	P	C
3	0	0	3

Course Objectives

To enable the students

- 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.

Course Outcomes

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

CO1. Describe the fundamentals of food processing and preservation

CO2. Familiar with the functional properties of Carbohydrates, fats, lipids, proteins in food

CO3. Knowledge about the importance of food additives and their function and will develop strategies that will promote food safety and prevent food borne illness

CO4. Analyze the uses of enzymes, modified proteins and develop novel products, explain, analyze and evaluate scenarios related to various unit operations in food processing and preservation

CO5. Identify spoilage and deterioration mechanism in food and methods to control deterioration and spoilage

CO6. Demonstrate packing methods, materials and factors affecting food packing.

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		2
4	3	3	2								3			2	
5		3	2								3			2	
6	3	2	2	2	2	1	2								

UNIT I FOOD AND ENERGY **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

UNIT II FOOD ADDITIVES **9**

Classification, intentional and non-intentional additives, functional role in food processing and preservation; 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 poisonings – 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

REFERENCES

1. T.P. Coultate – Food – The Chemistry Of Its Components, 2nd Edn. Royal Society,London,1992.
2. B. Sivasanker – Food Processing And Preservation, Prentice-Hall Of India Pvt. Ltd. New Delhi 2002.
3. W.C. Frazier And D.C. Westhoff – Food Microbiology, 4th Ed., Mcgraw-Hill Book Co., NewYork 1988.
4. J.M. Jay – Modern Food Microbiology, Cbs Pub. New Delhi, 1987.

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U19BTPE008 **INDUSTRIAL BIOSAFETY AND BIOETHICS**

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. identify the safety needs of industries

CO2. apply the principles and implementation of safety procedures

CO3. assess and analyze the various types of risk

CO4. analyse various hazard analysis models

CO5. Practice Hazop studies in industries

CO6. apply safety measures in all procedures

Course Articulation Matrix

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

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 HOURS

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

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U19BTPE009 **METABOLIC ENGINEERING**

L	T	P	C
3	0	0	3

Course Objectives

- To introduce the basic concepts of metabolic engineering
- To expose transport mechanisms and models to regulate enzymes
- To utilize the tools used for metabolic pathway manipulation

Course Outcomes

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

- CO1 : Apply cellular metabolism in growth regulation.
- CO2 : Analyze the need and scope of metabolic engineering
- CO3 : Study the scheme of regulatory pathways
- CO4 : Know the transport mechanisms and models
- CO5 : Evaluate the tools used in metabolic engineering
- CO6 : Apply the strategies used in metabolic pathway manipulation

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		2											2	
3	1		2											1	
4			2	2		3	2	2						2	
5				2		3	2	2							
6	1				2								2	1	1

3 – High, 2 – Medium, 1 – Low

UNIT I OVERVIEW OF CELLULAR METABOLISM 9

Transport processes, Fueling Reactions, Biosynthetic reactions, Polymerisation, growth energetics.

UNIT II INTRODUCTION TO METABOLIC ENGINEERING 9

Importance of metabolic engineering; Concept of metabolic pathway synthesis; Central Metabolism: Fueling metabolism, Supply of biomass precursors, Anabolism, Anaplerosis. Need for pathway synthesis, Paradigm shift; Information resources; Scope and future of metabolic engineering; Methods for metabolic characterization.

UNIT III REGULATION OF METABOLIC PATHWAY 9

Regulation of Enzymatic Activity, Regulation of Enzyme concentration, Regulation at whole cell level, Regulation of Metabolic networks, Transport mechanisms and their models, Mechanisms and their dynamic representation

UNIT IV TOOLS IN METABOLIC ENGINEERING 9

Metabolic flux analysis (MFA), Methods for MFA – Metabolite Balancing, Tracer Experiments, MS and NMR in labelling measurement, Metabolic control analysis (MCA), Determination of Flux control coefficients, MCA of Linear and Branched pathways.

UNIT V METABOLIC PATHWAY MANIPULATION 9

Enhancement of product yield and productivity, Extension of substrate range, Extension of product spectrum and novel products, Improved cellular properties, metabolic pathway synthesis – case study: lysine biosynthesis, Synthetic biology in metabolic engineering – heterologous pathway modification yeast, genome-wide analysis and engineering.

TOTAL: 45 HOURS

TEXT BOOKS

1. G.N. Stephanopoulos, A.A. Aristidou, J. Nielsen: Metabolic Engineering. Principles and Methodologies. Academic Press, 1998
2. S.Y. Lee & E.T. Papoutsakis, Metabolic Engineering, Marcel Dekker, New York, 1999.

REFERENCES

1. R.Heinrich and S. Schuster, The Regulation of Cellular Systems, Chapman & Hall, 1996
2. James E. Bailey and David F. Ollis, Biochemical Engineering Fundamentals, McGraw-Hill, 1986

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U19BTPE010 **FERMENTATION TECHNOLOGY**

L	T	P	C
3	0	0	3

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.

TOTAL: 45 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.

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U19BTPE011 **BIOMATERIALS** **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

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U19BTPE012 **CANCER BIOLOGY** **L T P C**
3 0 0 3

Course Objectives

- To Develop in depth knowledge in molecular biology of cancer and to Identify different cancer causing agents in our day to day life
- To Compute about the diagnosis and prevention of cancer and to Assess the recent techniques in cancer treatment
- To Develop new techniques in identification and mitigation of cancer based on high throughput screening

Course Outcomes

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

- CO1 : Apply profound knowledge in molecular biology of cancer
-
- CO2 : Analyze the role of signaling pathways in causing cancer
- CO3 : Analyze the relationship between genes and cancer
- CO4 : Evaluate the recent advancements in cancer diagnosis
- CO5 : Develop new strategies for the treatment of cancer
- CO6: Study about monoclonal antibodies

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	3												1	
3	1			3										1	
4					3			2							1
5					3			2							1
6	1			3										1	

3 - High, 2 - Medium, 1 – Low

UNIT I FUNDAMENTALS OF CELL CYCLE AND CANCER 9

Mitosis, Regulation of cell cycle - Check points, Cell proliferation and Apoptosis, Theory and mechanism of carcinogenesis- Chemical, physical & radiation carcinogenesis, Causes of cancer - Radiation, Stress, Tobacco, alcohol & coffee/Tea

UNIT II BIOLOGY OF CANCER 9

Effects on receptor, signal switches, signal targets and cancer, activation of kinases; Oncogenes, identification of oncogenes, mechanism of oncogenes activation, retroviruses and oncogenes, detection of oncogenes. Oncogenes/proto oncogene activity; tumor suppressor genes - Rb, p53, APC, BRCA paradigms; Telomerases

UNIT III PRINCIPLES OF CANCER METASTASIS 9

Mechanism of spread; Clinical significances of invasion, heterogeneity of metastatic phenotype, metastatic cascade, basement membrane disruption, three step theory of invasion, proteinases and tumour cell invasion; Angiogenesis

UNIT IV CANCER DETECTION 9

Cancer detection: Detection using biochemical assays and molecular; Different types of tumour markers, tumour imaging and molecular imaging, Gene expression profiling, Diagnostics- Imaging (MRI, PET) & Biopsy.

UNIT V CANCER THERAPY 9

Therapy forms surgery, chemotherapy & radiation, Hyperthermia and magnetic hyperthermia: basic principle with examples, advantages and limitations New approaches of cancer therapy: Monoclonal antibodies, vaccines, gene therapy, Stem cell therapy

TOTAL: 45 HOURS

TEXT BOOKS

1. Pelengaris. S and Khan. M., The Molecular Biology of cancer, Blackwell Scientific Publications, Oxford, 2006
2. Robin Hesketh, Introduction to Cancer Biology, Cambridge University Press, 2013

REFERENCES

1. Kufe, DW, Pollock, RE, Weichselbaum, RR, Bast R.C., Gansler TS., Holland JF Frei, E, Cancer medicine, 6th Edn, BC Deckker Inc., Toranto, Canada, 2003

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U19BTPE013 **LIFESTYLE DISEASES**

L	T	P	C
3	0	0	3

Course Outcomes

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

CO1 understand the various risk factors related to change in life style

CO2 to know the importance of diet and exercise

CO3 aware of different cancers and its diagnosis

CO4 know the various cardiovascular disease and its treatment

CO5 understand the role of glucose and BMI in diabetes mellitus

CO6 to be aware of chronic lung diseases

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			
2	2	1	2				1					2			
3	2	1	2									2			
4	2	1	2									2			
5	2	1	2									2			
6	2	1	2									2			

UNIT I INTRODUCTION **9**

Lifestyle diseases – Definition ; Risk factors – Eating, smoking, drinking, stress, physical activity, illicit drug use ; Obesity, diabetes, cardiovascular diseases, respiratory diseases, cancer; Prevention – Diet and exercise

UNIT II CANCER **9**

Types - Lung cancer, Mouth cancer, Skin cancer, Cervical cancer, Carcinoma oesophagus; Causes Tobacco usage, Diagnosis – Biomarkers, Treatment

UNIT III CARDIOVASCULAR DISEASES **9**

Coronoary atherosclerosis – Coronary artery disease; Causes -Fat and lipids, Alcohol abuse –– Diagnosis - Electrocardiograph, echocardiograph, Treatment, Exercise and Cardiac rehabilitation

UNIT IV DIABETES AND OBESITY **9**

Types of Diabetes mellitus; Blood glucose regulation; Complications of diabetes – Paediatric and adolescent obesity – Weight control and BMI

UNIT V RESPIRATORY DISEASES **9**

Chronic lung disease, Asthma, COPD; Causes - Breathing pattern (Nasal vs mouth), Smoking – Diagnosis - Pulmonary function testing.

TOTAL: 45 HOURS

TEXT BOOKS

1 R.Kumar&Meenal Kumar, "Guide to Prevention of Lifestyle Diseases", Deep & DeepPublications, 2003

2 Gary Eggar et al, "Lifestyle Medicine", 3rd Edition, Academic Press, 2017

REFERENCES

1 James M.R, "Lifestyle Medicine", 2nd Edition, CRC Press, 2013

2 Akira Miyazaki et al, "New Frontiers in Lifestyle-Related Disease", Springer, 2008

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U19BTPE014 **BIOPROCESS PLANT DESIGN AND ECONOMICS**

L	T	P	C
3	0	0	3

Course Objectives

To enable the students

- to understand the basic engineering fundamentals that include process selection, design and flow sheet preparation for the particular bioprocess plant
- To develop knowledge to select plant location, layout, utilities and safety considerations that will help in installation procedures of new process plants
- To understand the basic concepts of cost estimation and profitability analysis of bioprocess plants

Course Outcomes

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

C01: Understand the basics engineering fundamentals for project development and process design

C02: Design process equipment and consider safety, operability and other design constraints in bioprocess plant design

C03: Develop knowledge to select plant location, layout and utilities for new process plants.

C04: Calculate capital investment and operating costs for process plants

C05: Understand the basic concepts of cost estimation and profitability analysis.

C06: Implementation of profitability analysis

Course Articulation Matrix

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

3 - High, 2 - Medium, 1 – Low

UNIT I INTRODUCTION TO DESIGN PROJECT **9**

Introduction to Design – nature of design – Technical feasibility survey - Organization of project process development – data acquisition – design data information of project – Project documentation – codes and standards.

UNIT II PROCESS DESIGN DEVELOPMENT **9**

Equipment selection and specifications; materials of construction; flow sheeting; piping and instrumentation; process safety and loss prevention- HAZOP analysis.

UNIT III GENERAL SITE CONSIDERATIONS **9**

Introduction – plant location and site selection; site layout- plant layout utilities; environmental considerations – waste management – visual impact; government regulations and other legal restrictions; community factors and other factors affecting investment and production costs; human resources.

UNIT IV COSTING AND PROJECT EVALUATION **9**

Introduction – Accuracy and purpose of capital cost estimates; fixed and working capital operating costs – estimation of purchased costs – inflation – rapid and factorial method of cost estimation, Lang factors; plant overheads; Administration- safety and other auxiliary services - payroll overheads- warehouse and storage facilities etc.

UNIT V ECONOMIC EVALUATION OF PROJECTS **9**

Cash flow diagrams – tax depreciation – discounted cash flow – rate of return – payback timesensitivity analysis; computer methods for costing and project evaluation; accounting for uncertainty and variations for future development; Optimization techniques.

TOTAL: 45 HOURS

TEXT BOOKS

1 Moran, S., “An Applied Guide to Process and Plant Design”, Elsevier, 2015.

2 Towler, G., Sinnot, R.K., “Chemical Engineering Design Principles, Practice and Economics of Plant and Process Design”, 2nd Edition, Butterworth Heinemann, 2013.
3 Sinnott.R.K., “Coulson & Richardson‘s Chemical Engineering, Series Vol-6”, 2nd Edition, Butterworth Heinemann, 2005.
4 Peters, M., Timmerhaus,K., West,R., “Plant Design and Economics for Chemical Engineers”, 5th Edition , McGraw Hill, 2003.

REFERENCES

1 Backhurst, J.R., Harker, J.H., “Process Plant Design”, Butterworth-Heinemann, 2013.
2 Baasal, W.D., “Preliminary Chemical Engineering Plant Design”, Springer, 1989.

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U19BTPE015 **BIOENERGY** **L T P C**
3 0 0 3

Course Objectives

- To get exposure on solar radiation and its environmental impact to power.
- To know about the various collectors used for storing solar energy.
- To know about the various applications in solar energy.
- To learn about the wind energy and biomass and its economic aspects.
- To know about geothermal energy with other energy sources.

Course Outcomes

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

CO1 To state the challenges and problems associated with the use of various energy sources, including fossil fuels, with regard to future supply and the environment.

CO2 Discuss remedies/potential solutions to the supply and environmental issues associated with fossil fuels and other energy resources.

CO3 Illustrate and describe the primary renewable energy resources and technologies.

CO4 Demonstrate the basic electrical concepts and system components.

CO5 Estimate the quantify energy demands and make comparisons among energy uses, resources, and technologies

CO6 appraise the product produced from the renewable sources.

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	1	1	1								
2	3	2	3	3		2	3		1			1	1		
3	2	1	2	2		3	2					1	2		
4	1	1	1	1		1	3					2	1		
5	3	2	1	1		2	2					3	3		
6	3	2	1	1							1	3	2	1	

UNIT I PRINCIPLES OF SOLAR RADIATION **10**

Role and potential of new and renewable source, the solar energy option, Environmental impact of solar power, physics of the sun, the solar constant, extraterrestrial and terrestrial solar radiation, solar radiation on titled surface, instruments for measuring solar radiation and sun shine, solar radiation data.

UNIT II SOLAR ENERGY COLLECTION **8**

Flat plate and concentrating collectors, classification of concentrating collectors, orientation and thermal analysis, advanced collectors.

UNIT III SOLAR ENERGY STORAGE AND APPLICATIONS **7**

Different methods, Sensible, latent heat and stratified storage, solar ponds. Solar Applications- solar heating/cooling technique, solar distillation and drying, photovoltaic energy conversion.

UNIT IV WIND ENERGY **10**

Sources and potentials, horizontal and vertical axis windmills, performance characteristics, Betz criteria BIO-MASS: Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of Bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking, I.C.Engine operation and economic aspects.

UNIT V GEOTHERMAL ENERGY: **9**

Resources, types of wells, methods of harnessing the energy, potential in India. OCEAN ENERGY: OTEC, Principles utilization, setting of OTEC plants, thermodynamic cycles. Tidal and wave energy: Potential and conversion techniques, mini-hydel power plants, and their economics. DIRECT ENERGY CONVERSION:

Need for DEC, Carnot cycle, limitations, principles of DEC

TOTAL: 45 HOURS

TEXTBOOKS

1. Rai G.D. , “Non-Conventional Energy Sources”, Khanna Publishers, 2011
2. Twidell & Wier, “Renewable Energy Resources”, CRC Press (Taylor & Francis), 2011

REFERENCES

1. Tiwari and Ghosal, “Renewable energy resources”, Narosa Publishing House, 2007
2. Ramesh R & Kumar K.U , “Renewable Energy Technologies”,Narosa Publishing House,2004
3. Mittal K M , “Non-Conventional Energy Systems”, Wheeler Publishing Co. Ltd, New Delhi,2003
4. Kothari D.P, Singhal ., K.C., “Renewable energy sources and emerging technologies”, P.H.I, New Delhi, 2010

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U19BTPE016 **STRUCTURAL BIOLOGY** **L T P C**
3 0 0 3

Course Objectives

- Gain structural knowledge on proteins.
- Understand energetics and kinetics of proteins.

Course Outcomes

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

CO1 Be familiar with various mechanisms and driving forces in protein folding.
CO2 Understand the dynamics relationship to protein function.
CO3 Identify the computational approach in structural biology.
CO4 To learn and acquire knowledge about functional proteins
CO5 to understand the dynamics of polymeric chain
CO6 Understand the latest application of protein science in research

Course Articulation Matrix

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

UNIT I PROTEIN STRUCTURE 9

Conformational Properties of Amino Acids, Implications for Protein Structures, Hierarchies of Structure, Structural Characteristics of Globular Proteins.

UNIT II PROTEIN THERMODYNAMICS AND ENERGETICS 9

Driving forces in protein folding - Estimation of solvation free energies: Group contribution methods - Experiments on folding thermodynamics - Two-state and multiple state transitions.

UNIT III PROTEIN KINETICS 9

Mechanism of folding - Kinetic Intermediates - Classical kinetic modelling of protein folding/unfolding - Transition states - Effects of mutations.

UNIT IV CONFORMATIONAL DYNAMICS AND RELATIONSHIP TO FUNCTION 9

Fluctuation-dissipation theorem - Dynamics of polymeric chains - Dynamics of folded proteins: Gaussian network model - Contribution of nonlinear effects to equilibrium dynamics.

UNIT V COMPUTATIONAL STRUCTURAL BIOLOGY 9

Protein Models: Force fields and their derivation - The rugged energy surface: the difficulty to fold a protein - Methods for conformational search – energy and free energy as criteria of stability.

TOTAL: 45 HOURS

TEXTBOOKS

1. Liljas L, Nissen P, Lindblom G, Textbook of Structural Biology, Volume 8 of Series in structural biology, World Scientific, 2016.
2. Schwede T, Computational Structural Biology: Methods and Applications, World Scientific, 2008.

REFERENCES

1. Liljas A, Textbook of Structural Biology, World Scientific, 2009.
2. Petsko G, Ringe D, Protein structure and Function, Oxford University Press, 2009.
3. K.P.Murphy. Protein structure, stability and folding (2001) Humana press. ISBN 0-89603682-0
4. Arthur M.Lesk Introduction to protein architechcture (2001) Oxford University Press. ISBN

0198504748
5. A.McPherson, Introduction to Macromolecular Crystallography. 2nd edition (2009)., John Wiley Co.
6. Carl Branden and John Tooze and Carl Brandon Introduction to Protein Structure, (1999)

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U19BTPE017 **SYSTEM BIOLOGY** **L T P C**
3 0 0 3

Course Objectives

- To introduce the bottom-up and top-down design and analysis strategies for systems and synthetic biology
- To expose students to biological networks in cellular process
- To create deeper understanding of systems biological applications and work in computational and wet-lab projects

Course Outcomes

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

CO1 Understand the importance of Systems biology
CO2 Apply the knowledge of biological molecules in network analysis
CO3 Analyze the genes and regulatory networks to understand systems biology
CO4 Evaluate the concepts of systems biology with various tools
CO5 Evaluate systems biology modelling
CO6 Understand the simulation in 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										1		
2	2	2	1										1		
3	2	2	1												
4	3	2	1										1		
5	3	2	1										1		
6	2	2	1												

UNIT I INTRODUCTION TO SYSTEMS BIOLOGY 9

Overview of System Biology, Mechanisms of gene expression, Metabolic and signal transduction pathways, enzyme kinetics and thermodynamics, Networks and Motifs, Signaling& Experimental methods in systems biology, Robustness and optimality in Biology

UNIT II BIOLOGICAL NETWORKS 9

Biological networks: metabolic, signaling, regulatory,Network alignment and comparisons, network organization, Designing, simulating and building gene circuits, Genome design and synthesis

UNIT III GENE REGULATORY NETWORK 9

Clustering Coordinately Regulated Genes, Discovering Gene Regulatory Signals, Gene Regulatory Modules and Networks, MicroRNA Regulatory Networks, Gene networks

UNIT IV TOOLS IN SYSTEMS BIOLOGY 9

Flux analysis MFA & FBA, Bottom-up approach, Top-down approach, Computer aided design tools for metabolic engineering (lenera programs, retrosynthesis), Development of a flux theoretical model, correlation of the model with experimental data

UNIT V MODELLING AND APPLICATIONS OF SYSTEMS BIOLOGY 9

Modelling and simulation of biological cells, Stochastic modelling for systems biology, Applications of systems biology in various platforms.

TOTAL: 45 HOURS

TEXTBOOKS

1. Uri Alon, an Introduction to Systems Biology: Design Principles of Biological Circuits, Chapman & Hall, 2006.
2. James E. Bailey and David F. Ollis, Biochemical Engineering Fundamentals, McGraw-Hill, 1986

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U19BTPE018 **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

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U19BTPE019 **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

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U19BTPE020 **BIOORGANIC CHEMISTRY**

L	T	P	C
3	0	0	3

Course Objectives

To enable the students

- To know in detail about the elements of atom, charges and their bonding rule.
- To understand the various kinetic properties and types of reaction mechanisms
- To understand the possible bio-organic reactions involved in biosynthesis

Course Outcomes

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

CO1 Make use of the fundamentals of bio organic chemistry

CO2 Distinguish in detail about the elements of atoms, charges and their bonding rules

CO3 Classify the various kinetic properties and its types of reaction mechanisms

CO4 Determine the various bio organic reactions involved in biosynthesis

CO5 Compare the principles of chemical bonding, stereochemistry of bio organic molecules and their catalytic mechanisms

CO6 understannd the bioorganic reactions and energy transfer

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			
2	2	3	2	1	2	2						2			
3	3	1	2	1	1	3	2					2			
4	2		1		2	2	1								
5	2	1	3	2	2							3			
6	3		3	1	3							2			

UNIT I BONDING AND STEREOCHEMISTRY **9**

Atoms Electrons and orbitals - Covalent Bonds - Octet rule - Polar covalant Bonds - Electronegativity- formal charge - Resonance Acids and Bases - Arrhenius and Bronsted Lowry Theories - Acid Base equilbria - SP3 hybridization - Conformations analysis ethane, butane and cyclohexane - Cis- trans isomerism. Stereochem activity around the tetrahedral carbon – optical activity - Conformation of the peptide bond

UNIT II MECHANISMS OF SUBSTITUTION AND ADDITION REACTIONS **9**

SN1 and SN2 reactions on tetrahedral carbon- nucleophiles- mechanism steric effects – nucleophilic addition on Acetals and ketals -Aldehyde and ketone groups – reactions of carbonyl group with amines- acid catalyzed ester hydrolysis – Saponification of an esterhydrolysis of amides. Ester enolates - claisen .condensation – Michael condensation

UNIT III KINETICS AND MECHANISM **9**

Kinetic method – Rate law and mechanism – Transition states- Intermediates – Trapping of intermediates – Microscopic reversibility – Kinetic and thermodynamic reversibility – Isotopes for detecting intermediates. Primary and secondary isotopes – the Arrhenius equation Eyring equation - ΔG, ΔS, ΔH, Thermodynamics of coupled reactions

UNIT IV CATALYSIS **9**

Reactivity – Coenzymes – Proton transfer – metal ions – Intra molecular reactions – Covalent catalysis – Catalysis by organized aggregates and phases. Inclusion complexation

UNIT V BIOORGANIC REACTIONS **9**

Timing of Bond formation and fission – Acyl group transfer – C-C bond formation and fission – Catalysis of proton transfer reactions – Transfer of hydride ion – Alkyl group. Transfer – Terpene biosynthesis – Murrlfield state peptide synthesis – Sanger method for peptide and DNA sequencing.

TOTAL : 45 HOURS

TEXT BOOKS

1. Carey, Francis A.” Organic Chemistry”. 7th Edition, Tata MCGraw Hill, 2009.
2. Page, M.I. and Andrew Williams “Organic and Bio-organic Mechanisms”. Pearson, 2010.

REFERENCES

1. Dugas, Hermann “ Bioorganic Chemistry : A Chemical Approach to Enzyme Action” 3 rd Edition, Springer, 2003.

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U19BTPE021	BIOLOGICAL SPECTROSCOPY	L	T	P	C
		3	0	0	3

Course Objectives

To enable the students

- To learn the various spectroscopic techniques, the physical principles, experimental and instrumentation techniques
- To use the various atomic and molecular spectroscopic techniques to estimate and analyze the structure and dynamics of biomacromolecules
- The applications of X-ray crystallography, x-ray spectroscopy, mass spectrometry, electron spectroscopy etc in analysis of chemical and crystalline structure, molecular weight of biomolecules.

Course Outcomes

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

CO1 Understand the importance of different electronic spectroscopy

CO2 Apply the basic principles in spectral characterization of biomolecules

CO3 Analyze the role of different resonance spectroscopy and its application to biomolecules

CO4 Analyze the role of mass spectroscopy and its application in protein analysis

CO5 Evaluate the importance with applications of X ray spectroscopy

CO6 Evaluate the importance with applications electron spectroscopy

Course Articulation Matrix

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

UNIT I ELECTRONIC SPECTROSCOPY 9

Electronic Energy levels in atoms and molecules- Electronic transitions- Selection rule, properties associated with the transition dipole moments and interaction between them. Absorption range of biological chromophores.d-d transition in transition metals-charge transfer spectra- UV-Vis absoption (atomic & molecular) spectroscopy- Fluorescence spectroscopy-physical basis and biological applications. Atomic Emission spectroscopy (AES) - Polarized light - optical rotation - circular dichroism - Optical rotator dispersion-theory and applications to bimolecules

UNIT II INFRA-RED AND RAMAN SPECTROSCOPY 9

Measurement of Fourier - Transform Infrared spectrum - Physical basis of infrared spectra, Infrared of Polyatomic molecules, biological examples, infrared of oriented samples. Raman spectroscopy- Physical principle, polarization ratio and biological applications.

UNIT III RESONANCE SPECTROSCOPY 9

Nuclear Magnetic Resonance Spectroscopy: Spectral parameters-Intensity-Chemical shifts - spin - spin coupling - line widths, T1 and T2 relaxation mechanisms - nuclear overhauser effect(NOE) - multidimensional nmr spectroscopy - determination of macromolecular structure by NMR - magnetic resonance imaging , NOE in biology , assignment of NMR peaks, studies of Macromolecules, ligand binding, ionisation studies and pH kinetics, molecular motion. Electron Spin Resonance Spectroscopy: Introduction-Resonance condition-measurement-spectral parameters, intensity, g values-spectral anisotropy, time scale of EPR-spin labels, transition metal ions, spins trapping, and applications to biomolecules.

UNIT IV MASS SPECTROMETRY 9

Ion sources- sample introduction - mass analyzers and ion detectors - biomolecule mass sepctrometry - peptide and protein analysis - carbohydrates and small molecules - specific applications., TOF mass spectrometry.

UNIT V X-RAY ANALYSIS AND ELECTRON SPECTROSCOPY 9

Scattering by x- rays - diffraction by a crystal - measuring diffraction pattern - bragg reflection - unit cell - phase problem - anomalous diffraction - determination of crystal structure - X-ray fluorescence, photoelectron spectroscopy (XPS), ultraviolet photo electron spectroscopy (UPS), electron impact spectroscopy and auger electron spectroscopy -physical basis and applications.

TOTAL : 45 HOURS

TEXT BOOKS

1. D. Campbell and R. A. Dwek, Biological Spectroscopy, Benjamin Cummins and Company. 1986.
2. P. W. Atkins , Physical Chemistry, Oxford : Oxford University press, 2001
3. G. W. Ewing, Instrumental methods of chemical analysis, McGraw-Hill Book Company, 1985.
4. Jag Mohan., Organic spectroscopy: Principles and Applications, Narosa Publishing House, 2007.
5. P.S. Kalsi , Spectroscopy of organic compounds, New age International Publishers, 2016

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U19BTPE022 **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										

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

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U19BTPE023 **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 instrumentationss 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 Undestand 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										

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.

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U19BTPE024 **PHARMACEUTICAL BIOTECHNOLOGY** **L T P C**
3 0 0 3

Course Objectives

The aim of the course is to give strong foundation and advanced information on biopharmaceutical aspects in relation to drug development.

- This course provides core responsibilities for the development and monitoring of the drug and the preparation of medicines according to the norms.
- To gain knowledge in physicochemical properties, pharmacology and the formulation of commonly used biopharmaceuticals.

Course Outcomes

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

CO1 Define the basic pharmaceutical industry, therapeutic agents uses, regulatory issues.

CO2 Understand the mechanism of drug action and the principle of physico-chemical properties of drugs

CO3 Describe the process involved in manufacture of drugs, analyse the special requirements, reaction process and applications

CO4 Apply the principles of manufacturing requirements, tools used, evaluate the drug properties using analytical methods and quality management of different forms of drugs

CO5 Understand the biopharmaceuticals like vitamins, hormones, contraceptives, biologics, etc. CO6 understand the importance of the current and future biotechnology related products on the market

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	1	2	2	2	1	2	1	2	2	2	2	2	2	
3	3	3	3	3	3	3	2	3	2	2	2	3	3	3	2
4	3	3	3	3	3	3	3	3	2	3	2	3	3	3	3
5	3	3	3	3	3	3	3	3	3	3	2	3	3	3	3
6															

UNIT I **INTRODUCTION** **7**

Pharmaceutical industry & development of drugs ; types of therapeutic agents and their uses; economics and regulatory aspects .

UNIT II **DRUG ACTION, METABOLISM AND PHARMACOKINETICS** **9**

Mechanism of drug action; physico-chemical principles of drug metabolism; radioactivity; pharmacokinetics.

UNIT III **MANUFACTURE OF DRUGS, PROCESS AND APPLICATIONS** **7**

Types of reaction process and special requirements for bulk drug manufacture.

UNIT IV **PRINCIPLES OF DRUG MANUFACTURE** **15**

Compressed tablets; dry and wet granulation; slugging or direct compression; tablet presses; coating of tablets; capsule preparation; oval liquids – vegetable drugs – topical applications; preservation of drugs; analytical methods and other tests used in drug manufacture; packing techniques; quality management; GMP

UNIT V **BIOPHARMACEUTICALS** **7**

Various categories of therapeutics like vitamins, laxatives, analgesics, contraceptives, antibiotics, hormones and biologicals.

TOTAL:45 HOURS

TEXT BOOKS

1. Finkel, Richard, etal., “Lippincott’s Illustrated Reviews Pharmacology” 4 th Edition.Wolters Kluwer / Lippincott Williams & Wilkins, 2009.

2. Shayne Cox Gad. Pharmaceutical Manufacturing Handbook, Published by John Wiley & Sons, Inc., 2008.
3. Bernd Meibohm. Pharmacokinetics and Pharmacodynamics of biotech drugs, Published by Wiley-VCH, 2006.

REFERENCES

1. Gareth Thomas. Medicinal Chemistry. An introduction. John Wiley. 2000.
2. Katzung B.G. Basic and Clinical Pharmacology, Prentice Hall of Intl. 1995.

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LIST OF OPEN ELECTIVES

OPEN ELECTIVE I

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	U19AEOE001	Agricultural Waste Management	OE	4	3	0	0	3
2.	U19AEOE002	Farm Management	OE	4	3	0	0	3
3.	U19BTOE001	Basics of Bioinformatics	OE	4	3	0	0	3
4.	U19BTOE002	Introduction to Bioenergy and Biofuels	OE	4	3	0	0	3
5.	U19BMOE001	Bio Healthcare and Telemedicine	OE	4	3	0	0	3
6.	U19BMOE002	Embedded Systems in Medical Devices	OE	4	3	0	0	3
7.	U19BMOE003	Hospital Management system	OE	4	3	0	0	3
8.	U19CEOE001	Green buildings	OE	4	3	0	0	3
9.	U19CEOE004	Disaster Prepardness and Management	OE	4	3	0	0	3
10.	U19EDOE001	Intellectual Property Rights	OE	4	3	0	0	3
11.	U19CSOE001	Software Engineering	OE	4	3	0	0	3
12.	U19CSOE002	Database Management systems	OE	4	3	0	0	3
13.	U19ECOE003	Consumer Electronics	OE	4	3	0	0	3
14.	U19ECOE006	Medical Electronics	OE	4	3	0	0	3
15.	U19EEOE001	Renewable Energy Resources	OE	4	3	0	0	3
16.	U19EEOE002	Introduction To Control Systems	OE	4	3	0	0	3
17.	U19FTOE001	Food Science and Nutrition	OE	4	3	0	0	3
18.	U19FTOE002	Food Preservation Techniques	OE	4	3	0	0	3
19.	U19ITOE001	UI and UX Design	OE	4	3	0	0	3
20.	U19ITOE002	Multimedia Systems	OE	4	3	0	0	3
21.	U19MEOE001	Engineering Drawing	OE	4	3	0	0	3
22.	U19MEOE002	Modern Manufacturing Techniques	OE	4	3	0	0	3
23.	U19PHOE001	Nanotechnology and Engineering Applications	OE	4	3	0	0	3
24.	U19ENOE01	English for Competitive Exams	OE	4	3	0	0	3

U19AEOE001 **AGRICULTURAL WASTE MANAGEMENT**

L	T	P	C
3	0	0	3

Course Objectives

To impart knowledge to students on various methods of agricultural waste management for eco-friendly energy and manure production.

Course Outcomes

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

CO1. Understanding the importance of bio resources

CO2. Ability to classify the bio energy and characteristics of bio energy.

CO3. Knowledge in bio reactors and fermentors.

CO4. Ability to gain knowledge in Alcohol production process.

CO5. Understanding the importance of Energy and Environment

CO6. Knowledge in capturing and applying bioenergy on replacement of fossil fuels.

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
2	3	2	2											3	3
3	2	1	1											2	2
4	2	1	1											2	2
5	2	1	1											3	3
6	2	1	1											2	2

3 - High, 2 - Medium, 1 – Low

UNIT I INTRODUCTION **10**

Availability of different types of agriculture wastes - its overall characteristics – classification of agro wastes based on their characteristics- its recycling and utilization potential- current constraints in collection and handling of agricultural wastes – its environmental impact.

UNIT II COMPOSTING **8**

Definition- Solid waste suitable for composting – Methods of composting - vermicomposting - Mineralization process in composting - Biochemistry of composting – Factors involved – Infrastructure required – maturity parameters – value addition – application methods

UNIT III BIOMASS BRIQUETTING **9**

Definition – potential agro residues and their characteristics for briquetting – fundamental aspects and technologies involved in briquetting – economic analysis of briquetting – setting up of briquetting plant-appliances for biomass briquettes.

UNIT IV BIOCHAR PRODUCTION **9**

Definition - characteristics of agro wastes suitable for Biochar production – Methods of Biochar production – fast and slow pyrolysis – characteristics of Biochar – role of Biochar in soil nutrition and carbon sequestration

UNIT V BIOGAS AND BIO ETHANOL PRODUCTION **9**

Screening of suitable lingo cellulosic substrate for biogas production -determination of bio- energy potential of agro-waste by estimating total solids - volatile solids - Calorific value-per cent total carbohydrates, moisture, lignin and cellulosic contents – preparation of feed stocks for anaerobic bio- digestion – types of digesters – factors affecting - nutrient value and utilization of biogas slurry. Ethanol production from lingo cellulosic wastes – Processing of Biomass to Ethanol –pre- treatment-fermentation-distillation

TOTAL: 45 HOURS

TEXT BOOKS

1. Rai G.D,Non conventional sources of Energy, Khanna publishers, New Delhi, 1995.
2. Diaz,l.F.,M. de Bertoldi and W. Bidlingmaier. 2007. Compost science and technology, Elsevier pub., PP. 380.

REFERENCES

1. P.D. Grover & S.K. Mishra, “Biomass Briquetting: Technology and Practices”. Published by FA Regional Wood Energy Development Programme in Asia
2. Magdalena Muradin and Zenon Foltynowicz, “Potential for Producing Biogas from Agricultural Waste Rural Plants in Poland”. Sustainability, 2014, 6, 5065-5074.
3. Biochar production from agricultural wastes via low-temperature microwave carbonization

U19AEOE002 **FARM MANAGEMENT**

L	T	P	C
3	0	0	3

Course Objectives

To impart the fundamental knowledge and basic concepts of Economics and Farm Management

- To understand the types of resources and Investment analysis in agriculture sector
- To understand the Farm financial analysis, Investment and Budgeting for farms.
- To expose the students to different extension methods for communication to take the work from lab to field
- To plan the financial aspects, economics related to farm management in a cost effective manner.
- To impart knowledge to students on various methods of agricultural waste management for eco-friendly energy and manure production.

Course Outcomes

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

CO1. Gain knowledge in various farm management and farm layout aspects
CO2. familiarize with the various laws of economics and product relationship aspects
CO3. gain knowledge on cost curves and its applications
CO4. Understand about the various concepts of management of resources
CO5. Gain knowledge on farm management and financial analysis
CO6. Familiarize with budgeting and cost estimation for farm layout

Course Articulation Matrix

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

3 - High, 2 - Medium, 1 – Low

UNIT I FARM MANAGEMENT & PLANNING **10**

Farm Management – definition – scope- Classification of farms – Basic concepts in farm management - Relationship between farm management and other basic sciences - Farm layout – Farm records and accounts– Farm appraisal techniques – Valuation - Farm management- need and analysis –Elements of farm planning– Whole farm planning and partial planning – Farm level management system – Farm budgeting – whole farm budgeting and partial budgeting – Estimation of credit - examples of farm planning and budgeting

UNIT II LAWS OF ECONOMICS **8**

Agricultural Economics – definition and scope – Basic laws of economics – demand and supply concepts – law of increasing, diminishing and constant returns – Equi-marginal returns - Product relationship – Production function – definition and types – Production function curves – Optimum level of input use – Economies of scale external and internal economies and diseconomies - Cost concepts – types - Opportunity cost – comparison of costs – Factor relationship – concepts.

UNIT III COST CURVES **10**

Principle of substitution – isoquant, isocline, expansion path, ridge line and least cost combination of inputs- Product-product relationship – Production possibility curve, isorevenue line and optimum combination ofoutputs – Cost curves –Optimum input and output levels – Factor &relationship – Least cost combination ofinputs – Estimation of cost of cultivation and cost of production of crops - annual and perennial crops

UNIT IV MANAGEMENT OF RESOURCESAND FINANCIAL ANALYSIS **9**

Concept of risk and uncertainty – causes for uncertainty – Managerial decisions to reduce risks in production process – Management of resources – types of resources- land, labour, capital and measurement of their efficiencies – Mobilization of farm resources- Cost of machinery and maintenance – Break even analysis –

Investment analysis – Discounting techniques- Farm financial analysis – Balance sheet – Income statement –Cash flow analysis – Farm investment analysis – Time comparison principles - Preparation of interview schedule and farm visit for data collection.

UNIT V AGRICULTURAL EXTENSION 8

Communication – models – elements and their characteristics – types and barriers - Programme planning – monitoring and evaluation - Extension teaching methods - Audio-Visual aids – classification – purpose, planning and selection – individual, group and mass contact methods –Modern communication sources – internet, video and teleconferencing, Interactive Multimedia Compact Disk (IMCD), village kiosks, Kissan Call Centre (KCC), mobile phone – Diffusion - Adoption –Capacity building of extension personnel and farmers – types of training, training to farmers, farm women and rural youth, FTC & KVK.

TOTAL: 45 HOURS

TEXT BOOKS

1. R Johl, S.S., and Kapur, T.R.,Fundamentals of Farm Business Management", Kalyani publishers, Ludhian 2007
2. Subba Reddy, S., Raghu Ram, P., NeelakantaSastry T.V and Bhavani 3. Devi, I., "Agricultur Economics"Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 2006.

REFERENCES

1. Raju, V.T., "Essentials of Farm Management", Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi,2002.
2. Subba Reddy, S., and Raghu Ram, P. „ "Agricultural Finance and Management", Oxford and IBH Publishir Co. Pvt. Ltd., New Delhi, 2002.

U19BMOE001 **BIO HEALTHCARE AND TELEMEDICINE**

L	T	P	C
3	0	0	3

Course Objectives

The student should be made

- To enable the students to acquire knowledge about the principles and application of telemedicine in biomedical industry

Course Outcomes

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

CO1. Explain the development and transmission techniques used in telemedicine
CO2. Describe the types of communication and network systems
CO3. Explain the technologies used in data exchange and privacy of telemedicine
CO4. Illustrate the current system of tele-health and mobile health
CO5. Describe the currents and futures perspective of telemedicine
CO6. Acquire knowledge about the principles and application of telemedicine

Course Articulation Matrix

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

3 - High, 2 - Medium, 1 – Low

UNIT I BACKGROUND OF TELEMEDICINE **9**

Introduction ,definitions of telemedicine, telehealth and telecare, Origins and development of telemedicine: from beginning to modern times, modern telemedicine and telecare Drivers of telemedicine and telecare: technology drivers, non technological drivers, the funding dilemma Telemedicine in developed and underdeveloped countries ,benefits and limitations of telemedicine Types of information and transmission in telemedicine: audio, video, still images, text and data, Fax

UNIT II COMMUNICATION AND NETWORK SYSTEMS IN TELEMEDICINE **9**

Types of communication and network: public switched telephone network, plain old telephone service, integrated services digital network, internet, asynchronous transfer mode Wireless communications basics and its types Wireless sensor standards and homecare concerns, medical sensors for mobile communication devices Development of disposable adhesive wearable human monitoring system Implantable systems: implantable system architecture Signal Processing in implantable neural recording microsystems, electronic health signal processing

UNIT III TECHNOLOGIES FOR SAFEGUARDING MEDICAL DATA AND PRIVACY **9**

Data Exchanges: Network configuration, circuit and packetswitching, H.320 series Data security and standards: Encryption, cryptography, mechanisms of encryption, phases of encryption Cryptography, safeguarding patient medical history Anonymous data collection and processing, biometric security and identification

UNIT IV TELEHEALTH AND MOBILE HEALTH **9**

Medical robotics: surgical robots, rehabilitation robots Modern devices for tele-surgery: Main component and functionalities of a robotics tele-surgery System, design guidelines and methodology Microsurgery Systems: Robot-assisted microsurgery system,miniaturization, microsurgical tools, visualization methods and systems Image-guided microsurgery: Image guidance component and workflow, image guidance by surgical domain

UNIT V IMPLEMENTATION OF TELEMEDICINE AND FUTURE TRENDS IN TECHNOLOGY **9**

Telecardiology: Tools and devices Teleradiology and Tele-audiology Telepathology system development and implementation Acute care telemedicine and monitoring for elderly care Virtual doctor systems for medical

practices, wireless electrical impedance tomography Synthetic biometrics in biomedical systems, bio-kinematics for mobility

TOTAL: 45 HOURS

TEXT BOOKS

1. Bernard Fong, A.C.M. Fong, C.K. Li, —Telemedicine Technologies: Information Technologies in Medicir and Telehealth‖, Wiley, 1st edition,2010.
2. HalitEren,JohnG.Webster,—TheE-Medicine,E-Health,M-Health,Telemedicine,and Telehealth Handbook CRC Press,1st edition, 2015.
3. OlgaFerrer-Roca,M.SosaLudicissa,—HandbookofTelemedicine‖,IOSpress,1stedition,2002.

REFERENCES

1. GeorgiGraschew,StefanRakowsky,—TelemedicineTechniquesandApplications,In ech, 1stedition,2011
2. A.C.Norris,—EssentialsofTelemedicineandTelecare,JohnWiley&Sons,1stedition,2002.
3. RichardW.Carlson,—TelemedicineintheICU, AnIssueofCriticalCareClinics,(The Clinics: Internal Medicine) Elsevier, 1st edition,2015.

U19BMOE002 **EMBEDDED SYSTEMS IN MEDICAL DEVICES**

L	T	P	C
3	0	0	3

Course Objectives

The student should be made:

- Understand the design of embedded system for various medical devices.

Course Outcomes

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

CO1. Attain knowledge on the basic concepts and the building blocks for embeddedsystem
CO2. Understand the hardware and software partitioning in embeddedsystems
CO3. Gain knowledge about timers and memory organization of embeddedsystems
CO4. Design a pulse oximeter using embedded tool
CO5. Design a pacemaker using embedded tool
CO6. Understand the design of embedded system for various medical devices

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	3	3	
2	2	2	2	2	2	2					2	2	3	3	
3	3	3	2	3	2	1					2	2	2	2	
4	3	3	3	2	2	2					2	2	2	2	
5	2	2	2	3	2	1					2	2	2	2	
6	2	2	2	2	2	1					2	2	2	2	

3 - High, 2 - Medium, 1 – Low

UNIT I EMBEDDED DESIGN WITH MICROCONTROLLERS **9**

Product specification – hardware / software partitioning- Detailed hardware and software design – integration,product testing- Microprocessor Vsmicro controller- Performance tools, bench marking processors- RTOS micro controller -issues in selection of processors.

UNIT II PARTITIONING DECISION **9**

Hardware / software duality- Hardware-software portioning, coding for hardware/software development, ASIC revolution- Managing the risk,co-verification, execution environment- Memory organization of controller, memory enhancement- Firmware, speed and code density, system startup.

UNIT III FUNCTIONALITIES FOR SYSTEM DESIGN **9**

Timers, watch dog timers- RAM, flash memory, basic toolset, integration of hardware & firmware- Application programming, IDE, target configuration- Host based debugging analyser- Remote debugging, ROM emulators, logic

UNIT IV DESIGN OF PATIENT MONITORING DEVICES **9**

Design consideration of patient monitoring systems- Basic block diagram of pulse oximeter, design requirement of device- Circuit implementation of interfacing of oximeter sensors with microcontroller- Software coding and implementation.

UNIT V DESIGNING OF PACEMAKER **9**

System description of pacemaker- Design requirement and basic block diagram of pacemaker- Interfacing of pacemaker elements with processors- Software coding of pacemaker and implementation.

TOTAL: 45 HOURS

TEXT BOOKS

1. James K. Peckol, —Embedded system Design‖, John Wiley & Sons, 1st edition, 2010

REFERENCES

1. Geo Elicia White,—MakingEmbeddedSystems‖,O'ReillySeries,SPD,1stedition,2011.
2. Georgi Graschew StefanRakowsky,—TelemedicineTechniquesandApplications,In Tech, 1stedition,2011
3. G. Baura, "A Biosystems Approach to Industrial Patient Monitoring and DiagnosticDevices Morgan&Claypool, IEEE,2008.

U19BMOE003 **HOSPITAL MANAGEMENT SYSTEM**

L	T	P	C
3	0	0	3

Course Objective

The student should be made:

- To understand the fundamentals of hospital administration and management.
- To know the market related research process
- To explore various information management systems and relative supportive services.
- To learn the quality and safety aspects in hospital.

Course Outcomes

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

CO1: Explain the principles of Hospital administration.
CO2: Identify the importance of Human resource management.
CO3:List various marketing research techniques.
CO4: Identify Information management systems and its uses.
CO5: Understand safety procedures followed in hospitals
C06: Analyze the quality and safety aspects in hospital.

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO.1	3	2	3	3		1	2				1		2	2
CO.2	2	3	3	3		1	3				1		3	2
CO.3	2	3	3	3		1	3				1		3	3
CO.4	3	2	3	3		1	2				1		2	3
CO.5	2	2	3	3		1	2				1		2	2
CO.6	2	2	3	3		1	2				1		2	2

3 - High, 2 - Medium, 1 – Low

UNIT I OVERVIEW OF HOSPITAL ADMINISTRATION 9

Distinction between Hospital and Industry, Challenges in Hospital Administration – Hospital Planning· Equipment Planning – Functional Planning - Current Issues in Hospital Management – Telemedicine · Bio-Medical Waste Management.

UNIT II HUMAN RESOURCE MANAGEMENT IN HOSPITAL 9

Principles of HRM – Functions of HRM – Profile of HRD Manager – Tools of HRD –Human Resource Inventory – Manpower Planning. Different Departments of Hospital, Recruitment, Selection, Training Guidelines –Methods of Training – Evaluation of Training – Leadership grooming and Training, Promotion – Transfer, Communication – nature, scope, barriers, styles and modes of communication.

UNIT III MARKETING RESEARCH PROCESS 9

Marketing information systems - assessing information needs, developing & disseminating information - Market Research process - Other market research considerations – Consumer Markets & Consumer Buyer Behaviour - Model of consumer behaviour - The buyer decision process - Model of business buyer behavior – Major types of buying situations - WTO and its implications.

UNIT IV HOSPITAL INFORMATION SYSTEMS & SUPPORTIVE SERVICES 9

Management Decisions and Related Information Requirement - Clinical Information Systems - Administrative Information Systems - Support Service Technical Information Systems – Medical Transcription, Medical Records Department – Central Sterilization and Supply Department –Pharmacy– Food Services - Laundry Services.

UNIT V QUALITY AND SAFETY ASPECTS IN HOSPITAL 9

Quality system – Elements, implementation of quality system, Documentation, Quality auditing, International Standards ISO 9000 – 9004 – Features of ISO 9001 – ISO 14000 – Environment Management Systems. NABA, JCI, NABL. Security – Loss Prevention – Fire Safety – Alarm System – Safety Rules. Health Insurance & Managing Health Care – Medical Audit – Hazard and Safety in a hospital Setup.

TOTAL: 45 HOURS

TEXT BOOKS

1. R.C.Goyal, —Hospital Administration and Human Resource Management‖, PHI – Fourth Edition, 2006.
2. G.D.Kunders, —Hospitals – Facilities Planning and Management – TMH, New Delhi – Fifth Reprint 2007.

REFERENCE BOOKS

1. Cesar A.Caceres and Albert Zara, —The Practice of Clinical Engineering, Academic Press, New York, 1977.
2. Norman Metzger, —Handbook of Health Care Human Resources Management‖, 2nd edition Aspen Publication Inc. Rockville, Maryland, USA, 1990.
3. Peter Berman —Health Sector Reform in Developing Countries‖ - Harvard University Press, 1995.
4. William A. Reinke —Health Planning For Effective Management‖ - Oxford University Press.1988
5. Blane, David, Brunner, —Health and SOCIAL Organization: Towards a Health Policy for the 21st Century‖, Eric Calrendon Press 2002.
6. Arnold D. Kalcizony & Stephen M. Shortell, —Health Care Management‖, 6th Edition Cengage Learning, 2011.

U19BTOE001 **BASICS OF BIOINFORMATICS**

L	T	P	C
3	0	0	3

Course Objectives

To enable the students

- To improve the programming skills of the student
- To let the students know the recent evolution in biological science

Course Outcomes

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

CO1. Use bioinformatics tools with programming skills.

CO2. Apply computational based solutions for biological perspective

CO3. Alignment of nucleotide and protein sequences

CO4. Predict gene and protein structure.

CO5. Construct, interpret and assess the different molecular phylogenetic tree prediction and gene prediction algorithms

CO6. understand the Application of Bioinformatics

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 DATABASES **9**

Introduction to Bioinformatics-Biological information resources-Genome sequence acquisition and analysis-Retrieval of biological data-Data acquisition, databases, structure and annotation-Data mining and data characteristics.

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 matix, 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.

TOTAL: 45 HOURS

TEXT BOOKS:

3. Attwood, T. and P.S. David. 2006. Introduction to Bioinformatics. Pearson Education Ltd., New York.
4. Axevanis, A.D., and Ouellette, B.F.F. (eds) 2006. Bioinformatics A Practical Guide to Analysis of Genes and Proteins. 3rd Edition, John Wiley and Sons, New York.

U19BTOE002 **INTRODUCTION TO BIOENERGY AND BIOFUELS**

L	T	P	C
3	0	0	3

Course Objectives

To enable the students

- 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

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

CO1. Understand in depth of the bioenergy and biofuels.
CO2. Distinguish various forms of bioenergy and biofuels production
CO3. Analyse concepts related to and advantages of bioenergy.
CO4. Develop novel products from biofuels.
CO5. Understand the environmental sustainability.
CO6. Understand the yield and efficiency of Biofuels

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	2													
3	3	3	3	2	2	2		1	3					2	
4	3	1	1			1		1						1	
5	3	3	2	1	2			1						1	
6	3	3	2	1	2			1						1	

3 - High, 2 - Medium, 1 – Low

UNIT I BASIC CONCEPTS OF BIO-FUELS **9**

Biopower, Bioheat, Biofuesl, advanced liquid fuels, drop-in fuels, biobased products

UNIT II FEEDSTOCKS **9**

Harvested Feedstocks: First generation biofuels, Second generation biofuels, third generation biofuels. Residue Feedstocks: Agricultural wastes, forestry wastes, farm waste, organic components of residential, commercial, institutional and insdustrial waste.

UNIT III CONSERVATION TECHNOLOGIES **9**

Biorefinery concept – biorefineries and end products, Biochemical conversion – hydrolysis, enzyme and acid hydrolysis, fermentation, anaerobic digestion and trans-esterification, Thermochemical conversion – Combustion, Gasification, Pyrolysis, other thermochemical conversion technologies. Scaling up of emerging technologies.

UNIT IV BIOMETHANE AND BIOHYDROGEN **9**

Biomethanol − Principles, materials and feedstocks, Process technologies and techniques, Advantages and limitations − Biological hydrogen production methods, Fermentative hydrogen production, Hydrogen economy − Advantages and limitations

UNIT V SUSTAINABILITY AND RESILIENCE **9**

Environmental Sustainability, bioenergy sustainability, emissions of biomass to power generation applications, emissions from biofuels. ILUC issues, Carbon footprint, Advanced low carbon fuels

TOTAL: 45 HOURS

TEXT BOOKS:

1. Biorenewable Resources – Engineering new products. Robert C Brown. Blackwell Publishing Professional, 2003.
2. Biomass for Renewable Energy, Fuels and Chemicals. Donald Klass. Academic press. 1999
3. Introduction to Bioenergy.Vaughn C. Nelson and Kenneth L. Starcher

U19CEOE001 **GREEN BUILDINGS**

L	T	P	C
3	0	0	3

Course Objectives

This course aims to provide the students,

• To imbibe basics of green design and sustainable development concept.

• To identify various area of implementing strategies for green design in projects to enhance built environment.

• To learn institutional guidelines for development and certification of green designs.

Course Outcomes

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

CO1 : Know about the importance and necessity of green buildings.

CO2 : Understand the principles of green building certifications (LEED) and low-energy building strategies.

CO3 : Understand the concepts and principles in Green Building Design.

CO4 : Suggest materials and technologies to improve energy efficiency of building.

CO5 : Gain ideas various green composites used in building and sustainable development.

CO6 : Have an Insight about criteria for rating systems along with established Indian codes an guidelines

Course Articulation Matrix

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

3 - High, 2 - Medium, 1 – Low

UNIT I INTRODUCTION **9**

Green Building - Need for Green Building - Benefits of Green Buildings - Green Building Materials and Equipment in India - Key Requisites for Constructing a Green Building - Important Sustainable features for Green Building.

UNIT II GREEN BUILDING CONCEPTS AND PRACTICES **9**

Indian Green Building Council - Green Building Moment in India - Benefits Experienced in Green Buildings - Launch of Green Building Rating Systems - Residential Sector - Market Transformation. Green Building Opportunities And Benefits: Opportunities of Green Building - Green Building Features, Material and Resources - Water Efficiency - Optimum Energy Efficiency - Typical Energy Saving Approach in Buildings - LEED India Rating System and Energy Efficiency.

UNIT III GREEN BUILDING DESIGN **9**

Introduction - Reduction in Energy Demand - Onsite Sources and Sinks - Maximise System Efficiency - Steps to Reduce Energy Demand and Use Onsite Sources and Sinks - Use of Renewable Energy Sources. Eco-friendly captive power generation for factory - Building requirement.

UNIT IV UTILITY OF SOLAR ENERGY IN BUILDINGS **9**

Utility of Solar energy in buildings. Concepts of Solar Passive Cooling and Heating of Buildings - Low Energy Cooling. Case studies of Solar Passive Cooled and Heated Buildings.

UNIT V GREEN COMPOSITES FOR BUILDINGS **9**

Concepts of Green Composites - Water Utilisation in Buildings - Low Energy Approaches to Water Management, Management of Solid Wastes, Management of Sullage Water and Sewage, Urban Environment and Green Buildings, Green Cover and Built Environment.

TOTAL: 45 HOURS

TEXT BOOKS

1. K.S.Jagadish, B. U. Venkataramareddy and K. S. Nanjundarao. “Alternative Building Materials ar Technologies”. New Age International, 2007.

2. Low Energy Cooling for Sustainable Buildings. John Wiley and Sons Ltd, 2009
3. Sustainable Building Design Manual. Vol 1 and 2, Teri, New Delhi, 2004.

REFERENCES

1. Osman Attmann, “Green Architecture Advanced Technologies and Materials”. McGraw Hill, 2010.
2. Jerry Yudelson, “Green building Through Integrated Design”. McGraw Hill, 2009
3. Fundamentals of Integrated Design for Sustainable Building By Marian Keeler, Bill Burke.

U19CEOE002 **DISASTER PREPARDNESS AND MANAGEMENT**

L	T	P	C
3	0	0	3

Course Objectives

This course aims to provide the students,

• To Understand the basic concepts of disaster management.

• To acquire knowledge on types and categories of disasters.

• To understand the impacts and challenges posed by disasters.

Course Outcomes

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

CO1 : Understand the foundations of hazards, disasters and associated natural/social phenomena.

CO2 : Familiarity with disaster management theory (cycle, phases) and Methods of community involvement as an essential part of successful DRR.

CO3 : Apply knowledge about existing global frameworks and existing agreements.

CO4 : Understand consequences and inter relationship between development and disasters. CO5 : Draw the hazard and vulnerability profile of India, Scenarios in the Indian context.

CO6 : Conduct independent DM study including data search, analysis and presentation of disaster case study.

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	3	3	-	-	1	-	2	3	1	1
2	-	2	1	1	2	2	3	-	3	-	-	2	2	1	-
3	-	3	2	1	-	3	1	-	3	-	-	2	2	1	-
4	3	3	-	1	3	3	2	-	-	-	-	2	3	1	-
5	-	3	2	1	3	3	2	-	-	3	-	2	3	1	3
6	3	3	2	-	1	3	2	-	-	-	-	-	2	1	3

3 - High, 2 - Medium, 1 – Low

UNIT I INTRODUCTION TO DISASTER **9**

Concepts and definitions - disaster, hazard, vulnerability, resilience, risks severity, frequency and details, capacity, impact, prevention, mitigation. Global trends in disasters - urban disasters, pandemics, complex emergencies, Climate change. Disaster's classification - natural disasters - manmade disasters - hazard and vulnerability profile of India - mountain and coastal areas, ecological fragility. Dos and Don'ts during various types of Disasters.

UNIT II DISASTER IMPACTS **9**

Disaster impacts (environmental, physical, social, ecological, economic, political, etc.) - health, psycho, social issues - demographic aspects (gender, age, special needs) - hazard locations - global and national disaster trends - climate change and urban disasters.

UNIT III DISASTER RISK REDUCTION **9**

Disaster management cycle – its phases : prevention, mitigation, preparedness, relief and recovery; structural and non-structural measures - risk analysis - vulnerability and capacity assessment - early warning systems - Post disaster environmental response (water, sanitation, food safety, waste management, disease control, security, communications) - Roles and responsibilities of government – community - local institutions - NGOs and other stakeholders - Policies and legislation for disaster risk reduction - DRR programmes in India and the activities of National Disaster Management Authority

UNIT IV DISASTER RISK MANAGEMENT IN INDIA **9**

Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, Disaster Management Act and Policy - Other related policies, plans, programmes and legislation – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment.

UNIT V DISASTERS, ENVIRONMENT AND DEVELOPMENT 9

Factors affecting vulnerability such as impact of developmental projects and environmental modifications (including of dams, land use changes, urbanization etc.), sustainable and environmentally friendly recovery; reconstruction and development methods.

TOTAL: 45 HOURS

TEXT BOOKS

1. Singhal J.P. "Disaster Management", Laxmi Publications, 2010.
2. Singh B.K., 2008, Handbook of Disaster Management: Techniques & Guidelines, Rajat Publication.
3. Pradeep Sahni, 2004, Disaster Risk Reduction in South Asia, Prentice Hall.

REFERENCES

1. Govt. of India: Disaster Management Act, Government of India, New Delhi, 2005.
2. Disaster Medical Systems Guidelines. Emergency Medical Services Authority, State of California, EMS no.214, June 2003.
3. Government of India, National Disaster Management Policy,2009.

U19EDOE001 **INTELLECTUAL PROPERTY RIGHTS**

L	T	P	C
3	0	0	3

Course Objectives

This course aims to provide the students,

- Comprehensive knowledge on basic principles of IPR
- To know the rights and policies related to design, Patents, Copyright and Trademarks
- To understand the statutory provisions of IPRs
- To induce knowledge on Infringements
- To provide knowledge on how to keep the IP rights alive

Course Outcomes

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

CO1 : Differentiate and explain various forms of IPRs.

CO2 : Identify criteria's to fit one's own intellectual work in particular form of IPRs.

CO3 : Apply statutory provisions to protect particular form of IPRs.

CO4 : Analyse rights and responsibilities of holder of Patent, Copyright, Trademark, Industrial Design etc.

CO5 : Identify procedure to protect different forms of IPRs national and international level.

CO6 : Develop skill of making search using modern tools and technics.

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
2	2	1	-	-	-	2	1	-	2	-	2	1	1	1	-
3	-	-	-	-	-	3	-	3	-	1	-	2	2	1	-
4	-	2	-	-	-	1	-	3	2	-	-	1	2	1	2
5	-	2	1	1	-	2	1	3	1	1	-	2	2	1	-
6	2	1	1	-	3	2	1	3	1	-	-	2	2	1	2

3 - High, 2 - Medium, 1 – Low

UNIT I INTRODUCTION **9**

Basic Concepts - Need for IP - Types of IP - Design, Patent, Copyrights, Trademarks, Geographical Indications - Nature of IP – WTO – WIPO – TRIPS - Inventions and Innovations - Real time examples of IPR

UNIT II FORMS AND REGISTARTIONS **9**

Types of forms - Practical aspects - registration and validity of Design, Patents, Copyrights, Trademarks, Trade secrets and Geographical Indications - Difference between Indian and International Patents - Case studies on Industrial Patents

UNIT III AGREEMENTS AND LEGISLATIVE ACTS **9**

Patent Act of India - PCT agreement - Design Act - TRIPS Agreement - Patent Amendment Act - Trademark Act - Geographical Indication Act - Conventions and Infringements of IPR

UNIT IV IP LAWS AND DIGITAL INNOVATIONS **9**

IP Laws - Cyber Laws - Protection of Innovations - Development of Assets - Unfair Competition - Cyber Laws Realtime case Studies

UNIT V EMERGING TRENDS IN INNOVATIONS AND IPRs **9**

Emerging trends - Innovations in various domains - Industry 4.0 - Innocent Infringement - Case Studies of innovative products and services solving various social concerns

TOTAL: 45 HOURS

TEXT BOOKS

1. Deborah E. Bouchoux, "Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets", Cengage Learning, Third Edition, 2015.
2. S. V. Satakar, "Intellectual Property Rights and Copy Rights, Ess Publications, New Delhi, 2002.
3. V. Scople Vinod, Managing Intellectual Property, Prentice Hall of India pvt Ltd, 2012.

REFERENCES

1. Prabuddha Ganguli, “Intellectual Property Rights: Unleashing the Knowledge Economy”, McGraw HillEducation, 2011.
2. Edited by Derek Bosworth and Elizabeth Webster, The Management of Intellectual Property, EdwardElgar Publishing Ltd., 2013.

U19CSOE001 **SOFTWARE ENGINEERING**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

To understand the phases in a software project

- To understand fundamental concepts of requirements engineering and Analysis Modeling.
- To understand the various software design methodologies
- To learn various testing and maintenance measures

COURSE OUTCOMES

At the end of the course students should be able to

CO1. Identify the key activities in managing a software project and recognize different process model
CO2. Explain the concepts of requirements engineering and Analysis Modeling.
CO3. Outline the systematic procedures for software design and deployment
CO4. Compare various testing and maintenance methods
CO5. Interpret the project schedule, estimate project cost and effort required.
CO6. Develop a software using the software engineering principles

Course Articulation Matrix :

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1											2	2
CO2	2	1	1											2	2
CO3	3	2	2											2	2
CO4	3	2	2											2	2
CO5	3	2	2											2	2
CO6	3	2	2											2	2

3- High, 2- Medium, 1- Low

UNIT I SOFTWARE PROCESS AND AGILE DEVELOPMENT 9

Introduction to Software Engineering, Software Process, Perspective and Specialized Process Models – Introduction to Agility-Agile process-Extreme programming-XP Process.

UNIT II REQUIREMENTS ANALYSIS AND SPECIFICATION 9

Software Requirements: Functional and Non-Functional, User requirements, System requirements, Software Requirements Document – Requirement Engineering Process: Feasibility Studies, Requirements elicitation and analysis, requirements validation, requirements management Classical analysis: Structured system Analysis, Petri Nets- Data Dictionary.

UNIT III SOFTWARE DESIGN 9

Design process – Design Concepts-Design Model– Design Heuristic – Architectural Design - Architectural styles, Architectural Design, Architectural Mapping using Data Flow- User Interface Design: Interface analysis, Interface Design –Component level Design: Designing Class based components, traditional Components.

UNIT IV TESTING AND MAINTENANCE 9

Software testing fundamentals-Internal and external views of Testing-white box testing - basis path testing-control structure testing-black box testing- Regression Testing – Unit Testing – Integration Testing – Validation Testing – System Testing And Debugging –Software Implementation Techniques: Coding practices-Refactoring-Maintenance and Reengineering-BPR model-Reengineering process model-Reverse and Forward Engineering.

UNIT V PROJECT MANAGEMENT 9

Software Project Management: Estimation – LOC, FP Based Estimation, Make/Buy Decision COCOMO I & II Model – Project Scheduling – Scheduling, Earned Value Analysis Planning – Project Plan, Planning Process, RFP Risk Management – Identification, Projection - Risk Management-Risk Identification-RMMM Plan-CASE TOOLS

Total : 45 HOURS

TEXT BOOKS:

1. Roger S. Pressman, “Software Engineering – A Practitioner‟s Approach”, Seventh Edition, Mc Graw-Hill International Edition, 2010.
2. Ian Sommerville, “Software Engineering”, 9th Edition, Pearson Education Asia, 2011

REFERENCE BOOKS:

1. Rajib Mall, “Fundamentals of Software Engineering”, Third Edition, PHI Learning Private Limited, 2009
2. Pankaj Jalote, “Software Engineering, A Precise Approach”, Wiley India, 2010.
3. Kelkar S.A., “Software Engineering”, Prentice Hall of India Pvt Ltd, 2007.
4. Stephen R.Schach, “Software Engineering”, Tata McGraw-Hill Publishing Company Limited,2007

U19CSOE002 **DATABASE MANAGEMENT SYSTEMS**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To learn the fundamentals of data models and to represent a database system using ER
- diagrams.
- To study SQL and relational database design.
- To understand the internal storage structures using different file and indexing techniques which will help in physical DB design.
- To understand the fundamental concepts of transaction processing- concurrency control techniques and recovery procedures.
- To have an introductory knowledge about the Storage and Query processing Techniques

COURSE OUTCOMES

At the end of the course students should be able to

CO1. Discuss the fundamental concepts of relational database and SQL

CO2. Use ER model for Relational model mapping to perform database design effectively

CO3. Summarize the properties of transactions and concurrency control mechanisms

CO4. Outline the various storage and optimization techniques

CO5. Compare and contrast various indexing strategies in different database systems

CO6. Explain the different advanced databases

Course Articulation Matrix :

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1											2	2
CO2	3	2	2											3	3
CO3	2	1	1											2	2
CO4	2	1	1											2	2
CO5	2	1	1											3	3
CO6	2	1	1											2	2

3- High, 2- Medium, 3- Low

UNIT I RELATIONAL DATABASES **10**

Purpose of Database System – Views of data – Data Models – Database System Architecture – Introduction to relational databases – Relational Model – Keys – Relational Algebra – SQL fundamentals – Advanced SQL features – Embedded SQL– Dynamic SQL

UNIT II DATABASE DESIGN **8**

Entity-Relationship model – E-R Diagrams – Enhanced-ER Model – ER-to-Relational Mapping – Functional Dependencies – Non-loss Decomposition – First, Second, Third Normal Forms, Dependency Preservation – Boyce/Codd Normal Form – Multi-valued Dependencies and Fourth Normal Form – Join Dependencies and Fifth Normal Form

UNIT III TRANSACTIONS **9**

Transaction Concepts – ACID Properties – Schedules – Serializability – Concurrency Control – Need for Concurrency – Locking Protocols – Two Phase Locking – Deadlock – Transaction Recovery - Save Points – Isolation Levels – SQL Facilities for Concurrency and Recovery

UNIT IV TESTING AND MAINTENANCE **9**

RAID – File Organization – Organization of Records in Files – Indexing and Hashing –Ordered Indices – B+ tree Index Files – B tree Index Files – Static Hashing – Dynamic Hashing – Query Processing Overview – Algorithms for SELECT and JOIN operations – Query optimization using Heuristics and Cost Estimation.

UNIT V PROJECT MANAGEMENT **9**

Distributed Databases: Architecture, Data Storage, Transaction Processing – Object-based Databases: Object Database Concepts, Object-Relational features, ODMG Object Model, ODL, OQL - XML Databases: XML Hierarchical Model, DTD, XML Schema, XQuery – Information Retrieval: IR Concepts, Retrieval Models, Queries in IR systems.

Total: 45 Hours

TEXT BOOKS:

1.Abraham Silberschatz, Henry F. Korth, S. Sudharshan, “Database System Concepts”, Sixth Edition, Tata McGraw Hill, 2011.

2.Ramez Elmasri, Shamkant B. Navathe, “Fundamentals of Database Systems”, Sixth Edition, Pearson Education, 2011.

REFERENCE BOOKS:

1.C.J.Date, A.Kannan, S.Swamynathan, “An Introduction to Database Systems”, Eighth Edition, Pearson Education, 2006.

2.Raghu Ramakrishnan, ―Database Management Systems‖, Fourth Edition, McGraw-Hill College Publications, 2015.

3.G.K.Gupta,"Database Management Systems”, Tata McGraw Hill, 2011.

U19ECOE003 **CONSUMER ELECTRONICS**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- Understand troubleshooting in loudspeakers and Microphones
- Gain knowledge on television signals and components
- Gain knowledge on various types of audio recording and playback techniques
- Understand communication systems
- Understand principle of working of home appliances

PREREQUISITES

- Basic Electronics
- Electronic devices

COURSE OUTCOMES

At the end of the course students should be able to

CO1: Troubleshoot different types of microphones and speakers
CO2: Maintain audio systems
CO3: Analyse composite video signal used in TV transmission
CO4: Troubleshoot TV Receivers
CO5: Maintain various home appliances

Course Articulation Matrix

CO s	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PSO	PSO	PSO
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	2	2							2	1	3	3	1
CO2	3	2	2	2							2	1	3	3	1
CO3	3	2	2	2							2	1	3	3	1
CO4	3	2	2	2							2	1	3	3	1
CO5	3	2	2	2							2	1	3	3	1
CO6	3	2	2	2							2	1	3	3	1

3 - High, 2 - Medium, 1 – Low

UNIT I LOUDSPEAKERS AND MICROPHONES 9

Dynamic Loudspeaker, Electrostatic loudspeaker, Permanent Magnet Loudspeaker, Woofers and Tweeters - Microphone Characteristics, Carbon Microphones, Dynamic Microphones and Wireless Microphones

UNIT II TELEVISION STANDARDS AND SYSTEMS 9

Components of a TV system – interlacing – composite video signal. Colour TV – Luminance and Chrominance signal; Monochrome and Colour Picture Tubes - Colour TV systems – NTSC, PAL,SECAM - Components of a Remote Control.

UNIT III OPTICAL RECORDING AND REPRODUCTION 9

Audio Disc – Processing of the Audio signal – read out from the Disc –Reconstruction of the audio signal – Video Disc – Video disc formats- recording systems – Playback Systems.

UNIT IV TELECOMMUNICATION SYSTEMS 9

Telephone services - telephone networks – switching system principles –PAPX switching – Circuit, packet and message switching, LAN, MAN and WAN, Integrated Services Digital Network. Wireless Local Loop. VHF/UHF radio systems, Limited range Cordless Phones; cellular modems

UNIT V HOME APPLIANCES 9

Basic principle and block diagram of microwave oven; washing machine hardware and software; components of air conditioning and refrigeration systems

Total: 45 Hours

TEXT BOOKS:

1. S.P.Bali, “Consumer Electronics”, Pearson Education, 2005.
2. Gupta. R.G, “ Audio Video Systems principles maintenance and trouble shooting, Mc graw Hill, New Delhi, India, 2010

REFERENCE BOOKS:

1. Dhake .A.M, “ Television and Video Engineering”, Mc graw Hill, New Delhi, India, 2006
2. Modern television practice: Transmission, reception and applications, New age International, New Delhi, 2015

U19ECOE006	MEDICAL ELECTRONICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To gain knowledge about the various physiological parameters both electrical and non electrical and the methods of recording and also the method of transmitting these parameters
- To study about the various assist devices used in the hospitals
- To gain knowledge about equipment used for physical medicine and the various recently developed diagnostic and therapeutic techniques

PREREQUISITES

- Basic Electronics
- Electronic devices

COURSE OUTCOMES

At the end of the course students should be able to

CO1: Know the human body electro- physiological parameters and recording of bio-potentials
CO2: Comprehend the non-electrical physiological parameters and their measurement – body temperature, blood pressure, pulse, blood cell count, blood flow meter etc.
CO3: Interpret the various assist devices used in the hospitals viz. pacemakers, defibrillators, dialyzers and ventilators
CO4: Comprehend physical medicine methods eg. ultrasonic, shortwave, microwave surgical diathermies , and bio-telemetry principles and methods
CO5: Know about recent trends in medical instrumentation

Course Articulation Matrix

CO s	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PSO	PSO	PSO
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	2	2							2	1	3	3	1
CO2	3	2	2	2							2	1	3	3	1
CO3	3	2	2	2							2	1	3	3	1
CO4	3	2	2	2							2	1	3	3	1
CO5	3	2	2	2							2	1	3	3	1
CO6	3	2	2	2							2	1	3	3	1

3 - High, 2 - Medium, 1 – Low

UNIT I ELECTRO-PHYSIOLOGY AND BIO-POTENTIAL RECORDING 9

Sources of bio medical signals, Bio-potentials, Biopotential electrodes, biological amplifiers, ECG, EEG, EMG, PCG, typical waveforms and signal characteristics

UNIT II NON ELECTRICAL PARAMETER MEASUREMENTS 9

Blood flow meter-Types, Cardiac output measurements-Types, respiratory measurement, blood pressure measurement, temperature and pulse measurement, Blood Cell Counters

UNIT III THERAPEUTIC EQUIPMENTS 9

Cardiac pacemakers - types, Cardiac defibrillators-types, Dialyzers, Heart Lung Machines –Oxygenations, Diathermies-Shortwave, ultrasonic and microwave type and their applications, Surgical Diathermy

UNIT IV MEDICAL IMAGING 9

X-Ray machine, computer axial tomography- CT scans, Positron Emission Tomography- PET Scans. MRI and NMR Ultrasonic Imaging systems, Medical Thermograph

UNIT V RECENT TRENDS IN MEDICAL INSTRUMENTATION AND APPLICATION IN MEDICINE 9

Bio medical telemetry- remote patient monitoring systems, Telemedicine, Radio pill, Application of cryogenics in medicine, Application of LASERS in medicines. Diagnosis of Cancers and tumors using image processing, diagnosis of dental plague using image processing, diagnosis of various eye problems using image processing

Total : 45 Hours

TEXT BOOKS:

1. Leslie Cromwell, Biomedical Instrumentation and Measurement‖, Prentice Hall of India, New Delhi, 2007. (UNIT I – V)
2. Khandpur, R.S., —Handbook of Biomedical Instrumentation‖, TATA McGraw-Hill, New Delhi, 2003.(UNIT I – V)

REFERENCE BOOKS:

1. Dhake .A.M, " Television and Video Engineering", Mc graw Hill, New Delhi, India, 2006
2. Modern television practice: Transmission, reception and applications, New age International, New Delhi, 2015

U19EEOE001	RENEWABLE ENERGY RESOURCES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To get exposure on renewable energy source.
- To know about the solar radiation and its environmental impact to power.
- To learn about the wind energy and its economic aspects.
- To know about geothermal energy with other energy sources.
- To get exposure on distributed generation in storage systems

PREREQUISITES

- Fundamentals of electrical engineering
- Basic concepts of Differentiation
- Basic concepts of Integration
- Fundamentals of Battery concepts

COURSE OUTCOMES

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

CO1 Acquire knowledge on power demand scenario of world and the importance of renewable energy sources in meeting the power demand

CO2 Understand the working principle of solar photovoltaic system and its applications

CO3 Outline the various components and performance of wind energy conversion system

CO4 Explain the operation of geothermal and tidal power plants, fuel cell and ocean thermal energy conversion scheme.

CO5 Understand the necessity of distributed generation and energy storage elements.

CO6 Understand about the power generation through renewable energy sources

Course Articulation Matrix

Cos	PROGRAMME OUTCOMES (POs)												PSOs			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	-	2	2	-	1	3	-	-	-	2	-	3	3	2	2
CO2	3	-	2	2	-	1	3	-	-	-	2	-	2	2	2	2
CO3	3	-	2	2	-	1	3	-	-	-	2	-	2	3	3	1
CO4	3	-	2	2	-	1	3	-	-	-	2	-	1	2	2	2
CO5	3	-	2	2	-	1	3	-	-	-	2	-	2	2	2	2
CO6	3	-	2	2	-	1	3	-	-	-	2	-	3	2	2	2

3 - High, 2 - Medium, 1 – Low

UNIT I INTRODUCTION **9**

Energy scenario: National and International – Energy resources and their availability – Conventional power generation plant (Thermal power plant) - Environmental aspects of fossil fuels – Necessity for renewable energy sources – Types of renewable energy source and its limitation.

UNIT II SOLAR PHOTOVOLTAIC SYSTEM **9**

Introduction – Solar radiation and measurements – Basic principle of SPV conversion – Solar energy collectors – Solar energy storage: Solar pond – Types of solar PV cells – PV cell connections – Characteristics of PV module and its parameters - Application of solar energy: Solar pumping and solar cooking.

UNIT III WIND ENERGY SYSTEM **9**

Introduction – Wind energy conversion – Power produced from wind - Relationship between wind speed and power – Components of wind power plant (WPP) – Types of WPP – Selection of site for WPP – Advantages and challenges of WPP.

UNIT IV ENERGY FROM OTHER SOURCES 9

Geothermal energy (GTE): operation of GTE power plants - Types– Advantage of GTE- Tidal energy: Operation of tidal power plant – Ocean Thermal Energy Conversion system: Open and closed cycles - Fuel cell: Construction and working principle- Advantage and applications of Fuel cell.

UNIT V DISTRIBUTED GENERATION 9

Concept of DG – Benefits of DG – Types of DG resources – Security issues in integrating DG with power grid - Energy storage elements: Batteries, super-capacitors, flywheels - Captive power plants

Total: 45 Hours

TEXT BOOKS:

1. Rai, G.D., “Non-Conventional Energy Sources”, Khanna Publishers, Sixth Edition 2017
2. Khan, B.H, Non-Conventional Energy Resources”, Mc. Graw Hill Education Ltd, third reprint 2017.

REFERENCE BOOKS:

1. Rao S. Paruklekar,B.B, “Energy Technology –Non Conventional, Renewable and Conventional”, KhannaPublishers,1994
2. John Twidell and Tony Weir, “Renewable Energy Resources”, Tyalor and Francis Publications, Third edition, 2015.
3. Mukund R.Patel, “Wind and Solar Power Systems”, CRC Press LLC.

U19EEOE002	INTRODUCTION TO CONTROL SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To understand the concepts of control systems-open loop and closed loop control systems.
- To understand the (mathematical modelling) Transfer function from mechanical, electrical, block diagram and signal flow graph.
- To learn the concepts of steady state and transient responses from first and second order systems at different inputs and also steady state errors.
- To learn the stability concepts are Root locus, Bode plot and Polar plot
- To learn the concept of state space analysis applying on multi-input/output state of the system to find the stability.

PREREQUISITES

- Basic concepts of circuit analysis
- Fundamentals of electrical engineering
- Basic concepts of Differentiation
- Basic concepts of Integration

COURSE OUTCOMES

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

CO1	Ability to find the Mathematical models-differential equations, impulse response and transfer functions.
CO2	Ability to find the transfer function from mechanical, electrical, block diagram, signal flow graph and electronic system
CO3	Describe the concept of steady state and transient response at different inputs
CO4	Apply the concepts of stability in s-domain and Routh criteria and the concepts of plotting the response of a system on a graph
CO5	Design and implement any system using state space analysis
CO6	Ability to implement the real time applications of control systems

Course Articulation Matrix

COs	PROGRAMME OUTCOMES (POs)												PSOs			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	2	3	-	-	2	-	-	2	-	-	2	2	2	2	2
CO2	1	2	3	-	-	2	-	-	2	-	-	2	2	2	2	2
CO3	1	2	3	-	-	2	-	-	2	-	-	2	2	3	3	1
CO4	1	2	3	-	-	2	-	-	2	-	-	2	1	2	2	2
CO5	1	2	3	-	-	2	-	-	2	-	-	2	2	2	1	1
CO6	1	2	3	-	-	2	-	-	2	-	-	2	3	2	1	1

3 - High, 2 - Medium, 1 – Low

UNIT I INTRODUCTION **9**

Concepts of control systems-open loop and closed loop control systems and their differences-different examples of control systems-classification of control systems, feed-back characteristics, effects of feedback. Mathematical models-differential equations, impulse response and transfer functions.

UNIT II TRANSFER FUNCTION REPRESENTATION **9**

Block diagram representation of systems considering electrical systems as examples-block diagram algebra-representation by signal flow graph-reduction using mason's gain formula.

UNIT III TIME RESPONSE ANALYSIS **9**

Standard test signals-time response of first order systems- characteristic equation of feedback control systems, transient response of second order systems-time domain specifications-steady state response-steady state errors and error constants-effects of proportional derivative, proportional integral systems, PID controllers

UNIT IV STABILITY AND FREQUENCY RESPONSE ANALYSIS 9

The concept of stability-routh's stability criterion- The root locus concept –construction of root loci-effects of adding poles and zeros to G(S) H(S) on the root loci - Frequency domain specifications - bode diagrams- determination of frequency domain specifications and transfer function from the bode diagram-phase margin and gain margin-stability analysis from bode plots. Polar plots.

UNIT V STATE SPACE ANALYSIS 9

Concepts of state, state variables and state model, derivation of state models from block diagrams, diagonalization-solving the time invariant state equations-state transition matrix and it's properties-concepts of controllability and observability.

Total: 45 Hours

TEXT BOOKS:

1. C. Kuo, Automatic Control Systems, 8th edition, John Wiley and sons, India, 2003
2. J. Nagrath, M. Gopal, Control Systems Engineering, 2nd edition, New Age International (P) Limited, New Delhi.

REFERENCE BOOKS:

1. Katsuhiko Ogata, Modern Control Engineering, 3rd edition, Prentice Hall of India Pvt. Ltd., India, 1998
2. Norman S. Nice, Control Systems Engineering, 6th edition, John Wiley, India, 2015
3. N. K. Sinha(1998), Control Systems, 3rd edition, New Age International (P) Limited Publishers, India

U19FTOE001	FOOD SCIENCE AND NUTRITION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

Explain the basic concepts of food and nutrition. Define the overall classification, function, and source of carbohydrates, lipids and proteins. Discuss the overall aspects of vitamins. Outline the role of health and nutritional importance of micro and macro minerals. Summarize the recent trends in nutrition

PREREQUISITES

- Basic idea on biomolecules
- Knowledge of essential nutrition requirement
- Health benefits and function of nutrition
- Diet based nutrition
- Effect of storage and processing on nutrition

COURSE OUTCOMES

At the end of the course students should be able to

CO1: Discuss the basics in the area of nutritional assessment in health and disease and to categorize the recommended dietary allowances for different age groups

CO2: Express the classifications, functions and sources of carbohydrates, lipids and proteins

CO3: List the various attributes of fat- and water-soluble vitamins

CO4: Report the role, bioavailability, sources and deficiency diseases of macro and micro minerals

CO5: Recognize the diets and concepts of foods suggested for nutritional, chronic and acute disorders

CO6: Classify and to analyse the different techniques of qualitative and quantitative analysis

Course Articulation Matrix

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

3 – High, 2 – Medium, 1 – Low

UNIT I HUMAN NUTRITION **9**

Historical perspective of nutrient requirements – Assessment of nutritional status – recommended dietary allowances of macronutrients for all age groups – Assessment of protein quality – Malnutrition and related disorders – Balanced Diet. Factors influencing dietary intake: Food habits, food fads and fallacies, their influence on health and wellbeing.

UNIT II BIOMOLECULES **9**

Carbohydrates- Definition, classification, Functions, Sources of Carbohydrates, Deficiency. Lipids – Definition, classification, function, sources, Refined & Hydrogenated fats process. Proteins – Definitions, Classification, Function, Amino Acids, Sources of Proteins.

UNIT III VITAMINS **9**

Physiological role, bio-availability, requirements, sources and deficiency of Fat Soluble Vitamins: Vitamin A, Vitamin D, E & K. Water soluble vitamins: Vitamin C, Thiamine, Riboflavin, Niacin, Pantothenic acid, Biotin, Folic acid, Vitamin B12, VitaminB6.

UNIT IV MINERALS **9**

Physiological role, bio-availability, requirements, sources and deficiency of Macro minerals: Calcium, Phosphorus Magnesium, Sodium, Potassium chloride. Micro minerals: Iron, Zinc, copper, selenium, chromium, iodine, manganese, Molybdenum and fluoride.

UNIT V RECENT TRENDS IN DIETETICS 9

Principles of dietary management in gout, rheumatism, AIDS/HIV – Cancer-risk factors, symptoms, dietary management, role of food in prevention of Cancer. Role of functional foods, health foods and novel foods, organically grown foods, recent concepts in human nutrition like nutrigenomics, nutraceuticals etc.

Total: 45 Periods

TEXT BOOKS:

1. Gordon M. Wardlaw. Perspectives in Nutrition. WCB McGraw-Hill Publishers, Boston, 9th Edition. 2013.
2. Shubhangini A. Joshi. Nutrition and Dietetics. Tata Mc Grow- Hill publishing Company Ltd, New Delhi. 4th Edition. 2016.
3. Srilakshmi. B. Nutrition Science. New Age International Pvt. Ltd, Publishers. 6th Edition. 2017.

REFERENCE BOOKS:

1. Ronald Ross Watson. Functional foods and Nutraceuticals in Cancer Prevention. Ed. Wiley – Blackwell. 2003.
2. Sunetra Roday. Food Science and Nutrition. Oxford Higher Education/Oxford University Press. 3rd edition 2018.

U19FTOE002 **FOOD PRESERVATION TECHNIQUES**

L	T	P	C
3	0	0	3

Course Objectives

To introduce the students to the area of Food Processing and preservation.
To have an effective understanding of food processing and technology subjects.
To enable students to appreciate the importance of food processing with respect to the large-scale production.
To import knowledge on processing of food waste

Course Outcomes

At the end of the course, learners will be able to:
C01: Describe the fundamentals of food processing and preservation
C02: Familiar with the functional properties of Carbohydrates, fats, lipids, proteins in food
C03: Knowledge about the importance of food additives and their function and will develop strategies that will promote food safety and prevent food borne illness
C04: Analyze the uses of enzymes, modified proteins and develop novel products, explain, analyze and evaluate scenarios related to various unit operations in food processing and preservation
C05: Identify spoilage and deterioration mechanism in food and methods to control deterioration and spoilage
C06: Demonstrate packing methods, materials and factors affecting food packing

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		2
4	3	3	2								3			2	
5		3	2								3			2	
6	3	2	2	2	2	1	2								

3 - High, 2 - Medium, 1 – Low

UNIT I PROCESSING OF FOOD AND ITS IMPORTANCE **9**

Source of food - significance for processing and preservation of foods – Different food groups-, food pyramids, classification and functions, cooking of foods – methods and cooking media, advantages of processing of foods, changes of nutritional components in cooking, effects of processing of foods on antinutritional components.

UNIT II FOOD COMPONENTS **9**

Classification, Structure, nutritive value, processing outlines of major Cereals and millets-Pulses-fruits and vegetables, fats, oilseeds and nuts. Major and minor nutrients, sugar and related products, spices and aromatics, beverages and appetizers, organic foods

UNIT III PROCESSING OF ANIMAL FOODS **9**

Meat, Poultry and Fish-Structure, composition, nutritive value and processing outline. Processing of milk and milk products, egg processing and storage, need and nutritional benefits of animal products, value added products

UNIT IV INTRODUCTION TO FOOD PROCESSING AND PRESERVATION **9**

Food spoilage, fermentation, methods of preservation - High temperature and Low temperature Preservation, traditional methods of food processing and preservation, radiation processing, microwave, non-thermal techniques. Role of enzymes and additives in food preservation

UNIT V FOOD PACKAGING AND QUALITY 9

Food packaging – importance, types and functions, packaging materials – synthetic and natural, Impact of packaging materials on food quality, shelf-life of foods, bottling and canning, nutritional labelling, labelling of vegan and animal based products

TOTAL: 45 HOURS

TEXT BOOKS

1 Karnal, Marcus and D.B. Lund “Physical Principles of Food Preservation”. Rutledge, 2003.
2 Sivasankar, B. “Food Processing & Preservation”, Prentice Hall of India, 2002.

REFERENCES

1 Khetarpaul, Neelam, “Food Processing and Preservation”, Daya Publications, 2005

WEBSITES

1 https://www.heartfoundation.org.nz/educators/edu-resources/food-tech
2 https://www.stemcrew.org/guides/subjects/food-technology-teaching-resources/

U19ITOE001 **FUNDAMENTALS OF PYTHON PROGRAMMING** **L T P C**
2 0 2 3

COURSE OBJECTIVES

- To provide a sound knowledge in UI & UX
- To understand the need for UI and UX
- To understand the various Research Methods used in Design
- To explore the various Tools used in UI & UX
- Creating a wireframe and prototype.

COURSE OUTCOMES:

At the end of the course students should be able to

CO1: Understand the principles of UI and UX design, including user-centered design, information architecture, visual hierarchy, and usability testing.

CO2:Build UI for user Applications

CO3:Evaluate UX design of any product or application

CO4:Demonstrate UX Skills in product development

CO5:Implement Sketching principles

CO6:Create Wireframe and Prototype

Course Articulation Matrix

CO s	PROGRAMME OUTCOMES (POs)												PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	3		2				3		2	2	3	3	2
CO2	3	2	3		2				3		2	2	3	3	2
CO3	3	2	3		2				3		2	2	3	3	2
CO4	3	2	3		2				3		2	2	3	3	2
CO5	3	2	3		2				3		2	2	3	3	2
CO6	3	2	3		2				3		2	2	3	3	2

3 - High, 2 - Medium, 1 – Low

UNIT I FOUNDATIONS OF DESIGN **9**

UI vs. UX Design - Core Stages of Design Thinking - Divergent and Convergent Thinking - Brainstorming and Game storming - Observational Empathy

UNIT II FOUNDATIONS OF UI DESIGN **9**

Visual and UI Principles - UI Elements and Patterns - Interaction Behaviors and Principles – Branding - Style Guides 126

UNIT III FOUNDATIONS OF UX DESIGN **9**

Introduction to User Experience - Why You Should Care about User Experience - Understanding User Experience - Defining the UX Design Process and its Methodology - Research in User Experience Design - Tools and Method used for Research - User Needs and its Goals - Know about Business Goals.

UNIT IV WIREFRAMINF, PROTOTYPING AND TESTING **9**

Sketching Principles - Sketching Red Routes - Responsive Design – Wireframing - Creating Wireflows - Building a Prototype - Building High-Fidelity Mockups - Designing Efficiently with Tools - Interaction Patterns - Conducting Usability Tests - Other Evaluative User Research Methods - Synthesizing Test Findings - Prototype Iteration

UNIT V RESEARCH, DESIGNING, IDEATING, & INFORMATION ARCHITECTURE **9**

Identifying and Writing Problem Statements - Identifying Appropriate Research Methods - Creating Personas - Solution Ideation - Creating User Stories - Creating Scenarios - Flow Diagrams - Flow Mapping - Information Architecture.

Total : 45 Hours

TEXT BOOKS

1. Joel Marsh, “UX for Beginners”, O’Reilly , 2022

2. Jon Yablonski, “Laws of UX using Psychology to Design Better Product & Services” O’Reilly 2021 127

3. Ralf Steinmetz, Klara Nahrstedt, “Multimedia Systems”, Springer IE, 2004.

REFERENCE BOOKS

1. Jenifer Tidwell, Charles Brewer, Aynne Valencia, “Designing Interface” 3 rd Edition , O’Reilly 2020
2. Steve Schoger, Adam Wathan “Refactoring UI”, 2018
3. Steve Krug, “Don't Make Me Think, Revisited: A Commonsense Approach to Web & Mobile”, Third Edition, 2015
4. https://www.nngroup.com/articles/
5. https://www.interaction-design.org/literature.

U19ITOE002	CLOUD COMPUTING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To enrich student learning in multimedia systems.
- To train the students to acquire knowledge in multimedia related technologies.
- To acquire knowledge about multimedia techniques to enhance quality of service.
- To acquire knowledge on multimedia architecture.
- To learn about the multimedia elements in a comprehensive way.

COUUSE OUTCOMES

At the end of the course students should be able to

CO1: Handle the multimedia elements effectively

CO2: Encode and decode the multimedia elements.

CO3: Understand the underlying multimedia computing architectures used for media development.

CO4: Develop effective strategies to deliver Quality-of-Experience in multimedia applications.

CO5: Design and implement algorithms and techniques related to multimedia objects.

CO6: Design and develop multimedia applications in various domains.

Course Articulation Matrix

CO s	PROGRAMME OUTCOMES (POs)												PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	3		3	2	2			3	2		2		3
CO2	3	2	3		3	2	2			3	2		2		3
CO3	3	2	3		3	2	2			3	2		2		3
CO4	3	2	3		3	2	2			3	2		2		3
CO5	3	2	3		3	2	2			3	2		2		3
CO6	3	2	3		3	2	2			3	2		2		3

3 - High, 2 - Medium, 1 – Low

UNIT I INTRODUCTION TO MULTIMEDIA ELEMENTS 9

Multimedia – Medium – Properties of a Multimedia System – Traditional Data Stream Characteristics – Data Stream Characteristics of Continuous Media – Basic Sound Concepts – Speech – Images and Graphics – Computer Image Processing – Video and Animation – Computer Based Animation.

UNIT II MULTIMEDIA COMPRESSION 9

Storage Space – Coding Requirements – Hybrid Coding – JPEG: Image Preparation, Lossy Mode, Lossless Mode, Hierarchical Mode – H.261 – MPEG: Video Encoding, Audio Encoding, Data Stream, MPEG 3, MPEG 7, MPEG 21 – DVI – Audio Encoding

UNIT III MULTIMEDIA ARCHITECTURES 9

User Interfaces – OS multimedia support – Multimedia Extensions – Hardware Support – Distributed multimedia applications – Real time protocols – Play back Architectures – Synchronization – Document and document architecture – Hypermedia concepts – Hypermedia design – Digital copyrights – Digital Library – Multimedia Archives.

UNIT IV MULTIMEDIA OPERATING SYSTEM AND DATABASES 9

Real Time – Resource Management – Process Management – File systems – Interprocess communication and synchronization – Memory management – Device Management – Characteristics of MDBMS – Data Analysis – Data structures – Operations on data – Integration in a database model.

UNIT V MULTIMEDIA COMMUNICATION &APPLICATIONS 9

Tele Services – Implementation of Conversational Services, Messaging Services, Retrieval Services, Tele Action Services, Tele Operation Services – Media Consumption – Media Entertainment – Virtual Reality – Interactive Audio – Interactive Video – Games.

Total: 45 Hours

TEXT BOOKS

1. Ralf Steinmetz, Klara Nahrstedt, “Multimedia computing, communications, and applications”, Pearson India, 2009.
2. Ranjan Parekh, “Principles of Multimedia”, Second Edition, McGraw Hill Education, 2017.
3. Ralf Steinmetz, Klara Nahrstedt, “Multimedia Systems”, Springer IE, 2004. REFERENCE BOOKS
1. Tay Vaughan, “Multimedia: Making it Work”, McGraw – Hill Education, Ninth Edition, 2014.
2. Mark S Drew, Zee Nian Li, “Fundamentals of multimedia”, Prentice Hall, 2006.
3. Jerry D. Gibson, Toby Berger, Tom Lookabaugh, Dave Lindergh, Richard L. “Baker Digital Compression for Multimedia: Principles and Standards”, Elsevier, 2006.

19MEOE001	ENGINEERING DRAWING	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES

- To have the knowledge of interpretation of dimensions of different quadrant projections.
- To understand the basic principles of engineering drawing.
- To have the knowledge of generating the pictorial views

PRE-REQUISITES

Nil

COURSE OUTCOMES

On completion of this course students will be able to

CO1 : Prepare and understand drawings.
CO2 : Identify various D curves used in Engineering Drawing and their applications.
CO3 : Use the principles of orthographic projections.
CO4 : By studying about projections of solids students will be able to visualize three dimensionalobjects and that will enable them to design new products.
CO5 : Design and fabricate surfaces of different shapes.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2		3									3	2	
CO2	3	2		3				2					3	2	
CO3	3	3		3									3	2	
CO4	3	2		3				2					2	2	
CO5	3	2		3									3	2	

3 - High, 2 - Medium, 1 – Low

UNIT I INTRODUCTION TO ENGINEERING DRAWING 12

Principles of engineering graphics and theirsignificance – drawing instruments and their use – conventions in drawing – lettering – bisconventions. Dimensioning rules, geometrical constructioncurves used in engineering practice and their constructions: Conic sections,special curves-cycloids, epicycloids, and hypocycloids.

UNIT II ORTHOGRAPHIC PROJECTION IN FIRST ANGLE PROJECTION ONLY 12

Principles oforthographic projections – conventions – first and third angle projections. Projections of points andlines inclined to both the planes.

UNIT III PROJECTIONS OF PLANES AND SOLIDS 12

Projections of regular planes, inclined to both planes.Projections of regular solids inclined to both planes.

UNIT IV DEVELOPMENT OF SURFACES 12

Development of surfaces of right, regular solids – development ofprisms, cylinders, pyramids, cones and their parts.

UNIT V ISOMETRIC PROJECTIONS 12

Principles of Isometric Projections-Isometric Scale- Isometric Views-Conventions-Plane Figures, Simple and Compound Solids.**TRANSFORMATION OF PROJECTIONS**: Conversion of isometric Views to Orthographic Views.Conversion of orthographic views to isometric projections vice-versa

Total:45 Hours

TEXT BOOKS

1. BasantAgarwal, “Engineering Drawing”, TMH.

2. Jolhe, Dhananjay, “Engineering Drawing: With an Introduction to CAD”, Tata McGrawHill, India. 2006.

REFERENCE BOOKS

1. N. D. Bhat, “Engineering Drawing” Charotar Publications, New Delhi., 2006.
2. Trymbaka Murthy, “Computer Aided Engineering Drawing”, I.K. International Publishers, 2007

U19MEOE002	MODERN MANUFACTURING TECHNIQUES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To understand the various advancements in casting processes
- To learn about the different types of welding techniques.
- To understand the principles and process of forming.
- To understand the significance of different advancements such as CAE in manufacturing.
- To learn about the mechanics of high speed machining.

PRE-REQUISITES

1. Fundamentals of manufacturing processes.

COURSE OUTCOMES

At the end of the course students should have the

CO1 : Use appropriate casting technique to develop a given component
CO2 : Make the right choice of welding technique as per the required application
CO3 : Understand about the different significant factors in forming
CO4 : Formulate real time problems with the help of computer simulation tools
CO5 : Implementing the probable capabilities of artificial intelligence to develop end user products such as robots.

Course Articulation Matrix

	PO 1	PO 2	PO3	PO4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO 12	PSO 1	PSO 3	PSO 3
CO1	1	2		2		2		2		2			2		
CO2				1									1		
CO3		1		2									2		
CO4	1	1		1		1				1			1		
CO5	2			1		1		2					1		

3 - High, 2 - Medium, 1 – Low

UNIT I ADVANCED CASTING PROCESSESES 9

Expendable-Mold - shell mould casting, Vacuum Mould casing, investment casting, plaster-mold and ceramic-mold casting, Permanent-Mold casting processes - squeeze casting and semisolid metal casting, centrifugal casting, uses of Rapid Prototyping to produce pattern, process selection - dimensional tolerances for various casting processes and metals.

UNIT II ADVANCED WELDING PROCESSES 9

Electron beam welding, laser beam welding, Solid-State welding - diffusion welding, friction welding, ultrasonic welding, physics of welding, design considerations in welding, NDT methods for testing.

UNIT III ADVANCED FORMING PROCESSES 9

Material behavior in metal forming, temperature in metal forming, strain rate sensitivity, friction and lubrication in metal forming, bulk deformation processes, sheet metalworking, HERF, hydro forming, explosive forming, magnetic forming process

UNIT IV APPLICATION OF CAE IN MANUFACTURING 9

Need for CAE in manufacturing, simulation of molten metal flow using CAE Techniques, solidification process in casting, inspections of casting. Thermal analysis of Heat-Affected Zone (HAZ), analysis of forging process using CAE, CL data generation for machining process.

UNIT V HIGH-SPEED MACHINING 9

High-Speed machining centers, high-speed spindles, spindle sped, feed rate, cutting velocity, surface finish, selection of process parameters, ultra-high-speed machining centers, hard machining.

Total: 45 Hours

TEXT BOOKS

1. Mikell P Grover “Principles of Modern Manufacturing (SI Version)” John Wiley & Sons, 2014.
2. Paul DeGarmo E, Black J T and Ronald A Kohjer, “Materials and Processes in Manufacturing, John Wiley India, 2011.

REFERENCE BOOKS

1. Philip F Ostwald and Jairo Munoz, “Manufacturing Processes and Systems” John Wiley India, New Delhi, 2013.
2. Kaushish J P, “Manufacturing Processes”, Prentice Hall India, 2013.
3. Sanjay K Mazumdar, “Composite Manufacturing: Materials, Product and Process Engineering”, CRC Press, 2010.

U19PHOE001 **NANOTECHNOLOGY AND ENGINEERING APPLICATIONS**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To introduce the concept of nanotechnology and understand the importance of nanotechnology
- To give deep insight into fabrication and characterization techniques for nanostructures
- To provide an overview of the wide applications of nanotechnology in various technological fields.

PRE-REQUISITES: As a prerequisite for this course Nanotechnology and Engineering Applications, knowledge in Engineering Physics and Applied Physics is essentially required.

COURSE OUTCOMES

At the end of the course, students should be able to

CO1 Understand the basic concepts of nanotechnology

CO2 Gain basic knowledge on various synthesis and techniques involved in preparation of nanomaterials

CO3 Understand the general types and different classes of Nanomaterials

CO4 Apply the knowledge on different properties of Nanomaterials and selection of material for the specific purpose of application.

CO5 Understand and apply the knowledge of different characterization tools and characterization of Nanomaterials

CO6 Apply the basic knowledge about the wide applications of nanotechnology in various technological fields.

Course Articulation Matrix

Cos	PROGRAMME OUTCOMES (POs)												PSOs			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3	PSO4
CO1	3	3														
CO2	3	3														
CO3	3	3														
CO4	3	3														
CO5	3	3														
CO6	3	3														

3 - High, 2 - Medium, 1 – Low

THEORY COMPONENT CONTENTS

UNIT I INTRODUCTION AND SYNTHESIS OF NANOMATERIALS **9**

Introduction to nanotechnology –definition, invention, building blocks of nanotechnology, chemical bonds - Van der Waals Interactions, Dipole-Dipole interactions, Microstructure and Defects in Nanocrystalline Materials – dislocations, twins, stacking points and voids; grain boundaries, triple junctions and disclinations.

Synthesis of nanomaterials**:** Bottom – Up Approaches: physical vapour deposition (PVD), chemical vapour deposition (CVD), spray pyrolysis. Top- Down Approaches: Mechanical alloying, high pressure torsion (HPT)

UNIT II TYPES OF NANOMATERIALS **9**

Carbon Nanotubes (CNT): Introduction, classification of CNT'S, synthesis and physical properties of CNT (Electrical, Transport, Mechanical), applications.

Fullerenes: Introduction, synthesis and purification, physical properties, applications. Semiconductor Quantum dots: Introduction, synthesis of Quantum dots, physical and chemical properties, applications.

Nanocomposites: Introduction, synthesis and processing of Inorganic nanotubes and polymeric nanocomposites, applications.

Nanowires: Introduction, physical properties of nanowires – (structural, Optical, Chemical), Applications.

UNIT III PROPERTIES OF NANOMATERIALS **9**

Mechanical Properties: Introduction, Grain Size Effect, Creep, Hardness, Fracture Strength, Strengthening and Toughening Mechanisms, Crack Healing (Annealing Treatment). [From Advanced nanomaterials by Hofman, Powder Technology Laboratory, IMX, EPFL, Version 1 Sept 2009].

Electrical and Optical properties: Electrical conduction and tunnelling conduction in nanoparticles, electronic conduction with nanoparticles (AC Conductivity & DC Conductivity).

Optical properties: Transmission, Absorption, Reflection in nanoparticles, optical constants (Absorption coefficient, extinction coefficient and Refractive index).

UNIT IV CHARACTERIZATION TOOLS 9

XRD (X-Ray diffraction), SAXS (Small Angle X-ray Emission Spectroscopy), SEM (Scanning Electron Microscopy), TEM (Transmission Electron Microscopy), STM (Scanning Tunnelling Microscopy), AFM (Atomic Force Microscopy).

UNIT V APPLICATIONS OF NANOTECHNOLOGY 9

Electrical and electronic applications: MEMS (Micro Electro Mechanical Systems), NEMS (Nano Electro Mechanical Systems), Nanosensors, nanolithography.

Nanotechnology for Renewable Energy: Hydrogen energy, fuel cell technology, wind and solar energy. Nanotechnology for information technology and Data Storage applications.

Total:45 Hours

TEXT BOOKS

1. Köhler, Michael, and Wolfgang Fritzsche. Nanotechnology - An Introduction to Nanostructuring Techniques 2nd ed. Wiley.
2. T. Pradeep, Nano: The Essentials – Understanding Nano Science and Nano Technology, McGraw-Hill
3. K. Bandyopadhyay, Nano Materials, New Age International Publishers.
4. M. H. Fulekar, Nanotechnology - Importance and applications. I.K. International publishing house pvt. Ltd

REFERENCE BOOKS

1. B.S. Murty, P. Shankar, Baldev Raj, James Murday, Textbook of Nanoscience and Nanotechnology, Springer Berlin Heidelberg
2. B. Bhushan, Springer Handbook of Nano Technology

U19ENOE01 **ENGLISH for COMPETITIVE EXAMS**

L	T	P	C
3	0	0	3

Course Objectives

- To prepare learners to face the challenges of regular/online competitive exams I the English language globally.
- To enable students to prepare for competitive exams of various kinds especially meant for testing ability in the English language.
- To introduce students to the common question types asked in competitive examinations concerning English- grammar, vocabulary, comprehension, and other significant topics.
- To help the students to overcome the fear of English as a compulsory subject in various competitive exams.
- To encourage students to appear and prepare for the competitive exams.

Course Outcomes

At the end of the course, students should be able to,

CO1: Confidently use the English language at an advanced level sharing their points of view with effective conclusions.

CO2: Construct correct sentences with the advanced vocabulary of the fields like Banking, Indian polity, Education, Corporate, etc.

CO3: Read accurately using contextual, analytical thinking and logical thinking skills

CO4: Aware of the opportunities available in the government and private sectors

CO5: Demonstrate excellent Time Management skills with regard to various competitive exam patterns

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			2
2								1	2	3		2			2
3						2		2	3	3		2			2
4							3	2	1	3		3			3
5						3	3	3	3	3		3			3

3 - High, 2 - Medium, 1 – Low

UNIT I **9**

TypesofSentences - Sentencecorrection -Sentencesequence –Word Reordering - Data Interpretation: Tree Diagram, Flow Chart, Table, Line Graph – Discourse Markers – Identifying the exams interested to appear for - Online Course: Udemy, Edx, Future Learn

UNIT II **9**

Reading Comprehension: Focus on different levels of Comprehension- Literal, Inferential, Analytical, and Critical reasoning – Identifying keywords and signal words, decoding the building blocks of a passage, understanding the jargon and double distractors – Error Spotting Rules - IdentificationCommonErrors

UNIT III **9**

Listening Comprehension: Micro skills and Macro skills of Listening – Idioms and Phrases- Homonyms and Homophones – Collocations- Synonyms and Antonyms: Banking, Indian Constitution, Education, Corporate, and Higher Education - Para jumbles

UNIT IV **9**

Speaking: Presentation and Public: Record of videos – Verbal Ability; Sentence Completion, and Verbal analogies –Confirmation of registering for competitive exams

UNIT V 9

Industry Psychology: Characteristics of the workplace: Physical working conditions: Noise, Illumination, Colour, Music, Miscellaneous Factors; Work Schedules: Working Hours, Permanent Part-Time Employment, Flexible Work Schedules; Psychological and Social Issues - Stress management – Time management

TOTAL: 45 HOURS

TEXT BOOKS

1. Richards, C. Jack. Interchange Students Book-3 New Delhi: CUP, 2015.
2. Means,L. Thomas and Elaine Langlois. English and Communication For Colleges. Cengage Learning, USA: 2007.
3. The Official Guide to the GRE General Test, Third Edition (TEST PREP)by Educational Testing Service | 16 February 2017
4. The Yearly Current Affairs 2022 for Competitive Exams (Upsc, State Psc, Ssc, Bank Po/ Clerk, Bba, MBA, Rrb, Nda, Cds, Capf, Crpf), Disha Publication, Genre: General, ISBN: 9789355640888

REFERENCES

1. Brians, Paul. (2013). Common errors in English usage: Third edition. Wilsonville:Franklin,Beedle& AssociatesInc
2. Harrison, Louis. (2009). Achieve IELTS grammar and vocabulary: English forinternationaleducation. London: Cengage LearningEMEA.
3. Khashoggi, K.,&Astuni.A. (2014)SATreadingcomprehension workbook:Advancedpracticeseries. New York:IlexPublications.
4. Prasad, Hari Mohan.(2013). Objective English for competitive exams.New Delhi:TataMcGraw-Hill EducationIndia.
5. Seely, John. (2013). Oxford guide to effective writing and speaking: How tocommunicateclearly. Oxford: Oxford UniversityPress.

WEB RESOURCES

1. https://www.edubull.com/exams/competitive-exams
2. https://sscstudy.com/
3. https://examsdaily.in/important-study-materials-pdf
4. http://www.recruitmenttopper.com/study-material-for-all-competitive-exams/

OPEN ELECTIVE II

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	U19AEOE003	Introduction to Bio-Energy	OE	4	3	0	0	3
2.	U19AEOE004	Robotics in Agriculture	OE	4	3	0	0	3
3.	U19BMOE003	Hospital Management System	OE	4	3	0	0	3
4.	U19BMOE004	Biomedical Instrumentation	OE	4	3	0	0	3
5.	U19BTOE003	Analytical methods and Instrumentation	OE	4	3	0	0	3
6.	U19BTOE004	Industrial Waste management	OE	4	3	0	0	3
7.	U19CEOE003	Remote Sensing and GIS	OE	4	3	0	0	3
8.	U19CEOE004	Air Pollution And Control Engineering	OE	4	3	0	0	3
9.	U19EDOE002	Innovation And Entrepreneurship	OE	4	3	0	0	3
10.	U19CSOE003	Data Structures and Algorithms	OE	4	3	0	0	3
11.	U19ECOE001	Soft Computing	OE	4	3	0	0	3
12.	U19ECOE004	Advanced Wireless Communication	OE	4	3	0	0	3
13.	U19EEOE003	Sensors and Transducers	OE	4	3	0	0	3
14.	U19EEOE004	Energy Technology	OE	4	3	0	0	3
15.	U19FTOE003	Beverage Technology	OE	4	3	0	0	3
16.	U19FTOE004	Processing of Food Materials	OE	4	3	0	0	3
17.	U19ITOE003	Foundation Of Information Technology	OE	4	3	0	0	3
18.	U19ITOE004	Web design and Management	OE	4	3	0	0	3
19.	U19MEOE003	Automobile Technology	OE	4	3	0	0	3
20.	U19MEOE004	CAD/CAM	OE	4	3	0	0	3
21.	U19PHOE002	Thin film Technology and Applications	OE	4	3	0	0	3
22.	U19ENOE02	English for Employability Skills	OE	4	3	0	0	3

OPEN ELECTIVE II

U19AEOE003 **INTRODUCTION TO BIO-ENERGY**

L	T	P	C
3	0	0	3

Course Objectives

To introduce to the students the concepts of bio energy resources

· To expose the students to types of energy resources

· To enhance knowledge on estimation of bio energy plants.

· To expose the students to bio fuel production.

Course Outcomes

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

CO1. Understanding the importance of bio resources .

CO2. Ability to classify the bio energy and characteristics of bio energy.

CO3. Knowledge in bio reactors and fermentors.

CO4. Ability to gain knowledge in Alcohol production process

CO5. Understanding the importance of Energy and Environment

CO6. Knowledge in capturing and applying bioenergy on replacement of fossil fuels.

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	2	3
2	3	2				2	2						3	3	3
3	3	2				2	2						2	2	3
4	3	2				2	2						2	2	3
5	3	2				2	2						3	3	3
6	3	2				2	2						2	2	3

3 - High, 2 - Medium, 1 – Low

UNIT I BIO RESOURCE - AN INTRODUCTION **9**

Bio resource – origin – biomass types and characteristics- biomass conversion technology- Biodegradation - steps in biogas production- parameters affecting gas production- Types of biogas plants- Construction details- operation and maintenance.

UNIT II BIO ENERGY **9**

Slurry handling- enrichment and utilization – Biogas appliances- Biochemical characteristics of bio resources- Bioenergetics –Biocatalysis –Kinetics of product formation.

UNIT III BIO REACTORS AND FERMENTORS **9**

Bio reactors/ fermentors – Batch type – continuous stirred tank reactors- Biological waste water treatment- Activated sludge process- Down stream processing-Recovery and purification of products.

UNIT IV ALCOHOL PRODUCTION **9**

Alcohol ethanol production - Acid hydrolysis - enzyme hydrolysis-Methanol synthesis - Antibiotics- enzymes- principles of thermochemical conversion – combustion - pyrolysis- Gasification – types of gasifiers

UNIT V ENERGY AND ENVIRONMENT **9**

Principles of operation- chemical reaction- cleaning and cooling - Utilization- Improved wood burning stove - Energy plantations- Biomass briquetting - co generation- Impact on Environment – Bioenergy policy.

TOTAL: 45 HOURS

TEXT BOOKS

1. Rai G.D,Non conventional sources of Energy, Khanna publishers, New Delhi, 1995.
2. Bouley James .E & David Follis - Biochemical Engineering Fundamentals McGraw-Hill publishing company, Tokyo.1986

REFERENCES

1. Chawla O.P, Advances in Biogas Technology ICAR publication New Delhi 1986
2. Khandelwal K.C. and Mahdi, S.S. 1986. Biogas Technology. Tata Mc Graw Hill Pub. Co. Ltd., New Delhi.
3. Srivastava, P.K., Shukla, B.D. and Ojha, T.P. 1993. Technology and application of biogas. Jain Brothers, New Delhi.
4. Mathur,A.N.and Rathore,N.S.1993.,Biogas production Management and Utilisation. Himanshu Publication. New Delhi

U19AEOE004 **ROBOTICS IN AGRICULTURE** **L T P C**
3 0 0 3

Course Objectives

To introduce to the students the concepts of bio energy resources

- To introduce the overview of robotic systems and their dynamics
- To impart knowledge on system stability
- To acquire knowledge on joint space and task space control schemes
- To understand the concept of nonlinear control and observer schemes

Course Outcomes

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

CO1. Understand basic concept of robotic systems and their dynamics.

CO2. Analyze system stability and types of stability

CO3. Know about joint space and task space control schemes

CO4. Understand the concept of nonlinear control and observer schemes

CO5. Gain knowledege on farm management and financial analysis

CO6. Familiarize with budgeting and cost estimation for farm layout

Course Articulation Matrix

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

3 - High, 2 - Medium, 1 – Low

UNIT I INTRODUCTION AND OVERVIEW OF ROBOTIC SYSTEMS AND THEIR DYNAMICS 10

Forward and inverse dynamics. Properties of the dynamic model and case studies. Introduction to nonlinear systems and control schemes.

UNIT II SYSTEM STABILITY AND TYPES OF STABILITY 8

Lyapunov stability analysis, both direct and indirect methods. Lemmas and theorems related to stability analysis.

UNIT III JOINT SPACE AND TASK SPACE CONTROL SCHEMES 10

Position control, velocity control, trajectory control and force control.

UNIT IV NONLINEAR CONTROL SCHEMES 9

Proportional and derivative control with gravity compensation, computed torque control, sliding mode control, adaptive control, observer based control, robust control and optimal control

UNIT V NONLINEAR OBSERVER SCHEMES 8

Design based on acceleration, velocity and position feedback. Numerical simulations using software packages namely MATLAB/MATHEMATICA.

TOTAL: 45 HOURS

TEXT BOOKS

1. R Kelly, D. Santibanez, LP Victor and Julio Antonio, —Control of Robot Manipulators in Joint Space‖, Springer, 2005.
2. A Sabanovic and K Ohnishi, —Motion Control Systems‖, John Wiley & Sons (Asia), 2011

REFERENCES

1. R M Murray, Z. Li and SS Sastry, —A Mathematical Introduction to Robotic Manipulation‖, CRC Press, 1994.
2. J J Craig, —Introduction to Robotics: Mechanics and Control, Prentice Hall, 4th Ed, 2018.

U19BMOE003 **HOSPITAL MANAGEMENT SYSTEM**

L	T	P	C
3	0	0	3

Course Objectives

The student should be made:

- To understand the fundamentals of hospital administration and management.
- To know the market related research process
- To explore various information management systems and relative supportive services.
- To learn the quality and safety aspects in hospital.

Course Outcomes

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

CO1: Explain the principles of Hospital administration.

CO2: Identify the importance of Human resource management.

CO3:List various marketing research techniques.

CO4: Identify Information management systems and its uses.

CO5: Understand safety procedures followed in hospitals

C06: Analyze the quality and safety aspects in hospital.

Course Articulation Matrix

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

3 - High, 2 - Medium, 1 – Low

UNIT I OVERVIEW OF HOSPITAL ADMINISTRATION 9

Distinction between Hospital and Industry, Challenges in Hospital Administration – Hospital Planning- Equipment Planning – Functional Planning - Current Issues in Hospital Management – Telemedicine - Bio-Medical Waste Management.

UNIT II HUMAN RESOURCE MANAGEMENT IN HOSPITAL 9

Principles of HRM – Functions of HRM – Profile of HRD Manager – Tools of HRD –Human Resource Inventory – Manpower Planning. Different Departments of Hospital, Recruitment, Selection, Training Guidelines – Methods of Training – Evaluation of Training – Leadership grooming and Training, Promotion – Transfer, Communication – nature, scope, barriers, styles and modes of communication.

UNIT III MARKETING RESEARCH PROCESS 9

Marketing information systems - assessing information needs, developing & disseminating information - Market Research process - Other market research considerations – Consumer Markets & Consumer Buyer Behaviour - Model of consumer behaviour - The buyer decision process - Model of business buyer behavior – Major types of buying situations - WTO and its implications.

UNIT IV HOSPITAL INFORMATION SYSTEMS & SUPPORTIVE SERVICES 9

Management Decisions and Related Information Requirement - Clinical Information Systems - Administrative Information Systems - Support Service Technical Information Systems – Medical Transcription, Medical Records Department – Central Sterilization and Supply Department –Pharmacy– Food Services - Laundry Services.

UNIT V QUALITY AND SAFETY ASPECTS IN HOSPITAL 9

Quality system – Elements, implementation of quality system, Documentation, Quality auditing, International Standards ISO 9000 – 9004 – Features of ISO 9001 – ISO 14000 – Environment Management Systems. NABA, JCI, NABL. Security – Loss Prevention – Fire Safety – Alarm System – Safety Rules. Health

Insurance & Managing Health Care – Medical Audit – Hazard and Safety in a hospital Setup.

TOTAL: 45 HOURS

TEXT BOOKS

1. R.C.Goyal, —Hospital Administration and Human Resource Management‖, PHI – Fourth Edition, 2006.
2. G.D.Kunders, —Hospitals – Facilities Planning and Management – TMH, New Delhi – Fifth Reprint 2007.

REFERENCES

1. Cesar A.Caceres and Albert Zara, —The Practice of Clinical Engineering, Academic Press, New York, 1977.
2. Norman Metzger, —Handbook of Health Care Human Resources Management‖, 2nd edition Aspen Publication Inc. Rockville, Maryland, USA, 1990.
3. Peter Berman —Health Sector Reform in Developing Countries‖ - Harvard University Press, 1995.
4. William A. Reinke —Health Planning For Effective Management‖ - Oxford University Press.1988
5. Blane, David, Brunner, —Health and SOCIAL Organization: Towards a Health Policy for the 21st Century‖, Eric Calrendon Press 2002.
6. Arnold D. Kalcizony & Stephen M. Shortell, —Health Care Management‖, 6th Edition Cengage Learning, 2011.

U19BMOE004 **BIOMEDICAL INSTRUMENTATION** **L T P C**
3 0 0 3

Course Objectives

The student should be made:

• To impart knowledge of the principle of operation and design of sensory equipment's.

• To render a broad and modern account of neurological, muscular, cardiological and respiratory instruments.

• To introduce idea about instrumentation in patient care and diagnosis.

Course Outcomes

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

CO1: Demonstrate the principle of operation and design of sensory equipments

CO2: Determine the basic parameters of the equipment used in patientdiagnosis

CO3: Analyze the broad and modern account of neurological equipments.

CO4: Illustrate the principle and working of muscular and respiratory instruments

CO5: Render a broad and modern account of neurological, muscular, cardiological and respiratory instruments..

CO6: Gain idea about instrumentation in patient care and diagnosis.

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	3	3	
2	2	2	2	2	2	2					2	2	3	3	
3	3	3	2	3	2	1					2	2	2	2	
4	3	3	3	2	2	2					2	2	2	2	
5	2	2	2	3	2	1					2	2	2	2	
6	2	2	2	2	2	1					2	2	2	2	

3 - High, 2 - Medium, 1 – Low

UNIT I RECORDING OF BIOSIGNALS **9**

Biosignals characteristics – frequency and amplitude ranges. ECG – Einthoven's triangle, Lead configuration, 12 lead ECG machine circuit, common mode and interference reduction circuits, Vector cardiograph EEG – 10-20 electrode system. EMG– Recording, Electro encephalogram, Magneto encephalogram, EOG & ERG: origin, measurement of EOG, electroretinogram

UNIT II SENSORY INSTRUMENTATION **9**

Psychophysiological Measurements – polygraph, basal skin resistance (BSR), galvanic skin resistance (GSR), Sensory responses - Audiometer-Pure tone, Hearing and speech aids: conductive and nervous, hearing aids-Types, constructional and functional characteristics. Cochlear implants- Need, constructional details, speech trainer.

UNIT III CARDIAC EQUIPMENTS **9**

Normal and abnormal ECG waveform, diagnosis interpretation, cardiac pacemaker-external pacemaker, implantable pacemaker, different types of pacemakers, fibrillation, defibrillator, AC defibrillator, DC defibrillator, electrodes, synchronised and unsynchronised types. EEG diagnostic interpretation, recording and analysis of EMG waveforms.

UNIT IV RESPIRATORY MEASUREMENT SYSTEM **9**

Instrumentation for measuring the mechanics of breathing – Spirometer -Lung Volume and vital capacity, measurements of residual volume, Pneumotachometer – Airway resistance measurement, Whole body Plethysmograph, Intra-Alveolar and Thoracic pressure measurements, Apnoea Monitor. Types of Ventilators – Pressure, Volume, and Time controlled. Flow, Patient Cycle Ventilators, Humidifiers, Nebulizers, Inhalators.

UNIT V ADVANCED DEVICES **9**

Cardiac pacemakers and modern stimulators, Hemodyalysis ventilators, incubators, drug delivery devices,

surgical instruments, Therapeutic application of laser, Neonatal Monitoring.

TOTAL: 45 HOURS

TEXT BOOKS

1. SiamakNajarian, Javad Dargahi, Ali Abouei Mehrizi, - Artificial Tactile Sensing in Biomedical Engineering‖, McGraw Hill publication,2009
2. Martin Grunwald, - Human HapticPerception‖, Birkhaeuser Verlag AG, Boston Basel Berlin publication,2008

REFERENCES

1. Abdulmotaleb El Saddik, Mauricio Orozco, Mohamad Eid, Jongeun Chapaptics Technologies: Bringing touch to multimedia‖, Springer,2011
2. MyerKutz.,- Biomedical Engineering and Design Handbook, Vol2,McGrawHill

U19BTOE003 **ANALYTICAL METHODS AND INSTRUMENTATION**

L	T	P	C
3	0	0	3

Course Objectives

- To inculcate the entrepreneurship spark among the student community by converting their research ideas into commercial products
- To develop the entrepreneurial skill in the field of biotechnology
- To study the Business strategy and Technology Transfer

Course Outcomes

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

CO1. Learn the different bio potential and its propagation.

CO2. get Familiarize the different electrode placement for various physiological recording

CO3. design bio amplifier for various physiological recording

CO4. understand various technique non electrical physiological measurements

CO5. Understand the different biochemical measurements

CO6. Characterize and analyze various macromolecules

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 **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 – signal to noise ratio – sources of noise – Enhancement of signal to noise – types of optical instruments – Applications.

UNIT II **MOLECULAR SPECTROSCOPY** **9**

Molecular absorption spectrometry – Measurement of Transmittance and Absorbance – Beers law – Instrumentation – Applications -Theory of fluorescence and Phosphorescence – Instrumentation – Applications – Theory of Infrared absorption spectrometry – IR instrumentation – Applications -Theory of Raman spectroscopy – Instrumentation – applications.

UNIT III **NMR AND MASS SPECTROMETRY** **9**

Theory of NMR — chemical shift- NMR-spectrometers – applications of 1H and 13C NMR-Molecular mass spectra – ion sources. Mass spectrometer. Applications of molecular mass -Electron paramagnetic resonance- g values – instrumentation.

UNIT IV **SEPARATION METHODS** **9**

General description of chromatography – Band broadening and optimization of column performance- Liquid chromatography – Partition chromatography – Adsorption chromatography – Ion exchange chromatography -size exclusion chromatography- Affinity chromatography principles of GC and applications – HPLC- Capillary electrophoresis – Applications.

UNIT V **ELECTRO ANALYSIS AND SURFAVE MICROSCOPY** **9**

Electrochemical cells- Electrode potential cell potentials – potentiometry- reference electrode – ion selective and molecular selective electrodes – Instrument for potentiometric studies – Voltametry -Cyclic and pulse voltametry- Applications of voltametry . Study of surfaces – Scanning probe microscopes – AFM and STM.

TOTAL: 45 HOURS

TEXT BOOKS:

1. Skoog, D.A. F. James Holler, and Stanky, R.Crouch Instrumental Methods of Analysis.Cengage Learnir , 2007
2. Willard, Hobart, etal., Instrumental Methods of Analysis. VIIth Edition, CBS, 1986
3. Haven, Mary C., etal., Laboratory Instrumentation .IVth Edition, John Wiley, 1995.

U19BTOE004 **INDUSTRIAL WASTE MANAGEMENT**

L	T	P	C
3	0	0	3

Course Objectives

- To emphasize on the importance of waste management in the industries

Course Outcomes

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

- CO1. This course will make the students to design biological treatment units
- CO2. To undertake projects on biological wastewater treatment
- CO3. To design the treatment plants with fundamental understanding
- CO4. Be familiar with sampling of wastes.
- CO5. The students will undertake projects related to waste management.
- CO6. Understand various case studies related to waste management

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	2													
3	3	3	3	2	2	2		1	3					2	
4	3	1	1			1		1						1	
5	3	3	2	1	2			1						1	
6	3	3	2	1	2			1						1	

3 - High, 2 - Medium, 1 – Low

UNIT I INTRODUCTION TO WASTE MANAGEMENT **9**

Types of industries and industrial pollution – Characteristics of industrial wastes – Population equivalent – Bioassay studies – effects of industrial effluents on streams, sewer, land, sewage treatment plants and human health Environmental legislations related to prevention and control of industrial effluents and hazardous wastes.

UNIT II CLEANER PRODUCTION **9**

Waste management Approach – Waste Audit – Volume and strength reduction – Material and process modifications – Recycle, reuse and byproduct recovery – Applications.

UNIT III POLLUTION FROM MAJOR INDUSTRIES **9**

Sources, Characteristics, waste treatment flow sheets for selected industries such as Textiles, Tanneries, Pharmaceuticals, Electroplating industries, Dairy, Sugar, Paper, distilleries, Steel plants, Refineries, fertilizer, thermal power plants – Wastewater reclamation concepts

UNIT IV REACTORS USED IN WASTE WATER TREATMENT **9**

Theory: Modeling of Ideal Attached Growth Reactors, Bio-film Modeling Aerobic Growth of Biomass in PackedTowers, Aerobic Growth of Heterotrophs in Rotating Disc Reactors, Fluidized Bed Biological Reactors.

UNIT V CASE STUDIES **9**

Industrial manufacturing process description, Wastewater characteristics, Pollution Prevention Options and Treatment Flow sheets for selected Industries – Tanneries- Textiles- Pulp and PaperMetal finishing – Sugar and Distilleries.

TOTAL: 45 HOURS

TEXT BOOKS

1. Bhatia, Handbook of Industrial Pollution and Control, Volume I and II, CBS Publishers, New Delhi, 2003
2. Mahajan, S.P.Pollution Control in Process Industries, Tata McGraw Hill Publishing Co., New Delhi, 1991.

U19CEOE003 **REMOTE SENSING AND GIS**

L	T	P	C
3	0	0	3

Course Objectives

This course aims to provide the students,

- Understanding about the basic concepts of remote sensing and analyse satellite imagery and extract the required units.
- Usage of thematic maps for various application.

Course Outcomes

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

CO1 : Analyse the principles and components of photogrammetry and remote sensing.

CO2 : Gain knowledge on various types of sensors and platforms for satellites.

CO3 : Process of data acquisition of satellite images and their characteristics

CO4 : Analyse an image visually and digitally with digital image processing techniques.

CO5 : Explain the concepts and fundamentals of GIS.

CO6 : Apply the knowledge of remote sensing and GIS in different civil engineering filed.

Course Articulation Matrix

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

3 - High, 2 - Medium, 1 – Low

UNIT I REMOTE SENSING **9**

Basic concept of Remote sensing, Data and Information, Remote sensing data collection, Remote sensing advantages & Limitations, Remote Sensing process. Electromagnetic Spectrum, Energy interactions with atmosphere and with earth surface features (soil, water, and vegetation), Resolution, image registration and Image and False colour composite, elements of visual interpretation techniques.

UNIT II REMOTE SENSING PLATFORMS AND SENSORS **9**

Indian Satellites and Sensors characteristics, Remote Sensing Platforms, Sensors and Properties of Digital Data, Data Formats: Introduction, platforms – IRS, sensors, sensor resolutions, Basics of digital image processing - introduction to digital data, systematic errors and non-systematic errors, Image enhancements, image filtering.

UNIT III GEOGRAPHIC INFORMATION SYSTEM **9**

Introduction to GIS; components of a GIS; Geographically Referenced Data, Spatial Data- Attribute Data - Joining Spatial and attribute data, GIS Operations: Spatial Data Input – Attribute data Management, Geographic coordinate System, Datum; Map Projections: Types of Map Projections, Projected coordinate Systems. UTM Zones.

UNIT IV DATA MODELS **9**

Vector data model: Representation of simple features – Topology and its importance; coverage and its data structure, Shape file; Relational Database, Raster Data Model: Elements of the Raster data model, Types of Raster Data, Raster Data Structure, Data conversion.

UNIT V INTEGRATED APPLICATIONS OF REMOTE SENSING AND GIS **9**

Applications in land use land cover analysis, change detection, water resources, urban planning, environmental planning, Natural resource management and Traffic management. Location Based Services and Its Applications.

TOTAL: 45 HOURS

TEXT BOOKS

1. Anji Reddy M., “Remote sensing and Geographical information system”, B.S. Publications 2008
2. Narayan Panigrahi, “Geographical Information Science”, and University Press 2008.
3. Basudeb Bhatta, “Remote sensing and GIS”, Oxford University Press 2011

REFERENCES

1. Chor Pang Lo and Albert K.W Yeung, “Concepts & Techniques of GIS”, PHI, 2006
2. Peter A. Burrough, Rachael A. McDonnell, and Christopher D. Lloyd, “Principals of Geo physical Information system”, Oxford Publications 2004.
3. S Kumar, “Basics of remote sensing & GIS”, Laxmi publications 2005.

U19CEOE004	AIR POLLUTION AND CONTROL ENGINEEIRNG	L	T	P	C
		3	0	0	3

Course Objectives

This course aims to provide the students,

- Knowledge on the principle and design of control of Indoor/ particulate / gaseous air pollutant and its emerging trends.

Course Outcomes

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

CO1 : Understanding of the nature and characteristics of air pollutants and basic concepts of air quality management.

CO2 : Understand the type and nature of air pollutants, the behaviour of plumes and relevant meteorological determinants influencing the dispersion of air pollutants.

CO3 : Ability to identify, formulate and solve air and noise pollution problems.

CO4 : Ability to design stacks and particulate air pollution control devices to meet applicable standards.

CO5 : Ability to select control equipment's.

CO6 : Ability to ensure quality, control and preventive measures

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	3	3	-	1	-	-	3	2	-	1
2	3	2	2	-	3	1	3	-	-	-	-	2	2	1	1
3	2	3	2	-	-	3	3	-	-	-	-	2	3	1	-
4	2	2	-	-	-	3	3	-	1	-	-	2	3	1	1
5	1	1	-	-	3	3	3	-	1	-	-	1	2	-	-
6	2	2	-	-	3	3	3	-	-	-	-	2	3	-	1

3 - High, 2 - Medium, 1 – Low

UNIT I INTRODUCTION **9**

Structure and composition of Atmosphere – Definition, Scope and Scales of Air Pollution – Sources and classification of air pollutants and their effect on human health, vegetation, animals, property, aesthetic value and visibility- Ambient Air Quality and Emission standards

UNIT II METEROLOGY **9**

Effects of meteorology on Air Pollution - Fundamentals, Atmospheric stability, Inversion, Wind profiles and stack plume patterns - Atmospheric Diffusion Theories – Dispersion models, Plume rise

UNIT III CONTROL OF PARTICULATE CONTAMINANTS **9**

Factors affecting Selection of Control Equipment – Gas Particle Interaction – Working principle - Gravity Separators, Centrifugal separators Fabric filters, Particulate Scrubbers, Electrostatic Precipitators.

UNIT IV CONTROL OF GASEOUS CONTAMINANTS **9**

Factors affecting Selection of Control Equipment – Working principle - absorption, Adsorption, condensation, Incineration, Bio filters – Process control and Monitoring.

UNIT V INDOOR AIR QAULITY MANAGEMENT **9**

Sources, types and control of indoor air pollutants, sick building syndrome and building related illness Sources and Effects of Noise Pollution – Measurement – Standards –Control and Preventive measures.

TOTAL: 45 HOURS

TEXT BOOKS

1. Lawrence K. Wang, Norman C. Pareira, Yung Tse Hung, "Air Pollution Control Engineering", Tokyo, springer science media LLC,2004.
2. Noel de Nevers, "Air Pollution Control Engineering", Waveland press, Inc 2017.
3. Anjaneyulu. Y, "Air Pollution and Control Technologies", Allied Publishers (P) Ltd., India 2002.

REFERENCES

1. David H.F. Liu, Bela G. Liptak, “Air Pollution”, Lweis Publishers, 2000.
2. Arthur C. Stern, “Air Pollution (Vol. I – Vol. VIII)”, Academic Press, 2006.
3. Wayne T. Davis, “Air Pollution Engineering Manual”, John Wiley & Sons, Inc, 2000.

U19EDOE002 **INNOVATION AND ENTREPRENEURSHIP**

L	T	P	C
3	0	0	3

Course Objectives

This course aims to provide the students,

- Understanding the scope of Entrepreneur.
- Knowledge about key area of innovation and Development.
- Knowledge about the financial assistance provided by central government and State government.
- Ability to create their own business model.

Course Outcomes

At the end of the course, students should be able to,

CO1: Generate innovative ideas based on real time scenario.

CO2: Scale up a enterprise.

CO3: Understand the registration process and funding supports.

CO4: Create value proposition and business pitching.

CO5: Enable proper decision making and market fit.

CO6: Advance skills in customer development, validation, competitive analysis in real world problems and projects.

Course Articulation Matrix

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

3 - High, 2 - Medium, 1 – Low

UNIT I INTRODUCTION TO ENTREPRENEURSHIP **9**

Entrepreneurship and Entrepreneurs - Entrepreneurial Personality and Intentions - Characteristics, Traits and Behavioural Entrepreneurial Challenges.

UNIT II ENTREPRENEURIAL OPPORTUNITIES **9**

Opportunities-Idea Generation - Discovery/ Creation - Pattern Identification and Recognition for Venture Creation: Prototype and Exemplar Model - Reverse Engineering

UNIT III ENTREPRENEURIAL PROCESS AND DECISION MAKING **9**

Entrepreneurial Ecosystem, Ideation - Development and Exploitation of Opportunities – Negotiation Decision m aking Process and Approaches - Effectuation and Causation.

UNIT IV CRAFTING BUSINESS MODELS AND LEAN START-UPS **9**

Introduction to Business Models - Creating Value Propositions - Conventional Industry Logic - Value InnovationLogic - Customer Focused Innovation - Building and Analyzing Business Models - Business Model Canvas - Introduction to Lean Startups - Business Pitching

UNIT V ORGANIZING BUSINESS AND ENTREPRENEURIAL FINANCE **9**

Forms Of Business Organizations - Organizational Structures - Evolution of Organization - Sources and Selection of Venture Finance Options and its Managerial Implications - Policy Initiatives and Focus - Funding Support - Roles and Responsibilities in Promoting Entrepreneurship

TOTAL: 45 HOURS

TEXT BOOKS

1. S.S. Khanka “Entrepreneurial Development” S.Chand & Co. Ltd. Ram Nagar New Delhi, 1999.
2. Kuratko & Hodgetts, “Entrepreneurship – Theory, process and practices”, Thomson learning 6th edition.

REFERENCES

1. Hisrich R D and Peters M P, “Entrepreneurship” 5th Edition Tata McGraw-Hill, 2002.
2. Mathew J Manimala,” Entrepreneurship theory at crossroads: paradigms and praxis” Dream tech 2nd edition 2006.
3. Rabindra N. Kanungo “Entrepreneurship and innovation”, Sage Publications, New Delhi, 1998.
4. EDII “Faulty and External Experts – A HandBook for New Entrepreneurs Publishers: Entrepreneurship Development” Institute of India, Ahmadabad, 1986.

U19CSOE003 **DATA STRUCTURES AND ALGORITHMS**

L	T	P	C
3	0	0	3

Course Objectives

This course aims to provide the students,

- Understand the various algorithm design and analysis techniques
- To learn linear data structures – lists, stacks, and queues
- To learn different sorting and searching algorithms
- To understand Tree and Graph data structures

Course Outcomes

At the end of the course, students should be able to,

CO1: Define data structures like array, stack, queues and linked list.
CO2: Explain insertion, deletion and traversing operations on data structures.
CO3: Identify the asymptotic notations to find the complexity of an algorithm.
CO4: Compare various searching and sorting techniques.
CO5: Choose appropriate data structure while designing the algorithms.
CO6: Design advance data structures using non linear data structures.

Course Articulation Matrix

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

3 - High, 2 - Medium, 1 – Low

UNIT I ALGORITHM ANALYSIS, LIST ADT **9**

Algorithms: Notation - analysis – running time calculations. Abstract Data Types (ADTs): List ADT – array-based implementation – linked list implementation – singly linked lists- applications of lists: Polynomial Manipulation. Implementation of List ADT using an array and using a linked list in C.

UNIT II STACKS AND QUEUES **9**

Stack ADT – Operations – Applications – Balancing Symbols – Evaluating arithmetic expressions- Infix to Postfix conversion – Function Calls – Queue ADT – Operations – Circular Queue – DeQueue – Applications of Queues.

UNIT III SEARCHING AND SORTING ALGORITHMS **9**

Divide and conquer methodology - Searching: Linear Search - Binary Search. Sorting: Insertion sort – Merge sort – Quick sort – Heap sort. Analysis of searching and sorting techniques. Implementation of linear search, binary search, insertion sort, merge sort and quick sort algorithms in C.

UNIT IV TREES **9**

Tree ADT – tree traversals - Binary Tree ADT – expression trees – binary search tree ADT – applications of trees. Heap – applications of heap. Implementation of Binary search tree and its operations, tree traversal methods, finding height of the tree using C. Implementation of heap and heap sorting using arrays in C.

UNIT V GRAPHS **9**

Definition – Representation of Graph – Breadth-first traversal - Depth-first traversal – Dynamic programming Technique – Warshall's and Floyd's algorithm – Greedy method - Dijkstra's algorithm – applications of graphs. Implementation of graph, graph traversal methods, finding shortest path using Dijkstra's algorithm in C

TOTAL: 45 HOURS

TEXT BOOKS

1. Mark Allen Weiss, “Data Structures and Algorithm Analysis in C”, 2nd Edition, Pearson Education,1997..
2. Brian W. Kernighan and Dennis M. Ritchie, “The C Programming Language”, 2nd Edition, Pearson Education, 1988.

REFERENCES

1. Aho, Hopcroft and Ullman, “Data Structures and Algorithms”, Pearson Education,1983
2. S.Sridhar, “Design and Analysis of Algorithms”, First Edition, Oxford University Press. 2014
3. Byron Gottfried, Jitender Chhabra, “Programming with C” (Schaum’s Outlines Series), Mcgraw Hill Higher Ed., III Edition, 2010
4. Yashvant Kanetkar, “Data Structures Through C”, BPB publications, II edition, 2003

U19ECOE001 **SOFT COMPUTING**

L	T	P	C
3	0	0	3

Course Objectives

This course aims to provide the students,

- To learn the basic concepts of Soft Computing
- To become familiar with various techniques like neural networks, genetic algorithms and fuzzy systems.
- To apply soft computing techniques to solve problems.

Prerequisite

- Basic concepts of communication theory
- Basics of Computer Networks
- Basics of Biological systems
- Linear Algebra

Course Outcomes

At the end of the course, students should be able to,

CO1: Apply suitable neural computing techniques for various applications.
CO2: Explain various ANN models
CO3: Apply fuzzy concepts for various applications
CO4: Apply genetic algorithms to solve problems
CO5: Integrate various soft computing techniques for complex problems.
CO6: Apply neural techniques for various applications

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	1	3	3	1
2	3	2	2	2							2	1	3	3	1
3	3	2	2	2							2	1	3	3	1
4	3	2	2	2							2	1	3	3	1
5	3	2	2	2							2	1	3	3	1
6	3	2	2	2							2	1	3	3	1

3 - High, 2 - Medium, 1 – Low

UNIT I INTRODUCTION TO SOFT COMPUTING **9**

Introduction-Artificial Intelligence-Artificial Neural Networks-Fuzzy Systems-Genetic Algorithm and Evolutionary Programming-Swarm Intelligent Systems-Classification of ANNs-McCulloch and Pitts Neuron Model-Learning Rules: Hebbian and Delta- Perceptron Network-Adaline Network-Madaline Network.

UNIT II ARTIFICIAL NEURAL NETWORKS **9**

Back propagation Neural Networks - Kohonen Neural Network -Learning Vector Quantization -Hamming Neural Network - Hopfield Neural Network- Bi-directional Associative Memory -Adaptive Resonance Theory Neural Networks- Support Vector Machines - Spike Neuron Models.

UNIT III FUZZY SYSTEMS **9**

Introduction to Fuzzy Logic, Classical Sets and Fuzzy Sets - Classical Relations and Fuzzy Relations - Membership Functions -Defuzzification - Fuzzy Arithmetic and Fuzzy Measures - Fuzzy Rule Base and Approximate Reasoning - Introduction to Fuzzy Decision Making.

UNIT IV GENETIC ALGORITHMS **9**

Basic Concepts- Working Principles -Encoding- Fitness Function - Reproduction - Inheritance Operators - Cross Over - Inversion and Deletion -Mutation Operator - Bit-wise Operators -Convergence of Genetic Algorithm.

UNIT V HYBRID SYSTEMS **9**

Hybrid Systems -Neural Networks, Fuzzy Logic and Genetic -GA Based Weight Determination - LR-Type Fuzzy Numbers - Fuzzy Neuron - Fuzzy BP Architecture - Learning in Fuzzy BP- Inference by Fuzzy BP - Fuzzy ArtMap: A Brief Introduction - Soft Computing Tools - GA in Fuzzy Logic Controller Design - Fuzzy Logic Controller

TOTAL: 45 HOURS

TEXT BOOKS

1. N.P.Padhy, S.P.Simon, "Soft Computing with MATLAB Programming", Oxford University Press, 2015.
2. S.N.Sivanandam , S.N.Deepa, "Principles of Soft Computing", Wiley India Pvt.Ltd., 2nd Edition, 2011.
3. S.Rajasekaran, G.A.Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithm, Synthesis and Applications ", PHI Learning Pvt.Ltd., 2017.

REFERENCES

1. Jyh-Shing Roger Jang, Chuen-Tsai Sun, Eiji Mizutani, —Neuro-Fuzzy and Soft Computing‖, Prentice-Hall of India, 2002.
2. Kwang H.Lee, —First course on Fuzzy Theory and Applications‖, Springer, 2005.
3. George J. Klir and Bo Yuan, —Fuzzy Sets and Fuzzy Logic-Theory and Applications‖, Prentice Hall, 1996.

U19ECOE004 **ADVANCED WIRELESS COMMUNICATION** **L T P C**
3 0 0 3

Course Objectives

This course aims to provide the students,

- To expose the students to the importance of improving capacity of wireless channel using MIMO
- To enable understanding of channel impairment mitigation using space-time block and Trellis codes
- To teach advanced MIMO system like layered space time codes, MU-MIMO System and MIMO-OFDM systems

Prerequisite

- Basic concepts of communication theory
- Basics of Computer Networks
- Limits and Continuity
- Basic concepts of Differentiation
- Basic concepts of Integration

Course Outcomes

At the end of the course, students should be able to,

CO1: Comprehend and appreciate the significance and role of this course in the present contemporary world

CO2: Apply the knowledge about the importance of MIMO in today's communication

CO3: Appreciate the various methods for improving the data rate of wireless systems

CO4: Explain the working of layered space time transmitter and receiver

CO5: Describe various radio propagation techniques

CO6: Explain various MIMO systems

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	1	3	3	1
2	3	2	2	2							2	1	3	3	1
3	3	2	2	2							2	1	3	3	1
4	3	2	2	2							2	1	3	3	1
5	3	2	2	2							2	1	3	3	1
6	3	2	2	2							2	1	3	3	1

3 - High, 2 - Medium, 1 – Low

UNIT I CAPACITY OF WIRELESS CHANNELS **9**

The crowded spectrum, need for high data rate, MIMO systems – Array Gain, Diversity Gain, Data Pipes, Spatial MUX, MIMO System Model. MIMO System Capacity – channel known at the TX, Channel unknown to the TX – capacity of deterministic channels, Random channels and frequency selective channels.

UNIT II RADIO WAVE PROPAGATION **9**

Radio wave propagation – Macroscopic fading- free space and out door, small scale fading Fading measurements – Direct pulse measurements, spread spectrum correlation channel sounding frequency domain channel sounding, Antenna Diversity – Diversity combining methods

UNIT III SPACE TIME BLOCK CODES **9**

Delay Diversity scheme, Alamoti space time code – Maximum likelihood decoding maximum ratio combining. Transmit diversity space time block codes for real signal constellation and complex signal constellation - decoding of STBC.

UNIT IV SPACE TIME TRELLIS CODES **9**

Space time coded systems, space time code word design criteria, design of space time T C on slow fading

channels, design of STTC on Fast Fading channels, performance analysis in slow and fast fading channels, effect of imperfect channel estimation and Antenna correlation on performance, comparison of STBC & STTC.

UNIT V LAYERED SPACE TIME CODES 9

LST transmitter – Horizontal and Vertical LST receiver – ML Rx, Zero forcing Rx; MMSE Rx, SIC Rx, ZF V-blast Rx- MMSE V-blast Rx, Iterative Rx - capacity of MIMO – OFDM systems – capacity of MIMO multi user systems.

TOTAL: 45 HOURS

TEXT BOOKS

1. Mohinder Jankiraman, Space-time codes and MIMO systems, Artech House, Boston, London . www.artech house.com, ISBN 1-58053-865-7-2004
2. Paulraj Rohit Nabar, Dhananjay Gore, Introduction of space time wireless communication systems, Cambridge University Press, 2003.

REFERENCES

1. David Tse and Pramod Viswanath, —Fundamentals of Wireless Communication‖, Cambridge University Press, 2005.
2. Sergio Verdu — Multi User Detection‖ Cambridge University Press, 1998

U19EEOE003 **SENSORS AND TRANSDUCERS**

L	T	P	C
3	0	0	3

Course Objectives

This course aims to provide the students,

- To understand the concepts of measurement technology
- To learn the various sensors used to measure various physical parameters
- To learn the fundamentals of signal conditioning, data acquisition and communication systems used in mechatronics system development.

Course Outcomes

At the end of the course, students should be able to,

CO1: Expertise in various calibration techniques and signal types for sensors.
CO2: Understand about the various sensors
CO3: Apply the various sensors in the Automotive and Mechatronics applications
CO4: Study the basic principles of various smart sensors.
CO5: Implement the DAQ systems with different sensors for real time applications
CO6: Understand about different sensors with applications

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
1	2	-	3	-	3	2	-	-	2	-	2	-	2	2	2	2
2	2	-	3	-	3	2	-	-	2	-	2	-	3	2	2	2
3	2	-	3	-	3	2	-	-	2	-	2	-	2	3	3	3
4	2	-	3	-	3	2	-	-	2	-	2	-	3	2	2	2
5	2	-	3	-	3	2	-	-	2	-	2	-	2	2	2	3
6	2	-	3	-	3	2	-	-	2	-	2	-	3	2	1	3

3 - High, 2 - Medium, 1 – Low

UNIT I INTRODUCTION **9**

Basics of Measurement – Classification of errors – Error analysis – Static and dynamic characteristics of transducers – Performance measures of sensors – Classification of sensors – Sensor calibration techniques – Sensor Output Signal Types.

UNIT II MOTION, PROXIMITY AND RANGING SENSORS **9**

Motion Sensors – Potentiometers, Resolver, Encoders – Optical, Magnetic, Inductive, Capacitive, LVDT – RVDT – Synchro – Microsyn, Accelerometer.,– GPS, Bluetooth, Range Sensors – RF beacons, Ultrasonic Ranging, Reflective beacons, Laser Range Sensor (LIDAR).

UNIT III FORCE, MAGNETIC AND HEADING SENSORS **9**

Strain Gage, Load Cell, Magnetic Sensors –types, principle, requirement and advantages: Magneto resistive – Hall Effect – Current sensor Heading Sensors – Compass, Gyroscope, Inclinometers.

UNIT IV OPTICAL, PRESSURE AND TEMPERATURE SENSORS **9**

Photo conductive cell, photo voltaic, Photo resistive, LDR – Fiber optic sensors – Pressure – Diaphragm, Bellows, Piezoelectric – Tactile sensors, Temperature – IC, Thermistor, RTD, Thermocouple. Acoustic Sensors – flow and level measurement, Radiation Sensors - Smart Sensors - Film sensor, MEMS & Nano Sensors, LASER sensors.

UNIT V SIGNAL CONDITIONING AND DAQ SYSTEMS **9**

Amplification – Filtering – Sample and Hold circuits – Data Acquisition: Single channel and multi channel data acquisition – Data logging - applications - Automobile, Aerospace, Home appliances, Manufacturing, Environmental monitoring.

TOTAL: 45 HOURS

TEXT BOOKS

1. Ernest O Doebelin, “Measurement Systems – Applications and Design”, Tata McGraw-Hill, 2009.
2. Sawney A K and Puneet Sawney, “A Course in Mechanical Measurements and Instrumentation and Control”, 12th edition, Dhanpat Rai & Co, New Delhi, 2013.

REFERENCES

1. Patranabis D, “Sensors and Transducers”, 2nd Edition, PHI, New Delhi, 2010.
2. John Turner and Martyn Hill, “Instrumentation for Engineers and Scientists”, Oxford Science Publications, 1999
3. Richard Zurawski, “Industrial Communication Technology Handbook” 2nd edition, CRC Press,2015.

U19EEOE004 **ENERGY TECHNOLOGY**

L	T	P	C
3	0	0	3

Course Objectives

- Students will gain knowledge about different energy scenario
- To understand about the conventional energy sources.
- To understand about the non-conventional energy sources.
- To understand about the biomass energy sources.
- To learn the concept of energy conservation

Prerequisite

- Fundamentals of electrical engineering
- Basic concepts of Differentiation
- Basic concepts of Integration

Course Outcomes

At the end of the course, students should be able to,

CO1: Understand energy scenario in India

CO2: Understand conventional Energy sources,

CO3: Understand Non- conventional Energy sources,

CO4: Understand biomass sources and develop design parameters for equipment to be used in Chemical process industries

CO5: Understand energy conservation in process industries

CO6: Understand about different energy technology

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
1	2	1	3	-	3	-	2	-	2	-	2	-	2	2	2	2
2	2	1	3	-	3	-	2	-	2	-	2	-	2	2	2	2
3	2	1	3	-	3	-	2	-	2	-	2	-	2	3	3	3
4	2	1	3	-	3	-	2	-	2	-	2	-	3	2	3	2
5	2	1	3	-	3	-	2	-	2	-	2	-	2	3	2	3
6	2	1	3	-	3	-	2	-	2	-	2	-	3	2	1	3

3 - High, 2 - Medium, 1 – Low

UNIT I ENERGY **9**

Introduction to energy – Global energy scene – Indian energy scene - Units of energy, conversion factors, general classification of energy, energy crisis, energy alternatives.

UNIT II CONVENTIONAL ENERGY **9**

Conventional energy resources, Thermal, hydel and nuclear reactors, thermal, hydel and nuclear power plants

UNIT III NON-CONVENTIONAL ENERGY **9**

Solar energy, flat plate collectors, focusing collectors, solar water heating, solar cooling, solar distillation, solar refrigeration, solar dryers, solar pond, solar thermal power generation, energy plantations. Wind energy, types of windmills, types of wind rotors, wind electric power generation, wind power in India, economics of wind farm, ocean wave energy conversion, ocean thermal energy conversion, tidal energy conversion, geothermal energy.

UNIT IV BIOMASS ENERGY **9**

Biomass origin - Resources – Biomass estimation. Thermo chemical conversion – Biological conversion,– Hydrolysis & hydrogenation, solvolysis, biocrude, biodiesel power generation gasifier, biogas, integrated gasification.

UNIT V ENERGY CONSERVATION **9**

Energy conservation - Act; Energy management importance, duties and responsibilities; Energy audit –

Types methodology, reports, instruments. Benchmalcing and energy performance, material and energy balance, thermal energy management.

TOTAL: 45 HOURS

TEXT BOOKS

1. Rao, S. and Parulekar, B.B., Energy Technology, Khanna Publishers, 2005.
2. Rai, G.D., Non-conventional Energy Sources, Khanna Publishers, New Delhi, 1984.
3. Nagpal, G.R., Power Plant Engineering, Khanna Publishers, 2008.

REFERENCES

1. Nejat Vezirog, Alternate Energy Sources, IT, McGraw Hill, New York.
2. Handbook of Energy Audit by 7th edition Albert Thumann, P.E., C.E.M & William J Younger C.E.M, Faiment Press 2008
3. El. Wakil, Power Plant Technology, Tata McGraw Hill, New York, 2002.

U19FTOE003 **BEVERAGE TECHNOLOGY**

L	T	P	C
3	1	0	3

COURSE OBJECTIVES

Impart knowledge on processing and ingredients applied for beverage preparation according to the standard categorization of beverages. Based on the ingredients incorporated and type of processing method applied will give a classification of beverages. Sanitization schemes and quality control measures according to standards and regulations.

PREREQUISITES

- Basic classification of beverages in the market
- Storage and preparation of beverages
- Purpose of preparing beverages
- Market and trends in beverages sector

UNIT I INGREDIENTS IN BEVERAGES **9**

Beverage-definition--ingredients- water, quality evaluation and raw and processed water, bulk and intense sweeteners, water miscible and water dispersible flavouring agents, colours – natural and artificial, Micro and nano-emulsions of flavors and colors in beverages, preservatives, emulsifiers and stabilizers.

UNIT II CARBONATED BEVERAGES

Procedures- ingredients- preparation of Syrup making, carbonation of soft drinks. Carbonation equipments and machineries- -containers and closures. low-calorie and dry beverages; isotonic and sports drinks; Fruit based carbonated beverages, carbonated water

UNIT III NON-CARBONATED BEVERAGES **9**

Beverages based on tea, coffee, cocoa, spices, plant extracts, herbs, nuts, dairy based beverages, RTS beverages, isotonic Beverages. Flash pasteurization, Canning and Aseptic Packaging of beverages. bottled. Water; mineral water, natural spring water, flavored water.

UNIT IV ALCOHOLIC BEVERAGES **9**

Alcoholic beverages- types, manufacture and quality evaluation; the role of yeast in beer and other alcoholic beverages, ale type beer, lager type beer, technology of brewing process, equipment's used for brewing and distillation, wine and related beverages, distilled spirits

UNIT V SANITATION AND QUALITY CONTROL **9**

Quality control, Filling-inspection and quality controls-sanitation and hygiene in beverage industry-Quality of water used in beverages threshold limits of ingredients. FSSAI, EFSA and FDA regulations

Total: 45 HOURS

COURSE OUTCOMES

At the end of the course students should be able to

CO1: Capable of formulating beverages using various ingredients.
CO2: Demonstrate various unit operations involved in the food beverage manufacturing
CO3: Understand the various production techniques in beverages
CO4: Evaluate the quality parameters of all beverages
CO5: Familiarize with food laws and regulations of beverages
CO6: Understand the importance of quality control.

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	3												1	
3	1			3										1	
4					3			2							1
5					3			2							1
6	1	1		2											

3 - High, 2 - Medium, 1 – Low

TEXT BOOKS:

1 L.Jagan Mohan Rao and K.Ramalakshmi (2011)"Recent trend in Soft beverages", Woodhead Publishing India Pvt Ltd.

2 Boulton, Christopher, and David Quain (2008) Brewing yeast and fermentation. John Wiley & Sons.

REFERENCE BOOKS:

1 Hui, Yiu H., et al., eds. (2004) Handbook of food and beverage fermentation technology. Vol. 134. CRC Press.

2 Mitchell, Alan J. (199) "Formulation and Production Carbonated Soft Drinks". Springer Science & Business Media.

3 Woodroof, Jasper Guy, and G. Frank Phillips. (1981) Beverages: carbonated and noncarbonated. AVI Pub. Co

U19FTOE004	PRINCIPLES OF FOOD MATERIALS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

Explain the milling, extraction and manufacture of tremendous products from cereals, pulses and oil seeds. Summarize the production and processing methods of fruits and vegetables and to discuss the chemical composition, processing, production, spoilage and quality of milk and milk product. Outline the overall processes involved in the production of meat, poultry and fish products Review the production and processing methods of plantation and spice products

PREREQUISITES

- Need an idea of nature of food materials to be handled
- Prior storage conditions before processing the materials
- Basic handling techniques of materials
- Preparation of materials prior to processing

UNIT I CEREAL, PULSES AND OIL SEEDS TECHNOLOGY **9**

Rice milling, Pulse milling, Wheat milling - Oil extraction - Methods of manufacture of Bread - different processes of manufacture - types of breads - buns, biscuits, cakes and cookies -Pasta products -Tortilla - Method of manufacture.

UNIT II FRUITS AND VEGETABLE PROCESSING **9**

Production of Fruits and vegetables in India, Cause for heavy losses, preservation treatments - Basics of Canning, Minimal processing and Hurdle technology as applied to Vegetable and Fruit processing, Processing of fruit juices, Dehydration, Aseptic processing.

UNIT III DAIRY PROCESSING **9**

Basic dairy terminology, composition, General tests at reception, Dairy Processing - Method of manufacture of Standardized, toned and double toned milk, milk powder - Equipment - Pasteurizers, homogenizers and pumps - Method of manufacture of dairy products – Ice cream, Cheese, Paneer, Yoghurt - Pasteurization and microorganisms involved in spoilage of milk.

UNIT IV MEAT, POULTRY AND FISH PROCESSING **9**

Meat composition from different sources, Definitions and measurements, Carcass Processing, Meat Products, Processing of Poultry Products, Fish and other Marine Products Processing.

UNIT V PLANTATION PRODUCT TECHNOLOGY **9**

Processing of Tea, Coffee and Cocoa - Outline of the methods of manufacture of - green tea, black tea, instant tea, Instant coffee, Cocoa and Chocolate. Outline of the methods of processing of Pepper, cardamom, ginger, vanilla and turmeric

Total: 45 Periods

COURSE OUTCOMES

At the end of the course students should be able to

CO1: Discuss the various processing technologies involved in cereal, pulses and oilseed technology
CO2: Demonstrate the major operations applied in fruits and vegetable processing
CO3: Illustrate the techniques involved in the processing of dairy products
CO4: List the overall processing of meat, poultry and fish processing
CO5: Outline the processing of spices and plantation products
CO6: Analyse the manufacturing methods involved in various byproducts of food materials

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	3		3											
3	1													1	
4						3			2					1	
5						3			2						1
6	1	1		2											1

3 - High, 2 - Medium, 1 – Low

TEXT BOOKS:

1. Srivastava R.P. and Kumar S. Fruit and Vegetable Preservation: Principles and Practices. International Book Distributing Co. Lucknow. 3rd Edition. 2010.
2. Chakraverty A., Mujumdar A.S., Raghavan G.S.V and Ramaswamy H.S. Handbook of Post-harvest Technology: Marcel Dekker Press. USA. 1st Edition. 2003.

REFERENCE BOOKS:

1. Sukumar De. Outlines of Dairy Technology. Oxford University Press. New Delhi. 23rd impression. 2016.

U19ITOE003 **FOUNDATION OF INFORMATION TECHNOLOGY**

L	T	P	C
3	0	0	3

Course Objectives

- Understand the basic concepts and terminology of information technology
- Identify the components of a computer system and their functions
- Describe different types of software and their applications
- Explain the principles of computer networking and internet technologies
- Understand the basics of database design and management
- Use IT effectively in personal and professional settings

Course Outcomes

At the end of the course, students should be able to,

CO1: Understand fundamental concepts, principles, and applications of information technology

CO2: Understand the different types of software and their applications

CO3: Understand the basics of database design and management.

CO4: Understand the role of information systems in organizations and their applications

CO5: Understand the principles of computer networking and internet technologies

CO6: Apply IT effectively in personal and professional settings.

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		3	2	3	3		3
2	3		3			2		2		3	2	3	3		3
3	3		3			2		2		3	2	3	3		3
4	3		3			2		2		3	2	3	3		3
5	3		3			2		2		3	2	3	3		3
6	3		3			2		2		3	2	3	3		3

3 - High, 2 - Medium, 1 – Low

UNIT I BASICS OF INFORMATION TECHNOLOGY **9**

Internet: World Wide Web, Web servers, Web Clients, Web sites, Web Pages, Web Browsers, Blogs, News groups, HTML, Web address, E-mail address, URL, HTTP, FTP, downloading and uploading files from remote site; Services available on Internet: Information Retrieval, Locating sites using search engines and finding people on the net; Web Services: Chat, email, Video Conferencing, e-Learning, e-Banking, e-Shopping, e-Reservation, e-Governance, e-Groups, Social Networking

UNIT II INFORMATION PROCESSING TOOLS **9**

Office Tools: Database Management Tool: Basic Concepts and need for a database, Creating a database. DataTypes-Text, Number, Date, Time, Setting the Primary Key, Entering data into a database, Inserting and deleting Fields, Inserting and deleting Records, Field Size, Default Value, Creating Query using Design view.

UNIT III HYPER TEXT MARKUP LANGUAGE **9**

Introduction to Web Page Designing using HTML, Creating and saving an HTML document, accessing a web page using a web browser (Google Chrome, Internet Explorer, Mozilla Firefox, Opera, Apple Safari, Net scape Navigator);Elements in HTML.

UNIT IV XML **9**

Introduction to XML, Difference between XML and HTML with respect to the following: Data separation, data sharing, document structure, tags, nesting of elements, attributes, values. XML Elements - Defining own tags in XML, root elements, child elements and their attributes; Comments in XML, White space and new line in XML, well formed XML documents, validating XML documents, XML Parser, Viewing XML documents in a web browser.

UNIT V SOCIETAL IMPACTS OF IT **9**

Information Security: Virus, Worms, Trojans and Anti-Virus Software, Spyware, Malware, Spams, Data

Backup and recovery tools and methods, Online Backups, Hacker and Cracker with regard to Computer Data and Applications, Social Networking Information security provisions in e-commerce, Benefits of ICT in Education, Healthcare, Governance, Virtual, School, emergence of Knowledge economy, Impact of ICT on Society: Knowledge based society, Infomania, Digital Unity and Digital Divide

TOTAL: 45 HOURS

TEXT BOOKS

1. Introduction to Information Technology" by Turban, Rainer, and Potter (Wiley, 2015)
2. Discovering Computers" by Vermaat, Sebok, and Freund (Cengage Learning, 2019)

REFERENCES

1. Computer Science Illuminated" by Nell Dale and John Lewis (Jones & Bartlett Learning, 2018)
2. Computer Science Illuminated" by Nell Dale and John Lewis (Jones & Bartlett Learning, 2018)

U19ITOE004 **WEB DESIGN AND MANAGEMENT**

L	T	P	C
3	0	0	3

Course Objectives

- To Learn the basic concepts in HTML, CSS, Javascript.
- To Understand the responsive design and development.
- To Understand the responsive design and development.
- To Design a Website with HTML, JS, CSS / CMS - Word press.

Course Outcomes

At the end of the course, students should be able to,

CO1: Understand the principles of web design, including layout, color theory, typography, and user experience design.

CO2: Design Website using HTML CSS and JS

CO3: Design Responsive Sites

CO4: Manage, Maintain and Support Web Apps

CO5: Gain practical experience working on real-world web design projects, and learn how to collaborate with clients, stakeholders, and team members.

CO6:Develop an understanding of web analytics and digital marketing, and learn how to use data to improve website performance and user engagement.

Course Articulation Matrix

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

3 - High, 2 - Medium, 1 – Low

UNIT I WEB DESIGN - HTML MARKUP FOR STRUCTURE **9**

Working of Web - HTML Markup for Structure - Creating simple page - Marking up text - Adding Links - Adding Images - Table Markup - Forms - HTML5

UNIT II CSS AND JAVASCRIPT **9**

CSS - Formatting text - Colours and Background - Padding, Borders and Margins - Floating and positioning - Page Layout with CSS - Transition, Transforms and Animation - Javascript - Using Java Script

UNIT III RESPONSIVE WEB DESIGN **9**

Sass for Responsive Web Design - Marking Content with HTML5 - Mobile-First or Desktop-First - CSS Grids, CSS Frameworks, UI Kits, and Flexbox for RWD - Designing small UIs by Large Finger - Images and Videos in Responsive Web Design - Meaningful Typography for Responsive Web Design

UNIT IV WEB PROJECT MANAGEMENT **9**

Project Life Cycle - Project Definition - Discovery and Requirements - Project Schedule and Budgeting - Running the project - Technical Documentation - Development ,Communicaton, Documentation - QA and testing -Deployment - Support and operations

UNIT V PROJECT CASE STUDY **9**

Using HTML, CSS, JS or using Opensource CMS like Wordpress, design and develop a Website having Aesthetics, Advanced and Minimal UI Transitions based on the project - Host and manage the project live in any public hosting.

TOTAL: 45 HOURS

TEXT BOOKS

1. Jennifer Niederst Robbins, "Learning Web Design", O'REILLY 4th Edition
2. Ricardo Zea, "Mastering Responsive Web Design", PACKT Publishing, 2015

3. Justin Emond, Chris Steins, "Pro Web Project Management", Apress,2011

REFERENCES

1. Jon Duckett, "HTML and CSS: Design and Build Websites", John Wiley and Sons, edition 2014
2. Jon Duckett, Jack Moore, "JavaScript &JQuery: Interactive Front-End Web Development", John Wiley and Sons, edition 2014
3. Uttam K. Roy "Web Technologies" Oxford University Press, 13th impression, 2017
4. Wordpress - http://www.wpbeginner.com/category/wp-tutorials/

U19MEOE003 **AUTOMOBILE TECHNOLOGY** **L T P C**
3 0 0 3

Course Objectives

- To gain knowledge on the automobile architecture and understand its performance.
- To learn about the significant parameters that determine the engine performance.
- To learn about the different types of transmission systems used in automobiles
- To understand the different components and mechanism of a suspension system
- To learn about the mechanism involved in operation of steering

Course Outcomes

At the end of the course, students should be able to,

CO1: Apply the concepts of automobile architecture in an automobile assembly.

CO2: Device the right choice of process parameters to fine tune the performance.

CO3: Choose the right choice of transmission system as per the requirements

CO4: Make the right choice of suspension system for the given application

CO5: Visualize and understand the working mechanism of steering.

Course Articulation Matrix

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

3 - High, 2 - Medium, 1 – Low

UNIT I AUTOMOBILE ARCHITECTURE AND PERFORMANCE 9

Automotive components, subsystems and their positions- Chassis, frame and body, front, rear and four wheel drives, Operation and performance, Traction force and traction resistance, Power required for automobile-Rolling, air and gradient resistance.

UNIT II ENGINE ARCHITECTURE AND PERFORMANCE 9

Types of engine, multi valve engine, in-line engine, vee-engine, Petrol enginedirect, single point and multipoint injection, diesel engine-common rail diesel injection, supercharging and turbo charging, alternate fuels-ethanol and ethanol blend, compressed natural gas, fuel cells, hybrid vehicles, Engine Control Unit.

UNIT III TRANSMISSION SYSTEMS 9

Clutch : Types-coil spring and diaphragm type clutch, single and multi plate clutch, centrifugal clutch, Gear box : Types-constant mesh, sliding mesh and synchromesh gear box, layout of gear box, gear selector and shifting mechanism, overdrive, automatic transmission, Propeller shaft, universal joint, slip joint, differential and real axle arrangement, hydraulic coupling

UNIT IV SUSPENSION SYSTEM 9

Types-front and rear suspension, conventional and independent type suspension, leaf springs, coil springs, dampers, torsion bars, stabilizer bars, arms, air suspension systems.

UNIT V STEERING SYSTEM 9

Types of steering systems, Ackermann principle, Davis steering gear, steering gear boxes, steering linkages, power steering, wheel geometry-caster, camber toe-in, toe out etc., wheel Alignment and balancing.

TOTAL: 45 HOURS

TEXT BOOKS

1. Gupta .R.B, "Automobile Engineering ", SatyaPrakashan, 2009.
2. Kirpal Singh, “Automobile Engineering Vol-I & II”, Standard publishers, New Delhi, 2011.

REFERENCES

1. Julian Happian Smith, “An Introduction to Modern Vehicle Design”, Butterworth-Heinemann, New Delhi, 2002
2. Crouse W H, “Automotive Transmissions and Power trains”, McGraw Hill Book Co., New Delhi, 1976.
3. Heinz Heisler, “Vehicle and Engine Technology”, SAE International and Elsevier, 1999.

U19MEOE004 **CAD/CAM** **L T P C**
3 0 0 3

Course Objectives

- To impart knowledge on computer graphics which are used routinely in diverse areas as science, engineering, medicine, etc.

Prerequisite

- Engineering Drawing

Course Outcomes

At the end of the course, students should be able to,

CO1: Understand the fundamentals of computer graphics.
CO2: Apply different techniques for geometric modelling.
CO3: Apply different algorithm to create prismatic and lofted parts.
CO4: Discuss tolerance analysis and mass property calculations.
CO5: Explain data exchange standards and communication standards.

Course Articulation Matrix

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

3 - High, 2 - Medium, 1 – Low

UNIT I INTRODUCTION TO COMPUTER GRAPHICS FUNDAMENTALS 9

Output primitives (points, lines, curves etc.,), 2-D & 3-D transformation (Translation, scaling, rotation) windowing - view ports - clipping transformation.

UNIT II CURVES AND SURFACES MODELING 9

Introduction to curves - Analytical curves: line, circle and conics – synthetic curves: Hermite cubic spline- Bezier curve and B-Spline curve – curve manipulations. Introduction to surfaces - Analytical surfaces: Plane surface, ruled surface, surface of revolution and tabulated cylinder – synthetic surfaces: Hermitebicubic surface- Bezier surface and B-Spline surface- surface manipulations.

UNIT III NURBS AND SOLID MODELING 9

NURBS- Basics- curves, lines, arcs, circle and bi linear surface. Regularized Boolean set operations - primitive instancing - sweep representations - boundary representations – constructive solid Geometry - comparison of representations - user interface for solid modelling.

UNIT IV VISUAL REALISM 9

Hidden – Line – Surface – solid removal algorithms shading – coloring. Introduction to parametric and variational geometry based software's and their principles creation of prismatic and lofted parts using these packages

UNIT V ASSEMBLY OF PARTS AND PRODUCT DATA EXCHANGE 9

Assembly modeling - interferences of positions and orientation - tolerances analysis – mass property calculations - mechanism simulation. Graphics and computing standards– Open GL Data Exchange standards – IGES, STEP etc– Communication standards.

TOTAL: 45 HOURS

TEXT BOOKS

1. David F. Rogers, James Alan Adams, "Mathematical elements for computer graphics", second edition, Tata McGraw-Hill edition.
2. Ibrahim Zeid, "Mastering CAD/CAM", McGraw Hill, International Edition, 2007.

REFERENCES

1. Donald Hearn and M. Pauline Baker, "Computer Graphics" Prentice Hall, Inc., 1992.

U19PHOE002 **THIN FILM TECHNOLOGY AND APPLICATIONS**

L	T	P	C
3	0	0	3

Course Objectives

- To learn the fundamental atomistic mechanisms and thin film deposition techniques.
- To acquire knowledge on thin film devices.
- To provide an overview of the wide applications of thin film technology in various technological fields.

Prerequisite

- As a prerequisite for this course Nanotechnology and Engineering Applications, knowledge in Engineering Physics and Applied Physics is essentially required.

Course Outcomes

At the end of the course, students should be able to,

CO1: Understand the basic concepts of thin film technology.

CO2: Understand the classification of thin films.

CO3: Understand the various thin film deposition techniques.

CO4: Understand and apply the knowledge of different characterization tools and characterization of thin films.

CO5: Describe the properties of thin films.

CO6: Apply the basic knowledge about the wide applications of thin film technology in various technological fields

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 THIN FILM GROWTH **9**

Classification of films – formation of films – Condensation and nucleation, growth and coalescence of islands – nucleation theories: capillarity and atomistic models, sticking coefficient, adhesion, substrate effect, film thickness effect

UNIT II DEPOSITION TECHNIQUES **9**

Thin film deposition techniques – simple thermal evaporation – Chemical vapour deposition technique – advantages and disadvantages of Chemical vapour deposition, Physics vapour deposition, electron beam evaporation – RF sputtering, flash evaporation, laser ablation – Spin coating – molecular beam epitaxy – film thickness measurement – ellipsometry, quartz crystal oscillator techniques, structure, and microstructure of thin films.

UNIT III THIN FILM MATERIAL CHARACTERIZATION TECHNIQUES **9**

Characterization techniques: XRD (X-Ray diffraction), working principle of SEM (Scanning Electron Microscopy), working principle of TEM (Transmission Electron Microscopy), STM (Scanning Tunnelling Microscopy), AFM (Atomic Force Microscopy), Filed ion microscope.

UNIT IV PROPERTIES OF THIN FILMS **9**

Electrical conduction in continuous and discontinuous metallic thin films, transport and optical properties of metallic, semiconducting and dielectric films.

UNIT V THIN FILM DEVICES AND APPLICATIONS **9**

Anti – reflection Coatings, fabrication of thin film resistor, capacitor, diode, gas sensors and temperature sensors. Thin film solar cells, Quantum well and Quantum dot solar cells. Application of thin films, in

different areas such as electronics, medical defence, sports, and automobile.

TOTAL: 45 HOURS

TEXT BOOKS

1. Kasturi Chopra, Thin film device applications, McGraw Hill, Newyork, 2012
2. A. Goswami, Thin film fundamentals, New age international, 2006

REFERENCES

1. Manuel P. Soriaga, John Stickney, Lawrence A. Bottomley, Thin Films: Preparation, Characterization, Applications, Springer US
2. Krishna Seshan, Handbook of Thin film Deposition Processes and Techniques, Elseiver.

U19ENOE02 **ENGLISH for EMPLOYABILITY SKILLS**

L	T	P	C
3	0	0	3

Course Objectives

- To hone the employability-related communication skills of the students on the foundations built during Executive
- To assist students in becoming well-versed, responsible, creative communicators.
- To develop students' knowledge of communication skills in the structure, elucidation, and delivery of messages in diverse cultural and global communities; and
- To promote theoretical understanding and professional/personal practice of effective and ethical human communication between and within a broad range of contexts and communities.
- To write responses appropriately, organize ideas, and use vocabulary accurately

Course Outcomes

At the end of the course, students should be able to,

CO1: Be prepared for the personal interview through mock interviews while being aware of the various kinds of interviews.

CO2: Introspect & develop a planned approach towards his career & life in general.

CO3: Have clarity on his career exploration process and match his skills and interests with a chosen career path.

CO4: Explain the use of a functional and chronological resume.

CO5: Develop thinking ability and polish his expression in group discussions.

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			2
2								1	2	3		2			2
3						2		2	3	3		2			2
4							3	2	1	3		3			3
5						3	3	3	3	3		3			3

3 - High, 2 - Medium, 1 – Low

UNIT I **9**

SWOT Analysis – Perception Management – Positive Attitude – Empathy – Altruism – Self Management - Etiquette: Social, Dinner, Corporate, Telephone and Netiquette – Interview Skills

UNIT II **9**

Reading Comprehension: Technical passages –Kinds of sentences –Sentence correction – Error spotting – Idioms – Vocabulary: Jargon and Distractors – Punctuation errors – Online Course: Udemy, Edx, FutureLearn

UNIT III **9**

Letter writing: Formal Letters – Letters accepting Offers - Chart description – process description – Essays – – Internship Reports

UNIT IV **9**

Self-Introduction - Talking about friends and Family –Resume Preparation: Single Page and Detailed– Persuasion Skills – Emotional Intelligence – Teamwork - Establishing Credibility: Understanding the Workplace – Body Language

UNIT V **9**

Industry Psychology: Characteristics of the workplace: Physical working conditions: Noise, Illumination, Colour, Music, Miscellaneous Factors; Work Schedules: Working Hours, Permanent Part-Time Employment, Flexible Work Schedules; Psychological and Social Issues - Stress management – Time management

TOTAL: 45 HOURS

TEXT BOOKS

5. Richards, C. Jack. Interchange Students Book-3 New Delhi: CUP, 2015.
6. Skills for Employability, Dr. M. Sen Gupta, ISBN: 978-81-933819-1-5, 2020, First Edition
7. Soft Skills & Employability Skills, SABINA PILLAI, AGNA FERNANDEZ, Cambridge, ISBN: 9781316981320, 1316981320, 2017

REFERENCES

5. Bridging the Soft Skills Gap: How to Teach the Missing Basics to Todays Young, ASIN : 8126563435, ISBN-10 : 9788126563432, ISBN-13 : 978-8126563432, Pan Macmillan India; 2016
6. Soft Skills Training: A workbook to develop skills for employment, Amazon Digital Services; Large edition, 2012, ISBN-10: 1468096494, ISBN-13 : 978-1468096491
7. https://www.sirc-icai.org/images/cabf/Soft%20Skills%20&%20Personality%20Development.pdf
8. http://worldwideuniversity.org/library/bookboon/soft-skills.pdf
9. https://www.futurelearn.com/subjects/business-and-management-courses/soft-skills

WEB RESOURCES

https://bharatskills.gov.in/pdf/E_Books/EmployabilitySkillsSWB2W.pdf
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