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

DEPARTMENT OF BIOTECHNOLOGY

CURRICULUM AND SYLLABI
B.Tech in Biotechnology

REGULATION 2020

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
REGULATIONS – 2020
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

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

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MAPPING OF COURSE OUTCOMES WITH PROGRAMME OUTCOMES:

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

COURSE OUTCOMES		**PROGRAMME OUTCOMES**											
Sem	**Course Name**	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**
I	Communicative English									✓	✓		✓
	Matrices and calculus for Biotechnologists	✓	✓	✓		✓							✓
	Applied Physics for Biosciences	✓	✓										
	Computational Thinking and Problem Solving using C	✓	✓	✓					✓	✓	✓		
	Introduction to Biotechnology	✓	✓	✓	✓	✓				✓			
	Engineering Exploration I	✓	✓	✓	✓		✓		✓	✓	✓	✓	✓
	Crop Production I Laboratory	✓	✓										
	Applied Physics Laboratory	✓	✓								✓		
	Computational thinking and Problem-solving using C laboratory	✓	✓	✓					✓	✓	✓		
	Introduction to biotechnology Laboratory	✓	✓		✓	✓				✓			
	Language												
II	Applied English Skills										✓		✓
	Chemistry for Biotechnology	✓									✓		
	Laplace transform and advancedcalculus for Biotechnologists	✓	✓	✓		✓							✓
	Cell Biology	✓	✓	✓	✓	✓	✓	✓		✓	✓		✓
	Microbiology	✓	✓	✓	✓	✓	✓	✓					
	Programming in C and datastructures	✓	✓		✓		✓	✓		✓	✓		
	Engineering Exploration II	✓	✓	✓	✓		✓		✓	✓	✓	✓	✓
	Chemistry laboratory for biotechnology	✓									✓		
	Cell biology laboratory	✓				✓				✓			
	Microbiology laboratory	✓	✓	✓	✓	✓	✓	✓					
	Programming in C and datastructure laboratory	✓	✓	✓	✓	✓	✓	✓		✓	✓		
III	Environmental Science for Biotechnology	✓	✓			✓	✓	✓	✓		✓		
	Transforms and numerical methods for Biotechnologists	✓	✓	✓		✓							✓
	Unit Operation and Unit Principles	✓	✓	✓	✓	✓							
	Biochemistry	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓
	Enzyme technology	✓	✓	✓	✓	✓	✓					✓	
	Basics of bioinformatics	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Engineering Exploration III	✓	✓	✓	✓		✓		✓	✓	✓	✓	✓
	Career Enhancement Program-I	✓	✓				✓	✓	✓	✓	✓		✓
	Environmental Science for biotechnology Laboratory	✓	✓		✓	✓	✓	✓		✓	✓		
	Transforms and Numerical methods for biotechnology laboratory	✓	✓										
	Unit operations and unit principles laboratory	✓	✓		✓		✓					✓	

	Biochemistry Laboratory	✓	✓	✓	✓		✓	✓		✓	✓		✓
	Enzyme technology Laboratory	✓	✓	✓	✓	✓	✓						✓
	Basics of Bioinformatics laboratory	✓	✓	✓	✓	✓	✓			✓			✓
IV	Probability and Statistics for Biotechnologists	✓	✓	✓		✓							✓
	Applied Thermodynamics for Biotechnologists	✓	✓	✓	✓	✓							
	Plant Biotechnology	✓	✓	✓	✓		✓	✓				✓	✓
	Programming for biologists	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
	Molecular Biology	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓
	Basic Industrial Biotechnology	✓	✓	✓	✓	✓	✓	✓		✓	✓		✓
	Engineering Exploration IV	✓	✓	✓	✓		✓		✓	✓	✓	✓	✓
	Career Enhancement Program-II		✓	✓			✓	✓	✓	✓	✓	✓	✓
	Applied Thermodynamics for Biotechnologists Laboratory	✓	✓	✓	✓	✓							
	Plant Biotechnology Laboratory		✓		✓	✓							
	Programming for biologist laboratory	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Molecular biology laboratory	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓
	Basic Industrial Biotechnology laboratory	✓	✓		✓	✓				✓			
	Probability and Statistics for Biotechnologists Laboratory	✓	✓			✓							
V	Transport Phenomena	✓	✓	✓				✓			✓		✓
	Genetic Engineering	✓	✓	✓	✓	✓	✓		✓			✓	✓
	Bioprocess Engineering	✓	✓	✓	✓	✓						✓	✓
	Instrumental Methods of Analysis	✓	✓	✓	✓		✓						
	Professional Elective I												
	Professional Elective II												
	Genetic Engineering Laboratory	✓	✓	✓	✓	✓				✓			✓
	Bioprocess Engineering Laboratory	✓	✓	✓		✓						✓	✓
	Engineering Exploration V	✓	✓	✓	✓		✓		✓	✓	✓	✓	✓
	Career Enhancement Program - III		✓	✓				✓	✓		✓	✓	
VI	Applied Chemical Reaction Engineering	✓	✓	✓			✓	✓		✓	✓	✓	✓
	Immunology	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Professional Elective III												
	Professional Elective IV												
	Professional Elective V												
	Open Elective I												
	Mini Project	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Immunology Laboratory	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Engineering Exploration VI	✓	✓	✓	✓		✓		✓	✓	✓	✓	✓
	Career Enhancement Program - IV		✓	✓				✓	✓		✓	✓	
VII	Principles of Management and Professional Ethics							✓	✓	✓			✓
	Downstream Processing	✓	✓	✓	✓	✓				✓	✓		✓
	Biopharmaceutical Technology	✓	✓	✓									
	Animal Biotechnology	✓	✓	✓			✓	✓	✓				
	Open Elective II												
	Project Phase I	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Project Phase II	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

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

B. TECH BIOTECHNOLOGY

REGULATIONS – 2020

CHOICE BASED CREDIT SYSTEM

CURRICULAM AND SYLLABI

SEMESTER I								
SL. NO	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
THEORY								
1	20EN101	Communicative English	HS	4	2	1	0	3
2	20MA103	Matrices and Calculus for Biotechnologists	BS	5	3	1	0	4
3	20PH102	Applied Physics for Biosciences	BS	4	3	0	0	3
4	20BT101	Introduction to Biotechnology	PC	4	3	0	0	3
5	20CS101	Computational Thinking andProblem-Solving using C	ES	4	3	0	2	3
6	20TA101 20ML101 20TE101 20EL101	Language-Tamil. Language- Malayalam Language-Telugu Language-Foundation English	HS	2	2	0	0	2
PRACTICALS								
7	20BT111	Engineering Exploration I	EEC	3	1	0	2	2
8	20AG112	Crop Production – I Laboratory	BS	3	0	0	4	2
9	20PH111	Applied Physics Laboratory	BS	3	0	0	2	1
10	20CS112	Computational Thinking and Problem Solving using C Laboratory	ES	3	0	0	2	1
11	20BT112	Introduction to Biotechnology Laboratory	PC	3	0	0	2	1
TOTAL				**38**	**17**	**2**	**13**	**25**

SEMESTER II								
SL. NO	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
THEORY								
1	20EN201	Applied English Skills	HS	4	2	1	0	3
2	20CH202	Chemistry for Biotechnology	BS	4	3	0	0	3
3	20MA203	Laplace Transforms andAdvanced Calculus for Biotechnologists	BS	4	3	0	0	3
4	20BT201	Cell Biology	PC	4	3	0	0	3
5	20BT202	Microbiology	PC	4	3	0	0	3
6	20CS201	Programming in C and DataStructures	ES	4	3	0	0	3
PRACTICALS								
7	20BT211	Engineering Exploration-II	EEC	2	1	0	2	2
8	20CH212	Chemistry laboratory forBiotechnology	BS	2	0	0	2	1
9	20BT212	Cell Biology Laboratory	PC	2	0	0	2	1
10	20BT213	Microbiology Laboratory	PC	2	0	0	2	1
11	20CS212	Programming in C and DataStructures Laboratory	ES	2	0	0	2	1
TOTAL				**34**	**18**	**1**	**10**	**24**

SEMESTER III								
SL. NO	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
THEORY								
1	20BT301	Environmental Science for Biotechnology	PC	4	2	0	0	2
2	20MA303	Transforms and numerical methods for Biotechnology	BS	4	3	0	0	3
3	20BT302	Unit Operation and Unit Principles	ES	4	2	0	0	2
4	20BT303	Biochemistry	PC	4	3	0	0	3
5	20BT304	Enzyme Technology	PC	4	3	0	0	3
6	20BT305	Basics of Bioinformatics	PC	4	3	0	0	3
PRACTICALS								
7	20BT311	Engineering Exploration III	EEC	2	1	0	2	1
8	20EN301	Career Enhancement Program-I	EEC	2	1	1	0	1
9	20BT312	Environmental Science for Biotechnology Laboratory	PC	2	0	0	2	1
10	20MA313	Transforms and numerical methods for Biotechnology Laboratory	BS	2	0	0	2	1
11	20BT313	Unit Operation and Unit Principles Laboratory	PC	2	0	0	2	1
12	20BT314	Biochemistry Laboratory	PC	2	0	0	2	1
13	20BT315	Enzyme Technology Laboratory	PC	2	0	0	2	1
14	20BT316	Basics of Bioinformatics Laboratory	PC	2	0	0	2	1
TOTAL				**40**	**18**	**1**	**14**	**24**

SEMESTER IV								
SL. NO	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
THEORY								
1	20MA403	Probability and Statistics for Biotechnology	BS	4	3	0	0	3
2	20BT401	Applied Thermodynamics for Biotechnologists	ES	4	3	0	0	2
3	20BT402	Plant Biotechnology	PC	4	3	0	0	3
4	20BT403	Programming for Biologists	PC	4	3	0	0	2
5	20BT404	Molecular Biology	PC	4	3	0	0	3
6	20BT405	Basic Industrial Biotechnology	PC	4	3	0	0	3
PRACTICALS								
7	20BT411	Engineering Exploration IV	EEC	3	0	0	2	1
8	20EN401	Career Enhancement Program-II	EEC	2	1	1	0	1
9	20BT412	Applied Thermodynamics for Biotechnologists Laboratory	PC	2	0	0	2	1
10	20BT413	Plant Biotechnology Laboratory	PC	2	0	0	2	1
11	20BT414	Programming for Biologists Laboratory	PC	2	0	0	2	1
12	20BT415	Molecular Biology Laboratory	PC	2	0	0	2	1
13	20BT416	Basic Industrial Biotechnology Laboratory	PC	2	0	0	2	1
14	20MA413	Probability and Statistics for Biotechnology Laboratory	BS	2	0	0	2	1
TOTAL				**41**	**19**	**1**	**14**	**24**

SEMESTER V								
SL. NO	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
THEORY								
1	20BT501	Transport Phenomena	ES	4	3	1	0	4
2	20BT502	Genetic Engineering	PC	3	3	0	0	3
3	20BT503	Bioprocess Engineering	PC	3	3	0	0	3
4	20BT504	Instrumental Methods of Analysis	PC	3	3	1	0	4
5		Professional Elective I	PE	3	3	0	0	3
6		Professional Elective II	PE	3	3	0	0	3
PRACTICALS								
7	20BT511	Engineering Exploration V	EEC	3	1	0	2	1
8	20EN501	Career Enhancement Program - III	EEC	2	1	1	0	1
10	20BT512	Genetic Engineering Laboratory	PC	2	0	0	2	1
11	20BT51	Bioprocess Engineering Laboratory	PC	2	0	0	2	1
TOTAL				**32**	**20**	**1**	**6**	**24**

SEMESTER VI								
SL. NO	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
THEORY								
1	20BT601	Applied Chemical Reaction Engineering	ES	4	3	1	0	4
2	20BT602	Immunology	PC	3	3	0	0	3
3		Professional Elective III	PC	3	3	0	0	3
4		Professional Elective IV	PE	3	3	0	0	3
5		Professional Elective V	PE	3	3	0	0	3
6		Open Elective I	OE	3	3	0	0	3
PRACTICALS								
7	20EN601	Career Enhancement Program-IV	EEC	2	1	1	0	1
8	20BT611	Immunology Laboratory	ES	2	0	0	2	1
9	20BT612	Mini Project	PC	2	0	0	3	2
TOTAL				**31**	**19**	**1**	**9**	**23**

SEMESTER VII								
SL. NO	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
THEORY								
1	20MG701	Principles of Management of Professional Ethics	ES	3	3	0	0	3
2	20BT701	Downstream Processing	PC	3	3	1	0	4
3	20BT702	Biopharmaceutical Technology	PC	3	3	0	0	3
4	20BT703	Animal Biotechnology	PC	3	3	0	0	3
5		Open Elective II	OE	3	3	1	0	3
PRACTICALS								
6	20BT711	Project phase I	EEC	2	0	0	3	2
TOTAL				**31**	**12**	**2**	**3**	**18**

SEMESTER VIII								
SL. NO	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
1	20BT811	Project Phase II	EEC	8	0	0	16	8

HUMANITIES AND SOCIAL SCIENCES (HS)

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
I	20EN101	Communicative English	HS	4	2	1	0	3
I	20TA101, 20ML101, 20EL101	Language-Tamil. Language- Malayalam Language – Foundation English	HS	2	2	0	0	2
II	20EN201	Applied English Skills	HS	4	2	1	0	3

BASIC SCIENCES (BS)

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
I	20MA103	Matrices and calculus for Biotechnology	BS	5	3	1	0	4
I	20PH102	Applied Physics for Biosciences	BS	4	3	0	0	3
I	20PH111	Applied Physics Laboratory	BS	3	0	0	2	1
I	20AG112	Crop Production I Laboratory	BS	3	0	0	4	2
II	20MA203	Laplace transform and advanced calculus forBiotechnology	BS	3	3	0	0	3
II	20CH202	Chemistry for Biotechnology	BS	3	3	0	0	3
II	20CH212	Chemistry laboratory for Biotechnology	BS	2	0	0	2	1
III	20MA303	Transforms and numerical methods for Biotechnology	BS	4	3	0	2	4
III	20MA313	Transforms and numerical methods for Biotechnology Laboratory	BS	2	0	0	2	1
IV	20MA403	Probability and Statistics for Biotechnology	BS	4	3	0	2	4
IV	20MA413	Probability and Statistics for Biotechnology Laboratory	BS	2	0	0	2	1

ENGINEERING SCIENCES (ES)

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
I	20CS101	Computational Thinking and Problem-Solving using C	ES	4	3	0	0	3
I	20CS112	Computational Thinking and Problem-Solving using C Laboratory	ES	2	0	0	2	1
II	20CS201	Programming in C and Data Structures	ES	3	3	0	0	3
II	20CS212	Programming in C and Data Structures Laboratory	ES	2	0	0	2	1
III	20BT302	Unit Operation and Unit Principles	ES	4	2	0	0	2
V	20BT501	Transport Phenomena	ES	4	3	1	0	4
VI	20BT601	Applied Chemical Reaction Engineering	ES	4	3	0	0	3
VII	20MG701	Principles of Management of Professional Ethics	ES	3	3	0	0	3

PROFESSIONAL CORE (PC)

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
I	20BT101	Introduction to Biotechnology	PC	5	3	0	0	3
I	20BT112	Introduction to Biotechnology Laboratory	PC	2	0	0	2	1
II	20BT201	Cell Biology	PC	3	3	0	0	3
II	20BT212	Cell Biology Laboratory	PC	2	0	0	2	1
II	20BT202	Microbiology	PC	3	3	0	0	3
II	20BT213	Microbiology Laboratory	PC	2	0	0	2	1
III	20BT301	Environmental Science for Biotechnology	PC	4	2	0	0	2
III	20BT303	Biochemistry	PC	4	3	0	0	3
III	20BT304	Enzyme Technology	PC	4	3	0	0	3
III	20BT305	Basics of Bioinformatics	PC	4	3	0	0	3
III	20BT312	Environmental Science for Biotechnology Laboratory	PC	2	0	0	2	1
III	20BT313	Unit Operation and Unit Principles Laboratory	PC	2	0	0	2	1
III	20BT314	Biochemistry Laboratory	PC	2	0	0	2	1
III	20BT315	Enzyme technology Laboratory	PC	2	0	0	2	1
III	20BT316	Basics of Bioinformatics Laboratory	PC	2	0	0	2	1
IV	20BT402	Plant Biotechnology	PC	4	3	0	0	3
IV	20BT403	Programming for Biologists	PC	4	3	0	0	2
IV	20BT404	Molecular Biology	PC	4	3	0	0	3
IV	20BT405	Basic Industrial Biotechnology	PC	4	3	0	0	3
IV	20BT412	Applied Thermodynamics for Biotechnologists Laboratory	PC	2	0	0	2	1
IV	20BT413	Plant Biotechnology Laboratory	PC	2	0	0	2	1
IV	20BT414	Programming for Biologists Laboratory	PC	2	0	0	2	1
IV	20BT415	Molecular Biology Laboratory	PC	2	0	0	2	1
IV	20BT416	Basic Industrial Biotechnology Laboratory	PC	2	0	0	2	1
V	20BT502	Genetic Engineering	PC	3	3	0	0	3
V	20BT503	Bioprocess Engineering	PC	3	3	0	0	3
V	20BT504	Instrumental Method s of Analysis	PC	3	3	1	0	4
V	20BT512	Genetic Engineering Laboratory	PC	2	0	0	2	1
V	20BT513	Bioprocess Engineering Laboratory	PC	2	0	0	2	1
VI	20BT602	Immunology	PC	3	3	0	0	3
VI	20BT612	ImmunologyLaboratory	PC	2	0	0	2	1
VII	20BT701	Downstream Processing	PC	3	3	1	0	4
VII	20BT702	Biopharmaceutical Technology	PC	3	3	0	0	3
VII	20BT703	Animal Biotechnology	PC	3	3	0	0	3

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
I	20BT111	Engineering Exploration I	EEC	3	1	0	2	2
II	20BT211	Engineering Exploration-II	EEC	2	1	0	2	2
III	20BT311	Engineering Exploration III	EEC	3	1	0	2	1
III	20EN301	Career Enhancement Program-I	EEC	2	1	1	0	1
IV	20BT411	Engineering Exploration IV	EEC	3	0	0	2	1
IV	20EN401	Career Enhancement Program-II	EEC	2	1	1	0	1
V	20BT511	Engineering Exploration V	EEC	3	1	0	2	1
V	20EN501	Career Enhancement Program - III	EEC	2	1	1	0	1
VI	20EN601	Career Enhancement Program-IV	EEC	2	1	1	0	1
VI	20BT612	Mini Project	EEC	4	0	0	3	2
VII	20BT711	Project phase I	EEC	2	0	0	3	2
VIII	20BT811	Project Phase II	EEC	8	2	0	0	6

SUMMARY

S.No	SUBJECTAREA	CREDITS AS PER SEMESTER								CREDITSTOTAL	Percentage
		I	II	III	IV	V	VI	VII	VIII		
1	HS	5	3							8	**4.73%**
2	BS	10	7	4	4					25	**14.79%**
3	ES	4	4	2	2	4	4	3		23	**13.61%**
4	PC	4	8	16	16	12	7	9		72	**42.60%**
5	PE					6	9			15	**8.88%**
6	OE						3	3		6	**3.55%**
7	EEC	2	2	2	2	2	2	2	6	20	**11.83%**
Total		**25**	**24**	**24**	**24**	**24**	**23**			**169**	**100%**

SYLLABUS

SEMESTER I

20EN101	COMMUNICATIVE ENGLISH	L	T	P	C
		2	1	0	3

Course Objectives

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

Course Outcomes

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

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

Course Articulation Matrix

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

3 - High, 2 - Medium, 1 – Low

UNIT I COMMUNICATION CONCEPTS **9**

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

UNIT II FOCUS ON SOFT SKILLS **9**

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

UNIT III TECHNICAL WRITING **9**

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

UNIT IV BUSINESS CORRESPONDENCE **9**

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

UNIT V TECHNICAL COMMUNICATION **9**

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

TOTAL: 45 HOURS

TEXT BOOKS

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

REFERENCES

1. Jeff Butterfield, “Soft Skills for Everyone”, Cengage Learning, New Delhi, 2013.
2. Jean Naterop B. and Rod Revel , “Telephoning in English”, Cambridge University Press, Cambridge, 2011.

3. David A. Mc Murrey and Joanne Buckley, “Handbook for Technical Writing”, Cengage Learning, New Delhi, 2011.
4. Simon Sweeney, “English for Business Communication”, Cambridge University Press, New Delhi, 2012.

M.h.
(HoD/English)

20MA103 **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

CO1: Evaluate solutions of system of linear equations, Eigen values, and Eigen vectors of the given matrix.

CO2: Use the applicability of Cayley - Hamilton theorem to find the inverse of a matrix and Diagonalization of matrix.

CO3: Gain knowledge to find the radius of curvature and torsion of a curve, which are used for analyzing the output data.

CO4: Determine values of definite integrals exactly and apply Multiple integrals to evaluate area and volume over the given region.

CO5: Solve the differential equations arising in Biotechnology.Calculate the rank of a matrix, Eigenvalues and Eigenvectors and solutions of system of Linear Equations.

CO6: Apply integrals in Biotechnology problems.

Course Articulation Matrix

	PROGRAMME OUTCOMES (POs)												PSOs		
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	2		2							2	3	3	
CO2	3	3	2		2							2	3	3	
CO3	3	3	2		2							2	3	3	
CO4	3	3	2		2							2	3	3	
CO5	3	3	2		2							2	3	3	

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 **DIAGONALIZATION OF A REAL SYMMETRIC MATRICES** **8+3**

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

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

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

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

Definite and Indefinite integrals – Substitution rule – Integration by parts – Double integrals – Double integrals in polar coordinates – Simple problems – Area enclosed by plane curves –Triple integrals in Cartesian coordinates – Volume of solids as Triple integral in Cartesian coordinates – Simple Problems – Applications of Integral calculus in Biotechnology.

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

Higher order linear differential equations with constant coefficients – Cauchy's linear equations

– 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
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Coimbatore 641 062.

20PH102 **APPLIED PHYSICS FOR BIOSCIENCES** **L T P C**
3 0 0 3

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
- CO6: Describe the unit cell characteristics and the growth of crystals.

Course Articulation Matrix

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

3 - High, 2 - Medium, 1 – Low

UNIT I **FREE ELECTRON AND BAND THEORIES OF SOLIDS** **6**

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

UNIT II **SEMICONDUCTING MATERIALS** **6**

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

UNIT III **SUPER CONDUCTOR 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, Superparamagnetism- Applications

UNIT IV **DIELECTRIC MATERIALS** **6**

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

UNIT V **NANO STRUCTURE 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

REFERENCE BOOKS

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

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20PH111 **APPLIED PHYSICS LABORATORY**

L	T	P	C
0	0	2	1

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
- CO6.: Determine the band gap energy of a semiconductor

Course Articulation Matrix

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

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 using Air wedge method
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. Energy band gap using p-n junction
10. 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 Phvsics***, Second edition, -New age International Publication, 2015.

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20CS101	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.

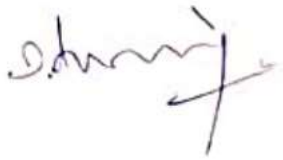
TOTAL: 45 HOURS

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.



20CS112 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

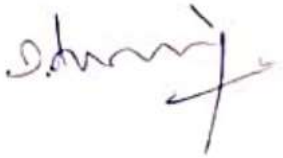
TOTAL: 30 HOURS

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.



20BT101 **INTRODUCTION TO BIOTECHNOLOGY**

L	T	P	C
3	0	0	3

Course Objectives

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

Course Outcomes

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

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

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															
5															
6	3	2	2	1	3								1	2	

3 - High, 2 - Medium, 1 – Low

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

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

UNIT II PLANT BIOTECHNOLOGY **9**

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

UNIT III ANIMAL BIOTECHNOLOGY **9**

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

UNIT IV MICROBIAL BIOTECHNOLOGY **8**

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

UNIT V FOOD AND BEVERAGE BIOTECHNOLOGY **9**

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

TOTAL: 45 HOURS

TEXT BOOKS

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

REFERENCES

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

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20BT112 **INTRODUCTION TO BIOTECHNOLOGY LABORATORY**

L	T	P	C
0	0	2	1

Course Objectives

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

Course Outcomes

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

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

Course Articulation Matrix

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

3 - High, 2 - Medium, 1 – Low

List of Experiments

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

TOTAL: 30 HOURS

TEXT BOOKS

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

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Sri Shakthi Institute of Engineering
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Coimbatore - 641 062. TN,India.

20BT111	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

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

20AG112 **CROP PRODUCTION-I LABORATORY**

L	T	P	C
0	0	4	2

Course Objectives

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

Course Outcomes

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

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

Course Articulation Matrix

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

3 - High, 2 - Medium, 1 – Low

List of Components

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

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

TOTAL: 30 HOURS

TEXT BOOKS

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

REFERENCES

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

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

20TA101 **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

20ML101 **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

https://e-resources.saraswatihouse.com

20EL101	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

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

REFERENCES

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

WEB RESOURCES

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

M.h.
(HOD/English)

SEMESTER II

20EN201	APPLIED ENGLISH SKILLS	L	T	P	C
		2	1	0	3

Course Objectives

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

Course Outcomes

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

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

Course Articulation Matrix

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

3 - High, 2 - Medium, 1 – Low

UNIT I APPLIED GRAMMAR 9

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

UNIT II READING 9

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

UNIT III LISTENING COMPREHENSION 9

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

UNIT IV SPEAKING 9

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

UNIT V PRINCIPLES OF WRITING 9

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

TOTAL: 45 HOURS

TEXT BOOKS

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

REFERENCES

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

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

M.h.
(HOD/English)

20CH202 **CHEMISTRY FOR BIOTECHNOLOGY** **L T P C**
3 0 0 3

Course Objectives

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

Course Outcomes

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

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

Course Articulation Matrix

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

3 - High, 2 - Medium, 1 – Low

UNIT I AQUATIC CHEMISTRY 10

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

UNIT II FUELS 10

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

UNIT III NANOMATERIALS 8

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

UNIT IV INSTRUMENTALS METHODS OF ANALYSIS 8

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

UNIT V CHEMICAL ASPECTS OF BIO TECHNOLOGY 9

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

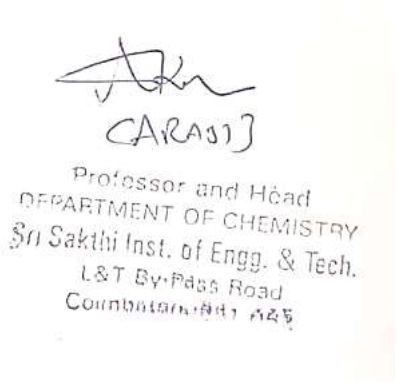
TOTAL: 45 HOURS

TEXT BOOKS

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

REFERENCES

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



20CH212 **CHEMISTRY FOR BIOTECHNOLOGY LABORATORY**

L	T	P	C
0	0	2	1

Course Objectives

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

Course Outcomes

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

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

Course Articulation Matrix

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

3 - High, 2 - Medium, 1 – Low

List of Experiments

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

TOTAL: 45 HOURS

TEXT BOOKS

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

REFERENCES

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

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

CARAJ]

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20MA203	LAPLACE TRANSFORMS AND ADVANCED CALCULUS FOR BIOTECHNOLOGISTS	L	T	P	C
		3	0	0	3

Course Objectives

- Engineering Mathematics is an essential tool for describing and analyzing engineering process and systems.
- It enables precise representation and communication of knowledge.
- The objective of the course is to expose students to understand the basics and importance of Laplace Transforms, 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

- CO1. Apply the Laplace transformation to solving the differential and integral equation.
- CO2. Apply the principles of partial differentiation to transform a function from one form to another and also to find the optimal values of functions of several variables.
- CO3. Perform vector calculus operations such as gradient, divergence and curl in vector and scalar fields, also apply the techniques of line, surface and volume integrals to solve application problems.
- CO4. Gain knowledge to construct the analytic function and to find the image of given region under conformal mapping.
- CO5. Gain knowledge to solve the problems by using complex integration.

Course Articulation Matrix

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

3 - High, 2 - Medium, 1 – Low

UNIT I LAPLACE TRANSFORMS AND ADVANCED CALCULUS FOR BIOTECHNOLOGY 9+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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20CS201 **PROGRAMMING IN C AND DATA STRUCTURES**

L	T	P	C
3	0	0	3

Course Objectives

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

Prerquisite

Computational Thinking and Problem Solving

Course Outcomes

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

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

Course Articulation Matrix

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

3 - High, 2 - Medium, 1 – Low

UNIT I POINTERS **9**

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

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

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

UNIT III INTRODUCTION TO DATA STRUCTURES **9**

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

UNIT IV LIST **8**

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

UNIT V STACK AND QUEUE **9**

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

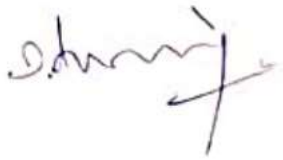
TOTAL: 45 HOURS

TEXT BOOKS

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

REFERENCES

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



20CS212 **PROGRAMMING IN C AND DATA STRUCTURE LABORATORY**

L	T	P	C
0	0	2	1

Course Objectives

The course aims to provide the students

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

Course Outcomes

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

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

Course Articulation Matrix

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

3 - High, 2 - Medium, 1 – Low

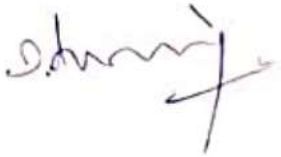
List of Experiments

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

TOTAL: 30 HOURS

TEXT BOOKS

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



20BT201 **CELL BIOLOGY**

L	T	P	C
3	0	0	3

Course Objectives

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

Course Outcomes

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

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

Course Articulation Matrix

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

3 - High, 2 - Medium, 1 – Low

UNIT I CELL STRUCTURE AND FUNCTIONAL OF ORGANELLES 9

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

UNIT II MEMBRANE ARCHITECTURE AND FUNCTION 9

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

UNIT III INTERCELLULAR INTERACTION 9

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

UNIT IV SPECIALIZED CELL TYPES 9

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

UNIT V CELL CYCLE AND REGULATION 9

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

TOTAL: 45 HOURS

TEXTBOOKS

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

REFERENCES

1. Sadava, D.E. “Cell Biology: Organelle Structure and Function”, Panima Publishing, 2004.

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

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20BT212 **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

- CO1. : Study the cell morphology using microscopic techniques
- CO2. : Calculate the cell concentration using haemocytometer in unit volume
- CO3. : Determine cell viability using membrane permeability assay
- CO4. : Identification of cellular components using various labelling techniques
- CO5. : Distinguish different stages of Mitotic cell division
- CO6 : 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	2				3				3				3		
2					3				3				3		
3									3				3		
4					3				3				3		
5	1								3				3		
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

TEXTBOOKS

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

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20BT202 **MICROBIOLOGY**

L	T	P	C
3	0	0	3

Course Objectives

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

Course Outcomes

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

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

Course Articulation Matrix

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

3 - High, 2 - Medium, 1 – Low

UNIT I INTRODUCTION TO MICROBIOLOGY **9**

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

UNIT II BASIC MICROBIAL STRUCTURE, GROWTH AND REPRODUCTION **9**

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

UNIT III CONTROL OF MICROORGANISMS **9**

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

UNIT IV MICROBIAL PRODUCTION OF METABOLITES **9**

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

UNIT V MICROBIAL FERMENTATIONS AND FOOD **9**

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

TOTAL: 45 HOURS

TEXTBOOKS

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

REFERENCES

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

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20BT213 **MICROBIOLOGY LABORATORY**

L	T	P	C
0	0	2	1

Course Objectives

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

Course Outcomes

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

- CO1. Examine microbes using the various microscopic techniques.
- CO2: Analysis the staining techniques for visualizing microbes.
- CO3. Explain microbial cell structure, growth and metabolism
- CO4.Understand the micrometry and different staining techniques
- CO5: Study of different cultivation techniques
- CO6:Apply the different biochemical test for identification of samples.

Course Articulation Matrix

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

TEXTBOOKS

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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20BT211	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

3 - High, 2 - Medium, 1 – Low

GUIDELINES

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

Total:45 Hours

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SEMESTER III

20BT301	ENVIRONMENTAL SCIENCE FOR BIOTECHNOLOGY	L	T	P	C
		2	0	0	2

Course Objectives

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

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

Course Outcomes

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

- CO1 : Identify the key concepts and scope of biotechnology in environmental protection
- CO2 : Summarize wastewater characteristics and treatment protocols
- CO3 : Construct systems for biotreatment of industrial effluents and solid wastes
- CO4 : Apply the concepts in developing environment-friendly bioproducts
- CO5 : Understand concepts of environmental monitoring
- CO6 : 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	3	1			2								1		
2	2				3			1					1		
3	3				2			1						2	
4	2	1			3									2	
5	2					3		1						2	
6	2	1				2	3			2					

3 - High, 2 - Medium, 1 – Low

UNIT I CONCEPT OF ENVIRONMENTAL BIOTECHNOLOGY 9

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

UNIT II BIOTECHNOLOGY AND POLLUTION ABATEMENT 9

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

UNIT III ROLE OF BIOTECHNOLOGY IN BIOREMEDIATION 9

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

UNIT IV BIOTECHNOLOGY AND VALUE ADDITION 9

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

UNIT V ENVIRONMENTAL MONITORING 9

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

TOTAL: 45 HOURS

TEXTBOOKS

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

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20BT312 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 : Summarize wastewater analysis and characterisation
- CO2 : Construct systems for biotreatment of industrial effluents and solid wastes
- CO3 : Apply the concepts in developing environment-friendly bioproduct
- CO4 : Demonstrate the basic electrical concepts and system components
- CO5 : Estimate the quantify energy demands and make comparison 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	1	1		2	3				1					2	
2	1	2		3	2				1					1	
3	1	3		2	1				1					1	
4															
5															
6	2	1				2	3			2					

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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20MA303 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

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

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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

3 - High, 2 - Medium, 1 – Low

UNIT I FOURIER SERIES 9

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

UNIT II FOURIER TRANSFORM 9

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

UNIT III BOUNDARY VALUE PROBLEM 9

One dimensional heat flow (concept only) – Solution of one dimensional heat equation (excluding insulated ends) by Fourier series – Two dimensional heat flow (concepts only) – Steady state solution of two dimensional heat equation in cartesian coordinates (excluding insulated edges): Long plates and finite plates by Fourier series – 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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	TRANSFORMS AND NUMERICAL METHODS FOR BIOTECHNOLOGY LABORATORY	L	T	P	C
20MA313		0	0	2	1

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

- CO1. Apply the concepts of the Fourier series for the Periodic function.
- CO2. Analyse the given system using the Fourier transform techniques.
- CO3. Solve the one dimensional heat equation using the Fourier series techniques.
- CO4. Apply Numerical techniques for solving the problems involving the interpolation concepts.
- CO5. Apply Numerical techniques for solving the problems involving a differentiation and Integration concepts.
- CO6.Apply the concepts thought in the transform methods in biotechnology

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2													
2	2	2													
3	2	2													
4	2	2													
5	2	2													
6	2	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. Array Operators- Array Multiplications , Transpose , Inverse an Rank
5. Calculate the roots of the polynomials.
6. Solve exponential, trigonometric and logarithmic functions.
7. Solve a system of equations.
8. Evaluate Definite and Indefinite Integrals of the given function.
9. Solve problems using Double Integrals.
10. Solve problems using Trapezoidal rule.
11. 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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20BT302 **UNIT OPERATION AND UNIT PRINCIPLES**

L	T	P	C
2	0	0	2

Course Objectives

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

Course Outcomes

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

- CO1 : Ability to understand the basic principle behind various mixers used in chemical Industries
- CO2 : Elaborate the knowledge of basic principles of fluid mechanics
- CO3 : Ability to analyze fluid flow measurements
- CO4 : Ability to perform simultaneous material and energy balances
- CO5 : Elaborate the principles of heat exchangers
- CO6: Apply the material balances solving in biotechnology process industry.

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	3	2		2										3	

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. I. Bhatt and S. B Thakore., "Stoichiometry", 5thEdn., Tata McGraw-Hill Publishing Company, New Delhi
4. B. Lakshmikutty, K. V. Narayanan, "Stoichiometry and Process Calculations", PHI Publishers, Delhi

REFERENCES

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

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20BT313	UNIT OPERATION AND UNIT PRINCIPLES LABORATORY	L	T	P	C
		0	0	2	1

Course Objectives

- To provide hands on training for the performance of sterilization and aseptic maintenance.
- To develop the skills for preparing the equipment through standard calibration protocol.
- To develop the skills in line with industry oriented biochemical experiments.

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
- CO6: Apply the techniques in different unit processes.

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

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. I. Bhatt and S. B Thakore., "Stoichiometry", 5thEdn., Tata McGraw-Hill Publishing Company, New Delhi
4. B. Lakshmikutty, K. V. Narayanan, "Stoichiometry and Process Calculations", PHI Publishers, Delhi

REFERENCES

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

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20BT303 **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

- CO1. Learn the fundamental structure and reactions of carbohydrates
- CO2. Correlate the structure and biochemical processes of lipids with applications in biotechnology
- CO3.Interpret the metabolic disorders of amino acid metabolism and evaluate the functions of proteins
- CO4: Imbibe the conformation and metabolism of nucleic acids and analyze the metabolic disorders of nucleic acids
- CO5: Conceptualize the biological oxido-reduction reactions and respiratory chain
- CO6: Summarize the principles and generation of energy in batteries, nuclear reactors, solar cells, wind mills and fuel 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	2	3	3						1	1	2	2
2	2	2	2	3	2	2						3	1	3	3
3	3	3	3	2	1	3						2	2	2	2
4	2	2	2	2	2	2						2	1	2	2
5	1	1	3	1	1	3						3	2	3	3
6	2	2	1	2	1	1			1	3	1	3	3	1	2

3 - High, 2 - Medium, 1 – Low

UNIT I CARBOHYDRATES **9**

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

Case Study: Importance of zinc implementation in diabetes mellitus.

UNIT II LIPIDS **9**

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

UNIT III AMINO ACIDS AND PROTEINS **9**

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

Case study – Role of proteins in Alzheimer's disease

UNIT IV NUCLEIC ACIDS **9**

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

UNIT V BIOENERGITICS AND OXIDATIVE PHOSPHORYLATION **9**

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

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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20BT314 **BIOCHEMISTRY LABORATORY**

L	T	P	C
0	0	2	1

Course Objectives

- The course make students learn the basic units of measurements and standardisation of various buffer solutions
- The course aims to learn and understand the principles behind the qualitative and quantitative estimation of biomolecules (proteins, carbohydrates, lipids, metabolites etc.,)

Course Outcomes

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

- CO1 evaluate the calculation for various buffer solutions
- CO2 describe various types of biochemical reaction
- CO3 know the various qualitative and quantitative techniques.
- CO4.determine the amount of the given acids using conductometric titrations
- CO5. Estimate the amount of the given acids using pH titrations
- CO6: Estimate the lipids and analysis by TLC

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	1
2	1	2	2	3										1	3
3	1	3	3	2										1	3
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. Practical Biochemistry by R.C. Gupta and S. Bhargavan.
2. Introduction of Practical Biochemistry by David T. Phummer. (II Edition)

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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20BT304 **ENZYME TECHNOLOGY**

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

- CO1. Describe the basics of enzymes, nomenclature and classification.
- CO2. Apply the knowledge to derive the kinetics for enzymes, Explain types of enzyme inhibitors.
- CO3. Illustrate and apply the different techniques for immobilization of enzymes and kinetics.
- CO4. Apply the knowledge on purification and characterization of enzyme.
- CO5. Discuss the applications of enzymes in different industries.
- CO6.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	3	1			2								1		
2	2				3								1		
3	3				2									2	
4	2	1			3									2	
5	2					3								2	
6	1	1	2	1							3				

3 - High, 2 - Medium, 1 – Low

UNIT I INTRODUCTION TO ENZYMES **9**

Introduction of enzymes: Nomenclature and Classification of enzymes; concept of active site, substrate binding site, allosteric site, and energetics of enzyme substrate complex formation; specificity of enzyme; Mechanisms of enzyme action; 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 Edition, Springer, 2003.
5. Faber K , Biotransformations in Organic Chemistry, IV edition , Springer

REFERENCES

1. Ashok Pandey, Collin Web, Carlos Ricard and Christian Larroche, (2006); Enzyme Technology, 2nd Edition, Springer Science + Business Media Inc. and Asiatech Publishers, Netherlands.
2. Nicholas Price and Lewis Stevens, (2009); Fundamentals of Enzymology, 3rd Edition, Oxford University Press, India.
3. Industrial Enzymology. Eds. Godfrey and West, Macmillan Press Ltd. 2nd Edition1996.

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20BT315 **ENZYME TECHNOLOGY LABORATORY**

L	T	P	C
0	0	2	1

Course Objectives

- To provide hands on training for the performance of enzyme and its activity.
- To develop the skills for preparing the equipment through standard assay protocol.
- To develop the skills in line with industry oriented enzymology experiments.

Course Outcomes

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

- CO1. Understand the basics of enzymes and its isolation.
- CO2. Realize importance of assay methods of enzyme activity.
- CO3. Gain experience in enzyme kinetics and immobilized enzyme studies.
- CO4.Analyse the physical parameters in the given enzymes
- C05.Evaluate the chemical parameters in the given enzymes
- C06.Apply the Km, Vmax concept in enzymes kinetic studies

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

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. Sadasivam. S and Manickam, A (2008), Biochemical Methods 3rd Ed, New Age. International Publishers, India.
2. Analytical Biochemistry and Separation Techniques. (English, paperback, Dr. P. Palanivelu) Twenty first Century Publications, New Delhi.
3. Ninfa. A.J, and Ballou. D.P (1998) Fundamental Lab approaches for biochemistry and biotechnology, 2nd Edn, Oxford University press, UK.

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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20BT305 **BASICS OF BIOINFORMATICS**

L	T	P	C
3	0	0	3

Course Objectives

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

Course Outcomes

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

- CO1: Use bioinformatics tools with programming skills.
- CO2: Apply different database for the analysing BLAST and FASTA
- CO3: Alignment of nucleotide and protein sequences using Phylogenetic Analysis
- CO4: Predict gene and protein structure.
  CO5: Importance of Bioinformatics in different fields like Pharmaceuticals and gene prediction algorithms
- CO6: Apply the protein structure in the ncbi link

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1		1		2				2				1		
2	1	2	2		2	3								2	
3		2				3	2	1		2				2	
4		2				3	2	1			1	3		2	
5							2	1				3		2	
6	3	3	2	2	2							2	2	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 matrix, PAM, searching sequence databases by sequence similarity-BLAST and FASTA.

UNIT III PHYLOGENY ANALYSIS **9**

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

UNIT IV STRUCTURAL BIOINFORMATICS **9**

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

UNIT V APPLICATIONS OF BIOINFORMATICS **9**

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

TOTAL: 45 HOURS

TEXTBOOKS

1. Bioinformatics : The Machine Learning Approach, by Pierre Baldi and Soren Brunak
2. Lehninger Principles of Biochemistry 6th Edition by David L. Nelson, Michael M. Co
3. Introduction To Bioinformatics 4th edition by ARTHUR M LESK

REFERENCES

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

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20BT316 **BASICS OF BIOINFOMATICS LABORATORY**

L	T	P	C
0	0	2	1

Course Objectives

- To introduce the different types of Database for Sequence Analysis
- To understand the importance of Sequence Alignment

Course Outcomes

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

- CO1: To understand different Databases for Sequence Analysis
- CO2: BLAST and FASTA helps in the comparison of Protein and DNA sequence
- CO3: To understand the Phylogentic analysis of Sequence
- CO4: To Understand different types of Alignment in sequence
- CO5: To Understand the importance of Chem-Informatics in Bioinformatics
- CO6: Study of gene sequences using bioinformatics tools.

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															
5				1					1			2			
6			3		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 (Rasmol, Deepview, Cn3D)
11. Submission of sequences to databases

TOTAL: 30 HOURS

TEXTBOOKS

1. Attwood, T. and P.S. David. 2006. Introduction to Bioinformatics. Pearson Education Ltd., New York.
2. Baxevanis, 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.

REFERENCES

1. Attwood T.K. and Higgs, P.G. 2005. Bioinformatics and molecular evolution. Blackwell Publishers, London.
2. Lesk, A.M. 2002. Introduction to Bioinformatics. Oxford University Press.

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20BT311	ENGINEERING EXPLORATION III	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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20EN301 **CAREER ENHANCEMENT PROGRAM – I**

L	T	P	C
1	1	0	1

Course Objectives

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

Course Outcomes

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

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

Course Articulation Matrix

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

3 - High, 2 - Medium, 1 – Low

UNIT I **6**

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

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

UNIT II **6**

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

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

UNIT III **6**

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

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

UNIT IV **6**

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

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

UNIT V **6**

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

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

TOTAL: 30 HOURS

TEXTBOOKS

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

REFERENCES

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

M.h.
(HoD/English)

SEMESTER IV

20MA403	PROBABILITY AND STATISTICS FOR BIOTECHNOLOGY	L	T	P	C
		3	0	2	4

Course Objectives

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

PREREQUISITES

- Differentiation
- Integration
- Statistics

Course Outcomes

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

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

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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

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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		L	T	P	C
20MA413	**PROBABILITY AND STATISTICS FOR BIOTECHNOLOGY LABORATORY**	**0**	**0**	**2**	**1**

Course Objectives

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

Course Outcomes

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

- CO1: 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
- CO6:Evaluate P,C,NP chart using mat lab tool

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	2			2								2	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, 20.

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20BT401 APPLIED THERMODYNAMICS FOR BIOTECHNOLOGISTS

L	T	P	C
3	0	0	2

Course Objectives

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

Course Outcomes

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

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

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	1	1	2										
2	1	2	2	1	2										
3	2	2	2	2	3								3	1	
4	1	1	1	2	3								2	1	
5		1	1	3	3								3	2	
6	3	2	2	1							3	2	3		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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20BT412 APPLIED THERMODYNAMICS FOR BIOTECHNOLOGISTS LABORATORY

L	T	P	C
0	0	2	1

Course Objectives

- To learn practical knowledge in thermodynamics studies on boiling and condensation
- To create deeper understanding on different types of flow rate through pipe
- To provide knowledge on pressure drop studies

Course Outcomes

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

- CO1: Outline the application of different types of heat transfer studies
- CO2: Describes the principle of distillation methods
- CO3: Illustrate the studies of pressure drops in packed bed and fluidized bed column
- CO4: Evaluate the different thermodynamics properties
- C05: Analysis the different flow rate.
- CO6: Apply the thermodynamic properties in industrial reactors.

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	3	2	1								2	1	
4	1	2	3	2	1								2	1	
5	1	3	2	1									1	1	1
6	1	2	2	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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20BT402 **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

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

Course Articulation Matrix

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

REFERENCE

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

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20BT413 **PLANT BIOTECHNOLOGY LABORATORY**

L	T	P	C
0	0	2	1

Course Objectives

- To familiarize the students with basic concepts and advanced research areas in plant biotechnology

Course Outcomes

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

- CO1: Understand the role of plant tissue culture in Biotechnology.
- CO2: Explore the principles underlying plant cell/organ culture from explants.
- CO3: Realize in vitro based plantlet and hybrid production of plants.
- CO4: Estimate the isolation of protoplasts from plants
- CO5: Estimate the Cell suspension culture of various plants
- CO6: Study of micro propagation project.

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

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. Plant Tissue Culture: Theory and Practice, a Revised Edition.Elsevier Science. S.S. Bhojwani and M.K. Razdan (Eds.).
2. Plant Cell Culture Protocols. Humana Press. Robert D. Hall.
3. Experiments in Plant Tissue Culture.Cambridge University Press. John H. Dodds, Lorin W. Roberts
4. Plant Cell Culture. Springer-Verlag Berlin Heidelberg.L. A. Anderson, J. D. Phillipson, M. F. Roberts (auth.)
5. Plant Tissue Culture: An Introductory Text. Springer India. Sant Saran Bhojwani, Prem Kumar Dantu (auth.)

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20BT403 **PROGRAMMING FOR BIOLOGISTS**

L	T	P	C
3	0	0	2

Course Objectives

- To introduce students to the foundations of computing, programming and problem solving.
- To develop basic programming skills necessary for engineering education.

Course Outcomes

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

- CO1: To understand Complexity of Operating system as a software
- CO2: Python application in Biotechnology will be inculcated
- CO3: Validate the program for all the possible inputs.
- CO4: R programming to Identify an appropriate approach to solve the problem with regard to sequence statistic
- CO5: R studio with its application in Image analysis
- CO6: Study of microarray techniques for DNA sequencing

Course Articulation Matrix

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

3 - High, 2 - Medium, 1 – Low

UNIT I BASICS OF LINUX/UNIX **9**

Introduction to operating systems, difference between Linux, Unix, Windows, architecture, basic commands, regular expression, file handling, installing NCBI packages, Text processing and parsing, shell programming, troubleshooting and shortcuts.

UNIT II PYTHON LANGUAGE **9**

Introduction to Python, Syntax, indentations, data types, input – output, variables – scalars, arrays, hashes, dictionary, lists, functions, operators, flow control, loops, sorting, Biopython applications

UNIT III 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.

UNIT IV STATISTICAL COMPUTING USING R PROGRAMMING **9**

R programming, Introduction, Overview – Variable, Data types, Operators, Useful Function, Data frames, Plotting the graphs and Pie charts.

UNIT V BIOLOGICAL DATA ANALYSIS USING R PROGRAMMING **9**

R studio-Working with images and strings, Library functions, Bioconductor, Large datasets, Transcription and translation of DNA sequence using seqinr, Microarray data analysis

TOTAL: 45 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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20BT414 **PROGRAMMING FOR BIOLOGISTS LABORATORY** **L T P C**
0 0 2 1

Course Objectives

- It enable the student to understand the application of programming in Biotechnology
- It enables the student to find out the complex sequence analysis through different programm techiniques.

Course Outcomes

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

- CO1. Implementation of Basics Operating System.
- CO2: Application of Python program for Sequence analysis.
- CO3. Application of Bio Perl in finding the sequence Alignment.
- CO4. Implementation of R programming in resolving EB Image Analysis.
- CO5: R Studio and its appications will be learnt.
- CO6: Study of microarray techniques for DNA sequencing

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	1		2	1			2		2			3			

3 - High, 2 - Medium, 1 – Low

List of Experiments

1. Basic UNIX comments
2. Python-Write a program to perform different arithmetic operations on numbers.
3. Python- Write a program to create, concatenate and print a string and accessing sub string from a given string.
4. Bio python – finding the amino acid weight
5. Bio Perl – Gene from Genscan
6. Bio Perl-To write a program to count the stop and start codons in the sequence
7. Bio Perl – To write a program to perform DNA mutation.
8. R programming- Introduction and packages, EB Image analysis
9. Basic statistical operations with R programming
10. R programming –Microarray data analysis

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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20BT404 **MOLECULAR BIOLOGY**

L	T	P	C
3	0	0	3

Course Objectives

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

Course Outcomes

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

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

Course Articulation Matrix

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

3 - High, 2 - Medium, 1 – Low

UNIT I NUCLEIC ACIDS AND DNA REPLICATION **9**

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

UNIT II DNA REPLICATION & REPAIR **9**

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

UNIT III TRANSCRIPTION **9**

Features of promoters and enhancers; Transcription factors; Classes of RNA molecules; Transcription 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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20BT415 **MOLECULAR BIOLOGY LABORATORY**

L	T	P	C
0	0	2	1

Course Objectives

- To make wider practical dexterity in the area of molecular biology tools and techniques
- To acquire practical skill in isolating and analyzing nucleic acid from living cells

Course Outcomes

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

- CO1: Execute the isolation of genomic DNA from bacteria, plant and animal tissues
- CO2: Execute the quantification of DNA using analytical techniques
- CO3: Organize the restriction digestion and molecular weight determination of DNA
- CO4: Quantify the nucleic acid
- C05: Examine the purification of biomolecules by electrophoresis.
- CO6: express a gene and produce therapeutically valuable proteins

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	3	1											1		
5	2	2			3				2			2	3	2	
6		3	3	3			3	3	3		2	3	3	2	2
Avg															

3 - High, 2 - Medium, 1 – Low

List of Experiments

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

TOTAL: 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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20BT405 **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

- CO1: Understand the basic principles of fermentation technology for industrial production
- CO2: Remember the importance of bioprocess for the production of metabolites
- CO3: Explain the steps involved in the design of fermentation types to improve the biologically important products via modern biotechnology
- CO4: Study the fermentation methods for producing commercially important bioproducts to meet the needs of the society
- CO5: To analyze the globally important and valuable products like enzymes and biopesticides through new processes to make bio-products in economically feasible way.
- CO6: Study of 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	2								3				2		3
2	3	3		2	3					2		2	3		3
3	3	2	3							3			3		2
4				3	3				2				2		2
5	3	3		2									3		2
6	3	3	3	3	1	1	1				2	2	3	2	3

3 - High, 2 - Medium, 1 – Low

UNIT I INTRODUCTION TO INDUSTRIAL BIOPROCESS 9

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

UNIT II STRAIN IMPROVEMENT AND MEDIA PREPARATION 9

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

UNIT III FERMENTATION PROCESS 9

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

UNIT IV PRODUCTION OF PRIMARY AND SECONDARY METABOLITES 9

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

UNIT V PRODUCTION OF MODERN BIOTECHNOLOGICAL PRODUCT 9

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

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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20BT416 **BASIC INDUSTRIAL BIOTECHNOLOGY LABORATORY**

L	T	P	C
0	0	2	1

Course Objectives

- To introduce students to the principles of fermentation principles
- To solve the problems in production of useful products using fermentation

Course Outcomes

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

- CO1. Analyse the microbial growth stages
- CO2: Apply the fermentation principles for milk based products
- CO3. Interpret the preparation of wine and beer
- CO4. Classify the biofertilizers.
- CO5: Understand the microbial enzymes production
- CO6. Describe the production of vermicompost and single cell proteins

Course Articulation Matrix

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

3 - High, 2 - Medium, 1 – Low

List of Experiments

1. 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. 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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20BT411	ENGINEERING EXPLORATION IV	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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20EN401 **CAREER ENHANCEMENT PROGRAM– II**

L	T	P	C
1	1	0	1

Course Objectives

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

Course Outcomes

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

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

Course Articulation Matrix

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

3 - High, 2 - Medium, 1 – Low

UNIT I **6**

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

UNIT II **6**

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

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

UNIT III **6**

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

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

UNIT IV **6**

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

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

UNIT V **6**

Applied Language Skills : Taking up certificate speaking test

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

TOTAL: 30 HOURS

TEXT BOOK

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

REFERENCE

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

M.h.
(HoD/English)

SEMESTER V

20BT501	TRANSPORT PHENOMENA	L	T	P	C
		3	1	0	4

Course Objectives

- To impart knowledge about individual and simultaneous momentum, heat and mass transfer, model development along with appropriate boundary conditions.

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
- CO6: Study of different separation techniques

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	1													1	

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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20BT502 **GENETIC ENGINEERING**

L	T	P	C
3	0	0	3

Course Objectives

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

Course Outcomes

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

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

Course Articulation Matrix

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

3 - High, 2 - Medium, 1 – Low

UNIT I ENZYMES USED IN GENETIC ENGINEERING **9**

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

UNIT II VECTORS FOR GENE CLONING AND EXPRESSION **9**

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

UNIT III CONSTRUCTION OF LIBRARIES **9**

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

UNIT IV TECHNIQUES FOR GENETIC ENGINEERING **9**

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

UNIT V APPLICATIONS OF GENETIC ENGINEERING **9**

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

Case Study:

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

TOTAL: 45 HOURS

TEXT BOOK

1. Smita Rastogi and Neelam Pathak, Genetic Engineering, Oxford University Press, 2009

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

REFERENCE

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

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20BT512 **GENETIC ENGINEERING LABORATORY**

L	T	P	C
0	0	2	1

Course Objectives

- To build sound practical knowledge in gene amplification using genetic engineering tools
- To acquire practical skills in gene cloning techniques
- To create deeper understanding on various techniques of gene manipulation

Course Outcomes

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

- CO1: Perform the bacterial gene amplification using PCR
- CO2: Demonstration of gene cloning using genetic engineering tools and techniques
- CO3: Organise the Plasmid profiling using chemical lysis method
- CO4: Construct recombinant DNA for microbial enzymes
- CO5: Preparation of vectors for cloning and expression of gene of interest
- CO6: Apply the genes in sequential order and find the protein structure

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

3 - High, 2 - Medium, 1 – Low

List of Experiments

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

TOTAL: 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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20BT503 **BIOPROCESS ENGINEERING** **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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20BT513 **BIOPROCESS ENGINEERING LABORATORY**

L	T	P	C
0	0	2	1

Course Objectives

- To provide practical knowledge with the basics of sterilization kinetics.
- To acquire practical skills on fermentor handling and production process
- To get knowledge on medium optimization techniques using software tools

Course Outcomes

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

- CO1: Evaluate the sterilization kinetics of media and able to design the holding time for batch sterilization.
- CO2: Develop a suitable mathematical model for batch, fed-batch and continuous fermentation and able to simulate and evaluate the constants for microbial growth.
- CO3: Provide knowledge on RTD
- CO4: Apply the knowledge of various optimization methods to design the media for fermentation broth.
- CO5: Understand and analyse the application of various bioreactors and importance of mass transfer effect in bioprocess engineering.
- CO6: solve problems related to heat transfer kinetics in bioreactors

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

TOTAL: 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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20BT504 **INSTRUMENTAL METHODS OF ANALYSIS**

L	T	P	C
3	1	0	4

Course Objectives

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

Course Outcomes

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

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

Course Articulation Matrix

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

3 - High, 2 - Medium, 1 – Low

UNIT I INTRODUCTION TO SPECTROMETRY **9**

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

UNIT II MOLECULAR SPECTROSCOPY **9**

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

UNIT III CHROMATOGRAPHIC TECHNIQUES **9**

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

UNIT IV RADIOACTIVE ISOTOPE TECHNIQUES AND ELECTROPHORESIS **9**

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

UNIT V CENTRIFUGATION AND STRUCTURAL ELUCIDATION METHODS 9

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

TOTAL: 45 HOURS

TEXT BOOKS

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

REFERENCES

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

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20EN501 **CAREER ENHANCEMENT PROGRAM – III**

L	T	P	C
1	1	0	1

Course Objectives

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

Course Outcomes

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

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

Course Articulation Matrix

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

3 - High, 2 - Medium, 1 – Low

UNIT I **6**

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

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

UNIT II **6**

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

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

UNIT III **6**

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

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

UNIT IV **6**

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

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

Interpretation.

UNIT V **6**

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

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

TOTAL: 30 HOURS

TEXTBOOKS

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

REFERENCES

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

M.h.
(HoD/English)

20BT511	ENGINEERING EXPLORATION V	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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SEMESTER VI

20BT601	APPLIED CHEMICAL REACTION ENGINEERING	L	T	P	C
		3	1	0	4

Course Objectives

To enable the students

- Understand types of reactors and find rate constants for different reactions.
- Enable students to calculate selectivity, reactivity, and yield for mixed reactions
- Understand principles of reaction kinetics and rate equations.
- Examine how far real reactors deviate from ideal.

Course Outcomes

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

- CO1: Apply the principles of reaction kinetics, formulate rate equations and analyse the batch reactor data
- CO2: Solve problems involving conversion and space time for different types of reactors
- CO3: Analyze the experimental kinetic data
- CO4: Evaluate selectivity, reactivity and yield for parallel and mixed reactions
- CO5: Examine how far real reactors deviate from the ideal
- CO6: Apply the chemical formula for the research purposes
-

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1			2									1			
2		1					209								
3	1													1	
4			1							2			1		
5															1
6	2					2			3		3		2	2	
6	2					2			3		3		2	2	

3 - High, 2 - Medium, 1 – Low

UNIT I REACTION KINETICS **9**

Reactions: Classifications, order and molecularity, rate equation, rate constant; Concentration and temperature dependence, Activation energy; Search for reaction mechanism; Methods of analyzing batch reactor data: Integral and differential; Analysis of total pressure data obtained in constant volume system, Reaction kinetics of enzymatic reactions.

UNIT II IDEAL REACTOR **9**

Performance equations: batch, plug flow and mixed flow reactors; Space time and Space velocity; Size comparison of single reactors, multiple reactor systems, Recycle reactor and autocatalytic reactions, Reactors for bioprocess industries.

UNIT III NON-IDEAL REACTORS **9**

RTD: Reasons for non-ideality in reactors, RTD function and measurement, RTD in plug flow and mixed flow reactor, Conversion in non ideal flow, relation among E,F and C curve, non - ideal flow models: tank-in-series and dispersion models, Non-ideal models for bioreactors.

UNIT IV HETEROGENEOUS REACTING SYSTEM **9**

Heterogeneous reacting system: Introduction, Ideal contacting patterns, Solid catalysed reactions: Surface kinetics and pore resistance; Kinetics of non catalytic fluid particle systems: Progressive conversion model and shrinking core model; Determination of rate controlling step, Rate controlling step in adsorption.

UNIT V INDUSTRIAL REACTORS **9**

Reactors to carry out G/L reactions on solid catalysts - Trickle bed, slurry, three phase fluidized bed, fluid-fluid and fluid-particle reactors, Multiphase bioreactors.

TOTAL: 45 HOURS

TEXT BOOKS

1. Octave Levenspiel. Chemical Reaction Engineering., 3rd edition, Wiley.2014
2. Fogler, H. Scott. Elements of Chemical Reaction Engineering. PHI learning private limited, 1999
3. Nauman, E. Bruce. Chemical Reactor Design, Optimization, and Scaleup. John Wiley & Sons, 2008

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20BT602 **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

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

Course Articulation Matrix

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

3 - High, 2 - Medium, 1 – Low

UNIT I IMMUNE SYSTEM **9**

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

UNIT II CELLS OF IMMUNE SYSTEM **9**

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

UNIT III HUMORAL SYSTEM **9**

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

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

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

UNIT V CLINICAL IMMUNOLOGY **9**

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

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)

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20BT611 **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

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

- CO1: Aware of immune system cells and tissues.
- CO2: Demonstrate and evaluate various antigen-antibody interactions and techniques.
- CO3: Evaluate the immunological /clinical tests.
- Co4: Knowledge on blotting techniques.
- C05: Study of different diffusion techniques
- CO6: Study of ELISA.

Course Articulation Matrix

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

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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20EN601 **CAREER ENHANCEMENT PROGRAM – IV**

L	T	P	C
1	1	0	1

Course Objectives

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

Course Outcomes

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

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

Course Articulation Matrix

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

3 - High, 2 - Medium, 1 – Low

UNIT I **6**

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

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

UNIT II **6**

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

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

UNIT III **6**

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

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

UNIT IV **6**

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

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

UNIT V **6**

Applied Language Skills : Taking up certificate test in reading

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

TOTAL: 30 HOURS

TEXTBOOKS

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

REFERENCES

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

M.h.
(HoD/English)

20BT612	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

20MG701	PRINCIPLES OF MANAGEMENT AND PROFESSIONAL ETHICS	L	T	P	C
		3	0	0	3

Course Objectives

The course aims to provide the students

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

Course Outcomes

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

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

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

CO3: (Apply) Apply motivational theories and leadership qualities

CO4: (Apply) Apply human values in engineering ethics

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

Course Articulation Matrix

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

3 - High, 2 - Medium, 1 – Low

UNIT I MANAGEMENT CONCEPTS **10**

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

UNIT II PLANNING and ORGANISATION **9**

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

UNIT III DIRECTING AND CONTROLLING **9**

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

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

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

UNIT V RIGHTS, RESPONSIBILITY OF ENGINEERS AND GLOBAL ISSUES 8

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

TOTAL: 45 HOURS

TEXT BOOKS

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

REFERENCES

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

20BT701 **DOWNSTREAM PROCESSING** **L T P C**
3 1 0 4

Course Objectives

To enable the students

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

Course Outcomes

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

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

Course Articulation Matrix

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

3 - High, 2 - Medium, 1 – Low

UNIT I INTRODUCTION **9**

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

UNIT II PHYSICAL METHODS OF SEPARATION **9**

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

UNIT III ISOLATION OF PRODUCTS **9**

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

UNIT IV PRODUCT PURIFICATION **9**

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

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

Crystallization, drying and lyophilization in final product formulation.

TOTAL: 45 HOURS

TEXT BOOKS

1. Belter, P.A., E.L. Cussler and Wei-Houhu “Bioseparations – Downstream Processing for Biotechnology”, John Wiley, 1988.

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

REFERENCES

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

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20BT702 **BIOPHARMACEUTICAL TECHNOLOGY** **L T P C**
3 0 0 3

Course Objectives

- Introduce diverse sources and classes of biopharmaceuticals
- Expose students to various modes of drug delivery
- Build deeper understanding of application of biotechnology tools in the world of medicine

Course Outcomes

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

- CO1. Understand the difference between chemical and bio-based pharmaceuticals
- CO2. Apply the knowledge of biological effects of bioactive substances for their use as therapeutics
- CO3. Analyze the need for formulation of biopharmaceuticals
- CO4. Analyze various criteria for selection of drug carriers that result in effective drug delivery
- CO5. Evaluate drug action based on the difference in physiological functions of a host
- CO6. Understand the mechanism of action of Biopharmaceuticals

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

3 - High, 2 - Medium, 1 – Low

UNIT I INTRODUCTION **9**

Biopharmaceuticals - definition, classification, current status and future prospects. traditional pharmaceuticals of biological origin, generic and branded biopharmaceuticals, biosimilars - global and Indian scenario, advantages and issues concern with the use of biosimilars

UNIT II PRODUCTION AND THERAPEUTIC APPLICATIONS OF BIOPHARMACEUTICALS **9**

Cytokines - IFN-, IL-2; Hormones - Insulin, Human growth hormone; Antibodies - Monoclonal and Polyclonal, Vaccines - hepatitis B, Porcilis pesti; Anticoagulant – Hirudin

UNIT III FORMULATION OF BIOPHARMACEUTICALS **9**

Rational for formulation of biotherapeutics, formulation excipients - solubility enhancers, anti aggregating agents, buffers, cryoprotectants, antioxidants, methods to enhance shelf- life of protein based therapeutics, preservatives and packaging techniques

UNIT IV CONVENTIONAL DOSAGE FORMS AND NOVEL DRUG DELIVERY SYSTEMS (NDDS) **9**

Liquid dosage forms - Suspensions, emulsions; Semisolid dosage forms - Ointments, creams; Soild dosage forms - Tablets, Capsules; modes of NDDS - targeted, controlled and modulated, advantages and factors affecting NDDS

UNIT V MECHANISM OF ACTION OF BIOPHARMACEUTICALS **9**

Mechanisms of drug absorption, distribution and metabolism, factors governing absorption, distribution and metabolism of a drug, Pharmacokinetics and Pharmacodynamics of therapeutic peptides, Bioavailability and Bioequivalence

TOTAL: 45 HOURS

TEXTBOOKS

1. Daan J A Crommelin, Pharmaceutical Biotechnology, Taylor &Francis Group, 2nd Edition, 2010

2. Gary Walsh, Biopharmaceuticals: Biochemistry and Biotechnology, John Wiley & Sons, Inc., 2nd Edition, 2003
3. Rodney J. Y. Ho, Biotechnology and Biopharmaceuticals: Transforming Proteins and Genes into Drugs, John Wiley & Sons, Inc., 2ndEdition, 2013
4. Gary Walsh, Pharmaceutical Biotechnology: Concepts and Applications, John Wiley & Sons, Inc., 2007
5. Oliver Kayser and Heribert Warzecha, Pharmaceutical Biotechnology: Drug Discovery and Clinical Applications, John Wiley & Sons, Inc., 2nd Edition, 2012

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20BT703 **ANIMAL BIOTECHNOLOGY**

L	T	P	C
3	0	0	3

COURSE OBJECTIVE:

- To provide the basics and applications of animal cell culture.
- To inculcate knowledge about the micro manipulation technology and transgenic animal production.

COURSE OUTCOMES:

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

CO1: Exploit the biomolecular techniques for the study and diagnosis of infective and parasitic animal diseases, as well as for the formulation of innovative biotechnological vaccines

CO2: Perceive and deduce the contemplative ethical problems subjective to testing protocols involving animals.

CO3: Demonstrate various diagnostic and therapeutic techniques for the identification and curing of animal diseases.

CO4: Reckon and utilize the concept of gamete and embryo manipulation technology for the production of transgenic animals and cloning.

CO5: Acquire knowledge about the concept of transgenic animal production and its significance in biotechnology.

CO6: Develop the technique for 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	3												3	1
2						2		3							
3	2	3	2											2	2
4	2	2	2			1		2						3	2
5	3	2	2			1	2	2						3	1
6	2	3	2			1	2	2						3	2

3 - High, 2 - Medium, 1 – Low

UNIT I ANIMAL CELL CULTURE **9**

Introduction to basic tissue culture techniques, Equipment and instruments in ATC - Chemically defined and Serum free media - Animal cell cultures - Maintenance and preservation - Various types of cultures; Suspension cultures – Continuous flow cultures – Immobilized cultures - Somatic cell fusion - Organ cultures

UNIT II ANIMAL DISEASES AND THEIR DIAGNOSIS **9**

Bacterial and viral diseases in animals - Monoclonal antibodies – Diagnosis - Molecular diagnostic techniques; PCR - in-situ hybridization - Northern blotting, Southern blotting, RFLP.

UNIT III THERAPY OF ANIMAL DISEASES **9**

Recombinant cytokines – Therapeutic applications of monoclonal antibody, Vaccines - DNA, sub unit, cocktail vaccines - Gene therapy for animal diseases.

UNIT IV MICROMANIPULATION OF EMBRYO **9**

Micromanipulation technology - Equipment - Enrichment of x and y bearing sperms from semen samples – Artificial insemination - Germ cell manipulations – In vitro fertilization -Embryo transfer - Micromanipulation technology and breeding of farm animals.

UNIT V TRANSGENIC ANIMALS **9**

Concepts of transgenic animal technology; Strategies for the production of transgenic and knock out animals– significance in biotechnology - Stem cell cultures in production of transgenic animals.

TOTAL: 45 HOURS

TEXTBOOKS

1. Ranga M.M, “Animal Biotechnology”, 3rd Edition, Agrobios India Limited 2010.
2. Ramadass. P and Meera Rani. S, “Text Book of Animal Biotechnology”, Agrobios India Limited 2002.
3. Sasidhara.R, “Animal Biotechnology”, MJP Publishers, 2009.

REFERENCES

1. Ashish S.Varma and Anchal singh, “Animal biotechnology-Models in Discovery and Translation”, Elsevier publication, 2014

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20BT711 **PROJECT PHASE I**

L	T	P	C
0	0	3	2

Course Objectives

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

Course Outcomes

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

CO1 :Identify technically and economically feasible problems of social relevance

CO2 :Plan and build the project team with assigned responsibilities

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

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

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

CO6 :Deploy and support the solutions for better manageability and provide scope of improvability

Course Articulation Matrix

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

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

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SEMESTER-VIII

20BT811	PROJECT PHASE II	L	T	P	C
		0	0	1	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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PROFESSIONAL ELECTIVES							
SL. NO	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**L**	**T**	**P**	**C**
1	20PBT01	Biofuels	PE	3	0	0	3
2	20BPT02	Biopolymers	PE	3	0	0	3
3	20BPT03	Protein structures and Engineering	PE	3	0	0	3
4	20PBT04	Marine Biotechnology	PE	3	0	0	3
5	20PBT05	Cancer Biology	PE	3	0	0	3
6	20PBT06	Biomaterials	PE	3	0	0	3
7	20PBT07	Nanobiotechnology	PE	3	0	0	3
8	20PBT08	Clinical Trials and Bioethics	PE	3	0	0	3
9	20PBT09	Stem Cell Technology	PE	3	0	0	3
10	20PBT10	Waste Management and Utilization	PE	3	0	0	3
11	20PBT11	IPR,Bioethics and Biosafety	PE	3	0	0	3
12	20PBT12	Molecular Modelling and Drug Design	PE	3	0	0	3
13	20PBT13	Metabolic Engineering	PE	3	0	0	3
14	20PBT14	Genomics and Proteomics	PE	3	0	0	3
15	20PBT15	Bioentrepreneurship	PE	3	0	0	3
16	20PBT16	Animal cell culture	PE	3	0	0	3
17	20PBT17	Forensic Technology	PE	3	0	0	3
18	20PBT18	Molecular Pathogenesis & Disease Diagnosis	PE	3	0	0	3
19	20PBT19	Total Quality Management for Biotechnologists	PE	3	0	0	3
20	20PBT20	Biotechnological Approach in Crop Improvement	PE	3	0	0	3
21	20PBT21	Quality Assurance and Quality control in Biotechnology	PE	3	0	0	3
22	20PBT22	Data Mining and Machine Learning Techniques for Bioinformatics	PE	3	0	0	3
23	20PBT23	Developmental Biology	PE	3	0	0	3
24	20PBT24	Petroleum Biotechnology	PE	3	0	0	3
25	20PBT25	Vaccine Biotechnology	PE	3	0	0	3

20PBT01 **BIOFUELS** **L T P C**
3 0 0 3

Course Objectives

- To understand and explore the scope of biofuels the most efficient renewable source of energy.
- To develop the expertise in the technology pertaining to their generation and employment in order
  to surrogate the existing conventional fuels and hence strives towards sustainable development
- To give way to the bolster green technology and incline towards more ecofriendly options.

Course Outcomes

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

CO1: Apply the bio resources that can be used for the production of biofuels.

CO2: Evaluate the physical and chemical properties of the biodiesel.

CO3: Analyze the mechanisms of improvising the quality and performance of engines using biofuels

CO4: Develop & analyze biofuel conversion technologies and their environmental attributes

CO5: Design major unit processes/operations of an integrated bio-refinery

CO6: Study of economics of biorefineries.

Course Articulation Matrix

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

3 - High, 2 - Medium, 1 – Low

UNIT I CLASSIFICATION AND RESOURCES 9

Introduction, biofuel as a renewable energy, classification of biofuels - First, second, third and fourth generation biofuels, different plant sources as biofuel feed stocks, Biogases, physical and chemical characteristics of vegetable oils - iodine number, hydroxyl, acid values, rancidity, hydrogenolysis and hydrolysis, Food vs energy.

UNIT II BIODIESEL 9

Definition, basics and chemistry of biodiesel, vegetable oils in biodiesel production, Transesterification: Chemical methods, enzymatic methods and types of catalysts, separation and purification, physical properties and characterization of biodiesel - Cloud point, pour point, cold filter plugging point, flash point, viscosity and cetane number.

UNIT III QUALITY BIODIESEL AND ENVIRONMENT 9

Producing Quality Biodiesel, quality control, test methods, ASTM specifications. Oxidative and thermal stability, estimation of mono, di, triglycerides and free glycerol, engine performance test, blending of ethanol with biodiesel, blending of biodiesel with high speed diesel (HSD) and their combustion properties.

UNIT IV BIOETHANOL AND BIOGASES 9

Ethanol as a fuel, microbial and enzymatic production of ethanol from biomass - lignocellulose, sugarcane, sugar beet, corn, wheat starch, purification - wet and dry milling processes, saccharification chemical and enzymatic. Production of biomethane and biohydrogen.

UNIT V BIOREFINERIES 9

Definition and types of biorefineries, co-products of biorefineries-oil cake and glycerol, purification of glycerol obtained in biodiesel plant; anaerobic and thermal gasification of biomass, economics of biorefineries.

TOTAL: 45 HOURS

TEXT BOOKS

1. Caye Drapcho, John Nghiem and Terry Walker, Biofuels Engineering process technology, McGraw Hill Professional, 2008.
2. Mousdale, Biofuels, CRC Press, 2008

REFERENCES

1. Ahindra Nag, Biofuels Refining and Performance, McGraw-Hill Professional, 2007.
2. Lisbeth Olsson, Biofuels (Advances in Biochemical Engineering/ Biotechnology), Springer, 2007

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20PBT02 **BIOPOLYMERS** **L T P C**
3 0 0 3

Course Objectives

- To know what are biopolymers, their classification and potential applications
- To expose how biopolymers help in the development of the next generation of materials, products, and processes
- To facilitate the students to undertake research work both for improving /modifying their functional properties and to develop new products and processes

Course Outcomes

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

CO1: Classify biopolymers based on the properties and structure and characterize them

CO2: Compare nucleic acid, proteins and polysaccharides and their synthesis and use

CO3: Analyze the synthesis and compare the uses of polyesters and polyisoprenoids

CO4: Generate synthetic biodegradable polymers for various applications

CO5: Produce animal and plant fibers for textile and composite applications

CO6: Study about biocompositions and apllications.

Course Articulation Matrix

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

3 - High, 2 - Medium, 1 – Low

UNIT I CLASSIFICATION AND STRUCTURE 9

Biopolymer/bio-macromolecule-definition and history, different methods of classification, structure, formation, modification-blending, grafting -properties, characterization- molecular weight, glass transition , amorphous and crystalline behavior, mechanical properties, thermal, bio and photodegradation and applications, Confirmations and Dynamics of biopolymers

UNIT II POLYNUCLEOTIDES, POLYAMIDES AND POLYSACCHARIDES 9

Polynucleotides- DNA, RNA, protein- chemical synthesis-Collagen, casein, pectin, albumin and polysaccharides-synthesis/biosynthesis, structure and applications of important members under each class

UNIT III POLYESTER, POLYISOPRENOIDS AND POLYPHOSPHATES 9

Poly(hydroxyalkanoates), cutan, cutin, poly(hydroxyl butyrate-co-hydroxy valerate), polyisoprenoids and polyphosphate-Structure, synthesis and specific uses with example

UNIT IV SYNTHETIC BIOPOLYMERS AND POLYMER HYDROGELS 9

Synthetic biodegradable polymers-Introduction, applications, and chemical synthesis of important members, biopolymer membrane preparation, characterization and copolymers of lactic, glycolic acid etc, poly (alpha amino acids), polyethylene glycol, polycaprolactone

UNIT V NATURAL FIBERS AND THEIR COMPOSITES 9

Silk, wool, flax, jute, linen, cotton, sisal, bamboo, pineapple leaf and oil palm fibers, kenaf, and industrial hemp, properties, applications, property improvement by biochemical treatment. Wood a composite material, Biocomposites- formation, properties and applications

TOTAL: 45 HOURS

TEXT BOOKS

1. R.M. Johnson, R. M. Mwaikambo, L. Y., Tucker, N. Biopolymers, Rapra Technology 2003
2. 2. Richard Wool., and Susan Sun, X (Eds)., Biobased polymers and composites, Academic Press 2005

REFERENCES

1. Alexander Steinbucghel (Ed.)Encyclopedia of Biopolymers, Vols.1-10, Wiley-VCH 2004
2. 4. Platt K., Biodegradable polymers, Rapra Technology 2006
3. 5. Biopolymers(New Materials for Sustainable Films and Coatings), Wiley, 2011

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20PBT03	PROTEIN STRUCTURES AND ENGINEERING	L	T	P	C
		3	0	0	3

Course Objectives

- To ensure the strong knowledge in protein architecture through a detailed study of protein structure.
- To realize the structure-functional relationships of proteins

Prerequisite

- Basic Fundamental knowledge of chemistry and biochemistry

Course Outcomes

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

- CO1 : Understand the basic protein structure and various interactions affecting it.
- CO2 : Elucidate the structure function relationship of proteins.
- CO3 : Understand the basics of post translational modification and peptide analysis
- CO4 : Understand the protein databases and use appropriate tools to predict the structure of proteins
- CO5 : Appraise different protein design strategies used to design completely new proteins tailored to specific tasks
- CO6: Understand the various application of protein engineering.

Course Articulation Matrix

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

3 - High, 2 - Medium, 1 – Low

UNIT I INTRODUCTION TO PROTEIN STRUCTURE 9

Primary structure (peptide bonds, polypeptide chains), secondary structure, alpha helix, β sheets, β turns & loops/coil; Ramachandran plots), tertiary structure (classification - globular (myoglobin) membrane (bacteriorhodopsin) & fibrous (collagen)), quaternary structure. Amino acids and its properties (size, solubility, charge, pKa), Different interactions in protein (ionic, hydrophobic, hydrogen bonding, covalent, vander wall, co-ordinate bonds), Protein folding, molten globule structure, characterization of folding pathways.

UNIT II STRUCTURE-FUNCTION RELATIONSHIP 9

DNA-binding proteins: prokaryotic transcription factors, Helix-turn-Helix motif in DNA binding, Trp repressor, Eukaryotic transcription factors, Zn fingers, helix-turn helix motifs in homeodomain, Leucine zippers, Membrane proteins: General characteristics, Transmembrane segments, prediction, bacteriorhodopsin and Photosynthetic reaction center Immunoglobulins: IgG Light chain and heavy chain architecture, Abzymes & Enzymes: Serine proteases

UNIT III POST TRANSLATIONAL MODIFICATION AND PEPTIDE ANALYSIS 9

Post translational modification- modification at N-terminus and C-terminus, Glycosylation; Determination of amino acid composition, peptide sequencing - automated edman method & mass-spectrometry, peptide synthesis, peptide mapping.

UNIT IV PROTEIN STRUCTURE PREDICTION 9

Databases for protein sequence and structure, Protein sequence analysis: sequence alignment, programs for sequence alignment, amino acid properties for sequence analysis. Overview on protein structure analysis, Secondary structure prediction-tools used, 3D Structure Prediction-Homology modelling, threading and Ab initio methods.

UNIT V PROTEIN ENGINEERING AND APPLICATIONS 9

Strategies for protein engineering, Random and site-directed mutagenesis, Various PCR based strategies, Role of low fidelity enzymes in protein engineering, Gene shuffling and Directed evolution of proteins, Protein backbone changes, Antibody engineering, de novoprotein design.

Case Study : Engineering Blood clotting Factor VIII for Hemophilia Gene Therapy

TOTAL: 45 HOURS

TEXT BOOKS

1. Carl Branden & John Tooze, 'Introduction to Protein Structure' Second Edition, Garland Publishing.
2. Gary Walsh, Protein- Biochemistry & Biotechnology, Wiley, 2019
3. Michael Gromiha, 'Protein Bioinformatics", Academic press, 2004
4. Lilia A, Protein Engineering in Industrial Biotechnology, Harwood publishers, 2005
5. Rangwala & Karypis, 'Introduction to Protein Structure Prediction', Wiley series, 2010

REFERENCES

1. Park S. J. and Cochran J. R., Protein Engineering and Design, 1st Edn., CRC, 2009. Oxford, UK
2. Gregory A. Petsko and Dagmar Ringe—Protein Structure and Function, second Edition, Oxford University Press USA, 2004
3. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3615458/

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20PBT04 **MARINE BIOTECHNOLOGY** **L T P C**
3 0 0 3

Course Objectives

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

Course Outcomes

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

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

Course Articulation Matrix

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

3 - High, 2 - Medium, 1 – Low

UNIT I INTRODUCTION TO MARINE ENVIRONMENT 9

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

UNIT II IMPORTANT MARINE ORGANISMS 9

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

UNIT III MARINE ENVIRONMENTAL BIOTECHNOLOGY 9

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

UNIT IV MARINE PHARMACOLOGY 9

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

UNIT V AQUACULTURE TECHNOLOGY 9

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

TOTAL: 45 HOURS

TEXT BOOKS

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

REFERENCES

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

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20PBT05 **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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20PBT06 **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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20PBT07 **NANOBIOTECHNOLOGY**

L	T	P	C
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

- CO1: Explain the basics of nanobiotechnology and synthesis of nanomaterials
- CO2: Apply the knowledge on characterization of nanoparticles with different techniques
- CO3: Explain the different nanomaterials applications
- CO4: Illustrate the interactions of nano molecules in biosystem towards applications
- CO5: Discuss the applications of nanotechnology in biotechnology
- CO6: Study about the nanoscale devices for drug delivery.

Course Articulation Matrix

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

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.

REFERENCES

1. Jain, K. K. (2006); NanoBiotechnology in molecular diagnostics –current technique and applications, First edition, Taylor and Francis.

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20PBT08 **CLINICAL TRIALS AND BIOETHICS** **L T P C**
3 0 0 3

Course Objectives

- The course will provide Fundamental ethical to Advanced clinical trial management including drug development and trial planning; Project management in clinical trials;
- Consent and data protection; Quality assurance and governance.

Course Outcomes

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

- CO1: To provide fundamental ethical to advanced clinical trial management including drug development and trial planning.
- CO2: To know the regulations of clinical trials.
- CO3: To understand Project management in clinical trials.
- CO4: To design consent and data protection.
- CO5: To understand quality assurance and governance.
- CO6: To apply the quality control guidance to management studies.

Course Articulation Matrix

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

3 - High, 2 - Medium, 1 – Low

UNIT I INTRODUCTION TO CLINICAL TRIALS 9

Fundamentals of clinical trials; Basic statistics for clinical trials; Clinical trials in practice; Reporting and reviewing clinical trials; Legislation and good clinical practice - overview of the European directives and legislation governing clinical trials in the 21stcentury; International perspectives; Principles of the International Committee on Harmonisation (ICH)-GCP.

UNIT II REGULATIONS OF CLINICAL TRIALS 9

Drug development and trial planning - pre-study requirements for clinical trials; Regulatory approvals for clinical trials; Consort statement; Trial responsibilities and protocols - roles and responsibilities of investigators, sponsors and others; Requirements of clinical trials protocols; Legislative requirements for investigational medicinal products.

UNIT III MANAGEMENT AND ETHICS OF CLINICAL TRIALS 9

Project management in clinical trials - principles of project management; Application in clinical trial management; Risk assessment; Research ethics and Bioethics - Principles of research ethics; Ethical issues in clinical trials; Use of humans in Scientific Experiments; Ethical committee system including ahistorical overview; the informed consent; Introduction to ethical codes and conduct; Introduction to animal ethics; Animal rights and use of animals in the advancement of medical technology; Introduction to laws and regulation regarding use of animals in research.

UNIT IV INFORMED CONSENT 9

Consent and data protection- the principles of informed consent; Consent processes; Data protection; Legislation and its application; Data management – Introduction to trial master Cfiles and essential documents; Data management.

UNIT V QUALITY CONTROL AND GUIDELINES 9

Quality assurance and governance - quality control in clinical trials; Monitoring and audit; Inspections; Pharmacovigilance; Research governance; Trial closure and pitfalls-trial closure; Reporting and legal requirements; Common pitfalls in clinical trial management.

TOTAL: 45 HOURS

TEXT BOOKS

1. Lee, Chi-Jen et al, “Clinical Trials or Drugs and Biopharmaceuticals” CRC/Taylor & Francis,2011.
2. Matoren, Gary M. “The Clinical Research Process in the Pharmaceutical Industry”, Marcel Dekker, 1984.
3. Lawrence M.Friedman et al, “Fundamentals of Clinical Trials”, Mosby,1996

REFERENCES

1. Curtis L Meinert et al, “Clinical Trials - Design Conduct and Analysis”, Oxford University Press 1986.

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20PBT09 **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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20PBT10 **WASTE MANAGEMENT AND UTILIZATION** **L T P C**
3 0 0 3

Course Objectives

- Understand and apply the basic scientific and sustainability principles behind waste management, for solving practical waste management challenges
- Understand the fundamental principles of existing and emerging technologies for the treatment of waste and recovery of value from waste
- Appreciate the increasing importance of waste and resource management in achieving environmental sustainability

Course Outcomes

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

- CO1: Explain the sources of the waste, properties of solid waste and management systems
- CO2: Implement collection, segregation and processing techniques for solid waste management
- CO3: Analyze various methods to minimize the waste and suitable treatment methods.
- CO4: Analyze the laws pertaining to the handling of hazardous waste and the technology for disposal
- CO5: Evaluate the energy generation from waste and bio-conversion technologies of waste
- CO6: Apply the waste management concepts

Course Articulation Matrix

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

3 - High, 2 - Medium, 1 – Low

UNIT I INTRODUCTION TO SOLID WASTE **9**

Definition, Sources and engineering classification, characterization, generation and quantification; physical, chemical and biological Properties. Objectives, principles, functional elements of solid waste management system, Regulatory aspects of solid waste management.

UNIT II COLLECTION AND PROCESSING TECHNIQUES **9**

Rate of generation, frequency, storage and refuse, collection, Types of waste collection methods, Handling and segregation of wastes at source, Collection (primary & secondary) and storage of municipal solid wastes, collection equipment, transfer stations

UNIT III WASTE MINIMIZATION AND TREATMENT TECHNOLOGIES **9**

4 R- Refuse processing technologies, recovery, recycle and reuse, case study and guide lines. Refuse processing technologies, Mechanical and thermal volume reduction. Onsite handling, Incineration, pyrolysis, gasification, composting of solid wastes, Land Fill Method of Disposal, Impacts of open dumping, site investigation and selection, sanitary land filling.

UNIT IV HAZARDOUS AND BIOMEDICAL WASTE **9**

Sources & Classification, physicochemical properties, Hazardous Waste Control & Treatment. Regulatory laws: RCRA, HSWA, CERCLA and SARA .Waste management techniques; land disposal of radioactive elements. Biomedical Waste Handling and management (Rules 2008), sources, treatment and disposal.

UNIT V ENERGY GENERATION FROM WASTE **9**

Basics, types, working and typical conversion treatment technologies, Biological and chemical techniques for energy and other resource recovery: composting, vermicomposting, efficiencies of composting, vermin composting, fermentation, anaerobic digestion, factors affecting bio-digestion. bio-mass conversion technologies (wet and dry process), photosynthesis, agricultural waste derived energy, urban waste derived energy.

TOTAL: 45 HOURS

TEXT BOOKS

1. L.D. Mackenzie and J.M. Susan, Principles of Environmental Engineering and Science, Mc Graw Hill, 2004.
2. R.M. Forbes, R.W. Peter, F. Marina and H. Peter, Integrated Solid Waste Management: A Life Cycle Inventory, Mc Graw Hill, 2009.
3. Wilber, L.C., (1989), Handbook of Energy Systems Engineering, Wiley and Sons.

REFERENCES

1. The Energy Research Institute (TERI), New Delhi, Publications.
2. Rai, G.D, Non-conventional Energy Sources, Khanna Publications.
3. Hazardous waste (management and handling) Rules, 2001 and Biomedical Rules 2008

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20PBT11 **IPR, BIOETHICS AND BIOSAFETY**

L	T	P	C
3	0	0	3

Course Objectives

- To understand the Bioethics and Biosafety
- To apply for intellectual Property rights

Course Outcomes

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

- CO1 Understand the basic issues of biosafety, bioethics and IPR
- CO2 Follow good laboratory procedures and practices
- CO3 Justify the design of confinement facilities at different Biosafety levels
- CO4 Understand the social and ethical issues related to plant, animal and modern biotechnology.
- CO5 Review international agreements and protocols for Biosafety
- CO6 To apply the moral leadership qualities

Course Articulation Matrix

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

3 – High, 2 – Medium, 1 – Low

UNIT I ENGINEERING ETHICS & BIOETHICS **9**

Senses of "Engineering Ethics"' - variety of moral issued - types of inquiry - moral dilemmas - moral autonomy - Kohlberg's theory - Gilligan's theory - consensus and controversy – Models of Professional Roles - theories about right action - Self-interest - customs and religion - uses of ethical theories. Introduction to Bioethics. Social and ethical issues in Biotechnology Definition of Biosafety. Biosafety for human health and environment. Social and ethical issues. Use of genetically modified organisms and their release in to the environment. Special procedures for r-DNA based products, Transgenic plants and Animals.

UNIT II REGULATORY AFFAIRS **9**

Regulation, national and international guidelines of Biosafety, r-DNA guidelines, Regulatory requirements for drugs and Biologics GLP and GMP .

UNIT III INTELLECTUAL PROPERTY RIGHTS **9**

Intellectual property rights and protection, patents and methods of application of patents, Trade Secrets copyrights, Trade Marks, legal implications, farmer's rights, plant breeder's rights. International and National conventions on biotechnology and related areas, WTO guidelines.

UNIT IV SAFETY, RESPONSIBILITIES AND RIGHTS **9**

Safety and risk - assessment of safety and risk - risk benefit analysis and reducing risk – the three mile island and case studies. Collegiality and loyalty - respect for authority - collective bargaining - confidentiality - conflicts of interest - occupational crime - professional rights - employee rights.

UNIT V GLOBAL ISSUES **9**

Multinational corporations - Environmental ethics - computer ethics - weapons development and bioterrorisms - engineers as managers-consulting engineers-engineers as expert witnesses and advisors - moral leadership-sample code of Ethics.

TOTAL: 45 HOURS

TEXT BOOKS

1. Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw-Hill, New York 1996.
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, " Engineering Ethics", Prentice Hall of India, New Delhi, 2004.
3. H.K.Das, Text Book of Biotechnology - Wiley India, (P) Ltd. New Delhi, 5th edition, 2007.

REFERENCES

1) Sasson A, Biotechnologies and Development, UNESCO Publications, 1988.
2) Sasson A. Biotechnologies in developing countries present and future, UNESCO publishers, 1993. 7. John R Boatright, “Ethics and the Conduct of Business”, Pearson Education, New
3) Edmund G Seebauer and Robert L Barry, “Fundamentals of Ethics for Scientists and Engineers”, Oxford University Press, Oxford, 2001. 9. Singh K. “Intellectual Property Rights on Biotechnology”, BCIL, New Delhi

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20PBT12	MOLECULAR MODELLING AND DRUG DESIGN	L	T	P	C
		3	0	0	3

Course Objectives

- Interpret the basic concepts in the field of drug design followed by advanced methodology in the molecular aspects of drug design.
- Apply modelling tools and docking programme for predicting the three- dimensional structure of biomolecules
- Analyze how drugs interact with macromolecules and strategies used in designing novel drugs and prodrugs

Course Outcomes

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

- CO1 : Explain the basic terms in the field of molecular modeling and drug design.
- CO2 : Apply the various computational simulation methods to analyze the result of simulation and estimating errors.
- CO3 : Develop new molecules with therapeutic values
- CO4: Study of dynamic simulation methods.
- CO5 : Evaluate the development of new biomolecules by modification
- CO6 : Create new lead molecules in drug design

Course Articulation Matrix

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

3 – High, 2 – Medium, 1 – Low

UNIT I EMPIRICAL FORCE FIELDS MOLECULAR MECHANISM 9

Bond Stretching -Angle Bending- Torsional terms – Out plane bonding motions – Electrostatic interactions – Van der Waals interactions – Effective pair Potentials -Hydrogen Bonding – Simulation of liquid water.

UNIT II COMPUTER SIMULATION METHODS 9

Calculation of thermodynamic properties – Phase space -Practical aspects pf computer simulation – Boundaries monitoring Equilibrium – Long range Process – Analyzing result of simulation and estimating errors.

UNIT III MOLECULAR DYNAMICS SIMULATION METHODS 9

Molecular Dynamics using simple modules – Molecular Dynamics with continuous potentials – Running Molecular Dynamics simulation -Constant dynamics – Time dependent properties – Molecular Dynamics at constant temperature and pressure – Monte Carlo simulation methods.

UNIT IV METROPOLIS METHODS 9

Monte Carlo simulation of molecules – Monte Carlo simulation of polymers – Calculating chemical potentials – Monte Carlo or Molecular Dynamics, Molecular modeling to discover and design new molecules.

UNIT V MOLECULAR MODELING IN DRUG DISCOVERY 9

Deriving and using 3D Pharmacophores – Molecular docking -Structure Based methods to identify lead components- De novo ligand design.

TOTAL: 45 HOURS

TEXT BOOKS

1. Andrew Leach. Molecular modeling: principles and applications. 2nd ed. Pearson Education. 2001
2. R. Leach – Molecular Modeling Principles and Application, 2nd edition, Longman Publications, 1996

REFERENCES

1. Burkert U and Allinger NL, Molecular Mechanics, ACS Monograph 177. Washington D.C., American Chemical Society, 1982
2. McCammon J A. and Harvey S C, Dynamics of Proteins and Nucleic Acids, Cambridge University Press, 1987
3. Hans Pieter H and Folkens G, Molecular Modelling, VCH, 1999

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20PBT13 **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, Cha
2. James E. Bailey and David F. Ollis, Biochemical Engineering Fundan

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20PBT14 **GENOMICS AND PROTEOMICS** **L T P C**
3 0 0 3

Course Objectives

- To understand the background of genomes and proteomes used in providing new insights in biotechnology tools
- To explore the genome and protein sequence analysis and determination.
- To formulate genome-related hypothesis and design an experimental plan for testing and analysis.

Course Outcomes

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

- CO1 : Understand the importance of genomes and proteomes
- CO2 : Apply the knowledge in genomic approaches for Biotechnology applications
- CO3 : Apply the knowledge in proteomic approaches for Biotechnology applications
- CO4: Study of chromatographic techniques.
- CO5 : Analyze the advanced genome-proteome based concepts
- CO6 : Evaluate genome and proteomic approaches in systems biology and other medical applications

Course Articulation Matrix

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

3 – High, 2 – Medium, 1 – Low

UNIT I INTRODUCTION **9**

Introduction to genomes, transcriptomes and proteomes; Organisation and structure of genomes; DNA sequencing methods; Recombinant DNA technology; Human genome project; Overview of Protein structure; Introduction to omics: Genomics, Proteomics, Transcriptomics, Metabolomics, Fluxomics

UNIT II GENOMICS **9**

Introduction and scope of genomics, Next generation sequencing methods, Genetic Mapping, Physical Mapping, Integration of mapping methods, Gene variation and Single Nucleotide Polymorphisms (SNPs), Expressed sequenced tags (ESTs), Gene-disease association, Polymorphism, Social, Legal and Ethical Implications of Human Genome Research

UNIT III PROTEOMICS **9**

Introduction and scope of proteomics, Protein separation techniques: ion-exchange, size-exclusion and affinity chromatography techniques, Polyacrylamide gel electrophoresis, Isoelectric focusing (IEF), Two dimensional PAGE for proteome analysis, Introduction to mass spectrometry, Protein sequencing, Protein modifications and proteomics

UNIT IV ADVANCED PROTEOMICS AND GEMOMICS **9**

Comparative genomics, Functional genomics, Structural genomics, Personal Genomics, Protein engineering, DNA and Protein chips, Functional proteomics, Quantitative proteomics, Structural proteomics, DNA Protein interactions, Protein Protein interactions, HTP Analysis

UNIT V APPLICATIONS OF GENOMICS AND PROTEOMICS **9**

Systems and Synthetic biology, Genomics based drug design, Predictive Medicine, Cytogenomics, Clinical and biomedical application of proteomics, Applications of proteome analysis to drug

TOTAL: 45 HOURS

TEXT BOOKS

1. T.A. Brown, Genomes 3, Garland Science, 2007.
2. D.C. Libeler, Introduction to Proteomics: Tools for the New Biology, Humana Press, 2006

3. Arthur M. Lesk, Introduction to Protein Science- Architecture, Function and Genomics, Oxford University Press, 2004.

REFERENCES

1. Peter Sudbery, Human Molecular genetics, Benjamin-Cummings Publishing Company, 2010
2. S. R Pennington, and M.J. Dunn, Proteomics: from Protein Sequence to Function First, Viva Books Private Limited, 2002
3. S.B Primrose and R.M Twyman, Principles of Genome Analysis and Genomics, Blackwell Publishing Co., 2005

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20PBT15 **BIOENTREPRENEURSHIP**

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:Understand the entrepreneurship skills to convert their research ideas into commercial products
- CO2: Analyse the history of pioneer biotech companies and start effective biotech venture
- CO3: Know the functions of business models to transfer technology from laboratory into market.
- CO4: Evaluate the effectiveness of business plan through feasible business strategies
- CO5: Know the factors necessary for Entrepreneurship.
- CO6: Apply the importance of Intellectual property rights to protect the biotechnology inventions

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

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.,
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 management MP-110
4. Rajeev roy, Entrepreneurship, oxford publications 2nd edition, 201

REFERENCES

1. S. N. Jogdand, Entrepreneurship and Business of Biotechnology, I
2. R Oliver, The coming biotech age: The business of biomaterials. N
3. S. Shaleesha. Bioethics, Wisdom educational service, Chennai, 20

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20PBT16 **ANIMAL CELL CULTURE**

L	T	P	C
3	0	0	3

Course Objectives

- To impart the knowledge on basic tissue culture techniques
- To train students on theoretical and practical aspects of animal cell culture
- To demonstrate knowledge of cell lines used in mammalian tissue culture, their origins and Applications

Course Outcomes

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

- CO1 : Apply the fundamental knowledge of cell culture techniques and their competence in laboratory techniques
- CO2 : Apply the knowledge of cell isolation, maintenance and characterization in organ culture
- CO3 : Analyze the proficiency in establishing and maintaining of cell lines
- CO4 : Analyze cell cytotoxicity in regard to cell proliferation and viability
- CO5 : Evaluate the potential benefits of cell culture techniques in disease management
- CO6 : Understand the concept of in vitro culturing techniques

Course Articulation Matrix

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

3 – High, 2 – Medium, 1 – Low

UNIT I INTRODUCTION TO CELL CULTURE **9**

Introduction, importance, history of cell culture development, Equipments for cell culture, Aseptic techniques, Layout of animal tissue culture laboratory, Safety protocols and sterilization techniques.

UNIT II CELL CULTURE MEDIA AND REAGENTS **9**

Different type of cell culture media, Growth supplements, Serum free media, Balanced salt solution, and Advantages, disadvantages and their applications

UNIT III CELL CULTURE TECHNIQUES **9**

Different cell culture techniques including primary and secondary culture, Continuous cell lines, suspension culture and organ culture, Subculture and propagation, Cell lines, nomenclature, cell line designations, Routine maintenance and immortalization of cell lines

UNIT IV DEVELOPMENT AND MAINTENANCE OF CELL LINES **9**

Development of cell lines, Characterization and maintenance of cell lines, Cryopreservation, Common cell culture contaminants, Measurement of viability and cytotoxicity

UNIT V APPLICATIONS OF CELL CULTURE **9**

Gene transfer techniques in mammalian cells, Viral and non-viral methods, Production of transgenic animals, ES and microinjection, retroviral method, applications of transgenic animal technology.

FURTHER READING : Animal cell staining: Histological and Immunohistochemical analysis, Adaptation of virus in cell culture

TOTAL: 45 HOURS

TEXT BOOKS

1. Freshney, Culture of Animal Cells, 5th Edition, Wiley-Liss, 2005
2. Ed. John R.W. Masters, Animal Cell Culture - Practical Approach, 3rd Edition, Oxford University Press, 2000

REFERENCES

1. Ed. Martin Clynes, Animal Cell Culture Techniques. Springer, 1998.

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20PBT17 **FORENSIC TECHNOLOGY**

L	T	P	C
3	0	0	3

Course Objectives

- To prepare students for entry-level positions in the fields of forensic technology
- To create deeper understanding in forensic science
- To render knowledge of how to perform research in interdisciplinary fields like forensic studies

Course Outcomes

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

- CO1 : Explain the forensic science and crime investigation process
- CO2 : Apply the principles and operation of analytical instruments in forensic analysis
- CO3 : Analyze various biological samples for forensic studies
- CO4 : Analyze the non biological samples and characterize
- CO5 : Implement forensic examination in different levels and documentation
- CO6 : Understand the pattern of biological samples for forensic studies

Course Articulation Matrix

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

3 – High, 2 – Medium, 1 – Low

UNIT I BASICS OF FORENSIC SCIENCE **9**

History and Development; Crime Scene Management and Investigation- Collection, preservation, packing and forwarding of physical and trace evidence for analysis; Legal and Court procedure pertaining to Expert Testimony

UNIT II ANALYTICAL INSTRUMENTATION **9**

Microscopy-Polarising, Fluorescent and Electron microscopes; Spectrophotometry- UV, Visible, IR atomic absorption; Chromatographic techniques (TLC, GLC, HPLC); Electrophoresis (Gel and Immunoelectrophoresis.)

UNIT III ANALYSIS OF BIOLOGICAL SAMPLES **9**

Fresh Blood-Grouping and typing of fresh blood samples; Analysis of stains of blood and allied body fluids for their groups; Cases of disputed paternity and maternity problems; DNA profiling; Identification of hair, determination of species origin, sex, site and individual identification from hair; Examination and identification of saliva, Urine and Faecal matter.

UNIT IV CHARACTERIZATION OF NON BIOLOGICAL SAMPLE **9**

Physical analysis - soil, glass, paints, lacquers, cement, inks, paper, tool marks, tyre marks, shoe prints, forensic examination of vehicles in cases of accident; Identification of individuals from bodily features; Examination and identification of deceased from skeletal remains

UNIT V FORENSIC EXAMINATION **9**

Preliminary examination of documents-Identification of hand writing, signatures and detection of forgeries; Reproduction of documents (photographic , mechanical) and their examination; Physical and chemical erasures, obliterations, additions, alterations, indentations, secret writings and charred documents; Inks, papers and their scientific examinations including instrumental analysis

TOTAL: 45 HOURS

TEXT BOOKS

1. William G. Eckert,Introduction to Forensic Sciences, 2nd Ed. New York: CRC press, 2000.
2. S.H.James, and J.J. Nordby, Forensic Science An Introduction to Scientific and Investigative Techniques. London: CRC Press, 2003

REFERENCES

1. B. D Alberts Bray, J. Lewis, K. Roberts and J.D. Watson. Molecular Biology of Cell., 2nd ed. New York: Garland Publishing, 1989
2. Simon, Ball. Environment Law: The Law and Policy Relating to Protection of Environment. Delhi: Universal Law Publishing, 1991

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20PBT18 **MOLECULAR PATHOGENESIS & DISEASE DIAGNOSIS**

L	T	P	C
3	0	0	3

Course Objectives

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

Course Outcomes

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

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

Course Articulation Matrix

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

3 – High, 2 – Medium, 1 – Low

UNIT I PATHOGEN AND ZOONOTIC DISEASES **9**

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

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

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

UNIT III VIRULENCE FACTOR AND TOXIN **9**

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

UNIT IV HOST-PATHOGEN INTERACTION **9**

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

UNIT V DISEASE DIAGNOSIS **9**

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

TOTAL: 45 HOURS

TEXT BOOKS

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

REFERENCES

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

Pathogenesis, Vol. 27, Academic Press, 1998
2. C.L. Gyles, F.P. John, G. Songer and C. O. Theon, Pathogenesis of Bacterial Infections in Animals, Blackwell Publishers, 2010.
3. Paul Digard, Anthony Nash and R. E. Randall, Molecular Pathogenesis of Virus Infections, Cambridge University Press, 2005

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20PBT19 TOTAL QUALITY MANAGEMENT FOR BIOTECHNOLOGISTS

L	T	P	C
3	0	0	3

Course Objectives

- The course aims to develop skills of the Students in various total quality management Principles, tools and quality systems in the Biotechnology industries.
- To understand the TQM tools for continuous process improvement of ISO and Quality systems

Course Outcomes

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

CO1. discuss various dimensions of product and service quality

CO2. apply the TQM principles for quality improvement in organization

CO3. distinguish various TQM tools and techniques used in manufacturing and service sectors

CO4. use QFD tool to design and develop a new product as per customer requirements

CO5. explain various ISO standards and quality systems practiced in various sector

CO6. summarize the basic concepts in total quality management relevant to manufacturing and service sectors

Course Articulation Matrix

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

UNIT I INTRODUCTION **9**

Introduction - Need for quality - Evolution of quality - Definition of quality - Dimensions of product and service quality - Basic concepts of TQM – TQM Framework - Contributions of Quality Gurus – Barriers to TQM – Cost of Quality.

UNIT II TQM PRINCIPLES **9**

Quality statements - Customer focus –Customer orientation, Customer satisfaction, Customer complaints, Customer retention - Continuous process improvement – PDCA cycle, 5s, Kaizen- Supplier partnership – Partnering, Supplier selection, Supplier Rating.

UNIT III TQM TOOLS & TECHNIQUES I **9**

The seven traditional tools of quality – New management tools – Six-sigma: Concepts, methodology, applications to manufacturing, service sector including IT – Bench marking – Reason to bench mark, Bench marking process – FMEA – Stages, Types.

UNIT IV TQM TOOLS & TECHNIQUES II **9**

Quality circles – Quality Function Deployment (QFD) – Taguchi quality loss function – TPM – Concepts, improvement needs – Performance measures - BPR.

UNIT V QUALITY SYSTEMS **9**

Need for ISO 9000- ISO 9000-2000 Quality System – Elements, Documentation, Quality auditing- QS 9000 – ISO 14000 – Concepts, Requirements and Benefits – Quality Council – Leadership, Employee involvement – Motivation, Empowerment, Team and Teamwork, Recognition and Reward.

TOTAL: 45 HOURS

TEXT BOOKS

- Dale H.Besterfiled, et al., “Total Quality Management”, Pearson Education Asia, Third Incubator Shaker 1 Spectrophotometer 2 Laminar Flow Chamber Glassware, Chemicals, Media 2 as required Edition, Indian Reprint , 2006.

REFERENCES

1. James R. Evans and William M. Lindsay, “The Management and Control of Quality”, (6th Edition), South-Western (Thomson Learning), 2005.
2. Oakland, J.S. “TQM – Text with Cases”, Butterworth – Heinemann Ltd., Oxford, Third Edition , 2003.
3. Suganthi,L and Anand Samuel, “Total Quality Management”, Prentice Hall (India) Pvt. Ltd., 2006 .
4. Janakiraman,B and Gopal, R.K, “Total Quality Management – Text and Cases”,Prentice Hall (India) Pvt. Ltd., 2006.

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20PBT20	BIOTECHNOLOGICAL APPROACH IN CROP IMPROVEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- The crops produced need to increase with ever increasing population. Conventional methods for crop improvement are not able to deliver fully. Therefore, high use of throughput technologies is need of the hour.
- This course is intended to give some idea to students how crop plants can be improved quantitatively and qualitatively using biotechnological approaches. Students are able to understand plant genome organization. To acquaint students with recent techniques for crop improvement Application of molecular markers for crop improvement

COURSE OUTCOMES:

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

- CO1. Understand the genomic organization of plants
- CO2. Understand and apply various Biotechnological approach for crop improvement
- CO3. Understand the role of Molecular Markers in crop improvement
- CO4. Apply the concepts of Molecular Markers in the improvement of crops.
- CO5. Understand the concept of Transgenic plants
- CO6. Understand the production of transgenic plants for field crops

Course Articulation Matrix

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

3 - High, 2 - Medium, 1 – Low

UNIT I PLANT GENOME ORGANIZATION 9

Features of plant chromosomes: centromere, telomere, euchromatin, heterochromatin and nucleolus organizing region (NOR); karyotype (asymmetric and symmetric). C-value paradox, range of interspecific and intraspecific variation, origin of quantitative DNA variation. Estimation of various components of higher-plant genome: highly repetitive sequences, middle repetitive sequences, and unique DNA sequences. Rice and maize genome sequencing projects; cereal genome databases.

UNIT II BIOTECHNOLOGICAL APPROACH FOR CROP IMPROVEMENT 9

Biotechnological approaches for disease resistance, protection against fungal pathogens and drought tolerance. Modification of crop-plant nutritional content (vitamins, amino acids and lipids). Modification of crop-plant taste and appearance (sweetness, starch and preventing discoloration). Polyploidy: induction of polyploidy by artificial methods; role of polyploidy in crop improvement.

UNIT III MOLECULAR MARKERS AND CROP IMPROVEMENT 9

Types of molecular markers used in analyzing genetic diversity for crop improvement; molecular mapping and tagging of agronomically important traits. Molecular cytogenetic markers: FISH and GISH, their application in crop improvement. Transposable elements: mechanism of action and their role in crop improvement. Quantitative trait loci (QTL) mapping: introduction, types of mapping populations; role in crop improvement.

UNIT IV APPLICATION OF MOLECULAR MARKERS 9

Construction of molecular maps (using F2, DH, RILs); gene tagging using bulked segregant analysis (BSA) and near isogenic lines (NILs); QTL analysis; map-based cloning of genes; elementary idea of marker-assisted selection (MAS) in plant breeding.

UNIT V PRODUCTION OF TRANSGENIC PLANTS IN VARIOUS FIELD CROPS 9

Cotton, wheat, maize, rice, soybean, oilseeds, sugarcane etc. Commercial releases. Biotechnology applications in male sterility/hybrid breeding, molecular farming. MOs and related issues (risk and regulations); GMO; International regulations, biosafety issues of GMOs; Regulatory procedures in major countries including India, ethical, legal and social issues; Intellectual property rights. Bioinformatics & Bioinformatics tools. Nanotechnology and its applications in crop improvement programmes.

TOTAL: 45 HOURS

TEXT BOOKS

1. Abelson, P. H. (1984). Biotechnology and Biological Frontiers. American Association for the Advancement of Science, Washington, U.S.A.
2. Ammirato, P. V., Evans, P. V., Evans, D. A., Sharp, W. R. and Yamada, Y. (Eds.) (1984). Handbook of Plant Cell Culture. Vols. 1, 2 & 3. MacMillan Publishing Co, New York.
3. Dodds, J. H. and Roberts, L. W. (1985). Experiments in Plant Tissue Culture. Cambridge University Press, Cambridge.
4. Mantell, S. H. and Smith, H. (Eds.) (1983). Plant Biotechnology. Cambridge University Press, Cambridge.
5. Swaminathan, M. S. (1991). Biotechnology in Agriculture – A dialogue. MacMillan India, New Delhi.
6. Gupta, P. K. (2004). Biotechnology and Genomics. Rastogi Publications, Meerut
7. Kung, S. and Arntzen, C. J. (Eds.). (1989). Plant Biotechnology. Butterworth, Boston.
8. Grierson D (Ed.). (1991). Plant Genetic Engineering: Plant Biotechnology Series, Volume I. Blockie, Glasgow, London.

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20PBT21 QUALITY ASSURANCE AND QUALITY CONTROL IN BIOTECHNOLOGY

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- The student shall be able to understand the scope of quality certifications.
- Appreciate the importance of documentation.
- The cGMP aspects in a pharmaceutical industry.
- To understand the responsibilities of QA & QC departments in biotechnology industries

COURSE OUTCOMES:

The students will be able to

- CO1. Understand the various aspects of quality control and quality assurance aspects of various biotechnological industries.
- CO2. Understand and apply the quality assurance and control in clinical trials
- CO3. Understand and apply the quality assurance in pharmaceutical industries
- CO4. Understand and apply the quality system regulations and quality control of medical devices.
- CO5. Understand the Quality of various biological products
- CO6. Know the important aspects like cGMP, QC tests, documentation, quality certifications, GLP and regulatory affairs.

Course Articulation Matrix

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

3 - High, 2 - Medium, 1 – Low

UNIT I INTRODUCTION **9**

Quality Assurance , Quality Control , Role of Quality Assurance**,** QA testing, Role of Quality Control, Test for quality control, Quality assurance – Quality control – Practice of cGMP- Overview of ICH Guidelines - QSEM, with special emphasis on Q-series guidelines. Good Laboratory Practices: Scope of GLP, Definitions, Quality assurance unit, protocol for conduct of non clinical testing, control on animal house, , scope of quality certifications - responsibilities of QA & QC departments, Analysis of raw materials, finished products, packaging materials, in process quality control (IPQC), Developing specification (ICH Q6 and Q3)

UNIT II QUALITY ASSURANCE AND QUALITY CONTROL IN CLINICAL TRIALS **9**

Audit criteria, Audit process, Responsibilities of stakeholders in audit process, Audit follow-up and documentation, Audit resolution and Preparing for FDA inspections, Fraud and misconduct management - Clinical Trial Data Management- Standard Operating Procedures, Data management plan, CRF & Data base design considerations, Study set-up, Data entry, CRF tracking and corrections, Central lab, IVRS, source data. Data cleaning, managing laboratory and ADR data, Data transfer and database lock, Quality Control and Quality Assurance in CDM, Data mining and warehousing

UNIT III QUALITY ASSURANCE AND QUALITY CONTROL IN PHARMACEUTICAL INDUSTRIES **9**

Schedule M – USFDA- Quality audit and self inspections SOPs – Documentation – Loan license auditing – Common technical documentation (CTD) – Drug master file (DMF).

UNIT IV QUALITY SYSTEM REGULATIONS AND QUALITY CONTROL OF MEDICAL DEVICES **9**

Quality System Requirements 21 CFR Part 820, Labeling requirements 21 CFR Part 801, Post marketing surveillance of MD and Unique Device Identification (UDI), Quality System requirements and clinical evaluation

and investigation. IMDRF study groups and guidance documents, ISO 13485, Quality Risk Management of Medical Devices: ISO 1497-

UNIT V QUALITY IN FOOD, NUTRACEUTICALS, BIOLOGICAL AND COSMETIC PRODUCTS **9**

WHO guidelines on nutrition. NSF International: Its Role in the Dietary Supplements and Nutraceuticals Industries, NSF Certification, NSF Standards for Food And Dietary Supplements. Good Manufacturing Practices for Nutraceuticals, Quality, safety and legislation for herbal products in India, USA and European Union, Analysis of Cosmetics, Toxicity screening and test methods: Quality control and toxicity studies as per Drug and Cosmetics Act, Analysis of Food additives- milk constituents and milk products- Pesticide analysis

TOTAL: 45 PERIODS

TEXT BOOKS

1. Willig, H., Tuckeman, M.M. and Hitchings, W.S., "Good Manufacturing Practices for Pharmaceuticals", 5th Edition, Marcel Dekker Drugs and the Pharmaceutical Sciences, by CRC Press, New York, 2000.
2. Medical Product Regulatory Affairs: Pharmaceuticals, Diagnostics, Medical Devices by John J. Tobin and Gary Walsh
3. P.P.Sharma. Cosmetics - Formulation, Manufacturing & Quality Control, Vandana Publications, New Delhi

REFERENCES

1. Mindy J. Allport-Settle, Current Good Manufacturing Practices: Pharmaceutical, Biologics, and Medical Device Regulations and Guidance Documents Concise Reference, Pharmalogika Inc., USA, 2009.

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20PBT22	DATA MINING AND MACHINE LEARNING TECHNIQUES FOR BIOINFORMATICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To learn various data mining techniques used to analyses huge biological data to find the hidden patterns.
- To familiarize students with a new rapidly evolving filed of machine learning and mining

COURSE OUTCOMES

Upon completion of this course,
Students will be able to

- CO1. Know the basic notions and terminology used in Machine learning and Data mining.
- CO2. Understand fundamental principles of modern data analysis.
- CO3. Understand the applications of Machine learning in biological data processing and visualization.
- CO4. Understand the applications of data mining in biological data processing and visualization.
- CO5. Understand the importance of data mining in Biotechnological applications
- CO6. Apply the concepts of data mining for data analysis in Biotechnology.

Course Articulation Matrix

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

3 - High, 2 - Medium, 1 – Low

UNIT I OVERVIEW OF MACHINE LEARNING TECHNIQUES 9

Supervised and unsupervised techniques. Empirical Risk Minimization, Structural Risk Minimization; Measuring the accuracy of learned hypotheses. Comparing learning algorithms: cross-validation, learning curves, and statistical hypothesis testing.

UNIT II MACHINE LEARNING TECHNIQUES 9

Classification: Decision tree, Bayesian, Rule based classification, ANN, SVM, HMM; Case based reasoning and Applications in Bioinformatics. Clustering: Partition Methods, Hierarchical methods, Density based methods, Grid based clustering, Model based clustering, clustering of high dimensional data, constraints based clustering, Analysis of MD trajectories, Protein Array data Analysis.

UNIT III INTRODUCTION TO DATA MINING 9

Introduction to Data mining, Data mining Functionalities, Classification of Data mining Systems, Data Mining Task Primitives, Integration of Data mining systems, Major issues of Data mining.

UNIT IV DATA PREPROCSSING AND VISUALIZATION 9

Overview of data preprocessing, Data cleaning, Data integration, Data reduction, Data transformation and discretization, Visualization- Visualizing a single attributes, Visualizing pair of attributes, Visualizing several attributes, Visualizing results of machine learning.

UNIT V APPLICATIONS OF DATA MINING 9

Application of Data Mining in Biodata analysis: DNA/protein sequence Analysis, Genome analysis, Protein Structure Analysis, Pathway analysis, microarray data analysis, annotation, gene ontology, gene mapping. Biological data mining tools: Entrez, Blast, sequence retrieval system (SRS).

TOTAL: 45 HOURS

TEXT BOOKS

1. Witten, H. I., Frank, E. and Hall, M. A. 2011. Data Mining: Practical Machine Learning Tools and Techniques.
2. Hastie, T., Tibshirani, R., Friedman, J. H. 2009. The Elements of Statistical Learning: Data Mining Interface and Prediction.

3. Clarke, S. B., Fokoue, E. and Zhang, H. H. 2009 Principles and Theory for Data Mining and Machine Learning.

REFERENCES

1. Data Mining: Concepts and Techniques by Jiawei Han and MichelineKamber, 2000
2. Data Mining Techniques, A. K. Pujari, UniversityPress, Hyderabad, 2006
3. Data mining in bioinformatics by Wang et al, Springer-Verlag, 2005

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20PBT23 **DEVELOPMENTAL BIOLOGY**

L	T	P	C
3	0	0	3

Course Objectives

- To ensure the strong knowledge in Developmental Biology
- To Understand the various stages in Development Biology

Course Outcomes

Upon completion of this course, students will be able to

- CO1. Understand the concepts of Developmental Biology
- CO2. Understand the early embryonic develoment.
- CO3. Know the embryonic development in later stages
- CO4. Understand the theories of post embryonic development.
- CO5. Understand and Apply the implications of Developmental Biology
- CO6. Understand the effects of embryonic development biology

Course Articulation Matrix

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

3 - High, 2 - Medium, 1 – Low

UNIT I INTRODUCTION **9**

Historical perspective and basic concepts: Phases of development, Cell-Cell interaction, Pattern formation, Differentiation and growth, Differential gene expression, Cytoplasmic determinants and asymmetric cell division

UNIT II EARLY EMBRYONIC DEVELOPMENT **9**

Gametogenesis, Spermatogenesis, Oogenesis; Types of eggs, Egg membranes; Fertilization (External and Internal): Changes in gametes, Blocks to polyspermy; Planes and patterns of cleavage; Types of Blastula; Fate maps (including Techniques); Early development of frog and chick up to gastrulation; Embryonic induction and organizers

UNIT III LATE EMBRYONIC DEVELOPMENT **9**

Fate of Germ Layers; Extra-embryonic membranes in birds; Implantation of embryo in humans, Placenta (Structure, types and functions of placenta)

UNIT IV POST EMBRYONIC DEVELOPMENT **9**

Metamorphosis: Changes in amphibians and insects; Regeneration: Modes of regeneration, epimorphosis, morphallaxis and compensatory regeneration (with one example each); Ageing: Concepts and Theories

UNIT V IMPLICATIONS OF DEVELOPMENTAL BIOLOGY **9**

Teratogenesis: Teratogenic agents and their effects on embryonic development; In vitro fertilization, Stem cell (ESC), Amniocentesis

TOTAL: 45 PERIODS

TEXT BOOKS

1. Gilbert, S. F. (2010). Developmental Biology, IX Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA
2. Balinsky B. I. and Fabian B. C. (1981). An Introduction to Embryology, V Edition, International Thompson Computer Press
3. Carlson, R. F. Patten's Foundations of Embryology Kalthoff (2008). Analysis of Biological Development, II Edition, McGraw-Hill Publishers
4. Lewis Wolpert (2002). Principles of Development. II Edition, Oxford University Press

20PBT24 **PETROLEUM BIOTECHNOLOGY**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To impart the knowledge about biotransformation in petroleum industries.
- To provide a core foundation for the analysis and design of Bio refineries.

COURSE OUTCOMES:

Upon completion of this course, the student would be able

- To demonstrate an ability to apply various process parameters.
- To conduct an experimental investigation in order to determine biotransformation process.
- To apply bioprocess and biochemical principles in petroleum refineries.
- To maintain a suitable environment to obtain quantitative qualitative outputs.
- To design an equipment for bio-based products to achieve production and yield Specifications in petroleum industries.
- To apply various methods to recovery, refining and remediation in the uses of petroleum and petroleum products.

Course Articulation Matrix

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

3 - High, 2 - Medium, 1 – Low

UNIT I INTRODUCTION TO PETROLEUM BIOTECHNOLOGY 9

Introduction: Petroleum microbiology, principles of biotechnology, Biotransformation of petroleum constituents, Alkane derivatives, Aromatic hydrocarbon derivatives, Factors affecting biotransformation, Reservoir character, Temperature and Pressure effects.

UNIT II MICROBIAL ENHANCED AND BIO UPGRADING OIL RECOVERY 9

Oil Recovery: Primary, secondary and Tertiary process. Mechanism and effects-permeability, wettability, Biological demulsification of crude oil, Bio desulfurization, Biodemetallization, Biodearomatization. Bio degrading microorganisms-Aerobic and anaerobic biotransformation, Biotransformation of Asphalts. Case studies and challenges.

UNIT III BIO CATALYTIC DESULFURISATION AND DENITROGENATION 9

Desulfurization-Hydro desulfurization, Adsorptive desulfurization, Oxidative desulfurization. Crudeoil and its fractions-Enzymatic oxidation of organosulfur compounds, Immobilization. Nano biocatalytic desulfurization. Hydro and Thermal denitrogenation, Biocatalytic denitrogenation. Case studies and challenges.

UNIT IV BIOREMEDATION 9

Kinetics of petroleum biotransformation in soil: Indigenous and augmented microbial population, pollutant type and concentration, soil characteristics studies- soil type, Degree of weathering, nutrient concentration, moisture content, temperature, soil interactions with macro and microorganisms, aeration, acidity-alkalinity, heavy metals, surfactants. Oil spill remediation methods, factors influencing rates of oil spill remediation, bioremediation technology for marine oil spill. Case studies and challenges.

UNIT V THE FUTURE OF PETROLEUM BIOTECHNOLOGY 9

Biorefining, technology potential, biorefinery products and by products, petroleum nanobiotechnology-modern applications for sustainable future. Challenges and prospects in biotechnology.

TOTAL: 45 HOURS

REFERENCES

1. James G.Speight, Nour Shafik El-Gendy “Introduction to p
Gulf Professional Publishin-2017

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20PBT25 **VACCINE TECHNOLOGY** **L T P C**
3 0 0 3

Course Objectives

- To study the various forms of vaccines
- To learn the techniques of vaccine production and their delivery methods
- To give an exposure on the regulatory and biosafety measures of vaccine

Course Outcomes

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

- CO1 : Apply the principle of vaccination for immunization processes
- CO2 : Attribute the types of vaccines and their applications
- CO3 : Evaluate vaccine purification, preservation and formulation techniques
- CO4 : Determine the advanced methods of vaccine delivery
- CO5 : Relate the quality measures and regulatory issues concerned with vaccine production
- CO6: Study the quality assurance in vaccine production.

Course Articulation Matrix

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

3 - High, 2 - Medium, 1 – Low

UNIT I INTRODUCTION **9**

Vaccines - definition, History of vaccine development, requirements for immunity, Basics of immunization- Epitopes, linear and conformational epitopes, characterisation and location of APC, MHC and immunogenicity; immunization programs and role of WHO in immunization programs

UNIT II TYPES AND METHODS OF APPLICATION **9**

Active and passive immunization; Viral/bacterial/parasite vaccine differences, methods of vaccine preparation - Live, killed, attenuated, sub unit vaccines; Vaccine technology- Role and properties of adjuvants, recombinant DNA and protein based vaccines, plant-based vaccines, edible vaccines, reverse vaccinology, combination vaccines, therapeutic vaccines; Peptide vaccines, conjugate vaccines; Cell based vaccines. Uses of nanoparticles in vaccine application. Reverse Vaccinology

UNIT III TECHNIQUES IN VACCINE PRODUCTION **9**

Purification, preservation and formulation techniques. Commercial production of DPT, TT, polio, rabies and hepatitis vaccines.

UNIT IV DELIVERY METHODS **9**

Needle free Vaccine delivery, ISCOMS, Adjuvant delivery systems, Intranasal and inhaled vaccine delivery, liquid jet and solid dose injectors, development of gene-based vectors.

UNIT V REGULATORY AND BIOSAFETY MEASURES **9**

Quality assurance in vaccine production. Regulatory issues - Environmental concerns with the use of recombinant vaccines - Disease security and biosecurity principles and OIE guidelines.

TOTAL: 45 PERIODS

TEXT BOOKS

1. P. Ramadass, Animal Biotechnology - Recent concepts and Developments, MJP Publications, 2008.
2. 2. T. J. Kindt, R. A. Goldsby, B. A. Osborne and J. Kuby, Kuby Immunology, W.H. Freeman & company, 2007.
3. S. A. Plotkin, W. A. Orenstein and P. A. Offit, Vaccines, W B Saunders Company, 2012.

REFERENCES

1. Cheryl Barton, Advances in Vaccine Technology and Delivery, Espicom Business Intelligence, 2009.
2. Ronald W. Ellis, New Vaccine Technologies, Landes Bioscience, 2001.

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

LIST OF OPEN ELECTIVES

OPEN ELECTIVE I

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	20OAG01	Agricultural Waste Management	OE	4	3	0	0	3
2.	20OAG02	Farm Management	OE	4	3	0	0	3
3.	20OBT01	Mushroom Cultivation and Vermi Composting	OE	4	3	0	0	3
4.	20OBT02	Basics of Bioinformatics	OE	4	3	0	0	3
5.	20OBM01	Bio Healthcare and Telemedicine	OE	4	3	0	0	3
6.	20OBM02	Embedded Systems in Medical Devices	OE	4	3	0	0	3
7.	20OCE01	Green buildings	OE	4	3	0	0	3
8.	20OCE02	Disaster Prepardness and Management	OE	4	3	0	0	3
9.	20OCS01	Software Engineering	OE	4	3	0	0	3
10.	20OCS02	Database Management systems	OE	4	3	0	0	3
11.	20OEC01	Soft Computing	OE	4	3	0	0	3
12.	20OEC02	Medical Electronics	OE	4	3	0	0	3
13.	20OEE01	Renewable Energy Resources	OE	4	3	0	0	3
14.	20OEE02	Introduction to Control Systems	OE	4	3	0	0	3
15.	20OFT01	Food Science and Nutrition	OE	4	3	0	0	3
16.	20OFT02	Food Preservation Techniques	OE	4	3	0	0	3
17.	20OIT01	UI and UX Design	OE	4	3	0	0	3
18.	20OIT02	Multimedia Systems	OE	4	3	0	0	3
19.	20OME01	Engineering Drawing	OE	4	3	0	0	3
20.	20OME02	Modern Manufacturing Techniques	OE	4	3	0	0	3
21.	20OPH01	Nanotechnology and Engineering Applications	OE	4	3	0	0	3
22.	20OEN01	English for Competitive Exams	OE	4	3	0	0	3

20OAG01 **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

20OAG02 **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.

20OBT01	MUSHROOM CULTIVATION AND VERMICOMPOSTING	L	T	P	C
		3	0	0	3

Course Objectives

- Understand the basic concepts, principles, potentials and limitations of mushroom cultivation and vermiculture techniques
- Apply the active compounds of mushroom for developing a solution for health care problems
- Develop mushroom cultivation and vermiculture skills for entrepreneurial activity

Course Outcomes

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

- CO1: Apply the active compounds of mushroom in food and pharmaceutical industry
- CO2: Knowledge on different harvesting technology
- CO3: Implement the cultivation techniques for mushroom production
- CO4: Apply post-harvest technology to preserve the quality of the product
- CO5: Evaluate the significance of earthworms in increasing the soil fertility
- CO6: Execute the techniques of vermicomposting for large scale production and marketing

Course Articulation Matrix

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

3 - High, 2 - Medium, 1 – Low

UNIT I INTRODUCTION **9**

Introduction and Importance of mushrooms; History of mushroom cultivation; Present status of mushroom industry in India; Cultivable edible mushroom; Biology of mushroom; Food value of edible mushrooms; Uses of mushrooms, Poisonous mushrooms, and Medicinal mushrooms.

UNIT II MUSHROOM CULTIVATION AND BIOLOGICAL IMPORTANCE **9**

Mushrooms farm structure; design and layout; Spawn principles, techniques of spawn production; Principle and techniques of compost and compositing; Cultivation techniques of White button mushroom, oyster mushroom.

UNIT III DISEASE AND POST-HARVEST TECHNOLOGY **9**

Management of fungal, bacterial and viral diseases in mushroom; Competitors, pests and nematodes in mushrooms. Post-harvest technology,: Freezing, Dry freezing , Drying, Canning.

UNIT IV VERIMICULTURE TECHNOLOGY **9**

Permaculture Technology; organic farming, soil fertility; Distribution and Ecology of Earthworms Earthworm taxonomy -Morphological and Anatomical characteristics of Earthworm -Food habits, excretion and life cycle. Types of Earthworms -Exotic and native species

UNIT V METHODS OF VERMICOMPOSTING **9**

Collection and preservation of earthworms for vermicomposting and culturing techniques of earthworms.Preparation of vermicomposting requirement, different methods of Vermicompositing (Heap method, Pot method, and Tray method).Changes during vermin compositing, Nutrient value of Vermicompositing; Problems in vermicomposting preparation; Earthworm as bioreactors. Influence of chemical inputs on earthworms activities. Large scale manufacture of Vermicomposting, packaging; financial supporting (Government and NGOs for vermi culture work)

TOTAL: 45 HOURS

TEXT BOOKS

2. Keshav Singh, Textbook of Vermicompost: Vermiwash and Biopesticides, 2014
3. Robin Gogoi Yella Rathaiah T R Borah, Mushroom Cultivation Technology, Scientific Publishers, 2006

REFERENCES

5. S.C. Tiwari & Pankaj Kapoor, Mushroom Cultivation, 2018
6. NPCS Board of Consultants & Engineers, The Complete Technology Book on Vermiculture and Vermicomposting, 2004

20OBT02 **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.

20OBM01 **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 Medicine 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.

20OBM02 **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.

20OCE01 **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 and 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.

20OCE02 **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, EMSA no.214, June 2003.
3. Government of India, National Disaster Management Policy,2009.

		L	T	P	C
20OCS01	**SOFTWARE ENGINEERING**	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:

- Rajib Mall, "Fundamentals of Software Engineering", Third Edition, PHI Learning Private Limited, 2009
- Pankaj Jalote, "Software Engineering, A Precise Approach", Wiley India, 2010.
- Kelkar S.A., "Software Engineering", Prentice Hall of India Pvt Ltd, 2007.
- Stephen R.Schach, "Software Engineering", Tata McGraw-Hill Publishing Company Limited,2007

20OCS02 **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.

20OEC01 **SOFT COMPUTING** **L T P C**
3 0 0 3

Course Objectives

- 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.

Course Outcomes

At the end of the course, learners will 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 **8**

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 PERIODS

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, 200.

20OEC02 **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

20OEE02	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

20OFT01	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.

20OFT02 **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/

20OIT01	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.

20OIT02	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.

20OME01	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

20OME02	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.

20OPH01 **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

20OEN01 **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.	20OAG03	Introduction to Bio-Energy	OE	4	3	0	0	3
2.	20OAG04	Robotics in Agriculture	OE	4	3	0	0	3
3.	20OBT03	Industrial waste management	OE	4	3	0	0	3
4.	20OBT04	Fundamentals of Bioengineering	OE	4	3	0	0	3
5.	20OBM03	Hospital Management System	OE	4	3	0	0	3
6.	20OBM04	Biomedical Instrumentation	OE	4	3	0	0	3
7.	20OCE03	Remote Sensing and GIS	OE	4	3	0	0	3
8.	20OCE04	Air Pollution And Control Engineering	OE	4	3	0	0	3
9.	20OCS03	Data Structures and Algorithms	OE	4	3	0	0	3
10.	20OEC03	Consumer Electronics	OE	4	3	0	0	3
11.	20OEC04	Advanced Mobile Communication	OE	4	3	0	0	3
12.	20OEE03	Sensors and Transducers	OE	4	3	0	0	3
13.	20OEE04	Energy Technology	OE	4	3	0	0	3
14.	20OFT03	Beverage Technology	OE	4	3	0	0	3
15.	20OFT04	Processing of Food Materials	OE	4	3	0	0	3
16.	20OIT03	Foundation Of Information Technology						
17.	20OIT04	Web design and Management	OE	4	3	0	0	3
18.	20OME03	Automobile Technology	OE	4	3	0	0	3
19.	20OME04	CAD/CAM	OE	4	3	0	0	3
20.	20OPH02	Thin film Technology and Applications	OE	4	3	0	0	3
21.	20OEN02	English for Employability Skills	OE	4	3	0	0	3
22.	20OED01	Intellectual Property Rights	OE	4	3	0	0	3

20OAG03 **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

20OAG04 **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.

20OBT03 **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.

20OBT04 **FUNDAMENTALS OF BIOENGINEERING**

L	T	P	C
3	0	0	3

Course Objectives

- To make the students aware of the overall industrial bioprocess.
- To understand the basic configuration and parts of a fermentor.
- To study the production of primary and secondary metabolites.
- To understand the production of modern biotechnology products.

Course Outcomes

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

- CO1 : Understand the basics of industrial bioprocess.
- CO2: Explain the principle of a fermentation process and the chronological development of
- fermentation industry.
- CO3: Understand the basic configuration of a fermentor and its ancillaries.
- CO4: Learn the production of various primary and secondary metabolites.
- CO5: Understand the production of biotechnological products.
- CO6: Develop products through modern biotechniques

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 INDUSTRIAL BIOPROCESS **9**

Fermentation - Bacterial, Fungal and Yeast, Biochemistry of fermentation. Traditional and Modern Biotechnology - A brief survey of organisms, processes, products. Basic concepts of Upstream and Downstream processing in Bioprocess.

UNIT II FERMENTATION INDUSTRY **9**

Overview of fermentation industry, Basic configuration of Fermentor and ancillaries, main parameters to be monitored and controlled in fermentation processes. Types of fermentation – Solid state, submerged, batch, continuous, fed batch fermentation methods.

UNIT III PRODUCTION OF PRIMARY METABOLITES **9**

A brief outline of processes for the production of some commercially important organic acids - Citric acid, lactic acid ,acetic acid; amino acids - glutamic acid, phenylalanine; ethanol.

UNIT IV PRODUCTION OF SECONDARY METABOLITES **9**

Study of production processes for various classes of secondary metabolites: Antibiotics: beta lactams – penicillin and cephalosporin; aminoglycosides – streptomycin; macrolides - erythromycin, vitamin - B9, B12.

UNIT V PRODUCTS THROUGH MODERN BIOTECHNIQUES **9**

Production of industrial enzymes - proteases, amylases, lipases; Production of single cell protein from wastes; biopreservatives – Bacterosin; biopolymers - xanthan gum and PHA. Industrial uses of enzymes in detergents, beverage and food.

TOTAL: 45 HOURS

TEXT BOOKS

1. Peter F. Stanbur., Stephen J. Hall., A. Whitake., “Principles of Fermentation Technology”, Science & Technology Books. 2007.
2. Presscott, S.C., Cecil G., Dun, “Industrial Microbiology”, Agrobios (India), 2005.
3. Casida, L.E., “Industrial Microbiology”, New Age International (P) Ltd, 1968.

REFERENCES

1. Crueger, W., Anneliese Cruege.,“Biotechnology: A Textbook of Industrial Microbiology”, Panima Publishing Corporation, Edition 2, 2003.
2. Sathyanarayana, U., “Biotechnology”, Books and Allied (P) Ltd. Kolkata, 2005.
3. Ratledge C., Kristiansen B., “Basic Biotechnology”, Cambridge University Press, second Edition, 2001.
4. Michael J. Waites., “Industrial Microbiology: An Introduction”, Blackwell Publishing,2001.

20OBM03 **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.

20OBM04 **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

20OCE03 **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.

20OCE04	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.

20OCS03 **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

20OEC03 **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

Course Outcomes

At the end of the course, learners will 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: Construct various home appliances
CO6: Maintain various home appliances

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 LOUDSPEAKERS AND MICROPHONS 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 8

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 PERIODS

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

REFERENCES

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

20OEC04	ADVANCED MOBILE 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

20OEE03	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.

20OEE04 **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.

20OFT03	BEVERAGE TECHNOLOGY	L	T	P	C
		3	0	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.

Course Outcomes

At the end of the course, learners will 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

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 9

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 8

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 PERIODS

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.

REFERENCES

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

20OFT04	PROCESSING 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

Course Outcomes

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

CO1: Discuss the various processing technologies involved in cereal, pulses and oil seed 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												1	
3	1			3										1	
4					3			2							1
5					3			2							1
6	1	1		2											

3 - High, 2 - Medium, 1 – Low

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 8

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

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.

REFERENCES

1.Sukumar De. Outlines of Dairy Technology. Oxford University Press. New Delhi. 23rd impression. 2016.

20OIT03 **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)

20OIT04 **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/

20OME03 **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.

20OME04	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.

20OPH02	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.

20OEN02 **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
https://link.springer.com/book/10.1007/978-3-319-75166-5
https://cbseacademic.nic.in/web_material/Curriculum21/publication/secondary/Employability_Skills10

20OED01 **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.