DEPARTMENT OF BIOTECHNOLOGY

REGULATIONS 2021
(Approved for the students admitted in the Batch 2021 – 2025)

B.TECH BIOTECHNOLOGY

CHOICE BASED CREDIT SYSTEM

VISION AND MISSION OF THE DEPARTMENT

Vision of the Department

- To provide a world class department to facilitate learning, training, and research in Biotechnology by providing infrastructural facilities and competent faculty leading to technological innovations to serve the global society.

Mission of the Department

- The Mission of the Department is to provide quality education to students and to produce competent Biotechnologists to meet the challenges faced by industry and mankind.
- To inculcate high moral, ethical & professional standards among our students.
- To develop the overall personality of the students.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

The primary objective of the Bachelor of Biotechnology program is to prepare professionals with the skills required to work in the Biotechnology industry with particular emphasis on the engineering aspects of manufacturing and design.

Biotech Graduates are trained to

I. To provide the necessary background in basic sciences like physics, chemistry, Computers, and advanced mathematics and to provide opportunities for students to gain knowledge in multidisciplinary subjects and labs.

II. To provide training to design and solve problems relevant to the general practice of Biotechnological process development, product optimization, commercialization, and social application taking into account their impacts on the environment.

III. To impart job-related skills in the field of biotechnology with an awareness of professional codes and bioethical practices.

IV. To promote a life-long learning process for a successful professional career in industries and research organizations leading to successful employability.

The Overall objective of the Program is to promote education and research in biotechnology and provide academic and professional excellence for immediate productivity in industrial, governmental, or clinical settings for an ultimate benefit of society and environment.

PROGRAM OUTCOMES(POs)

As a result of this program, the student will be able to:

1. **Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **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.

3. **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 public health and safety, and cultural, societal, and environmental considerations.

4. **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 proceed to valid conclusions.

5. **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.

6. **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.

7. **Environment and sustainability:** Understand the impact of professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of and need for sustainable development.

8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and team work:** Function effectively as an individual and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **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.

11. **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 in multidisciplinary environments.

12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

1. Our Biotech graduates shall possess strong knowledge in the field of biotechnology and applied sciences.

2. Our Biotech graduates shall be able to design and conduct experiments in biotechnology as well as analyze and interpret data.

3. Our Biotech graduates shall be able to use current techniques, skills and modern tools necessary for modelling and design of bioprocesses.

Mapping of Programme Educational Objectives (PEOs)with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)

PEOs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
I		✓	✓			✓	✓	✓	✓		✓	✓	✓	✓	✓
II	✓		✓		✓	✓		✓	✓	✓	✓		✓	✓	
III		✓	✓	✓	✓		✓			✓	✓	✓	✓	✓	✓
IV	✓			✓	✓	✓	✓		✓	✓		✓		✓	✓

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)

YEAR	SEM	SUBJECT NAME	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
YEAR 1	SEM 1	Communicative English	-	✓	✓	✓	✓	-	✓	-	✓	✓	-	-
		Engineering Mathematics – I	✓	✓	✓	✓	✓	✓	-	-	✓	✓	✓	✓
		Engineering Physics	✓	✓	✓	✓	✓	✓	✓	✓	-	✓	✓	✓
		Engineering Chemistry	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Problem Solving and Python Programming	✓	✓	✓	✓	✓	-	-	-	-	✓	✓	✓
		Engineering Graphics	✓	✓	✓	✓	✓	✓	-	-	✓	✓	✓	✓
		Python Programming Laboratory	✓	✓	✓	✓	✓	-	-	-	-	✓	✓	✓
		Physics and Chemistry Laboratory	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	SEM 2	Professional English	-	-	-	✓	-	-	✓	-	✓	✓	-	-
		Engineering Mathematics – II	✓	✓	✓	✓	✓	✓	-	-	-	-	-	✓

YEAR	SEM	SUBJECT NAME	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
		Physics of Materials	✓	✓	✓	✓	✓	✓	✓	-	-	-	-	✓
		Environmental Science and Engineering	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Basic Civil and Mechanical Engineering	✓	✓	✓	✓	✓	✓	✓	-	✓	✓	-	✓
		Cell Biology	✓	✓	✓	✓	✓	-	-	-	-	-	-	✓
		Engineering Practices Lab	✓	✓	✓	✓	-	✓	✓	-	-	-	✓	✓
		Cell Biology Lab	✓	✓	✓	✓	✓	✓	✓	-	-	-	-	-
YEAR 2	SEM 3	Transforms and Partial Differential Equations	✓	✓	✓	✓	-	-	-	-	✓	-	✓	-
		Process Calculations	✓	✓	✓	✓	✓	✓	-	-	✓	-	✓	✓
		Basic Industrial Biotechnology	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Microbiology	✓	✓	✓	✓	✓	✓	-	✓	✓	✓	-	✓
		Biochemistry - I	✓	✓	✓	✓	✓	✓	-	-	-	-	-	✓
		Molecular Biology	✓	✓	✓	✓	✓	-	-	-	-	-	-	✓
		Microbiology Laboratory	✓	-	-	✓	-	✓	✓	✓	✓	✓	-	✓
		Biochemistry Laboratory	✓	✓	✓	✓	✓	✓	-	-	-	-	-	✓
		Professional Skills Lab	✓	✓	✓	-	-	✓	-	-	✓	✓	✓	✓
	SEM 4	Applied Probability and Statistics	✓	✓	✓	✓	✓	✓	✓	-	-	-	✓	✓
		Biochemistry - II	✓	✓	-	✓	-	✓	-	-	-	-	✓	✓
		Enzyme Engineering	✓	✓	✓	✓	-	✓	✓	-	-	-	-	✓
		Fluid Mechanics and Heat Transfer Operations	✓	✓	✓	✓	-	✓	✓	✓	✓	✓	✓	✓

YEAR	SEM	SUBJECT NAME	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
		Bioprocess Principles	✓	✓	✓	✓	-	✓	✓	-	-	-	-	✓
		Applied Thermodynamics for Biotechnologists	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Chemical Engineering Lab	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	-	✓
		Molecular Biology Laboratory	✓	✓	✓	✓	✓	✓	✓	✓	-	-	-	-
YEAR 3	SEM 5	Mass Transfer Operations	✓	-	✓	✓	-	✓	-	-	-	-	✓	-
		Bioprocess Engineering	✓	✓	✓	✓	✓	✓	✓	✓	✓	-	- ✓	
		Analytical methods & Instrumentation	✓	✓	-	✓	-	✓	-	-	-	-	✓	✓
		Protein Engineering	✓	✓	✓	✓	✓	✓	✓	✓	✓	-	-	✓
		Bioprocess Laboratory I	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	-	-
		Analytical methods & Instrumentation Lab	-	-	-	✓	-	-	✓	-	✓	-	✓	✓
	SEM 6	Computational Biology	✓	✓	✓	✓	✓	-	-	-	-	-	-	-
		Applied Chemical Reaction Engineering	✓	✓	✓	✓	-	✓	-	-	-	-	✓	-
		Genetic Engineering	✓	✓	✓	✓	✓	✓	✓	✓	✓	-	-	✓
		Bioprocess Laboratory II	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	-	-
		Genetic Engineering Laboratory	✓	✓	✓	✓	✓	✓	✓	✓	-	-	-	-
YEAR 4	SEM 7	Total Quality Management for Biotechnologists	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Downstream Processing	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Immunology	✓	✓	✓	✓	✓	✓	✓	-	-	-	-	✓

YEAR	SEM	SUBJECT NAME	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
		Downstream Processing Laboratory	✓	✓	✓	✓	✓	✓	✓	-	✓	✓	✓	✓
		Immunology Laboratory	✓	✓	✓	✓	✓	-	-	✓	-	-	-	✓
	SEM 8	Project Work	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

DEPARTMENT OF BIOTECHNOLOGY

B. TECH BIOTECHNOLOGY

REGULATIONS 2021
(Approved for the students admitted in the Batch 2021 – 2025)

I TO VIII SEMESTERS CURRICULUM

SEMESTER I

S.No	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	HS1101	Communicative English	HSMC	3	3	0	0	3
2	MA1102	Engineering Mathematics – I	BSC	4	3	1	0	4
3	PH1103	Engineering Physics	BSC	3	3	0	0	3
4	CY1104	Engineering Chemistry	BSC	3	3	0	0	3
5	GE1105	Problem solving and python programming	ESC	3	3	0	0	3
6	GE1106	Engineering Graphics	ESC	6	2	0	4	4
PRACTICALS								
7	GE1107	Python Programming Laboratory	ESC	4	0	0	4	2
8	BS1108	Physics and Chemistry Laboratory	BSC	4	0	0	4	2
			TOTAL	**31**	**19**	**0**	**12**	**24**

SEMESTER II

S.No	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	HS1201	Professional English	HSMC	3	3	0	0	3
2	MA1202	Engineering Mathematics – II	BSC	4	3	1	0	4
3	PH1255	Physics of Materials	BSC	3	3	0	0	3
4	GE1204	Environmental science and Engineering	HSMC	3	3	0	0	3
5	GE1205	Basic Civil and Mechanical Engineering	ESC	3	3	0	0	3
6	BT1206	Cell Biology	PCC	3	3	0	0	3
PRACTICALS								
7	GE1207	Engineering Practices lab	ESC	4	0	0	4	2
8	BT1208	Cell Biology Lab	PCC	4	0	0	4	2
			TOTAL	**28**	**20**	**0**	**8**	**23**

SEMESTER III

S.No	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	MA1301	Transforms and Partial Differential Equations	BSC	4	3	1	0	4
2	BT1301	Process Calculations	PCC	3	3	0	0	3
3	BT1302	Basic Industrial Biotechnology	PCC	3	3	0	0	3
4	BT1303	Microbiology	PCC	3	3	0	0	3
5	BT1304	Biochemistry-I	PCC	3	3	0	0	3
6	BT1305	Molecular Biology	PCC	3	3	0	0	3
PRACTICALS								
7	BT1307	Microbiology Laboratory	PCC	4	0	0	4	2
8	BT1308	Biochemistry Laboratory	PCC	4	0	0	4	2
9	HS1310	Professional Skills Lab	EEC	2	0	0	2	1
			TOTAL	**29**	**19**	**2**	**10**	**24**

SEMESTER IV

S.No	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	MA1452	Applied Probability and Statistics	BSC	4	3	1	0	4
2	BT1401	Biochemistry-II	PCC	3	3	0	0	3
3	BT1402	Enzyme Engineering	PCC	3	3	0	0	3
4	BT1403	Fluid Mechanics and Heat Transfer Operations	ESC	3	3	0	0	3
5	BT1404	Bioprocess Principles	PCC	3	3	0	0	3
6	BT1405	Applied Thermodynamics for Biotechnologists	PCC	3	3	0	0	3
7		Audit Course*	AC	2	2	0	0	0
PRACTICALS								
8	BT1407	Chemical Engineering Lab	ESC	4	0	0	4	2
9	BT1408	Molecular Biology Laboratory	PCC	4	0	0	4	2
			TOTAL	**29**	**21**	**0**	**8**	**23**

* Registration for any one of the audit courses is optional for the students

SEMESTER V

S.No	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	BT1501	Mass Transfer Operations	PCC	3	3	0	0	3
2	BT1502	Bioprocess Engineering	ESC	3	3	0	0	3
3	BT1503	Analytical methods and Instrumentation	PCC	3	3	0	0	3
4	BT1504	Protein Engineering	PCC	3	3	0	0	3
5		Professional Elective- I	PEC	3	3	0	0	3
6		Open Elective-I	OEC	3	3	0	0	3
PRACTICALS								
7	BT1507	Bioprocess Laboratory-I	PCC	4	0	0	4	2
8	BT1508	Analytical methods and Instrumentation Lab	PCC	4	0	0	4	2
9	BT1510	In-plant Training**	EEC	0	0	0	0	1
			TOTAL	**26**	**18**	**0**	**8**	**23**

**Students should undergo two-week In-plant Training during IV semester vacation which will be evaluated during the V semester

SEMESTER VI

S.No	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	BT1601	Computational Biology	PCC Theory cum Lab	5	3	0	2	4
2	BT1602	Applied Chemical Reaction Engineering	ESC	3	3	0	0	3
3	BT1603	Genetic Engineering	PCC	3	3	0	0	3
4		Professional Elective-II	PEC	3	3	0	0	3
5		Professional Elective-III	PEC	3	3	0	0	3
6		Professional Elective-IV	PEC	3	3	0	0	3
PRACTICALS								
7	BT1607	Bioprocess Laboratory-II	PCC	4	0	0	4	2
8	BT1608	Genetic Engineering Laboratory	PCC	4	0	0	4	2
			TOTAL	**28**	**18**	**0**	**10**	**23**
Value added course* (**BVA001 - Advancements in Drug Designing- 1 week)			EEC	3	1	0	2	2

*** The credits earned through Value added course shall be over and above the total credits prescribed in the curriculum for the award of the degree

SEMESTER VII

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	BT1701	Total Quality Management for Biotechnologists	BSC	3	3	0	0	3
2	BT1702	Downstream Processing	PCC	3	3	0	0	3
3	BT1703	Immunology	PCC	3	3	0	0	3
4		Professional Elective V	PEC	3	3	0	0	3
5		Professional Elective VI	PEC	3	3	0	0	3
6		Open Elective II	OEC	3	3	0	0	3
PRACTICALS								
7	BT1707	Downstream Processing Laboratory	PCC	4	0	0	4	2
8	BT1708	Immunology Laboratory	PCC	4	0	0	4	2
TOTAL				**26**	**18**	**0**	**8**	**22**

SEMESTER VIII

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
PRACTICALS								
1	BT1807	Project work	EEC	20	0	0	20	10
TOTAL				**20**	**0**	**0**	**20**	**10**

TOTAL NO. OF CREDITS:172

AUDIT COURSE* (AC)

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	AD1001	Constitution of India	AC	2	2	0	0	0
2.	AD1002	Value Education	AC	2	2	0	0	0
3.	AD1003	Pedagogy Studies	AC	2	2	0	0	0
4.	AD1004	Stress Management by Yoga	AC	2	2	0	0	0
5.	AD1005	Personality Development Through Life Enlightenment Skills	AC	2	2	0	0	0
6.	AD1006	Unnat Bharat Abhiyan	AC	2	2	0	0	0
7.	AD1007	Essence of Indian Knowledge Tradition	AC	2	2	0	0	0
8.	AD1008	Sanga Tamil Literature Appreciation	AC	2	2	0	0	0

* Registration for any of these courses is optional for students

PROFESSIONAL ELECTIVES

PROFESSIONAL ELECTIVE–I

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	BT1001	Biophysics	PEC	3	3	0	0	3
2	BT1002	Principles of Food Processing	PEC	3	3	0	0	3
3	CE1025	Disaster Management	PEC	3	3	0	0	3
4	BT1004	Marine Biotechnology	PEC	3	3	0	0	3

PROFESSIONAL ELECTIVE–II

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	BT1005	Animal Biotechnology	PEC	3	3	0	0	3
2	BT1006	Systems Biology	PEC	3	3	0	0	3
3	BT1007	Biological Spectroscopy	PEC	3	3	0	0	3
4	GE1001	Intellectual Property Rights	PEC	3	3	0	0	3

PROFESSIONAL ELECTIVE–III

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	BT1009	Cancer Biology	PEC	3	3	0	0	3
2	BT1010	Biopharmaceutical Technology	PEC	3	3	0	0	3
3	BT1011	Molecular pathogenesis of diseases	PEC	3	3	0	0	3
4	BT1012	Bio-Entrepreneurship	PEC	3	3	0	0	3

PROFESSIONAL ELECTIVE–IV

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	BT1013	Bioethics	PEC	3	3	0	0	3
2	GE1004	Fundamentals of Nanoscience	PEC	3	3	0	0	3
3	BT1015	Genomics and Proteomics	PEC	3	3	0	0	3
4	BT1016	Lifestyle diseases	PEC	3	3	0	0	3

PROFESSIONAL ELECTIVE–V

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	BT1017	Plant Biotechnology	PEC	3	3	0	0	3
2	BT1018	Metabolic Engineering	PEC	3	3	0	0	3
3	BT1019	Genetics	PEC	3	3	0	0	3
4	BT1020	Clinical Trials	PEC	3	3	0	0	3

PROFESSIONAL ELECTIVE–VI

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	BT1021	Tissue Engineering	PEC	3	3	0	0	3
2	BT1022	Biosafety and Hazard Management	PEC	3	3	0	0	3
3	BT1023	Stem Cell Technology	PEC	3	3	0	0	3
4	BT1024	Immunotechnology	PEC	3	3	0	0	3

OPEN ELECTIVE – I

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	OCE101	Air pollution and Control	OEC	3	3	0	0	3
2.	OME101	Automotive Systems	OEC	3	3	0	0	3
3.	OEI103	Basics of Biomedical Instrumentation	OEC	3	3	0	0	3
4.	OCS103	Introduction to Cloud computing	OEC	3	3	0	0	3
5.	OCH103	Environment and Agriculture	OEC	3	3	0	0	3
6.	OEI101	Sensors and Transducers	OEC	3	3	0	0	3

OPEN ELECTIVE–II

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	OME102	Design of Experiments	OEC	3	3	0	0	3
2.	OCE104	Green Building Design	OEC	3	3	0	0	3
3.	OCH101	Hospital Management	OEC	3	3	0	0	3
4.	OEI102	Robotics	OEC	3	3	0	0	3
5.	OCS101	Introduction to C programming	OEC	3	3	0	0	3
6.	OMB102	Logistics and Supply Chain Management	OEC	3	3	0	0	3

SUBJECT AREA-WISE DETAILS

HUMANITIES, SOCIAL SCIENCES AND MANAGEMENT COURSES (HSMC)

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	HS1101	Communicative English	HSMC	3	3	0	0	3
2.	HS1201	Professional English	HSMC	3	3	0	0	3
3.	GE1204	Environmental Science and Engineering	HSMC	3	3	0	0	3

ENGINEERING SCIENCE COURSES (ESC)

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	GE1105	Problem Solving and Python Programming	ESC	3	3	0	0	3
2.	GE1106	Engineering Graphics	ESC	6	2	0	4	4
3.	GE1107	Python Programming Laboratory	ESC	4	0	0	4	2
4.	GE1205	Basic Civil and Mechanical Engineering	ESC	4	3	0	0	3
5.	GE1207	Engineering Practices Laboratory	ESC	4	0	0	4	2
6.	BT1403	Fluid Mechanics and Heat Transfer Operations	ESC	4	3	0	0	3
7.	BT1407	Chemical Engineering Laboratory	ESC	4	0	0	4	2
8.	BT1502	Bioprocess Engineering	ESC	3	3	0	0	3
9.	BT1602	Applied Chemical Reaction Engineering	ESC	3	3	0	0	3

BASIC SCIENCE COURSES (BSC)

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	MA1102	Engineering Mathematics-I	BSC	4	3	1	0	4
2.	PH1103	Engineering Physics	BSC	3	3	0	0	3
3.	CY1104	Engineering Chemistry	BSC	3	3	0	0	3
4.	BS1108	Physics and Chemistry Laboratory	BSC	4	0	0	4	2
5.	MA1202	Engineering Mathematics-II	BSC	4	3	1	0	4
6.	PH1255	Physics of Materials	BSC	3	3	0	0	3
7.	MA1301	Transforms and Partial Differential Equations	BSC	4	3	1	0	4
8.	MA1452	Applied Probability and Statistics	BSC	4	3	1	0	4
9.	BT1701	Total Quality Management for Biotechnologists	BSC	3	3	0	0	3

PROFESSIONAL CORE COURSES (PCC)

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
1.	BT1304	Biochemistry-I	PCC	3	3	0	0	3
2.	BT1308	Biochemistry Laboratory	PCC	4	0	0	4	2
3.	BT1301	Process Calculations	PCC	3	3	0	0	3
4.	BT1405	Applied Thermodynamics for Biotechnologists	PCC	3	3	0	0	3
5.	BT1302	Basic Industrial Biotechnology	PCC	3	3	0	0	3
6.	BT1401	Biochemistry – II	PCC	3	3	0	0	3
7.	BT1206	Cell Biology	PCC	3	3	0	0	3
8.	BT1307	Microbiology Laboratory	PCC	4	0	0	4	2
9.	BT1208	Cell Biology Laboratory	PCC	4	0	0	4	2
10.	BT1303	Microbiology	PCC	3	3	0	0	3
11.	BT1305	Molecular Biology	PCC	3	3	0	0	3
12.	BT1402	Enzyme Engineering	PCC	3	3	0	0	3
13.	BT1404	Bioprocess Principles	PCC	3	3	0	0	3
14.	BT1408	Molecular Biology Laboratory	PCC	4	0	0	4	2
15.	BT1501	Mass Transfer Operations	PCC	3	3	0	0	3
16.	BT1503	Analytical Methods and Instrumentation	PCC	3	3	0	0	3
17.	BT1504	Protein Engineering	PCC	3	3	0	0	3
18.	BT1507	Bioprocess Laboratory-I	PCC	4	0	0	4	2
19.	BT1508	Analytical Methods and Instrumentation Laboratory	PCC	4	0	0	4	2
20.	BT1601	Computational Biology	PCC	5	3	0	2	4
21.	BT1603	Genetic Engineering	PCC	4	3	0	0	3
22.	BT1607	Bioprocess Laboratory II	PCC	4	0	0	4	2
23.	BT1608	Genetic Engineering Laboratory	PCC	4	0	0	4	2
24.	BT1702	Downstream Processing	PCC	3	3	0	0	3
25.	BT1703	Immunology	PCC	3	3	0	0	3
26.	BT1707	Downstream Processing Laboratory	PCC	4	0	0	4	2
27.	BT1708	Immunology Laboratory	PCC	4	0	0	4	2

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
1.	HS1310	Professional skills Lab	EEC	2	0	0	2	1
2.	BT1510	In-plant Training	EEC	0	0	0	0	1
3.	BVA001	Advancements in Drug Designing	EEC	2	1	0	2	2
4.	BT1807	Project Work	EEC	20	0	0	20	10

SUMMARY OF CREDITS

S. No.	SUBJECT AREA	CREDITS PER SEMESTER								TOTAL CREDITS
		I	II	III	IV	V	VI	VII	VIII	
1	HSMC	3	6	-	-	-	-	-	-	09
2	BSC	12	7	4	4	-	-	3	-	30
3	ESC	9	5	-	5	3	3	-	-	25
4	PCC	-	5	19	14	13	11	10	-	72
5	PEC	-	-	-	-	3	9	6	-	18
6	OEC	-	-	-	-	3	-	3	-	06
7	AC	-	-	-	-	-	-	-	-	00
8	EEC	-	-	1	-	1	-	-	10	12
Total		**24**	**23**	**24**	**23**	**23**	**23**	**22**	**10**	**172**

I SEMESTER

HS1101	COMMUNICATIVE ENGLISH	L	T	P	C
		3	0	0	3

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.

UNIT I: SHARING INFORMATION RELATED TO ONESELF/FAMILY& FRIENDS **9**

Reading – critical reading – finding key information in a given text – shifting facts from opinions - Writing - autobiographical writing - developing hints. Listening- short texts- short formal and informal conversations. Speaking- basics in speaking - introducing oneself - exchanging personal information- speaking on given topics & situations Language development– voices- Wh-Questions- asking and answering-yes or no questions– parts of speech. Vocabulary development- - prefixes- suffixes- articles - Polite Expressions. **CO1**

UNIT II GENERAL READING AND FREE WRITING **9**

Reading: Short narratives and descriptions from newspapers (including dialogues and conversations ; Reading Comprehension Texts with varied question types - Writing – paragraph writing- topic sentence- main ideas- free writing, short narrative descriptions using some suggested vocabulary and structures –. Listening - long texts - TED talks - extensive speech on current affairs and discussions Speaking – describing a simple process – asking and answering questions - Language development – prepositions, clauses. Vocabulary development- guessing meanings of words in context – use of sequence words. **CO2**

UNIT III GRAMMAR AND LANGUAGE DEVELOPMENT **9**

Reading- short texts and longer passages (close reading) & making a critical analysis of the given text Writing – types of paragraph and writing essays – rearrangement of jumbled sentences. Listening: Listening to ted talks and long speeches for comprehension. Speaking- role plays - asking about routine actions and expressing opinions. Language development- degrees of comparison-pronouns- Direct vs. Indirect Questions. Vocabulary development – idioms and phrases- cause & effect expressions, adverbs. **CO3**

UNIT IV READING AND LANGUAGE DEVELOPMENT **9**

Reading- comprehension-reading longer texts- reading different types of texts- magazines. Writing-letter writing, informal or personal letters-e-mails-conventions of personal email- Listening: Listening comprehension (IELTS, TOEFL and others). Speaking -Speaking about friends/places/hobbies - Language development- Tenses- simple present-simple past- present continuous and past continuous- conditionals – if, unless, in case, when and others Vocabulary development- synonyms-antonyms- Single word substitutes- Collocations. **CO4**

UNIT V EXTENDED WRITING **9**

Reading: Reading for comparisons and contrast and other deeper levels of meaning –Writing-brainstorming -writing short essays – developing an outline- identifying main and subordinate ideas- dialogue writing- Listening - popular speeches and presentations - Speaking - impromptu **CO5**

speeches & debates Language development-modal verbs- present/ past perfect tense - Vocabulary development-Phrasal verbs- fixed and semi-fixed expressions.

TOTAL PERIODS: 45

TEXT BOOKS:

1. Board of Editors. Using English A Course book for Undergraduate Engineers and Technologists. Orient Black Swan Limited, Hyderabad: 2020
2. Sanjay Kumar & Pushp Lata Communication Skills Second Edition, Oxford University Press: 2015.
3. Richards, C. Jack. Interchange Students' Book-2 New Delhi: CUP, 2015.

REFERENCES:

1. Bailey, Stephen. Academic Writing: A practical guide for students. New York: Rutledge,2011.
2. Means, L. Thomas and Elaine Langlois. English & Communication For Colleges. Cengage Learning ,USA: 2007
3. Redston, Chris &Gillies Cunningham Face 2 Face (Pre-intermediate Student's Book& Workbook) Cambridge University Press, New Delhi: 2005
4. Comfort, Jeremy, et al. Speaking Effectively: Developing Speaking Skills for Business English. Cambridge University Press, Cambridge: Reprint 2011
5. Dutt P. Kiranmai and Rajeevan Geeta Basic Communication Skills, Foundation Books: 2013

John Eastwood et al : Be Grammar Ready: The Ultimate Guide to English Grammar, Oxford University Press: 2020.

COURSE OUTCOMES

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

CO1	Speak clearly, confidently, comprehensibly, and communicate with one or many listeners using appropriate communicative strategies.
CO2	Write cohesively and coherently and flawlessly avoiding grammatical errors, using a wide vocabulary range, organizing their ideas logically on a topic.
CO3	Read different genres of texts adopting various reading strategies.
CO4	Listen/view and comprehend different spoken discourses/excerpts in different accents
CO5	Identify topics and formulate questions for productive inquiry

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	2	3	-	-	2	-	2
CO2	-	1	-	2	-	-	-	-	-	3	-	-	2	-	2
CO3	-	2	-	3	-	-	-	-	-	2	-	-	2	-	1
CO4	-	-	-	-	-	-	-	-	2	2	-	-	2	-	2
CO5	-	2	1	1	2	-	2	-	-	3	-	-	1	-	2

MA1102	ENGINEERING MATHEMATICS –I	L	T	P	C
		3	1	0	4

OBJECTIVES:

- The goal of this course is to achieve conceptual understanding and to retain the best traditions of traditional calculus.
- The syllabus is designed to provide the basic tools of calculus mainly for the purpose of modeling the engineering problems mathematically and obtaining solutions.
- Matrix Algebra is one of the powerful tools to handle practical problems arising in the field of engineering.
- This is a foundation course of Single Variable and multivariable calculus plays an important role in the understanding of science, engineering, economics and computer science, among other disciplines.

UNIT I: MATRICES **12**

Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigenvalues and Eigenvectors – Cayley-Hamilton theorem – Diagonalization of matrices – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms **CO1**

UNIT II: CALCULUS OF ONE VARIABLE **12**

Limit of a function - Continuity - Derivatives - Differentiation rules – Interval of increasing and decreasing functions – Maxima and Minima - Intervals of concavity and convexity. **CO2**

UNIT III: CALCULUS OF SEVERAL VARIABLES **12**

Partial differentiation – Homogeneous functions and Euler‘s theorem – Total derivative – Change of variables – Jacobians – Partial differentiation of implicit functions – Taylor‘s series for functions of two variables – Maxima and minima of functions of two variables – Lagrange‘s method of undetermined multipliers. **CO3**

UNIT IV: INTEGRAL CALCULUS **12**

Definite and Indefinite integrals - Substitution rule - Techniques of Integration - Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions - Improper integrals. **CO4**

UNIT V: MULTIPLE INTEGRALS **12**

Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Change of variables from Cartesian to polar in double integrals-Triple integrals – Volume of solids **CO5**

TOTAL PERIODS: 60

TEXT BOOKS:

1. Grewal B.S., Higher Engineering Mathematics‖, Khanna Publishers, New Delhi, 43rd Edition, 2014.
2. James Stewart, "Calculus: Early Transcendental", Cengage Learning, 7th Edition, New Delhi,2015. [For Units I & III - Sections 2.2, 2.3, 2.5, 2.7(Tangents problems only), 2.8, 3.1 to 3.6, 3.11, 4.1, 4.3, 5.1(Area problems only), 5.2, 5.3, 5.4 (excluding net change theorem), 5.5, 7.2 - 7.4 and 7.8].

REFERENCES:

1. Anton, H, Bivens, I and Davis, S, "Calculus", Wiley, 10th Edition, 2016.
2. Jain R.K. and Iyengar S.R.K., —Advanced Engineering Mathematicsll, Narosa Publications, New Delhi, 3rd Edition, 2007.
3. Narayanan, S. and Manicavachagom Pillai, T. K., —Calculus" Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2007.
4. Srimantha Pal and Bhunia, S.C, "Engineering Mathematics" Oxford University Press, 2015.
5. T. Veerarajan. Engineering Mathematics – I, McGraw Hill Education; First edition 2017.

COURSE OUTCOMES

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

CO1 Have a clear idea of matrix algebra pertaining Eigenvalues and Eigenvectors in addition dealing with quadratic forms.

CO2 Understand the concept of limit of a function and apply the same to deal with continuity and derivative of a given function. Apply differentiation to solve maxima and minima problems, which are related to real world problems.

CO3 Have the idea of extension of a function of one variable to several variables. Multivariable functions of real variables are inevitable in engineering.

CO4 Understand the concept of integration through fundamental theorem of calculus. Also acquire skills to evaluate the integrals using the techniques of substitution, partial fraction and integration by parts along with the knowledge of improper integrals.

CO5 Do double and triple integration so that they can handle integrals of higher order which are applied in engineering field.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	1	2	3	-	-	3	2	3	3	3	3	2
CO2	3	3	3	2	2	1	-	-	-	-	1	2	3	3	2
CO3	3	3	3	2	2	1	-	-	-	-	1	2	2	3	2
CO4	3	3	3	2	2	1	-	-	-	-	1	2	2	3	1
CO5	3	3	3	2	1	1	-	-	-	-	1	2	2	3	1

PH1103	ENGINEERING PHYSICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To make the students to understand about the elastic property and stress strain diagram.
- To educate the students about principle of laser and its role in optical fibers and its applications as sensors and communication.
- To teach the students about the heat transfer through solids and liquids.
- To educate the students about the quantum concepts and its use to explain black body radiation, Compton effect, tunnelling electron microscopy and its applications.
- To make the students to understand the importance of various crystal structures and various growth techniques.

UNIT I: PROPERTIES OF MATTER **9**

Elasticity – Stress-strain diagram and its uses - factors affecting elastic modulus and tensile strength – torsional stress and deformations – twisting couple - torsion pendulum: theory and experiment - bending of beams - bending moment – cantilever: theory and experiment – uniform and non-uniform bending: theory and experiment – Practical applications of modulus of elasticity-I-shaped girders - stress due to bending in beams. **CO1**

UNIT II: LASER AND FIBER OPTICS **9**

Lasers : population of energy levels, Einstein's A and B coefficients derivation – resonant cavity, optical amplification (qualitative) – Nd-YAG Laser-Semiconductor lasers: homojunction and heterojunction – Industrial and medical applications of Laser– Fiber optics: principle, numerical aperture and acceptance angle - types of optical fibres (material, refractive index, mode) – losses associated with optical fibers – Fabrication of Optical fiber-Double crucible method-fibre optic sensors: pressure and displacement-Industrial and medical applications of optical fiber-Endoscopy-Fiber optic communication system. **CO2**

UNIT III: THERMAL PHYSICS **9**

Transfer of heat energy – thermal expansion of solids and liquids – expansion joints - bimetallic strips - thermal conduction, convection and radiation – heat conductions in solids – thermal conductivity –Rectilinear flow of heat- Lee's disc method: theory and experiment - conduction through compound media (series and parallel)-Radial flow of heat– thermal insulation – applications: heat exchangers, refrigerators, oven, Induction furnace and solar water heaters. **CO3**

UNIT IV: QUANTUM PHYSICS **9**

Black body radiation – Planck's theory (derivation) – Compton effect: theory and experimental verification – wave particle duality – electron diffraction – concept of wave function and its physical significance – Schrödinger's wave equation – time independent and time dependent equations – particle in a one-dimensional rigid box – Electron microscope-tunnelling (qualitative) - scanning tunnelling microscope-Applications of electron microscopy. **CO4**

UNIT V: CRYSTAL PHYSICS **9**

Single crystalline, polycrystalline and amorphous materials – single crystals: unit cell, crystal systems, Bravais lattices, directions and planes in a crystal, Miller indices – inter-planar distances coordination number and packing factor for SC, BCC, FCC, HCP and diamond structures – Graphite structure-crystal imperfections: point defects, line defects – Burger vectors, stacking faults – growth of single crystals: solution and melt growth techniques-Epitaxial growth-Applications of Single crystal (Qualitative). **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Bhattacharya, D.K. & Poonam, T. “Engineering Physics”. Oxford University Press, 2019.
2. Gaur, R.K. & Gupta, S.L. “Engineering Physics”. Dhanpat Rai Publishers, 2017.
3. Pandey, B.K. & Chaturvedi, S. “Engineering Physics”. Cengage Learning India, 2019.

REFERENCES:

1. Halliday, D., Resnick, R. & Walker, J. “Principles of Physics”. Wiley, 2015.
2. Serway, R.A. & Jewett, J.W. “Physics for Scientists and Engineers”. Cengage Learning, 2019.
3. Tipler, P.A. & Mosca, G. “Physics for Scientists and Engineers with Modern Physics’. W.H.Freeman, 2007.

COURSE OUTCOMES

Upon completion of the course,

CO1 Gain knowledge on the basics of properties of matter and its applications,

CO2 Acquire knowledge on the concepts of waves and optical devices and their applications in fibre optics.

CO3 Have adequate knowledge on the concepts of thermal properties of materials and their applications in expansion joints and heat exchangers.

CO4 Get knowledge on advanced physics concepts of quantum theory and its applications in tunneling microscopes, and

CO5 Understand the basics of crystals, their structures and different crystal growth techniques.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	1	2	-	-	-	-	-	1	1	1	1	2
CO2	2	2	1	3	2	1	-	-	-	1	1	2	2	2	3
CO3	2	2	1	3	2	1	-	-	-	1	1	2	2	2	3
CO4	2	2	1	3	3	1	2	-	-	1	1	2	2	2	3
CO5	2	2	2	3	3	2	-	1	-	2	1	2	2	2	3

CY1104 **ENGINEERING CHEMISTRY** **L T P C**
3 0 0 3

OBJECTIVES:

- Principles of water characterization and treatment for industrial purposes.
- Principles and applications of surface chemistry and catalysis.
- Phase rule and various types of alloys.
- Various types of fuels, applications and combustion.
- Conventional and non–conventional energy sources and energy storage device.

UNIT I: WATER AND ITS TREATMENT **9**

Hardness of water – Types – Expression of hardness – Units – Estimation of hardness by EDTA method – Numerical problems on EDTA method – Boiler troubles (scale and sludge, caustic embrittlement , boiler corrosion, priming and foaming) – Treatment of boiler feed water – Internal treatment (carbonate, phosphate, colloidal, sodium aluminate and calgon conditioning) – External treatment – Ion exchange process, Zeolite process – Desalination of brackish water by reverse Osmosis. **CO1**

UNIT II: SURFACE CHEMISTRY AND CATALYSIS **9**

Surface chemistry: Types of adsorption – Adsorption of gases on solids – Adsorption of solute from solutions – Adsorption isotherms – Freundlich's adsorption isotherm – Langmuir's adsorption isotherm – Kinetics of uni-molecular surface reactions – Adsorption in chromatography – Applications of adsorption in pollution abatement using PAC. **CO2**

Catalysis: Catalyst – Types of catalysis – Criteria – Contact theory – Catalytic poisoning and catalytic promoters – Industrial applications of catalysts – Catalytic convertor – Auto catalysis – Enzyme catalysis – Michaelis-Menten equation.

UNIT III: PHASE RULE AND ALLOYS **9**

Phase rule: Introduction – Definition of terms with examples – One component system – Water system – Reduced phase rule – Thermal analysis and cooling curves – Two component systems – Lead-silver system – Pattinson process. **CO3**

Alloys: Introduction – Definition – Properties of alloys – Significance of alloying – Functions and effect of alloying elements – Nichrome, Alnico, Stainless steel (18/8) – Heat treatment of steel – Non-ferrous alloys – Brass and bronze.

UNIT IV: FUELS AND COMBUSTION **9**

Fuels: Introduction – classification of fuels – Comparison of solid, liquid, gaseous fuels – Coal – Analysis of coal (proximate and ultimate). – Carbonization – Manufacture of metallurgical coke (Otto Hoffmann method) – Petroleum – Cracking – Manufacture of synthetic petrol (Bergius process, Fischer Tropsch Process) – Knocking – Octane number – Diesel oil – Cetane number – Compressed natural gas (CNG) – Liquefied petroleum gases (LPG) – Power alcohol and biodiesel. **CO4**

Combustion of fuels: Introduction – Calorific value – Higher and lower calorific values – Theoretical calculation of calorific value – Ignition temperature – Spontaneous ignition temperature – Explosive range – Flue gas analysis by Orsat Method.

UNIT V: NON–CONVENTIONAL ENERGY SOURCES AND STORAGE DEVICES **9**

Nuclear energy – Fission and fusion reactions – Differences – Chain reactions – Nuclear reactors – Classification of reactors – Light water nuclear reactor for power generation – Breeder reactor – Solar energy conversion – Solar cells – Wind energy – Fuel cells – Hydrogen-oxygen fuel cell . Batteries – Types of batteries - Alkaline batteries – Lead-acid, Nickel-cadmium and Lithium batteries. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. P.C.Jain, Monica Jain, “Engineering Chemistry” 17th Ed. Dhanpat Rai Pub. Co., New Delhi,(2015).
2. S.S. Dara, S.S. Umare, “A text book of Engineering Chemistry” S.Chand & Co.Ltd., New Delhi (2020).
3. S. Vairam, P. Kalyani and Suba Ramesh, “Engineering Chemistry”, Wiley India (P) Ltd. New Delhi, (2018).
4. P. Kannan, A. Ravikrishnan, “Engineering Chemistry”, Sri Krishna Hi-tech Publishing Company (P) Ltd. Chennai, (2009).

REFERENCES:

1. B.K.Sharma “Engineering chemistry” Krishna Prakasan Media (P) Ltd., Meerut (2001).
2. B. Sivasankar “Engineering Chemistry” Tata McGraw–Hill Pub.Co.Ltd, New Delhi (2008).
3. Prasanta Rath, “Engineering Chemistry”, Cengage Learning India (P) Ltd., Delhi, (2015).
4. Shikha Agarwal, “Engineering Chemistry–Fundamentals and Applications”, Cambridge University Press, Delhi, (2015).
5. A. Pahari, B. Chauhan, “Engineering Chemistry”, Firewall Media., New Delhi., (2010).
6. Sheik Mideen., Engineering Chemistry, Airwalk Publications, Chennai (2018).

COURSE OUTCOMES

Upon completion of the course,

CO1 Able to understand impurities in industrial water, boiler troubles, internal and external treatment methods of purifying water.

CO2 Able to understand concepts of absorption, adsorption, adsorption isotherms, application of adsorption for pollution abatement, catalysis and enzyme kinetics.

CO3 Able to recognize significance of alloying, functions of alloying elements and types of alloys, uses of alloys. They should be acquainted with phase rule and reduced phase and its applications in alloying.

CO4 Able to identify various types of fuels, properties, uses and analysis of fuels. They should be able to understand combustion of fuels, method of preparation of bio-diesel, synthetic petrol.

CO5 Able to understand conventional, non–conventional energy sources, nuclear fission and fusion, power generation by nuclear reactor, wind, solar energy and preparation, uses of various batteries.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	2	3	2	2	2	2	2	2	2	1
CO2	3	3	2	2	2	2	2	1	1	1	1	2	2	1	1
CO3	3	3	3	3	3	2	2	1	2	2	2	2	2	2	2
CO4	3	3	3	2	2	3	3	2	2	3	2	2	3	1	2
CO5	3	2	3	3	3	3	3	2	2	2	2	2	3	2	3

GE1105	PROBLEM SOLVING AND PYTHON PROGRAMMING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To know the basics of algorithmic problem solving
- To write simple python programs
- To develop python program by using control structures and functions
- To use python predefined data structures
- To write file-based program

UNIT I: ALGORITHMIC PROBLEM SOLVING **9**

Algorithms, Building blocks of algorithms: statements, state, control flow, functions, Notation: pseudo code, flow chart, programming language, Algorithmic problem solving: Basic algorithms, flowcharts and pseudocode for sequential, decision processing and iterative processing strategies, Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi. **CO1**

UNIT II: INTRODUCTION TO PYTHON **9**

Python Introduction, Technical Strength of Python, Python interpreter and interactive mode, Introduction to colab , pycharm and jupyter idle(s) ,Values and types: int, float, boolean, string, and list; Built-in data types, variables, Literals, Constants, statements, Operators: Assignment, Arithmetic, Relational, Logical, Bitwise operators and their precedence, Expressions, tuple assignment, Accepting input from Console, printing statements, Simple Python programs. **CO2**

UNIT III: CONTROL FLOW, FUNCTIONS AND STRINGS **9**

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: while, for; Loop manipulation using pass, break, continue, and else; Modules and Functions: function definition and use, flow of execution, parameters and arguments, local and global scope, return values, function composition, recursion. Strings: string slices, immutability, string functions and methods, string module; Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search. **CO3**

UNIT IV: LISTS, TUPLES, DICTIONARIES **9**

Lists: Defining list and list slicing, list operations, list slices, list methods, list loop, list Manipulation, mutability, aliasing, cloning lists, list parameters, lists as arrays. Tuples: tuple assignment, tuple as return value, tuple Manipulation; Dictionaries: operations and methods; advanced list processing – list comprehension; Illustrative programs: selection sort, insertion sort, merge sort, histogram. **CO4**

UNIT V: FILES, MODULES, PACKAGES **5**

Files and exception: Concept of Files, Text Files; File opening in various modes and closing of a file, Format Operators, Reading from a file, Writing onto a file, File functions- open(), close(), read(),readline(), readlines(),write(), writelines(),tell(),seek(), Command Line arguments; Errors and exceptions: handling exceptions; modules, packages; introduction to numpy, matplotlib. Illustrative programs: word count, copy a file. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Allen B. Downey, “Think Python: How to Think Like a Computer Scientist ‘‘, 2nd edition, Updated for Python 3, Shroff/O‘Reilly Publishers, 2016 (http://greenteapress.com/wp/thinkpython/)
2. Guido van Rossum and Fred L. Drake Jr, — An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011.
3. Reema Thareja, Python Programming: Using Problem Solving Approach, Oxford University Press, 2019.

REFERENCES:

1. John V Guttag, —Introduction to Computation and Programming Using Python‘‘, Revised and expanded Edition, MIT Press , 2013
2. Robert Sedgewick, Kevin Wayne, Robert Dondero, —Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
3. Timothy A. Budd, —Exploring Python‖, Mc-Graw Hill Education (India) Private Ltd.,, 2015.
4. Kenneth A. Lambert, —Fundamentals of Python: First Programs‖, CENGAGE Learning, 2012.
5. Charles Dierbach, —Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 2013.
6. Paul Gries, Jennifer Campbell and Jason Montojo, —Practical Programming: An Introduction.

COURSE OUTCOMES

Upon completion of the course,

- **CO1** Develop algorithmic solutions to simple computational problems
- **CO2** Develop simple console application in python
- **CO3** Develop python program by applying control structure and decompose program into functions.
- **CO4** Represent compound data using python lists, tuples, and dictionaries.
- **CO5** Read and write data from/to files in Python.

MAPPING OF COs WITH POs AND PSOs

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

GE1106	ENGINEERING GRAPHICS	L	T	P	C
		2	0	4	4

OBJECTIVES:

- To develop in students, graphic skills for communication of concepts, ideas and design of Engineering products
- To expose them to existing national standards related to technical drawings.

CONCEPTS AND CONVENTIONS (Not for Examination) **1**

Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.

UNIT I: PLANE CURVES AND FREEHAND SKETCHING **7+12**

Basic Geometrical constructions, Curves used in engineering practices: Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of square and circle – Drawing of tangents and normal to the above curves.
Visualization concepts and Free Hand sketching: Visualization principles –Representation of Three-Dimensional objects – Layout of views- Freehand sketching of multiple views from pictorial views of objects **CO1**

UNIT II: PROJECTION OF POINTS, LINES AND PLANE SURFACE **6+12**

Orthographic projection- principles-Principal Planes-First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method. **CO2**

UNIT III: PROJECTION OF SOLIDS **5+12**

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes by rotating object method. **CO3**

UNIT IV: PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES **5+12**

Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones. **CO4**

UNIT V: ISOMETRIC AND PERSPECTIVE PROJECTIONS **6+12**

Principles of isometric projection – isometric scale –Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions - Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method. **CO5**

TOTAL PERIODS: 90

TEXT BOOKS:

1. Natarajan K.V., “A text book of Engineering Graphics”, Dhanalakshmi Publishers, Chennai, Twenty Ninth Edition 2016
2. Venugopal K. and Prabhu Raja V., “Engineering Graphics”, New Age International (P) Limited, 2011.

REFERENCES:

1. Bhatt N.D. and Panchal V.M., “Engineering Drawing”, Charotar Publishing House, 53rd Edition, 2019.
2. Basant Agarwal and Agarwal C.M., “Engineering Drawing”, Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
3. Gopalakrishna K.R., “Engineering Drawing” (Vol. I&II combined), Subhas Stores, Bangalore, 2018.
4. Luzzader, Warren.J. and Duff,John M., “Fundamentals of Engineering Drawing with an introduction to Interactive Comput er Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
5. N S Parthasarathy and Vela Murali, “Engineering Graphics”, Oxford University, Press, New Delhi, 2015.
6. Shah M.B., and Rana B.C., “Engineering Drawing”, Pearson, 2nd Edition, 2009.

COURSE OUTCOMES

Upon completion of the course, the students will

- **CO1** Understand the fundamentals and standards of Engineering graphics
- **CO2** Perform freehand sketching of basic geometrical constructions and multiple views of objects
- **CO3** Understand the concept of orthographic projections of lines and plane surfaces
- **CO4** Draw the projections of section of solids and development of surfaces
- **CO5** Visualize and to project isometric and perspective sections of simple solids

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	1	2	1	1	-	-	3	3	2	3	1	1	1
CO2	3	1	2	2	1	1	-	-	3	3	2	3	1	1	1
CO3	3	1	1	3	1	1	-	-	3	3	2	3	1	1	1
CO4	3	1	1	3	1	1	-	-	3	3	2	3	1	1	1
CO5	3	1	2	3	1	1	-	-	3	3	2	3	1	1	1

GE1107 PYTHON PROGRAMMING LABORATORY

L	T	P	C
0	0	4	2

OBJECTIVES

- To write, test, and debug simple Python programs.
- To implement Python programs with conditionals and loops.
- Use functions for structuring Python programs.
- Represent compound data using Python lists, tuples, and dictionaries.
- Read and write data from/to files in Python.

LIST OF EXPERIMENTS

1. Write an algorithm and draw flowchart illustrating mail merge concept.
2. Write an algorithm, draw flowchart and write pseudo code for a real life or scientific or technical problems
3. Scientific problem-solving using decision making and looping. **CO1**
    - Armstrong number, palindrome of a number, Perfect number.
4. Simple programming for one dimensional and two-dimensional arrays.
    - Transpose, addition, multiplication, scalar, determinant of a matrix
5. Program to explore string functions and recursive functions.
6. Utilizing 'Functions' in Python
    - Find mean, median, mode for the given set of numbers in a list.
    - Write a function dups to find all duplicates in the list.
    - Write a function unique to find all the unique elements of a list. **CO2**
    - Write function to compute gcd, lcm of two numbers.
7. Demonstrate the use of Dictionaries and tuples with sample programs.
8. Implement Searching Operations: Linear and Binary Search.
9. To sort the 'n' numbers using: Selection, Merge sort and Insertion Sort.
10. Find the most frequent words in a text of file using command line arguments.
11. Demonstrate Exceptions in Python. **CO3**
12. Applications**:** Implementing GUI using turtle, pygame.

TOTAL PERIODS: 60

REFERENCE BOOKS

1. Reema Thareja, Python Programming: Using Problem Solving Approach, Oxford University Press, 2019
2. Allen B. Downey , " Think Python: How to Think Like a Computer Scientist", Second Edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016.
3. Shroff "Learning Python: Powerful Object-Oriented Programming; Fifth edition, 2013.

4. David M.Baezly “Python Essential Reference”. Addison-Wesley Professional; Fourth edition, 2009.
5. David M. Baezly “Python Cookbook” O’Reilly Media; Third edition (June 1, 2013)

WEB REFERENCES

http://www.edx.org

COURSE OUTCOMES

Upon completion of the course,

CO1 Develop simple console applications through python with control structure and functions

CO2 Use python built in data structures like lists, tuples, and dictionaries for representing compound data.

CO3 Read and write data from/to files in Python and applications of python.

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO2	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO3	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2

BS1108 **PHYSICS AND CHEMISTRY LABORATORY** **L T P C**

0 0 4 2

OBJECTIVES

The students will be trained to perform experiments to study the following.

- The Properties of Matter
- The Optical properties, Characteristics of Lasers & Optical Fibre
- Electrical & Thermal properties of Materials
- Enable the students to enhance accuracy in experimental measurements.
- To make the student to acquire practical skills in the determination of water quality parameters through volumetric analysis
- Instrumental method of analysis such as potentiometry, conductometry and pHmetry

LIST OF EXPERIMENTS– PHYSICS

(A minimum of 5 experiments to be performed from the given list)

1. Determination of Young’s modulus of the material of the given beam by Non-uniform bending method. **CO1**

2. Determination of rigidity modulus of the material of the given wire using torsion pendulum.	**CO1**
3. Determination of wavelength of mercury spectra using Spectrometer and grating.	**CO2**
4. Determination of dispersive power of prism using Spectrometer.	**CO2**
5. (a) Determination of wavelength and particle size using a laser.	**CO2**
(b) Determination of numerical aperture and acceptance angle of an optical fibre.	**CO1**
(c) Determination of width of the groove of compact disc using laser	
6. Determination of Young's modulus of the material of the given beam by uniform bending method.	**CO2** **CO2**
7. Determination of energy band gap of the semiconductor.	
8. Determination of coefficient of thermal conductivity of the given bad conductor using Lee's disc.	**CO1**

DEMONSTRATION EXPERIMENT

1. Determination of thickness of a thin sheet / wire – Air wedge method

LIST OF EXPERIMENTS – CHEMISTRY

(A minimum of 6 experiments to be performed from the given list)

1. Estimation of HCl using Na_2CO_3 as primary standard and determination of alkalinity in water sample.	**CO5** **CO5**
2. Determination of total, temporary & permanent hardness of water by EDTA method.	**CO5**
3. Determination of DO content of water sample by Winkler's method.	**CO3** **CO3**
4. Determination of chloride content of water sample by argentometric method.	**CO3** **CO4**
5. Estimation of copper content of the given solution by Iodometry.	**CO4**
6. Determination of strength of given hydrochloric acid using pH meter.	**CO4**
7. Determination of strength of acids in a mixture of acids using conductivity meter.	**CO4**
8. Estimation of iron content of the given solution using potentiometer.	**CO3**
9. Determination of molecular weight of polyvinyl alcohol using Ostwald viscometer.	
10. Conductometric titration of strong acid vs strong base.	**CO5**

DEMONSTRATION EXPERIMENTS

1. Estimation of iron content of the water sample using spectrophotometer (1, 10-Phenanthroline / thiocyanate method).
2. Estimation of sodium and potassium present in water using flame photometer.

TOTAL: 60 PERIODS

COURSE OUTCOMES

Upon completion of the course, the students will be

CO1	Able to understand the concept about the basic properties of matter like stress, strain and types of moduli. Able to understand the concept of optics like reflection, refraction, diffraction by using spectrometer grating.
CO2	Able to understand the thermal properties of solids, specific heat and some models for specific heat calculation. Able to understand the working principle of laser components and working of different laser system. Able to understand the phenomenon of light, applications of fibre optics.
CO3	Able to understand the concept of determining the pH value by using pH meter. Able to understand the concept about the amount of chloride present in the given sample of water.
CO4	Able to understand the concept of determining the emf values by using potentiometer Able to understand the concept about the measurement of conductance of strong acid and strong base by using conductivity meter.
CO5	Able to understand the amount of dissolved oxygen present in the water. Able to understand the concept of estimation of hardness of water by EDTA method. Able to understand the concept of estimation of alkalinity in water sample.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	1	2	2	2	1	1	1	3	2	2	3	2	2	2
CO2	3	1	2	1	1	1	1	1	2	1	1	2	2	2	2
CO3	3	1	2	1	2	2	2	1	2	1	1	1	2	2	1
CO4	3	2	1	1	2	1	1	1	2	1	1	2	2	1	2
CO5	3	2	1	1	1	2	2	1	2	1	2	1	2	1	1

II SEMESTER

HS1201	PROFESSIONAL ENGLISH	L	T	P	C
		3	0	0	3

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 specialization.

UNIT I: INTRODUCTION TO PROFESSIONAL ENGLISH **9**

Listening: Listening to technical talks with comprehension tasks - Speaking – conversation methods in real life occurrences using expressions of different emotions and imperative usages - Reading – reading short technical texts from journals- newspapers- Writing- purpose statements – extended definitions – writing instructions – checklists-recommendations-Vocabulary Development- technical vocabulary Language Development – tenses- subject verb agreement - compound words. **CO1**

UNIT II: READING AND STUDY SKILLS **9**

Listening-Listening Comprehension of a discussion on a technical topic of common interest by three or four participants (real life as well as online videos). -Speaking – describing a process- Reading: Practice in chunking and speed reading - Paragraphing- Writing- interpreting charts, graphs- Vocabulary Development: Important foreign expressions in Use, homonyms, homophones, homographs- easily confused words Language Development- impersonal passive voice, numerical adjectives. **CO2**

UNIT III: TECHNICAL WRITING AND GRAMMAR **9**

Listening – listening to conversation – effective use of words and their sound aspects, stress, intonation & pronunciation - Speaking – mechanics of presentations -Reading: Reading longer texts for detailed understanding. (GRE/IELTS practice tests); Writing-Describing a process, use of sequence words- Vocabulary Development- sequence words- Informal vocabulary and formal substitutes-Misspelled words. Language Development- embedded sentences and Ellipsis. **CO3**

UNIT IV: REPORT WRITING **9**

Listening – Model debates & documentaries and making notes. Speaking – expressing agreement/disagreement, assertiveness in expressing opinions-Reading: Technical reports, advertisements and minutes of meeting - Writing- email etiquette- job application – cover letter – Résumé preparation(via email and hard copy)- analytical essays and issue based essays-- Vocabulary Development- finding suitable synonyms-paraphrasing- Language Development- clauses- if conditionals. **CO4**

UNIT V: GROUP DISCUSSION AND JOB APPLICATIONS **9**

Listening: Extensive Listening. (radio plays, rendering of poems, audio books and others) Speaking –participating in a group discussion - Reading: Extensive Reading (short stories, novels, poetry and others)– Writing reports- minutes of a meeting- accident and survey- Writing a letter/ sending an email to the Editor - cause and effect sentences -Vocabulary Development- verbal analogies. Language Development- reported speech. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Board of editors. Fluency in English A Course book for Engineering and Technology. Orient Blackswan, Hyderabad: 2020.
2. Barun K Mitra, Effective Technical Communication Oxford University Press : 2006.
3. Sudharshana.N.P and Saveetha. C. English for Technical Communication. Cambridge University Press: New Delhi, 2016.

REFERENCES:

1. Raman, Meenakshi and Sharma, Sangeetha- Technical Communication Principles and Practice. Oxford University Press: New Delhi, 2014.
2. Kumar, Suresh. E. Engineering English. Orient Blackswan: Hyderabad,2015
3. Booth-L. Diana, Project Work, Oxford University Press, Oxford: 2014.
4. Grussendorf, Marion, English for Presentations, Oxford University Press, Oxford: 2007
5. Means, L. Thomas and Elaine Langlois, English & Communication For Colleges. Cengage Learning,USA: 2007.
6. Caroline Meyer & Bringi dev, Communicating for Results Oxford University Press: 2021.
7. Aruna Koneru, Professional Speaking Skills, Oxford University Press:2015.

COURSE OUTCOMES

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

CO1	Speak clearly, confidently, comprehensibly, and communicate with one or many listeners using appropriate communicative strategies.
CO2	Write cohesively and coherently and flawlessly avoiding grammatical errors, using a wide vocabulary range, organizing their ideas logically on a topic.
CO3	Read different genres of texts adopting various reading strategies.
CO4	Listen/view and comprehend different spoken discourses/excerpts in different accents
CO5	Identify topics and formulate questions for productive inquiry

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	2	3	-	-	1	-	2
CO2	-	1	-	2	-	-	-	-	-	3	-	-	1	-	2
CO3	-	2	-	3	-	-	-	-	-	2	-	-	1	-	1
CO4	-	-	-	-	-	-	-	-	2	2	-	-	1	-	1
CO5	-	2	1	1	2	-	-	-	-	3	-	-	1	-	2

MA1202	ENGINEERING MATHEMATICS - II	L	T	P	C
		3	1	0	4

OBJECTIVES:

- This course is designed to cover topics such as Differential Equations, Vector Calculus, Complex Analysis and Laplace Transform.
- The various methods of complex analysis and Laplace transforms can be used for efficiently solving the problems that occur in various branches of engineering disciplines

UNIT I: ORDINARY DIFFERENTIAL EQUATIONS **12**

Higher order linear differential equations with constant coefficients - Method of variation of parameters– Homogenous equation of Euler‘s and Legendre‘s type – System of simultaneous first order linear differential equations with constant coefficients **CO1**

UNIT II: VECTOR CALCULUS **12**

Gradient and directional derivative – Divergence and curl - Vector identities – Irrotational and Solenoidal vector fields – Line integral over a plane curve – Surface integral - Volume integral - Green‘s, Gauss divergence and Stoke‘s theorems – Verification and simple application in evaluating line, surface and volume integrals. **CO2**

UNIT III: COMPLEX VARIABLES **12**

Analytic functions – Necessary and sufficient conditions for analyticity in Cartesian and polar coordinates (C-R equations) - Properties – Harmonic conjugates – Construction of analytic function (Milne-Thomson method) – Conformal mapping – Standard transformations W = Z + C, CZ, 1/Z - Bilinear transformation. **CO3**

UNIT IV: COMPLEX INTEGRATION **12**

Cauchy’s integral theorem –Cauchy’s integral formula – Taylor’s and Laurent’s series – Singularities – Residues – Cauchy’s Residue theorem – Application of residue theorem for evaluation of real integrals – Use of circular contour and semi-circular contour(excluding poles on the real line). **CO4**

UNIT V: LAPLACE TRANSFORMS **12**

Existence conditions – Transforms of elementary functions – Transform of unit step function and unit impulse function - Basic properties - Shifting theorems – transforms of derivatives and integrals –Transform of periodic functions - Inverse transforms using properties, partial fractions and Convolution theorem – Application to solution of linear second order ordinary differential equations with constant coefficients. **CO5**

TOTAL PERIODS: 60

TEXT BOOKS:

1. Grewal B.S., ―Higher Engineering Mathematics‖, Khanna Publishers, New Delhi,43rd Edition, 2014.
2. Kreyszig Erwin, "Advanced Engineering Mathematics ", John Wiley and Sons, 10th Edition, New Delhi, 2016

REFERENCES:

1. G Bali N., Goyal M. and Watkins C., —Advanced Engineering Mathematics‖, Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
2. Jain R.K. and Iyengar S.R.K., — Advanced Engineering Mathematics ‖, Narosa Publications, New Delhi, 3rd Edition, 2007.
3. O'Neil, P.V. —Advanced Engineering Mathematics‖, Cengage Learning India Pvt., Ltd, New Delhi, 2007.
4. Sastry, S.S, —Engineering Mathematics", Vol. I & II, PHI Learning Pvt. Ltd,4th Edition, New Delhi, 2014.
5. Wylie, R.C. and Barrett, L.C., —Advanced Engineering Mathematics —Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012

COURSE OUTCOMES

Upon completion of the course,

CO1	The students will be imbibed with techniques in solving ordinary differential equations that arises in most of the engineering problems
CO2	The students will be acquainted with the concepts of vector calculus like Gradient, Divergence, Curl, Directional derivative, Irrotational vector and Solenoidal vector. The course gives an understanding of Vector integration, needed for problems in all engineering disciplines.
CO3	The students will develop an understanding of the standard techniques of complex variable and mapping so as to enable the student to apply them with confidence, in application areas such as heat conduction, elasticity, fluid dynamics and flow of electric current.
CO4	The student will be exposed to the concept of Cauchy's integral theorem, Taylor and Laurent expansions, Singular points, Application of residue theorem to evaluate complex integrals.
CO5	Students will understand the purpose of using transforms to create new domain which can give easier ways to handle the problem that is being investigated.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	1	-	-	-	-	1	2	2	1	1
CO2	3	3	3	1	1	1	-	-	-	-	2	1	2	1	1
CO3	3	3	3	2	1	1	-	1	-	-	1	1	1	1	-
CO4	3	3	3	1	-	-	-	-	-	-	1	-	1	1	1
CO5	3	3	3	1	-	-	-	-	-	-	1	-	1	1	-

PH1255	PHYSICS OF MATERIALS	L	T	P	C
		3	0	0	3

OBJECTIVES:

To make the student conversant with the

- Electronic properties in metals, properties of superconductors and its applications.
- Intrinsic and extrinsic semi conductors, Hall effect, LED, organic LED and solar cells.
- Types of magnetic materials and their applications, types of polarization and application
- Types, synthesis, properties and applications of nanostructured materials.
- Importance of various new engineering materials like ceramics, SMA, metallic glasses and biomaterials.

UNIT I: CONDUCTING AND SUPERCONDUCTING MATERIALS **9**

Classical free electron theory – expression for electrical conductivity – thermal conductivity, Wiedemann-Franz law – electrons in metals: particle in a three-dimensional box (Qualitative) – degenerate states – Fermi-Dirac statistics – density of energy states – electron in periodic potential (concept only) – electron effective mass – concept of hole – Superconducting phenomena, properties of superconductors – Meissner effect and isotope effect. Type I and Type II superconductors, High Tc superconductors – Magnetic levitation and SQUIDS. **CO1**

UNIT II: SEMICONDUCTING MATERIALS **9**

Elemental Semiconductors – Compound semiconductors – Origin of band gap in solids (qualitative) – carrier concentration in an intrinsic semiconductor (derivation) – Fermi level –variation of Fermi level with temperature – electrical conductivity – band gap determination – carrier concentration in n-type and p-type semiconductors (derivation) – variation of Fermi level with temperature and impurity concentration – Hall effect – determination of Hall coefficient – LED – Organic LED-Solar cells. **CO2**

UNIT III: DIELECTRIC AND MAGNETIC MATERIALS **9**

Dielectric materials – Electronic, Ionic, Orientational and space charge polarization –Internal field and deduction of Clausius Mosotti equation –Frequency and temperature variation of dielectric materials- dielectric loss – different types of dielectric breakdown – classification of insulating materials and their applications - Introduction to magnetic materials - Domain theory of ferromagnetism, Hysteresis, Soft and Hard magnetic materials – Anti-ferromagnetic materials – Ferrites - magnetoresistance - Giant magnetoresistance - Introduction to spintronics. **CO3**

UNIT IV: NANO MATERIALS **9**

Nanoscience and technology – Surface to volume ratio – Classifications of nanostructured materials – nano particles – quantum dots, nanowires, ultra-thin films-multilayered materials. Bottom-up Synthesis –Top-down Approach: Co-Precipitation, Ultrasonication, ball Milling, sol-gel method-Properties: electrical, magnetic, catalytic and antimicrobial resistance – Applications of nanomaterials in agriculture and medicine. **CO4**

UNIT V: NEW MATERIALS AND APPLICATIONS **9**

Metallic glasses – Shape memory alloys: Copper, Nickel and Titanium based alloys – graphene, graphene oxide and its properties – Ceramics: types and applications – Composites:classification, role of matrix and reinforcement – processing of fibre reinforced plastics and fibre reinforced metals – Biomaterials: hydroxyapatite – PMMA – Silicone – Sensors: Chemical Sensors - Bio-sensors – conducting and semiconducting polymers – Nano fluids-Electro and magneto rheological fluids.. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Balasubramaniam, R. “Callister's Materials Science and Engineering”. Wiley India Pvt. Ltd. 2014.
2. Kasap, S.O. “Principles of Electronic Materials and Devices”. McGraw-Hill Education, 2017.
3. Wahab, M.A. “Solid State Physics: Structure and Properties of Materials”. Narosa Publishing House, 2009.

REFERENCES:

1. Askeland, D. “Materials Science and Engineering”. Brooks/Cole, 2010
2. Raghavan, V. “Materials Science and Engineering : A First course”. PHI Learning, 2015.
3. Smith, W.F., Hashemi, J. & Prakash. R. “Materials Science and Engineering”. Tata McGraw Hill Education Pvt. Ltd., 2014.

COURSE OUTCOMES

Upon completion of the course,

CO1 Have the knowledge about carrier density calculation in metals, properties of superconductors and its applications.

CO2 Have the knowledge about carrier density calculation in intrinsic and extrinsic semiconductors, Hall effect, LED, OLED and solar cells

CO3 Obtain the knowledge about magnetic and dielectric materials and their applications.

CO4 Explore the knowledge about types, synthesis, properties and applications of nanostructured materials.

CO5 Understand the importance, properties and applications of various new engineering materials like ceramics, SMA, metallic glasses and biomaterials.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	1	1	1	1	1	1	1	1	1	2	1	1
CO2	3	3	2	2	1	1	1	1	1	1	1	2	2	1	1
CO3	3	3	2	3	2	1	1	1	1	1	1	3	3	2	1
CO4	3	3	3	3	2	3	3	1	2	1	2	3	3	2	1
CO5	3	3	3	3	2	3	2	1	2	1	2	3	3	2	1

GE1204 ENVIRONMENTAL SCIENCE AND ENGINEERING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To study the inter relationship between living organism and environment.
- To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.
- To find and implement scientific, technological, economic and political solutions to environmental problems.
- To study the integrated themes and biodiversity, natural resources, pollution control and waste management.
- To study the dynamic processes and understand the features of the earth's interior and surface.

UNIT I: ENVIRONMENT, ECOSYSTEM AND BIODIVERSITY **9**

Definition, scope and importance of environment – Need for public awareness – Role of Individual in Environmental protection – Concept of an ecosystem – Structure and function of an ecosystem – Producers, consumers and decomposers – Energy flow in the ecosystem – Food chains, food webs and ecological pyramids – Ecological succession – Types, characteristic features, structure and function of forest, grass land, desert and aquatic (ponds, lakes, rivers, oceans, estuaries) ecosystem. Biodiversity – Definition – Genetic, species and ecosystem diversity – Value of biodiversity – Consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local levels – India as a mega–diversity nation – Hot spots of biodiversity – Threats to biodiversity– Habitat loss, poaching of wild life, human-wildlife conflicts – Wildlife protection act and forest conservation act –Endangered and endemic species – Conservation of biodiversity – In-situ and ex–situ conservation of biodiversity. **CO1**

UNIT II: ENVIRONMENTAL POLLUTION **9**

Definition – Causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – Solid waste management: causes, effects and control measures of municipal solid wastes – Problems of e-waste – Role of an individual in prevention of pollution – Pollution case studies – Disaster management – Floods, earthquake, cyclone, tsunami and landslides – Field study of local polluted site – Urban / Rural / Industrial / Agricultural. **CO2**

UNIT III: NATURAL RESOURCES **9**

Forest resources: Use and over-exploitation – Deforestation – Case studies – Timber extraction, mining, dams and their effects on forests and tribal people – Water resources – Use and overutilization of surface and ground water, floods, drought, conflicts over water – Dams: benefits and problems – Mineral resources: Use and exploitation – Environmental effects of extracting and using mineral resources – Case studies – Food resources: World food problems – Changes caused by agriculture and overgrazing – Effects of modern agriculture: fertilizer–pesticide problems, water logging, salinity – Case studies – Energy resources: Growing energy needs – Renewable and non renewable energy sources – Use of alternate energy sources – Case studies – Land resources: Land as a resource – Land degradation, man induced landslides, soil erosion and desertification – Role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles – Field study of local area to document environmental assets – River / Forest / Grassland / Hill / Mountain. **CO3**

UNIT IV: SOCIAL ISSUES AND THE ENVIRONMENT **9**

From unsustainable to sustainable development – Urban problems related to energy – Water conservation, rain water harvesting, watershed management – Resettlement and rehabilitation of people; its problems and concerns, case studies – Role of non-governmental organization – Environmental ethics – Issues and possible solutions – Climate change – Global warming – Acid rain, Ozone layer depletion –Nuclear accidents and holocaust – Case studies – Wasteland reclamation – Consumerism and waste products – Principles of Green Chemistry – Environment protection act – Air (Prevention and Control of Pollution) Act – Water (Prevention and control of Pollution) Act – Wildlife protection Act – Forest conservation act – Enforcement machinery involved in environmental legislation– Central and state pollution control boards– National Green Tribunal – Public awareness. **CO4**

UNIT V: HUMAN POPULATION AND THE ENVIRONMENT **9**

Population growth – Variation among nations – Population explosion – Family welfare programme – Environment and human health – Human rights – Value education – HIV / AIDS – COVID 19 – Women and child welfare – Role of information technology in environment and human health – Case studies. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, (2014).
2. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, (2004).
3. Dr. A. Sheik Mideen and S.Izzat Fathima, "Environmental Science and Engineering", Airwalk Publications, Chennai, (2018).

REFERENCE BOOKS:

1. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India Pvt Ltd, New Delhi, (2007).
2. Erach Bharucha, "Textbook of Environmental Studies", Universities Press (I) Pvt, Ltd, Hydrabad, (2015).
3. G. Tyler Miller,Scott E. Spoolman, "Environmental Science", Cengage Learning India Pvt.Ltd,Delhi, (2014).
4. R. Rajagopalan, 'Environmental Studies-From Crisis to Cure', Oxford University Press, (2005).
5. Anubha Kaushik , C.P. Kaushik, "Perspectives in Environmental Studies", New Age international Pvt. Ltd, New Delhi, (2004).
6. Frank R. Spellman, "Handbook of Environmental Engineering", CRC Press, (2015).

COURSE OUTCOMES

Upon completion of the course,

CO1	Obtain knowledge about environment, ecosystems and biodiversity.
CO2	Take measures to control environmental pollution.
CO3	Gain knowledge about natural resources and energy sources.
CO4	Find and implement scientific, technological, economic and political solutions to environmental problems.
CO5	Understand the impact of environment on human population.

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	2	3	3	3	3	3	2	2	2	3	2	1	2
CO2	3	2	3	3	2	3	3	3	3	2	2	3	2	2	2
CO3	3	3	2	2	3	3	2	2	1	2	1	3	2	2	2
CO4	3	3	3	3	1	2	3	3	2	2	2	2	2	1	2
CO5	3	2	3	2	3	3	3	2	2	2	2	3	3	2	3

GE1205 BASIC CIVIL AND MECHANICAL ENGINEERING

L	**T**	**P**	**C**
3	**0**	**0**	**3**

OBJECTIVES:

- The objective of this course is to introduce basic knowledge on Civil Engineering Materials, Surveying, Foundations, Civil Engineering Structures, IC Engine, Working Principle of Power Plant, Accessories Of Power Plant, Refrigeration And Air Conditioning System

UNIT I: SCOPE OF CIVIL AND MECHANICAL ENGINEERING **6**

Overview of Civil Engineering - Civil Engineering contributions to the welfare of Society – Specialized sub disciplines in Civil Engineering – Structural, Construction, Geotechnical, Environmental, Transportation and Water Resources Engineering
Overview of Mechanical Engineering - Mechanical Engineering contributions to the welfare of Society –Specialized sub disciplines in Mechanical Engineering - Production, Automobile, Energy Engineering - Interdisciplinary concepts in Civil and Mechanical Engineering **CO1**

UNIT II: SURVEYING AND CIVIL ENGINEERING MATERIALS **9**

Surveying: Objects – classification – principles – measurements of distances – angles – leveling – determination of areas– contours - examples.
Civil Engineering Materials: Bricks – stones – sand – cement – concrete – steel – timber - modern materials **CO2**

UNIT III: BUILDING COMPONENTS AND STRUCTURES **12**

Foundations: Types of foundations - Bearing capacity and settlement – Requirement of good foundations. Civil Engineering Structures: Brick masonry – stonemasonry – beams – columns – lintels – roofing flooring – plastering – floor area, carpet area and floor space index – Types of Bridges and Dams – water supply - sources and quality of water - Rain water harvesting - introduction to high way and rail way. **CO3**

UNIT IV: INTERNAL COMBUSTION ENGINES AND POWER PLANTS **12**

Classification of Power Plants - Internal combustion engines as automobile power plant – Working principle of Petrol and Diesel Engines – Four stroke and two stroke cycles – Comparison of four stroke and two stroke engines – Working principle of steam, Gas, Diesel, Hydro - electric and Nuclear Power plants –- working principle of Boilers, Turbines, Reciprocating Pumps (single acting and double acting) and Centrifugal Pumps. **CO4**

UNIT V: REFRIGERATION AND AIR CONDITIONING SYSTEM **6**

Terminology of Refrigeration and Air Conditioning. Principle of vapour compression and absorption system–Layout of typical domestic refrigerator–Window and Split type room Air conditioner. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. . Shanmugam G and Palanichamy MS ,"Basic Civil and Mechanical Engineering", Tata McGraw Hill PublishingCo.,NewDelhi,1996.

REFERENCES:

1. . Palanikumar, K. Basic Mechanical Engineering, ARS Publications, 2010.
2. Ramamrutham S.,"Basic Civil Engineering", Dhanpat Rai Publishing Co.(P) Ltd.1999.
3. Seetharaman S.,"BasicCivil Engineering",AnuradhaAgencies,2005.
4. ShanthaKumar SRJ.,"Basic Mechanical Engineering", Hi-tech Publications, Mayiladuthurai, 2000.
5. Venugopal K. and Prahu Raja V., "Basic Mechanical Engineering", Anuradha Publishers, Kumbakonam,2000.

COURSE OUTCOMES

Upon completion of the course, students will be able

CO1 To impart basic knowledge on Civil and Mechanical Engineering

CO2 To familiarize the materials and measurements used in Civil Engineering.

CO3 To provide the exposure on the fundamental elements of civil engineering

CO4 To enable the students to distinguish the components and working principle of power plant, IC engines

CO5 To provide the exposure on the fundamental elements of R & AC system.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	3	3	3	-	3	2	2	3	2	3	2
CO2	3	2	3	3	3	3	2	-	2	1	1	3	1	2	1
CO3	3	2	3	3	2	3	2	-	3	2	1	3	1	2	1
CO4	3	2	3	2	2	3	2	-	3	2	2	3	1	1	1
CO5	3	2	3	2	2	3	2	-	2	2	1	3	1	2	1

BT1206	CELL BIOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

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

UNIT I: CELL STRUCTURE AND FUNCTION OF THE ORGANELLES **9**

Prokaryotic, Eukaryotic cells, Sub-cellular organelles and functions. Principles of membrane organization membrane proteins, cyto-skeletal proteins. Extra cellular matrix, cell-cell junctions **CO1**

UNIT II: CELL DIVISION, CANCER, APOPTOSIS AND IMMORTALIZATION OF CELLS **9**

Cell cycle – Mitosis, Meiosis, Molecules controlling cell cycle, cancer, role of Ras and Raf in oncogenesis and apoptosis. Stem cells, Cell culture and immortalization of cells and its applications. **CO2**

UNIT III: TRANSPORT ACROSS CELL MEMBRANE **9**

Passive and Active Transport, Permeases, Ion channels, ATP pumps. Na+ / K+ / Ca+ 2Tpumps, uniport, symport antiporter system. Ligand gated / voltage gated channels, Agonists and Antagonists. **CO3**

UNIT IV: SIGNAL TRANSDUCTION **9**

Receptors – extracellular signaling, Cell surface / cytosolic receptors and examples, Different classes of receptors antocrine / paracrine / endocrine models, Secondary messengers molecules **CO4**

UNIT V: TECHNIQUES USED TO STUDY CELLS **9**

Cell fractionation and flow cytometry, Morphology and identification of cells using microscopic studies like SEM, TEM and Confocal Microscopy. Localization of proteins in cells – Immuno staining. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Lodish, Harvey etal., “Molecular Cell Biology”, 7th Edition, W.H.Freeman, 2005.
2. Cooper, G.M. and R.E. Hansman “The Cell: A Molecular Approach”, VIIth Edition, ASM Press, 2007.

REFERENCES:

1. Alberts, Bruce etal., “Molecular Biology of the Cell”, IVth Edition, Garland Science (Taylors Francis), 2002.

COURSE OUTCOMES

Upon completion of the course, the students would have

CO1 Deeper understanding of cell at structural and functional level

CO2 Broad knowledge on the Cell division, and cell culturing methods

CO3 Deep knowledge on Cell transport mechanism and molecular interaction between cells.

CO4 Clear understanding of the signal transduction, secondary messengers.

CO5 Skill on working principles of microscopy and identification of cell types.

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	1	-	2	1	-	-	-	-	1	-	2	3	3	2
CO2	3	1	-	2	1	-	-	-	-	1	-	2	3	3	2
CO3	3	1	-	2	1	-	-	-	-	1	-	2	3	3	2
CO4	3	1	-	2	1	-	-	-	-	1	-	2	3	3	2
CO5	3	1	-	2	1	-	-	-	-	1	-	2	3	3	2

GE 1207 **ENGINEERING PRACTICES LABORATORY** **L P T C**

0 0 4 2

OBJECTIVES

- To provide exposure to the students with hands on experience on various basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering

LIST OF EXPERIMENTS

GROUP A (CIVIL & MECHANICAL)

I CIVIL ENGINEERING PRACTICE **13**

Buildings:

(a) Study of plumbing and carpentry components of residential and industrial buildings. Safety aspects.

Plumbing Works:

(a) Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in household fittings.

(b) Study of pipe connections requirements for pumps and turbines.

(c) Preparation of plumbing line sketches for water supply and sewage works. **CO1**

(d) **Hands-on-exercise:**

Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components.

(e) Demonstration of plumbing requirements of high-rise buildings.

Carpentry using Power Tools only:

(a) Study of the joints in roofs, doors, windows and furniture.

(b) Hands-on-exercise:

Wood work, joints by sawing, planing and cutting.

II MECHANICAL ENGINEERING PRACTICE **18**

Welding:

(a) Preparation of butt joints, lap joints and T- joints by Shielded metal arc welding.

(b) Gas welding practice **CO2**

Basic Machining:

(a) Simple Turning and Taper turning

(b) Drilling Practice

Sheet Metal Work:

(a) Forming & Bending:
(b) Model making – Trays and funnels.
(c) Different type of joints.

Machine assembly practice:

(a) Study of centrifugal pump
(b) Study of air conditioner

Demonstration on:

(a) Smithy operations, upsetting, swaging, setting down and bending. Example –Exercise – Production of hexagonal headed bolt.
(b) Foundry operations like mould preparation for gear and step cone pulley.
(c) Fitting – Exercises – Preparation of square fitting and V – fitting models.

GROUP B (ELECTRICAL & ELECTRONICS)

III ELECTRICAL ENGINEERING PRACTICE 13

1. Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2. Fluorescent lamp wiring. **CO3**
3. Stair case wiring
4. Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit.
5. Measurement of energy using single phase energy meter. **CO4**
6. Measurement of resistance to earth of an electrical equipment.

IV ELECTRONICS ENGINEERING PRACTICE 16

1. Study of electronic components and equipment's – Resistor, colour coding measurement of AC signal parameter (peak-peak, rms period, frequency) using CR. **CO5**
2. Study of logic gates AND, OR, EX-OR and NOT.
3. Generation of Clock Signal.
4. Soldering practice – Components Devices and Circuits – Using general purpose PCB. Measurement of ripple factor of HWR and FWR.

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S.No.	Description of Equipment	Quantity required
	CIVIL	
1.	Assorted components for plumbing consisting of metallic pipes, plastic pipes, flexible pipes, couplings, unions, elbows, plugs and other fittings.	**15 sets**
2.	Carpentry vice (fitted to work bench)	**15 Nos**
3.	Standard woodworking tools 15 Sets.	**15 Sets.**

4.	Models of industrial trusses, door joints, furniture joints	**5 each**
	Power Tools:	
	(a) Rotary Hammer	
	(b) Demolition Hammer	
5.	(c) Circular Saw	**2 Nos**
	(d) Planer	
	(e) Hand Drilling Machine	
	(f) Jigsaw	

MECHANICAL

1.	Arc welding transformer with cables and holders.	**5 Nos**
2.	Welding booth with exhaust facility.	**5 Nos**
3.	Welding accessories like welding shield, chipping hammer, wire brush, etc.	**5 Sets**
4.	Oxygen and acetylene gas cylinders, blow pipe and other welding outfit.	**2 Nos**
5.	Centre lathe.	**2 Nos**
6.	Hearth furnace, anvil and smithy tools.	**2 Sets**
7.	Moulding table, foundry tools.	**2 Sets**
8.	Power Tool: Angle Grinder.	**2 Nos**
9.	Study-purpose items: centrifugal pump, air-conditioner.	**1 each**

ELECTRICAL

1.	Assorted electrical components for house wiring.	**15 Sets**
2.	Electrical measuring instruments.	**10 Sets**
3.	**Study purpose items:** Iron box, fan and regulator, emergency lamp.	**1 each**
4.	Megger (250V/500V).	**1 No.**
	Power Tools:	
5.	(a) Range Finder	**2 Nos**
	(b) Digital Live-wire detector	

ELECTRONICS

1.	Soldering guns 10 Nos.	**10 Nos.**
2.	Assorted electronic components for making circuits 50 Nos.	**50 Nos.**
3.	Small PCBs.	**10 Nos.**
4.	Multimeters	**10 Nos.**
5.	**Study purpose items:** Telephone, FM radio, low-voltage power supply	**1 each**

COURSE OUTCOMES

Upon completion of the course, students will be

CO1 Able to fabricate carpentry components and pipe connections including plumbing works.

CO2 Able to use welding equipment to join the structures, carry out the basic machining operations, and make the models using sheet metal works.

CO3 Students will be able to isolate, grow and study the effect of external parameters on the microbial growth in batch culture.Able to illustrate on centrifugal pump, air conditioner, operations of smithy, foundry and fittings.

CO4 Able to carry out basic home electrical works and appliances, measure the electrical quantities.

CO5 Able to elaborate on the electronic components and gates, soldering practices.

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	1	3	-	-	3	2	-	1	1	-	3	1	1	3
CO2	3	2	3	-	-	3	1	-	2	1	-	3	2	2	3
CO3	3	1	2	-	-	2	2		1	1	-	3	2	1	3
CO4	3	2	3	3	1	3	1	1	1	1	2	3	1	1	3
CO5	3	2	3	3	1	2	1	1	1	1	2	3	1	1	3

BT1208 **CELL BIOLOGY LAB** **L T P C**
0 0 4 2

OBJECTIVES:

- To demonstrate various techniques to learn the morphology, identification and propagation

LIST OF EXPERIMENTS

1. Introduction to principles of sterile techniques and cell propagation
2. Principles of microscopy, phase contrast and fluorescent microscopy
3. Identification of plant, animal and bacterial cells by microscopy
4. Gram's Staining
5. Leishman Staining
6. Giemsa Staining
7. Thin Layer Chromatography
8. Separation of Peripheral Blood Mononuclear Cells from blood
9. Osmosis and Tonicity
10. Trypan Blue Assay
11. Staining for different stages of mitosis in Allium Cepa (Onion)

TOTAL PERIODS: 60

Equipment Needed for 20 Students

1. Hot Air Oven -1
2. Incubators -2
3. Light Microscopes -4
4. Incubator Shaker -1
5. Laminar Flow Chamber -2
6. Glassware, Chemicals as required

REFERENCE:

1. Rickwood, D. and J.R. Harris “Cell Biology : Essential Techniques”,

COURSE OUTCOMES

Upon completion of the course, the students will be able

CO1 To understand the basic techniques to work with cells

CO2 To demonstrate working principles of Microscopy

CO3 To understand and perform cell staining techniques

CO4 To identify the various stages of mitosis

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	-	-	2	2	-	-	-	1	-	1	1	3	3	2
CO2	1	1	1	2	3	-	-	-	1	-	1	-	3	3	2
CO3	1	2	1	1	2	-	1	-	1	-	1	1	3	3	2
CO4	1	1	1	1	2	1	-	-	1	-	1	2	3	3	2

SEMESTER III

MA1301	TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS	L	T	P	C
		3	1	0	4

OBJECTIVES:

- To introduce the basic concepts of Partial differential equation and to find its solutions.
- To introduce Fourier series analysis which is vital to many applications in engineering apart from its use in solving boundary value problems.
- To acquaint the student with Fourier series techniques to solve heat and wave flow problems in engineering.
- To familiarize the student with Fourier transform techniques used in solving various practical engineering problems.
- To introduce the effective mathematical tools for the solutions of difference equations that model several physical processes and to develop transform techniques for discrete time systems.

UNIT I: PARTIAL DIFFERENTIAL EQUATIONS **12**

Formation of partial differential equations – Singular integrals – Solutions of standard types of first order partial differential equations (except $f(x^m z^k p, y^n z^k q) = 0$) – Lagrange's linear equation – Linear partial differential equations of second and higher order with constant coefficients of both homogeneous and non-homogeneous types **CO1**

UNIT II: FOURIER SERIES **12**

Dirichlet's conditions -Necessary and sufficient condition for existence of Fourier series – General Fourier series – Odd and even functions – Half range sine series –Half range cosine series – Complex form of Fourier series – Parseval's identity – Harmonic analysis. **CO2**

UNIT III: APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS **12**

Classification of PDE – Method of separation of variables – Fourier Series Solutions of one-dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two dimensional equation of heat conduction. **CO3**

UNIT IV: FOURIER TRANSFORMS **12**

Statement of Fourier integral theorem – Fourier transform pair – Fourier sine and Cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity. **CO4**

UNIT V: Z - TRANSFORMS AND DIFFERENCE EQUATIONS **12**

Z-transforms – Elementary properties – Inverse Z-transform (using partial fraction and residues) – Initial and final value theorems – Convolution theorem – Formation of difference equations – Solution of difference equations using Z – transform. **CO5**

TOTAL PERIODS: 60

TEXT BOOKS:

1. Grewal B.S., “Higher Engineering Mathematics”, 44th Edition, Khanna Publishers, New Delhi, 2017.
2. Erwin Kreyszig, “Advanced Engineering Mathematics “, 10th Edition, John Wiley, India, 2016.
3. Bali. N.P and Manish Goyal, “A Textbook of Engineering Mathematics”, 9th Edition, Laxmi Publications Pvt. Ltd, 2014.

REFERENCES:

1. Dass, H.K., and Er.RajnishVerma, “Higher Engineering Mathematics”, S.Chand Private Ltd.,2011.
2. Peter V.O’Neil, “Advanced Engineering Mathematics”, 7th Edition, Cengage learning,2012
3. James, G., “Advanced Modern Engineering Mathematics”, 3rd Edition, Pearson Education, 2012.
4. Ramana. B.V., “Higher Engineering Mathematics”, McGraw Hill Education Pvt. Ltd, New Delhi,2016.
5. Wylie, R.C. and Barrett, L.C., “Advanced Engineering Mathematics “Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012

COURSE OUTCOMES

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

CO1 Understand how to solve the partial differential equations and apply these concepts in the field of engineering.

CO2 Learn Fourier series analysis which plays a vital role in the application of electrical engineering, vibration analysis, acoustics, optics, signal and image processing.

CO3 Appreciate the physical significance of Fourier series techniques in solving one and two-dimensional heat flow problems and one dimensional wave equations and this concept is applied in the fields like elasticity, heat transfer ,quantum mechanics and also extensively in physical phenomenon.

CO4 Understand the mathematical principles on transforms and gain the ability to formulate and solve some of the physical problems like designing electrical circuits, signal processing, signal analysis, image processing etc.

CO5 Learn to use the effective mathematical tools like Z- transform for the solving difference equations in discrete time signals etc.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	1	1	2	-	2	1	2	-	3	1	1
CO2	3	3	2	2	1	2	1	-	1	-	2	-	2	1	1
CO3	3	3	2	2	-	1	-	-	1	-	2	-	2	1	1
CO4	3	2	1	2	1	-	1	1	-	-	3	-	1	1	1
CO5	3	3	2	2	1	-	1	-	2	1	2	-	1	-	1

BT1301	PROCESS CALCULATIONS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- The course aims to develop skills of the students in the area of Chemical Engineering with emphasis in process calculations and fluid mechanics.
- This will enable the students to perform calculations pertaining to processes and operations.

UNIT I: BASIC CHEMICAL CALCULATIONS **9**

Dimension – Systems of units esp. engineering FPS, Engineering MKS & SI systems – Conversion from one system to the other – composition of mixtures and solutions – mass fraction, mass %, mole fraction, mole %, mass ratios, molarity, molality, normality, ppm, composition by density. **CO1**

UNIT II: IDEAL AND ACTUAL GAS EQUATIONS **9**

Ideal and actual gas equations, Vander Walls, compressibility factor equations, Application to pure gas & gas mixtures – partial pressures, partial volumes – Air-water vapour systems, Humidity, Molar Humidity, Relative Humidity, % Saturation, humid Volume – Humidity chart – wet, Dry bulb, Dew point temperatures, pH of solutions, Vapour pressure. **CO2**

UNIT III: MATERIAL BALANCE WITHOUT CHEMICAL REACTIONS **9**

Material balance concept – overall & component – material balance applications for evaporator, gas absorber without reaction, Distillation (Binary system), Liquid extraction, solid-liquid extraction, drying, crystallization, Humidification, Reverse Osmosis separation and Mixing Recycle and Bypass illustration **CO3**

UNIT IV: ENERGY BALANCE **9**

General energy balance equation for open systems, closed system sensible heat calculation, Heat required for phase change thermo chemistry, application of steam tables, Saturated and superheated steam application in bioprocess **CO4**

UNIT V: MATERIAL BALANCE WITH CHEMICAL REACTION **9**

Chemical Reaction-Limiting, excess component, Fractional conversion, Percent conversion, Fractional yield in multiple reactions. Simple problems, Combustion Reactions **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Bhatt B.I & SB Thakore, Stoichiometry - Fifth edition Tata McGraw Hill 2012
2. Geankoplis C.J. “Transport process & Separation process Principles 4th edition-PHI 2006.

REFERENCES:

1. McCabe W.L & J.C.Sonith & P.Harriot “Unit operations of chemical Engineering” 6thEdn McGraw Hill 2001
2. Robert W.Fox, Alan T.McDonald & Philip J.Pritchard “Introduction to FluidMechanics” 6th edn John Wiley & Sons 2003.
3. Himmelblau D.M “Basic principles & Calculations in Chemical Engineering” 6th edn PHI 2006.

COURSE OUTCOMES

Upon completion of the course, the students will be able

CO1 Tosolve problems related to units and conversions and fit the given data using the methodologies

CO2 Toapply their knowledge in the field of biochemical engineering from the principles of thermodynamics

CO3 Tosolve problems related to material balance concepts & design reactors for biochemical processes

CO4 To solve problems related to energy balance concepts & perform calculations pertaining to processes and operations.

CO5 To gain extensive knowledge on Conversion and Percent Yield for single and multiple chemical reactions.

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	1	1	-	-	-	-	-	-	-	-	1	1	1
CO2	3	2	1	1	1	-	-	-	-	-	-	-	1	1	1
CO3	3	2	2	1	1	1	-	-	-	-	-	-	1	1	1
CO4	3	2	2	1	1	1	-	-	-	-	-	-	1	1	1
CO5	3	2	2	1	1	1	-	-	-	-	-	-	1	1	1

BT1302 BASIC INDUSTRIAL BIOTECHNOLOGY

L	**T**	**P**	**C**
3	**0**	**0**	**3**

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

UNIT I: INTRODUCTION TO INDUSTRIAL BIOPROCESS **9**

Introduction to fermentation, Biochemistry of fermentation. Traditional and Modern Biotechnology- A brief survey of organisms, processes, products. Basic concepts of Upstream and Downstream processing in Bioprocess, Process flow sheeting – block diagrams, pictorial representation. **CO1**

UNIT II: PRODUCTION OF PRIMARY METABOLITES **9**

Primary Metabolites- Production of commercially important primary metabolites like organic acids, amino acids and alcohols. **CO2**

UNIT III: PRODUCTION OF SECONDARY METABOLITES **9**

Secondary Metabolites- Production processes for various classes of secondary metabolites: Antibiotics, Vitamins and Steroids. **CO3**

UNIT IV: PRODUCTION OF ENZYMES AND OTHER BIOPRODUCTS **9**

Production of Industrial Enzymes, Biopesticides, Biofertilizer, Biopreservatives, Biopolymers Biodiesel. Beer, Cheese, SCP & Mushroom culture **CO4**

UNIT V: PRODUCTION OF MODERN BIOTECHNOLOGY PRODUCTS **9**

Production of recombinant proteins having therapeutic and diagnostic applications, vaccines. **CO5** Bioprocess strategies in Plant Cell and Animal Cell culture.

TOTAL PERIODS: 45

TEXT BOOKS:

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

REFERENCES:

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.
4. Moo-Young, Murrey, “Comprehensive Biotechnology”, 4 Vols. Pergamon Press, (Elsevier) 2004.
5. Stanbury, P.F., A. Whitaker and S.J. Hall “Principles of Fermentation Technology”, IInd Edition, Butterworth – Heinemann (an imprint of Elsevier), 1995.
6. C.F.A Bryce and EL.Mansi, Fermentation microbiology & Biotechnology, 1999.
7. K.G.Ramawat & Shaily Goyal, Comprehensive Biotechnology, 2009, S.Chand publications.

COURSE OUTCOMES

Upon completion of the course,

CO1	Students will be able to learn, define and understand the basics in industrial bioprocess and to explain the steps involved in the production of bioproducts and methods to improve modern biotechnology.
CO2	Students will be able to measure and manufacture the primary metabolites of commercial importance and apply basic biotechnological principles, methods and models to solve biotechnological tasks.
CO3	Students will be able to measure, manufacture and formulate the secondary metabolites of commercial importance.
CO4	Students will be able to isolate, identify, characterize and apply in the production of enzymes and bioproducts.
CO5	Students will be able to estimate, evaluate and express the production of therapeutic and diagnostic products and design and deliver useful modern biotechnology products to the Society

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	-	-	1	2	-	-	-	-	-	1	1	1	1	2
CO2	2	2	1	3	2	1	-	-	-	1	1	2	2	2	3
CO3	2	2	1	3	2	1	-	-	-	1	1	2	2	2	3
CO4	2	2	1	3	3	1	2	-	-	1	1	2	2	2	3
CO5	2	2	2	3	3	2	-	1	-	2	1	2	2	2	3

BT1303 **MICROBIOLOGY** **L T P C**
3 0 0 3

OBJECTIVES:

- TointroducestudentstotheprinciplesofMicrobiologytoemphasizestructure, multiplication and biochemical aspects of various microbes
- To solve the problems in microbial infection and their control
- To Apply the knowledge in Industrial and environmental Biotechnology using microorganism

UNIT I: INTRODUCTION **9**

Basics of microbial existence; history of microbiology, classification and nomenclature of microorganisms, microscopic examination of microorganisms, light and electron microscopy; principles of different staining techniques like gram staining, acid fast, capsular staining, flagellar staining. **CO1**

UNIT II: MICROBES- STRUCTURE AND MULTIPLICATION **9**

Structural organization and multiplication of bacteria, viruses, algae and fungi, with special mention of life history of actinomycetes, yeast, mycoplasma and bacteriophages. **CO2**

UNIT III: MICROBIAL NUTRITION, GROWTHANDMETABOLISM **9**

Nutritional requirements of bacteria; different media used for bacterial culture; growth curve and different methods to quantify bacterial growth; aerobic (Glycolysis, Pentose pathway) and anaerobic bioenergetics (TCA cycle and Glyoxylate cycle) and utilization of energy for biosynthesis of important molecules (Synthesis of amino acid, protein, peptidoglycan and nucleotides) **CO3**

UNIT IV: CONTROL OF MICROORGANISMS **9**

Physical and chemical control of microorganisms; host-microbe interactions; anti-bacterial, anti-fungal and anti-viral agents; mode of action and resistance to antibiotics; clinically important microorganisms. **CO4**

UNIT V: INDUSTRIAL AND ENVIRONMENTAL MICROBIOLOGY **9**

Primary metabolites; secondary metabolites and their applications; preservation of food; productionof penicillin, alcohol, vitamin B-12; biogas; bioremediation; leaching of ores by microorganisms; biofertilizers and biopesticides; microorganisms and pollution control; biosensors **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

5. TalaronK,Talaron A, Casita, Pelczar and Reid.Foundations in Microbiology,W.C. Brown Publishers,1993.
6. PelczarMJ, Chan ECS and Krein NR, Microbiology, Tata McGraw Hill Edition, New Delhi,India.
7. PrescottL.M.,HarleyJ.P.,KleinDA,Microbiology,3rdEdition,Wm.C.BrownPublishers,1996

COURSE OUTCOMES

Upon completion of the course,

CO1 Students will develop skills in the identification and grouping of different microbes using staining and microscopic techniques.

CO2 Students will gain the ability to define the structural features of microbes through microscopy by structure and biochemical aspects of various microbes.

CO3 Students will be able to understand the microbial metabolism and nutritional requirements of various microbes.

CO4 Students will be able to select a suitable method for the control of microbes and design of antimicrobial agents to prevent microbial infection.

CO5 Students will be able to realize and identify various micro organism for industrial and environmental applications

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	2	2	1	-	-	-	-	-	-	3	2	2
CO2	1	2	1	2	1	1	-	-	-	-	-	-	3	2	1
CO3	1	1	3	2	2	1	1	-	1	-	-	2	3	2	2
CO4	2	3	3	3	2	2	2	1	1	-	-	2	3	3	2
CO5	3	2	3	3	1	1	2	1	2	-	-	2	3	3	2

BT1304	BIOCHEMISTRY - I	L	T	P	C
		3	0	0	3

OBJECTIVES:

To enable the students

- To know in detail about the elements of atom, charges and their bonding rule.
- To understand the fundamentals of biomolecules and biochemical process.
- To understand the reactions of intermediate metabolism and regulations

UNIT I: INTRODUCTION TO ORGANIC CHEMISTRY **9**

Basic principles of organic chemistry- Atoms, Electrons and Orbitals - Covalent Bonds - Octet rule - Polar covalent Bonds -Electronegativity- formal charges, Isomers-Structural and Stereoisomers. Acids and Bases - Arrhenius and Bronsted Lowry Theories, Lewis acid and base. Role of carbon, types of functional groups, chemical nature of water, pH and biological buffers- Types of buffers. **CO1**

UNIT II: STRUCTURE AND PROPERTIES OF CARBOHYDRATES **9**

Structure, Types and properties of Monosaccharides, Oligosaccharides and Polysaccharides. Chemical reaction of monosaccharides, Isomers- D and L configurations, epimers, anomers. Optical activity of Carbohydrates- Dextro and Levorotatory- Mutarotation. Proteoglycans, glucosaminoglycans. mutarotation, glycosidic bond, reducing sugars. Starch, glycogen, cellulose and chitin. Proteoglycans, glycosaminoglycans. Hyaluronic acid, chondroitin sulfate. **CO2**

UNIT III: STRUCTURE AND PROPERTIES OF PROTEIN **9**

Amino Acids and their types, Peptides, Proteins, measurement, structures, hierarchy of organization primary, secondary, tertiary and quaternary structures, glycoproteins, lipoproteins. Determine of primary structure. Strategy of Peptide Synthesis-Merrifield state peptide synthesis – Sequencing of Proteins- Sanger's and Edman's Method. **CO3**

UNIT IV: STRUCTURE AND PROPERTIES OF LIPIDS AND NUCLEIC ACIDS **9**

Lipids: fatty acids, glycerol-simple lipids: fats, oils and waxes-complex lipids: phospholipids, glycolipids, sphingolipids - derived lipids: steroids, terpenoids and carotenoids - Functions of lipids -saponification, iodination and hydrogenation. **CO4**

Nucleic acids: purines, pyrimidines, nucleoside, nucleotide, structure and function of RNA-mRNA, tRNA, rRNA and Watson and Crick structure of DNA. Sangers method of DNA Sequencing.

UNIT V: INTERMEDIARY METABOLISM AND REGULATION **9**

Glycolysis, TCA cycle, gluconeogenesis, pentose phosphate shunt & glyoxalate shunt. Fatty acid biosynthesis and oxidation, Cholesterol synthesis, Terpenes Biosynthesis. Amino acid degradation-deamination, transamination and decarboxylation, urea cycle. Electron transport chain- ATP cycle, calculation of ATP yield during oxidation of glucose and fatty acids. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

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

REFERENCES:

1. Berg, Jeremy M. et al. “Biochemsitry”, 6th Edition, W.H. Freeman & Co., 2006.
2. Murray, R.K., etal “Harper’s Illustrated Biochemistry”, 27th Edition, McGraw-Hill, 2006.
3. Voet, D. and Voet, J.G., “Biochemistry”, 3rd Edition, John Wiley & Sons Inc.,2004.

COURSE OUTCOMES

Upon completion of the course,

CO1 Students will be able to outline the basics of organic chemistry.

CO2 Students will be able to describe the basic structure, types and function of carbohydrates.

CO3 Students will be able to gain extensive knowledge on amino acids and protein.

CO4 Students will be able to gain extensive knowledge on Lipids and nucleic acids.

CO5 Students will be able to gain knowledge in intermediate metabolism and to consolidate the energy yield from different metabolic pathway

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	-	-	-	-	-	-	-	-	-	1	2	2	-
CO2	1	2	-	-	-	-	-	-	-	-	-	1	2	2	1
CO3	1	2	2	1	2	1	-	-	-	-	-	1	2	2	2
CO4	1	2	1	1	1	1	-	-	-	-	-	1	2	2	1
CO5	1	2	-	-	-	-	-	-	-	-	-	1	2	2	-

BT1305 MOLECULAR BIOLOGY

L	T	P	C
3	0	0	3

OBJECTIVES:

- Familiarize students with the cell and molecular biology of both Prokaryotes and Eukaryotes.
- This will be needed for any project work in modern biotechnology.
- By doing this course students will acquire basic fundamental knowledge and explore skills in molecular biology and become aware of the complexity and harmony of the cells.
- This course will emphasize the molecular mechanism of DNA replication, repair,transcription, protein synthesis and gene regulation in various organisms.

UNIT I: CHEMISTRY OF NUCLEIC ACIDS **9**

Introduction to nucleic acids: Nucleic acids as genetic material, Structure and physicochemical properties of elements in DNA and RNA, Biological significance of differences in DNA and RNA. Primary structure of DNA: Chemical and structural qualities of 3’,5’-Phosphodiester bond. Secondary Structure of DNA: Watson & Crick model, Chargaff’s rule, X–ray diffraction analysis of DNA, Forces stabilizes DNA structure, Conformational variants of double helical DNA, Hogsteen base pairing, Triple helix, Quadruple helix, Reversible denaturation and hyperchromic effect. Tertiary structure of DNA: DNA supercoiling. **CO1**

UNIT II: DNA REPLICATION & REPAIR **9**

Overview of Central dogma. Organization of prokaryotic and eukaryotic chromosomes. DNA replication: Meselson& Stahl experiment, bi–directional DNA replication, Okazaki fragments, Proteomics of DNA replication, Fidelity of DNA replication, Inhibitors of DNA replication, Overview of differences in prokaryotic and eukaryotic DNA replication, Telomere replication in eukaryotes. D-loop and rolling circle mode of replication. Mutagens, DNA mutations and their mechanism, various types of repair mechanisms. **CO2**

UNIT III: TRANSCRIPTION **9**

Structure and function of mRNA, rRNA and tRNA. Characteristics of promoter and enhancer sequences. RNA synthesis: Initiation, elongation and termination of RNA synthesis, Proteins of RNA synthesis, Fidelity of RNA synthesis, Inhibitors of transcription, Differences in prokaryotic and eukaryotic transcription. Basic concepts in RNA world: Ribozymes, RNA processing: 5'-Capping, Splicing-Alternative splicing, Poly 'A' tail addition and base modification. **CO3**

UNIT IV: TRANSLATION **9**

Introduction to Genetic code: Elucidation of genetic code, Codon degeneracy, Wobble hypothesis and its importance, Prokaryotic and eukaryotic ribosomes. Steps in translation: Initiation, Elongation and termination of protein synthesis. Inhibitors of protein synthesis. Posttranslational modifications and its importance. **CO4**

UNIT V: REGULATION OF GENE EXPRESSION **9**

Organization of genes in prokaryotic and eukaryotic chromosomes, Hierarchical levels of gene regulation, Prokaryotic gene regulation –lac and trp operon, Regulation of gene expression with reference to λ phage life cycle. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Friefelder, David. "Molecular Biology." Narosa Publications, 1999
2. Weaver, Robert F. "Molecular Biology" IInd Edition, Tata McGraw-Hill, 2003.
3. Karp, Gerald "Cell and Molecular Biology: Concepts and Experiments" IVth Edition, John Wiley, 2005.
4. Friefelder, David and George M. Malacinski "Essentials of Molecular Biology" IInd Edition, Panima Publishing, 1993.

REFERENCES:

1. Tropp, Burton E. "Molecular Biology: Genes to Proteins". IIIrd Edition. Jones and Bartlett, 2008.
2. Glick , B.R. and J.J. Pasternak. "Molecular Biotechnology: Principles and Applications of Recombinant DNA" 4th Edition. ASM, 2010.

COURSE OUTCOMES

Upon completion of the course, the students will

CO1 Understand the basic structure and physicochemical properties of elements in DNA and RNA.

CO2 Understand the Central dogma of life and identify the principle and differences between the DNA replication of prokaryotes and eukaryotes.

CO3 Gain knowledge about the mechanism behind prokaryotic and eukaryotic transcription. They also additionally understand the basic concepts in RNA world: Ribozymes and RNA processing.

CO4 Know how to elucidate the genetic code and understand the mechanism and differences between prokaryotes and eukaryotes translation.

CO5 Gain knowledge about gene organization and mechanism of gene expression in various organisms.

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2	3	1	1	-	1	-	-	-	-	1	3	2	1
CO2	1	1	3	2	2	-	1	-	-	-	-	1	3	2	1
CO3	1	1	2	2	3	-	1	-	-	-	-	1	3	2	1
CO4	1	1	2	2	3	-	1	2	-	1	-	1	3	2	1
CO5	1	1	2	1	3	2	2	1	-	-	-	1	3	2	1

BT1307 **MICROBIOLOGY LABORATORY** **L T P C**
0 0 4 2

OBJECTIVES:

- To demonstrate various techniques to learn the morphology, identification and propagation of microbes
- The course prepares the students to have an idea in growth kinetics and behaviour of organism with antibiotic treatments

Exp No : 1 Introduction, Laboratory Safety, Use of Equipment; Sterilization Techniques
Exp No : 2 Culture Media-Types and Use; Preparation of Nutrient broth and agar
Exp No : 3 Culture Techniques, Isolation and Preservation of Cultures- Broth: flask, test tubes; Solid:Pour plates, streak plates, slants, stabs
Exp No : 4 Microscopy – Working and care of Microscope
Exp No : 5 Microscopic Methods in the Study of Microorganisms., Microscopic identification of yeast/mould
Exp No : 6 Staining Techniques Simple, Differential- Gram's Staining, spore /capsule staining
Exp No : 7 Quantification of Microbes: Sampling and Serial Dilution; Bacterial count in Soil – TVC
Exp No : 8 Effect of Disinfectants- Phenol Coefficient
Exp No : 9 Antibiotic Sensitivity Assay
Exp No : 10 Growth Curve in Bacteria and Yeast

Exp No : 11 Effect of pH, Temperature, UV radiation on Growth Bacteria

TOTAL PERIODS: 60

EQUIPMENT NEEDED FOR 30 STUDENTS

1. Autoclave - 1,
2. Hot Air Oven - 1,
3. Incubators - 2 ,
4. Light Microscopes - 4,
5. Incubator Shaker - 1,
6. Colorimeter - 2,
7. Lamina Flow Chamber - 2 ,
8. Glassware, Chemicals, Media as required.

TEXT BOOKS:

1. Cappuccino, J.G. and N. Sherman "Microbiology: A Laboratory Manual", 4th Edition, Addison-Wesley, 1999.
2. Collee, J.G. etal., "Mackie & McCartney Practical Medical Microbiology" 4th Edition, ChurchillLivingstone, 1996.

COURSE OUTCOMES

Upon completion of the course,

CO1 Students will be able to culture and grow microbes on media.

CO2 Students will gain knowledge on identification and quantification of microbes.

CO3 Students will be able to isolate, grow and study the effect of external parameters on the microbial growth in batch culture.

CO4 Students will also study the effect of disinfectant and antibiotics on microbes.

CO5 Students will gain knowledge on radiation impacts on the microbes

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	2	2	1	-	-	-	-	-	-	3	2	2
CO2	1	2	1	2	1	1	-	-	-	-	-	-	3	2	1
CO3	1	1	3	2	2	1	1	-	1	-	-	2	3	2	2
CO4	2	3	3	3	2	2	2	1	1	-	-	2	3	3	2
CO5	3	2	3	3	1	1	2	1	2	-	-	2	3	3	2

BT1308 BIOCHEMISTRY LABORATORY

L	T	P	C
0	0	4	2

AIM:

- To learn and understand the principles behind the qualitative and quantitative estimation of biomolecules (proteins, carbohydrates, lipids, metabolites etc.,) and laboratory analysis of the same in the body fluids.

EXPERIMENTS

1. General guidelines for working in biochemistry lab (theory)
2. Units of volume, weight, density and concentration measurements and their range in biological measurements. Demonstration of proper use of volume and weight measurement devices.
3. Accuracy, precision, sensitivity and specificity (theory)
4. Preparation of buffer –titration of a weak acid and a weak base.
5. Qualitative tests for carbohydrates – distinguishing reducing from non-reducing sugars and keto from aldo sugars.
6. Quantitative method for amino acid estimation using ninhydrin – distinguishing amino from imino acid.
7. Protein estimation by Biuret and Lowry's methods.
8. Protein estimation by Bradford and spectroscopic methods.
9. Extraction of lipids and analysis by TLC.

10. Estimation of nucleic acids by absorbance at 260 nm and hyperchromic effect (demo).
11. Enzymatic assay: phosphatase from potato.
12. Enzymatic assay: estimation of glucose by GOD-POD method after hydrolysis of starch with acid and specificity of the enzymatic method.

TOTAL PERIODS: 60

Equipment Needed for 20 Students

1. Autocalve-1
2. Hot Air Oven -1
3. Incubators -2
4. Light Microscopes -4
5. Incubator Shaker -1
6. Colorimeter -2
7. Laminar Flow Chamber -2
8. Glassware, Chemicals, Media asrequired

TEXT BOOKS

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

REFERENCE:

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

COURSE OUTCOMES

Upon completion of the course, the students will gain knowledge on

CO1	The basic guidelines in laboratory and gain knowledge in fundamentals of units, measurements, accuracy and precision
CO2	The basic principles behind the qualitative analysis of carbohydrates and amino acids
CO3	Extraction and analysis of lipids
CO4	Different biochemical estimation methods of biomolecules and will be able to carry out both qualitative and quantitative analyses of the same.
CO5	Estimation of enzymatic activity and perform titrations using acids and bases.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	-	-	-	-	-	-	-	2	2	2	-
CO2	2	-	2	1	-	1	-	-	-	-	-	-	2	1	-
CO3	2	-	2	1	-	1	-	-	-	-	-	-	2	1	-
CO4	2	2	2	1	-	-	-	-	-	-	-	-	2	2	1
CO5	1	2	1	1	-	-	-	-	-	-	-	-	2	1	1

HS1310	PROFESSIONAL SKILLS LABORATORY	L	P	T	C
		0	0	2	1

OBJECTIVES

- Enhance the Employability and Career Skills of students
- Orient the students towards grooming as a professional
- Make them Employable Graduates
- Develop their confidence and help them attend interviews successfully.

LIST OF EXPERIMENTS

UNIT I **6**

Introduction to Soft Skills- Hard skills & soft skills - employability and career Skills—Grooming as a professional with values—Making an Oral Presentation–Planning and preparing a model presentation; Organizing the presentation to suit the audience and context; Connecting with the audience during presentation; Projecting a positive image while speaking; Emphasis on effective body language-General awareness of Current Affairs. **CO1**

UNIT II **6**

Self-Introduction-organizing the material - Introducing oneself to the audience – introducing the topic – answering questions – individual presentation practice—– Making a Power Point Presentation -- Structure and format; Covering elements of an effective presentation; Body language dynamics. Making an Oral Presentation–Planning and preparing a model presentation; Organizing the presentation to suit the audience and context; Connecting with the audience during presentation; Projecting a positive image while speaking; Emphasis on effective body language **CO2**

UNIT III **6**

Introduction to Group Discussion— Participating in group discussions – understanding group dynamics - brainstorming the topic -– questioning and clarifying –GD strategies- Structure and dynamics of a GD; Techniques of effective participation in group discussion; Preparing for group discussion; Accepting others' views / ideas; Arguing against others' views or ideas, etc **CO3**

UNIT IV **6**

Basics of public speaking; Preparing for a speech; Features of a good speech; Speaking with a microphone. (Famous speeches may be played as model speeches for learning the art of public speaking). Interview etiquette – dress code – body language – attending job interviews– telephone/skype interview -one to one interview &panel interview –Job Interviews: purpose and process; How to prepare for an interview; Language and style to be used in an interview; Types of interview questions and how to answer them. **CO4**

UNIT V **6**

Recognizing differences between groups and teams- managing time managing stress- networking professionally- respecting social protocols understanding career management- developing a long- term career plan making career changes **CO5**

TOTAL : 30 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

One Server
30 Desktop Computers
One Hand Mike
One LCD Projector

REFERENCE BOOKS

1. Butterfield, Jeff Soft Skills for Everyone. Cengage Learning: New Delhi, 2015
2. E. Suresh Kumar et al. Communication for Professional Success. Orient Blackswan: Hyderabad, 2015
3. Raman, Meenakshi and Sangeeta Sharma. Professional Communication. Oxford University Press: Oxford, 2014

4. S. Hariharan et al. Soft Skills. MJP Publishers: Chennai, 2010
5. Interact English Lab Manual for Undergraduate Students, Orient BalckSwan: Hyderabad, 2016.

COURSE OUTCOMES

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

CO1 Make effective presentations

CO2 Participate confidently in Group Discussions

CO3 Attend job interviews and be successful in them.

CO4 Develop adequate Soft Skills required for the workplace

CO5 Develop their speaking skills to enable them speak fluently in real contexts

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	2	-	2	1	-	-	-	2	3	-	-	1	2	1
CO2	-	2	-	2	-	-	-	-	2	3	-	-	1	2	1
CO3	-	-	-	-	-	-	-	-	2	2	-	-	-	2	1
CO4	-	-	-	-	-	-	-	-	2	2	-	2	-	2	1
CO5	-	2	1	1	2	-	2	-	2	3	-	2	1	2	1

IV SEMESTER

MA1452	APPLIED PROBABILITY AND STATISTICS	L	T	P	C
		3	1	0	4

OBJECTIVES:

- This course aims at providing the required skill to apply the statistical tools in engineering problems.
- To introduce the basic concepts of probability and random variables.
- To introduce the basic concepts of two dimensional random variables.
- To acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems.
- To introduce the basic concepts of classifications of design of experiments which plays very important roles in the field of agriculture and statistical quality control.

UNIT I: PROBABILITY AND RANDOM VARIABLES **12**

Probability – The axioms of probability – Conditional probability – Baye's theorem - Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions. **CO1**

UNIT II: TWO - DIMENSIONAL RANDOM VARIABLES **12**

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and linear regression – Central limit theorem (for independent and identically distributed random variables). **CO2**

UNIT III: TESTING OF HYPOTHESIS **12**

Sampling distributions - Estimation of parameters - Statistical hypothesis - Large sample tests based on Normal distribution for single mean and difference of means -Tests based on t, Chi-square and F distributions for mean, variance and proportion - Contingency table (test for independent) – Goodness of fit. **CO3**

UNIT IV: DESIGN OF EXPERIMENTS **12**

One way and Two way classifications - Completely randomized design – Randomized block design –Latin square design **CO4**

UNIT V: STATISTICAL QUALITY CONTROL **12**

Control charts for measurements (and R charts) – Control charts for attributes (p, c and np charts) –Tolerance limits - Acceptance sampling. **CO5**

TOTAL PERIODS: 60

TEXT BOOKS:

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 IndianEdition, 2017.

REFERENCES:

1. Devore. J.L., "Probability and Statistics for Engineering and the Sciences", CengageLearning,New Delhi, 9th Edition, 2017.
2. Papoulis, A. and Unnikrishnapillai, S., "Probability, Random Variables and Stochastic Processes", McGraw Hill Education India, 4th Edition, New Delhi, 2017.
3. Ross, S.M., "Introduction to Probability and Statistics for Engineers and Scientists", 4thEdition,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 Edition, 2008.
5. Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics for Engineersand Scientists", Pearson Education, Asia, 9th Edition, 2012.

COURSE OUTCOMES

Upon completion of the course, the students will be able

CO1 Get exposure to random variables and well-founded knowledge of standard distributions which can describe real life phenomena.

CO2 Get ideas to handle situations involving more than one random variable

CO3 Gain the knowledge on Large Samples and Small Samples. These concepts are very useful in biological, economical and social experiments and all kinds of generalizations based on information about a smaller sample and larger samples. Apply the appropriate test in the problems related with sampling.

CO4 Apply the basic concepts of design of experiments and handle the same.

CO5 Understand the concept of the Control charts to apply in the field of quality assessment, Production processes, to monitor process stability and control of the manufacturing product.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	2	1	-	-	-	-	1	1	2	2	1
CO2	3	3	2	2	2	1	-	-	-	-	1	1	2	1	1
CO3	3	3	2	3	3	2	1	-	-	-	2	2	2	2	1
CO4	3	3	2	3	2	2	1	-	-	-	1	2	1	2	1
CO5	3	3	3	3	2	2	1	-	-	-	2	1	2	2	1

BT1401	BIOCHEMISTRY-II	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To orient towards the application of knowledge acquired in solving clinical problems.
- To provide a base for molecular modelling and drug designing

UNIT I: METABOLISM OF AMINO ACIDS **9**

Biosynthesis of Gly, Ser and Cys; Biosynthesis of six essential amino acids (Met, Thr, Lys, Ile,Val, Leu) and regulation of branched chain amino acids (concerted inhibition, allosteric regulation and enzyme multiplicity, sequential feedback) from oxaloacetate and pyruvate; Biosynthesis of aromatic amino acids. Metabolic disorders associated with branched chain and aromatic amino acid degradation. Important molecules derived from amino acids (auxins, DOPA, Serotonin, porphyrins, T3, T4, Adrenaline, Noradrenaline, histamine, GABA, polyamines etc) **CO1**

UNIT II: PROTEIN TRANSPORT AND DEGRADATION **9**

Protein targeting, signal sequence, secretion; Folding, Chaperons and targeting of organelle proteins, Protein degradation, receptor-mediated endocytosis, turnover. **CO2**

UNIT III: BIOCHEMISTRY OF MUSCLE CONTRACTION **9**

Contractile proteins, Actin, Myosin, Actin Polymerization, acto-myosin complexes, mechanism of myosin ATPase activity, excitation – contraction coupling nad relaxation, microtubules, microfilaments and their role in organelle movements. **CO3**

UNIT IV: VITAMINS AND COENZYMES **9**

Fat Soluble Vitamins, provitamins (A, D, E and K). Structure, physiological significance and deficiency symptoms. Water soluble vitamins, structure, coenzyme role and deficiency symptoms. Thiamine, riboflavin, pyridoxine, niacin, folic acid, biotin and Vitamin B12. Recommended dietary intake. Coenzymes: Their role in metabolic pathways. NAD, FAD, TPP, PLP, carboxy biotin. **CO4**

UNIT V: HORMONES **9**

Introduction. Effects of Hormones. Chemical classification of hormones. Peptide hormone vasopressin, protein hormone- insulin. Lipid and phospholipid derived hormones prostaglandin and phospholipids. Steroid hormones-testosterone, estrogen, cortisol. Monoamines: thyroxine, adrenaline. Mechanism of action of the different classes of hormones. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Nelson, D.L et al., “Lehninger’s Principles of Biochemistry” Stryer, Lubert.
2. “Biochemistry”.IVth Edition, W.H Freeman & Co., 2000.
3. Voet, D.J and J.G. Voet and C.W. Pratt “Principles of Biochemistry” IIIrd Edition, John Wiley & Sons Inc., 2008.
4. Murray, R.K., et al., “Harper’s Illustrated Biochemistry”. XXVIIth Edition. McGraw-Hill,2006..

REFERENCE:

1. Creighton. T.E., “Proteins: Structure and Molecular Properties” IInd Edition, W.H. Freeman and Co.,1993.
2. Salway, J.G., “Metabolism at a Glance”. IInd Edition, Blackwell Science Ltd., 2000.

COURSE OUTCOMES

Upon completion of the course,

CO1 Student will gain knowledge on the reaction involve in amino acid synthesis

CO2 Students will have knowledge on protein transport and degradation

CO3 Students will gain knowledge in biochemistry of muscle contraction

CO4 Student will gain knowledge on the role of vitamins and co-enzymes in metabolic pathway

CO5 Students will gain knowledge on biomembranes, transport and electrical conductivity.

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	1	2	-	-	-	-	-	-	-	-	-	1	2	2	-
CO2	1	2	-	-	-	-	-	-	-	-	-	1	2	2	-
CO3	1	2	-	1	-	-	-	-	-	-	-	1	2	2	-
CO4	1	2	-	-	-	-	-	-	-	-	-	1	2	2	-
CO5	1	2	-	1	-	-	-	-	-	-	-	1	2	2	-

BT1402 **ENZYME ENGINEERING** **L T P C**

3 0 0 3

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

UNIT I: INTRODUCTION TO ENZYMES **9**

Classification of enzymes. Mechanisms of enzyme action; concept of active site and energetics of enzyme substrate complex formation; specificity of enzyme action; principles of catalysis – collision theory, transition state theory; role of entropy in catalysis. **CO1**

UNIT II: KINETICS OF ENZYME ACTION **9**

Kinetics of single substrate reactions; estimation of Michelis – Menten parameters, multisubstrate reactions - mechanisms and kinetics; turnover number; types of inhibition & models –substrate, product. Allosteric regulation of enzymes, Monod Changeux Wyman model, pH and temperature effect on enzymes & deactivation kinetics. **CO2**

UNIT III: ENZYME IMMOBILIZATION AND BIOSENSORS **9**

Physical and chemical techniques for enzyme immobilization – adsorption, matrix entrapment, encapsulation, cross-linking, covalent binding etc., - examples, advantages and disadvantages, design of enzyme electrodes and their application as biosensors in industry, healthcare and environment. **CO3**

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

Production and purification of crude enzyme extracts from plant, animal and microbial sources; methods of characterization of enzymes; development of enzymatic assays. **CO4**

UNIT V: INDUSTRIAL APPLICATIONS OF ENZYMES **9**

Enzymes in organic synthesis – Enzymes for food, pharmaceutical, tannery, textile, paper and pulp industries – Enzyme for environmental applications- Enzymes for analytical and diagnostic applications – Enzymes for molecular biology research. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Trevor Palmer , Enzymes IInd Horwood Publishing Ltd
2. Faber K ,Biotransformations in Organic Chemistry, IV edition , Springer

REFERENCES:

1. Harvey W. Blanch, Douglas S. Clark, Biochemical Engineering, Marcel Dekker, Inc.
2. James M. Lee, Biochemical Engineering, PHI, USA.
3. James. E. Bailey & David F. Ollis, Biochemical Engineering Fundamentals, McGraw Hill.
4. Wiseman, Enzyme Biotechnology, Ellis Horwood Pub.

COURSE OUTCOMES

Upon completion of the course, the students will be able

CO1	To gain knowledge on enzyme and enzyme reactions which will be the key step to proceed towards various concepts in biotechnology
CO2	To understand theoretical and practical aspects of kinetics which will deliver the importance and utility of enzyme kinetics towards research.
CO3	To know the process of immobilization which enables them to apply its techniques in food, pharmaceutical and chemical industries.
CO4	To technologically work on processing, production and purification of enzymes at an industrial scale.
CO5	To receive theoretical knowledge on biotransformation and industrial, health care and research application of enzymes.

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	1	1	2	2	-	-	-	-	-	-	-	1	3	3	1
CO2	2	2	3	3	3	1	1	-	-	-	-	1	3	3	3
CO3	1	2	3	3	3	2	2	2	-	-	-	1	3	3	1
CO4	1	2	3	3	3	2	2	2	-	-	-	1	3	3	3
CO5	1	1	3	3	3	2	2	2	-	-	-	1	3	3	3

BT1403 FLUID MECHANICS AND HEAT TRANSFER OPERATIONS

L	**T**	**P**	**C**
3	**0**	**0**	**3**

OBJECTIVES:

- To introduce the students to the mechanics of fluids through a thorough understanding of the properties of the fluids, behaviour of fluids under static conditions.
- The dynamics of fluids is introduced through the control volume approach which gives an integrated understanding of the transport of mass, momentum and energy and flow measurements.
- To enable the students to understand the fundamental principles and concepts of heat transfer by conduction, convection and radiation.
- The course will develop skills in the design and application of heat exchangers.
- This course will be a prerequisite for certain engineering subjects offered in the subsequent semesters.

UNIT I: FLUID PROPERTIES & FLUID MECHANICS **9**

Fluid definition- compressible, in compressible fluids – coefficient of isothermal compressibility, Density, specific gravity, specific weight, surface tension, vapour pressure, viscosity. Newtonian and Non-newtonian fluids. Fluid statics – Barometric equation – application for incompressible and compressible fluids. Pressure changes in atmospheric air – Gauge and absolute pressure – pressure measurement with Bourdon gauge & manometers. Fluid Dynamics – equation of continuity – Bernoulli's equation – pressure loss in straight pipes – in fittings – expansion and contraction losses (applied to Newtonian Fluids only) Fluid flow measurement, Orifice, venturimeter & Rotameter for Newtonian fluids. **CO1**

UNIT II: FLOW OF FLUID THROUGH PACKINGS **9**

Fluidization, Fluid transport -Industrial application of fluid flow through packing-characteristics of packed bed-Bed surface area-void fraction-Laminar flow and turbulent flow through packed bed - pressure drop experienced by the fluid-equations and application problems. Fluidization phenomena-Industrial application - minimum fluidization velocities. Industrial pipes and fittingsFluid moving machinery-pumps centrifugal, Reciprocating-gear, Peristaltic pumps, Introduction togas moving machinery-Fans, blowers, compressors. **CO2**

UNIT III: CONDUCTION HEAT TRANSFER **9**

Heat transfer phenomena-thermodynamics & heat transfer. Heat conduction – Fourier's equation – steady state conduction in planar and radial systems – Resistance concept – series and–and parallel resistances in conduction – unsteady state conduction – lumped capacity model – extended surfaces (Fins) –combined conduction & convection – 2 dimensional conduction. **CO3**

UNIT IV: CONVECTION HEAT TRANSFER **9**

Forced and natural convection – Dimensional analysis- Dimensional numbers- Convection heat transfer coefficient- Correlations for flow over plate, through tubes, over spheres and cylinders- Agitated systems- Packed columns- condensation phenomena- Film and drop wise condensation over tubes- Boiling phenomena- heat transfer coefficient. **CO4**

UNIT V: RADIATION HEAT TRANSFER AND HEAT TRANNSFER EQUIPMENTS **9**

Electromagnetic waves- energy of radiation- Planck's equation-Blackbody- Radiation exchange. Kirchhoff's law, Stefan Boltzmann equation of radiant energy – Wien's law- Radiation exchange between surfaces – black- gray bodies- view factors-sample problems. Concept of overall heat transfer coefficient- Heat exchangers- types, boilers- Kettles- Heat exchanger Design concept- NTU concept. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Geamkoplis. C.J "Transport Process & separation Process Principles" IVth Edition Prentice Hall of India,2005.
2.Heat & Mass Transfer by P. K. Nag, Tata McGraw Hill – IIIrd Edition 2003

REFERENCES:

1. Principles of Heat Transfer Frank Kreith, Raj M. ManglikVIIth edition Cenage Learning Inc Mark S. Bohn

COURSE OUTCOMES

Upon completion of the course, the students will gain knowledge on

CO1	The basic understanding of the properties and behaviour of fluids, static and dynamic equilibrium .
CO2	The dynamics of fluids and integrated understanding of transport of mass, momentum and energy.
CO3	The process of Heat transfer through different bodies by means of conduction, convection and radiation.
CO4	The concept of heat flow over surfaces by natural and forced convection, phenomena of boiling and condensation heat transfer , estimation of heat transfer coefficient.
CO5	The basic laws, concept and mechanism of thermal radiation , types of heat exchangers and the design of heat exchangers for various bioprocesses.

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2	-	1	1	1	-	-	-	-	1	2	2	1	-
CO2	2	2	1	1	1	-	1	-	-	1	2	2	2	1	1
CO3	2	2	2	2	2	1	1	1	1	1	-	2	1	2	1
CO4	2	2	1	2	1	1	1	1	1	1	2	2	-	1	1
CO5	2	2	2	2	2	2	2	2	2	2	2	2	-	2	2

BT1404 **BIOPROCESS PRINCIPLES** **L T P C**
3 0 0 3

OBJECTIVES:

- To impart knowledge on design and operation of fermentation processes with all its prerequisites.
- To endow the students with the basics of microbial kinetics, metabolic Stoichiometry and energetics.

UNIT I: OVERVIEW OF FERMENTATION PROCESSES **9**

Overview of fermentation industry, general requirements of fermentation processes, basic configuration of fermentor (CSTR) and ancillaries, main parameters to be monitored and controlled in fermentation processes **CO1**

UNIT II: RAW MATERIALS AND MEDIA DESIGN FOR FERMENTATION PROCESS **9**

Criteria for good medium, medium requirements for fermentation processes, carbon, nitrogen, minerals, vitamins and other complex nutrients, oxygen requirements, medium formulation of optimal growth and product formation, examples of simple and complex media, design of various commercial media for industrial fermentations – medium optimization methods **CO2**

UNIT III: STERILIZATION KINETICS **9**

Thermal death kinetics of microorganisms, batch and continuous heat sterilization of liquid media, filter sterilization of liquid media, air sterilization and design of sterilization equipment - batch and continuous. **CO3**

UNIT IV: METABOLIC STOICHIOMETRY AND ENERGETICS **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, thermodynamic efficiency of growth. **CO4**

UNIT V: KINETICS OF MICROBIAL GROWTH AND PRODUCT FORMATION 9

Batch cultivation and continuous cultivation. Simple unstructured models for microbial growth, Monod model, product formation kinetics - Leudeking- Piret models, substrate and product inhibition on cell growth and product formation. Biomass estimation – Direct and Indirect methods. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Shuler, Michael L. and Fikret Kargi, " Bioprocess Engineering ", Prentice Hall, 1992.
2. Doran, Pauline "of Bioprocess Engineering Principles ". Elsevier, 1995
3. Peter F. Stanbury, Stephen J. Hall & A. Whitaker, Principles of Fermentation Technology, Science & Technology Books.

REFERENCES:

1. Lydersen, Bjorn K. "Bioprocess Engineering Systems, Equipment and Facilities" John Wiley, 1994.
2. Bailey, James E. and David F. Ollis, "Biochemical Engineering Fundamentals", IInd Edition. McGraw Hill , 1986.
3. Harvey W. Blanch, Douglas S. Clark, Biochemical Engineering, Marcel Dekker, Inc.

COURSE OUTCOMES

Upon completion of the course, the students will

CO1 Understand about the assembly and functioning of Bioreactors and its utilities

CO2 Gain knowledge on media components, perform scientific media design and optimize its concentrations

CO3 Analyze the various sterilization methods and its Kinetics and solve the problems associated with it.

CO4 Understand the concepts of Metabolic stoichiometry, Energetics of cell growth and product formation

CO5 Gain knowledge on kinetics of Microbial growth and Product formation

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	-	2	-	-	-	-	-	-	1	3	2	2
CO2	1	1	3	3	2	-	1	-	-	-	-	1	1	3	2
CO3	2	3	3	3	2	-	-	-	-	-	-	-	1	3	2
CO4	1	2	2	3	1	-	-	-	-	-	-	-	1	3	1
CO5	1	2	3	2	2	-	-	-	-	-	-	-	1	3	1

BT1405	APPLIED THERMODYNAMICS FOR BIOTECHNOLOGISTS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To enable the students to learn about basic concepts of classical and statistical thermodynamics

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 behavior; residual properties; estimation of thermodynamic properties using equations of state; calculations involving actual property exchanges; Maxwell's relations and applications. **CO1**

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. **CO2**

UNIT III: PHASE EQUILIBRIA **9**

Criteria for phase equilibria; VLE calculations for binary and multi component systems; liquid-liquid equilibria and solid-solid equilibria. **CO3**

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. **CO4**

UNIT V: THERMODYNAMIC DESCRIPTION OF MICROBIAL GROWTH AND PRODUCT FORMATION **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. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

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

REFERENCES:

1.Sandler S.I. "Chemical and Engineering Thermodynamics", John Wiley,1989.

COURSE OUTCOMES

Upon completion of the course, the students will

CO1 Explain the theoretical concepts of thermodynamics and how it applies to energy conversion in technological applications and biological systems.

CO2 Demonstrate the capability to analyze the energy conversion performance in a variety of modern applications in biological systems.

CO3 Design and carry out bioprocess engineering experiments, and analyze and interpret fundamental data to do the design and operation of bioprocesses.

CO4 Describe the criteria when two phases coexist in equilibrium and the vapour liquid equilibrium calculations microbial growth and product formation.

CO5 Apply their knowledge in the field of biochemical engineering from the principles of thermodynamics.

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	-	2	1	1	-	-	-	-	-	-	1	1	-
CO2	2	2	-	3	1	1	-	-	-	-	-	-	1	-	-
CO3	2	2	-	3	1	1	-	-	-	-	-	-	1	2	-
CO4	2	2	-	1	1	2	-	-	-	-	-	-	1	2	-
CO5	2	2	-	3	1	3	-	-	-	-	-	-	-	1	2

BT1407 **CHEMICAL ENGINEERING LAB** **L T P C**
0 0 4 2

OBJECTIVES:

- To provide basic understanding of chemical engineering principles and operations
- To course will enable the students to apply the principles in other chemical engineering and biotechnology subjects offered in higher semesters

LIST OF EXPERIMENTS

1.Flow measurement - Orifice meter
2. Flow measurement - Venturimeter,
3. Flow measurement - Rotameter
4. Pressure drop in flow through pipes
5. Pressure drop in flow through packed column
6. Pressure drop in flow through fluidized beds
7. Characteristics of centrifuge pump
8. Filtration through plate and frame filter press
9. Filtration in leaf filter
10. Simple and steam distillation
11. Adsorption phenomenon
12. Drying characteristics

TOTAL PERIODS: 60

COURSE OUTCOMES

Upon completion of the course, the students will gain knowledge on

CO1 To have knowledge on the basic principles of chemical engineering.

CO2 To apply the skill of material balance and energy balance in unit operations and unit process of chemical engineering and biotechnology.

CO3 To analyze the principles of chemical engineering and its applications in chemical, mechanical and biological perspectives.

CO4 To understand and analyze the mass transfer process and apply its knowledge in an industrial perspective.

CO5 To understand the design and working principles of fluid moving machinery and transport phenomena

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	1	1	1	1	1	-	-	-	-	-	-	1	2	1
CO2	2	2	2	2	1	1	-	-	-	-	-	-	1	2	1
CO3	2	2	2	2	1	1	-	-	-	-	-	-	1	2	1
CO4	2	2	2	2	1	1	-	-	-	-	-	-	1	2	1
CO5	2	2	2	2	1	1	-	-	-	-	-	-	1	2	1

BT1408 **MOLECULAR BIOLOGY LABORATORY** **L T P C**
0 0 4 2

OBJECTIVES:

- Provide hands-on experience in performing basic molecular biology techniques.
- Introduce students to the theory behind in each technique and to describe common applications of each methodology in biological research. This will facilitate the students to take up specialized project in Molecular biology and will be a pre-requisite for research work

LIST OF EXPERIMENTS

1. Electrophoresis _-Agarose and Polyacrylamide Gel
2. Isolation of microbial DNA
3. Isolation of genomic DNA
4. Quantification of DNA (UV/ Vis) and analysis of purity
5. Restriction enzyme digestion& Ligation
6. Competent cells preparation & Transformation
8. Selection of recombinants – Antibiotic sensitivity assay
9. Plating of λ phage
10. Lambda phage lysis of liquid cultures

Requirements:

Equipment Needed for 30 Students

1. Electrophoresis Kit 1
2. PCR 1
3. Incubators 2
4. Light Microscopes 4
5. Incubator Shaker 1
6. Spectrophotometer 2
7. Laminar Flow Chamber 2
8. Glassware, Chemicals, Media as required

TOTAL PERIODS: 60

REFERENCES:

1. Sambrook, Joseph and David W. Russell " The Condensed Protocols: From Molecular Cloning: A Laboratory Manual" Cold Spring Harbor , 2006.

COURSE OUTCOMES

Upon completion of the course,

CO1 Students will be aware of the hazardous chemicals and safety precautions in case of emergency.

CO2 Students will learn to isolate nucleic acids from biological samples.

CO3 Demonstrate knowledge and understanding of the principles underpinning important techniques in molecular biology.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	3	-	-	-	2	2	3	-	3	-	-	3	-	-
CO2	2	3	-	3	2	-	-	-	-	-	-	-	3	3	2
CO3	2	3	1	3	2	-	-	-	-	-	-	-	3	3	3

V SEMESTER

BT1501	MASS TRANSFER OPERATIONS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To define the principles of adsorption, absorption, leaching and drying extraction, distillation crystallization operations.
- To begin the concept of membrane separation process and develop skills of the students in the area of mass transfer operations with emphasis on separation and purification of products.

UNIT I: DIFFUSION AND MASS TRANSFER **9**

Molecular diffusion in fluids and solids; Interphase Mass Transfer; Mass Transfer coefficients; Analogies in Transport Phenomenon. **CO1**

UNIT II: GAS LIQUID OPERATIONS **9**

Principles of gas absorption; Single and Multi component absorption; Absorption with Chemical Reaction; Design principles of absorbers; Industrial absorbers; HTU, NTU concepts. **CO2**

UNIT III: VAPOUR LIQUID OPERATIONS **9**

V-L Equilibria; Simple, Steam and Flash Distillation; Continuous distillation; McCABE-THIELE & PONCHON-SAVARIT Principles; Industrial distillation equipments, HETP, HTU and NTU concepts. **CO3**

UNIT IV: EXTRACTION OPERATIONS **9**

L-L equilibria, Staged and continuous extraction, Solid-liquid equilibria, Leaching Principles. **CO4**

UNIT V: SOLID FLUID OPERATIONS **9**

Adsorption equilibria – Batch and fixed bed adsorption-Drying-Mechanism-Drying curves- Time of Drying; Batch and continuous dryers. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Treybal R.E. Mass Transfer Operations.IIIrd edition. Mcgraw Hill, 1981.
2. Geankoplis C.J. Transport Processes and Unit Operations. IIIrd edition, Prentice Hall of India, 2002.

REFERENCES:

1.Coulson and Richardson’s Chemical Engineering. Vol I & II, Asian Books Pvt Ltd, 1998.

COURSE OUTCOMES

Upon completion of the course, the students will gain knowledge on

CO1	Gas -liquid, vapour- liquid and solid- liquid and liquid–liquid equilibrium.
CO2	Classify and use the accurate engineering correlations of diffusion and mass transfer coefficients to model a separation process.
CO3	Investigate multi-stage equilibrium separation processes, simultaneous phase equilibrium and mass balances in continuous separation processes
CO4	Design and understand operating principles of extraction and leaching
CO5	Design and construction with operating principles of process economics of separating equipments (Dryers and Adsorbers)

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	3	2	1	-	-	-	-	-	-	-	2	2	2
CO2	2	2	3	2	1	-	-	-	-	-	-	-	2	2	3
CO3	3	2	3	2	-	-	-	-	-	-	-	-	2	3	3
CO4	2	2	3	2	1	1	-	-	-	-	-	-	3	3	3
CO5	3	2	2	3	1	-	-	-	-	-	-	-	3	3	3

BT1502 **BIOPROCESS ENGINEERING** **L T P C**
3 0 0 3

OBJECTIVES: The course will enable the students

- To impart knowledge about bioreactor configuration and their application in processes.
- To understand the regime analysis of bioprocesses in reactor design.
- To learn about kinetics and applications of immobilised systems.
- To develop skills in modelling and simulation of bioprocessses.
- To understand the requirements of recombinant cell cultivation and bioreactor considerations.

UNIT - I **CONFIGURATION OF BIOREACTORS**

Ideal reactors and its characteristics, Fed batch cultivation, Cell recycle cultivation, Cell recycle cultivation in waste water treatment, two stage cultivation, Packed bed reactor, airlift reactor, introduction to fluidized bed reactor, bubble column reactors. **CO1**

UNIT - II **BIOREACTOR SCALE – UP** **9**

Regime analysis of bioreactor processes, oxygen mass transfer in bioreactors – microbial oxygen demands; methods for the determination of mass transfer coefficients; mass transfer correlations. Scale up criteria for bioreactors based on oxygen transfer, power consumption and impeller tip speed. **CO2**

UNIT - III **BIOREACTOR CONSIDERATION IN ENZYME SYSTEMS** **9**

Analysis of film and pore diffusion effects on kinetics of immobilized enzyme reactions; formulation of dimensionless groups and calculation of effectiveness factors. Design of immobilized enzyme reactors – packed bed, fluidized bed and membrane reactors **CO3**

UNIT - IV **MODELLING AND SIMULATION OF BIOPROCESSES** **9**

Study of structured models for analysis of various bioprocess – compartmental models, models of cellular energetics and metabolism, single cell models, plasmid replication and plasmid stability model. Dynamic simulation of batch, fed batch, steady and transient culture metabolism. **CO4**

UNIT V RECOMBINANT CELL CULTIVATION 9

Different host vector system for recombinant cell cultivation strategies and advantages. E.coli, yeast Pichiapastoris / Saccharomyces cereviseae, Animal cell cultivation, plant cell cultivation, Insect cell cultivation. High cell density cultivation, process strategies, reactor considerations in the above system **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Michael L. Shuler and FikretKargi, Bioprocess Engineering, Basic Concept, 2nd Edition Prentice Hall PTR, 2002.
2. Pauline Doran, Bioprocess Engineering Calculation, Blackwell Scientific Publications
3. Harvey W. Blanch, Douglas S. Clark, Biochemical Engineering, Marcel Dekker, Inc

REFERENCES:

1. Anton Moser, “Bioprocess Technology, Kinetics and Reactors”, , Springer Verlag.
2. James E. Bailey & David F. Ollis, Biochemical Engineering Fundamentals, McGraw Hill.
3. James M. Lee, Biochemical Engineering, PHI, USA.
4. Atkinson, Handbook of Bioreactors,

COURSE OUTCOMES

Upon completion of the course, the students will be able

CO1 To select appropriate bioreactor configurations and operation modes based on the nature of bio products and other criteria.

CO2 To analyse the regime analysis and hydrodynamics of bioprocesses and apply the criteria in the design of bioreactors.

CO3 To apply and analyse diffusion effects and kinetics of immobilized enzyme systems and the design of immobilized enzyme reactors.

CO4 To develop skills in modelling and simulation of bioprocesses so as to reduce costs and to enhance the quality of products and systems.

CO5 To plan a research career or to work in the biotechnology industry with strong foundation about bioreactor processes and design considerations.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2	1	2	1	1	1	1	2	2	2	2	2
CO2	2	2	2	1	2	2	1	1	2	2	2	2	2	2	3
CO3	2	2	2	2	2	1	2	1	1	2	2	1	2	3	3
CO4	2	2	2	3	3	2	2	2	2	2	2	2	2	3	3
CO5	1	1	2	3	2	2	2	2	2	2	2	2	2	3	3

BT1503 ANALYTICAL METHODS AND INSTRUMENTATION

L	T	P	C
3	0	0	3

OBJECTIVES:

To enable the students

- To have a fundamental knowledge about the Light spectrum, Absorption, Fluorescence, NMR, Mass spectroscopy
- To acquire knowledge on the different chromatographic methods for separation of biological products.

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 – signal to noise ratio - sources of noise – Enhancement of signal to noise - types of optical instruments – Principle of Fourier Transform optical Measurements. **CO1**

UNIT II: MOLECULAR SPECTROSCOPY **9**

Molecular absorption spectrometry – Measurement of Transmittance and Absorbance – Beer's law – Instrumentation - Applications -Theory of fluorescence and Phosphorescence – Instrumentation – Applications – Theory of Infrared absorption spectrometry – IR instrumentation – Applications – Theory of Raman spectroscopy – Instrumentation – applications. **CO2**

UNIT III: MAGNETIC RESONANCE SPECTROSCOPY AND MASS SPECTROMETRY **9**

Theory of NMR – environmental effects on NMR spectra – chemical shift- NMR-spectrometers – applications of 1H and 13C NMR- Molecular mass spectra – ion sources – Mass spectrometer. Applications of molecular mass - Electron paramagnetic resonance- g values – instrumentation **CO3**

UNIT IV: SEPARATION METHODS **9**

General description of chromatography – Band broadening and optimization of column performance- Liquid chromatography – Partition chromatography – Adsorption chromatography – Ion exchange chromatography -size exclusion chromatography- Affinity chromatography principles of GC and applications – HPLC- Capillary electrophoresis – Applications. **CO4**

UNIT V: ELECTRO ANALYSIS AND SURFACE MICROSCOPY **9**

Electrochemical cells- Electrode potential cell potentials – Potentiometry- reference electrode – ion selective and molecular selective electrodes – Instrument for potentiometric studies – Voltammetry – Cyclic and pulse voltammetry- Applications of voltammetry . Study of surfaces – Scanning probe microscopes – AFM and STM. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Skoog, D.A. F. James Holler, and Stanky, R.Crouch "Instrumental Methods of Analysis". 6th Edition, Cengage Learning , 2016.
2. Willard, Hobart, etal., "Instrumental Methods of Analysis". 7th Edition, CBS, 1986.
3. Braun, Robert D. "Introduction to Instrumental Analysis". Pharma Book Syndicate, 1987.
4. Ewing,G.W. "Instrumental Methods of Chemical Analysis", 5th Edition, McGraw-Hill, 1985.

REFERENCES:

1. Sharma, B.K. “Instrumental Methods of Chemical Analysis: Analytical Chemistry” Goel Publishing House, 1972.
2.Haven, Mary C., etal., “Laboratory Instrumentation “. 4th Edition, John Wiley, 1995.

COURSE OUTCOMES

Upon completion of the course, the students will gain knowledge on

CO1	Students would have a fundamental knowledge about the light spectrum and basics of measurement.
CO2	Students would have gained knowledge about the working principle of optical methods and working principle of spectroscopic techniques.
CO3	Students would have developed knowledge about the working principle of resonance and mass spectrometry.
CO4	At the end of the course the student would acquire knowledge on different types of chromatographic methods for separation of biological products
CO5	At the end of the course the student would acquire knowledge on different types of electroanalytical methods and electron microscopes.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	1	3	-	-	-	-	-	-	2	3	-	-
CO2	3	-	-	1	3	-	-	-	-	-	-	2	3	2	2
CO3	3	-	-	2	3	-	-	-	-	-	-	3	3	2	3
CO4	3	-	-	1	3	-	-	-	-	-	-	3	3	2	2
CO5	3	-	-	1	3	-	-	-	-	-	-	3	3	2	3

BT1504 PROTEIN ENGINEERING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To make the students identify the importance of protein biomolecules.
- The course prepares the students to realize the structure-function relationships in proteins.

UNIT I: BONDS, ENERGIES, BUILDING BLOCKS OF PROTEINS **9**

Covalent, Ionic, Hydrogen, Coordinate, hydrophobic and Vander walls interactions in protein structure. Interaction with electromagnetic radiation (radio, X-ray) and elucidation of protein structure. Amino acids (the students should be thorough with three and single letter codes) and their molecular properties (size, solubility, charge, pKa), Chemical reactivity in relation to post-translational modification (involving amino, carboxyl, hydroxyl, thiol, imidazole groups). **CO1**

UNIT II: PROTEIN ARCHITECTURE **9**

Primary structure: peptide mapping, peptide sequencing - automated Edman method & mass spec. High-throughput protein sequencing setup Secondary structure: Alpha, beta and loop structures and methods to determine Super-secondary structure: Alpha-turn-alpha, beta-turn beta (hairpin), beta-sheets, alpha-beta-alpha, topology diagrams, up and down & TIM barrel structures nucleotide binding folds, prediction of substrate binding sites. **CO2**

UNIT III: TERTIARY STRUCTURE **9**

Tertiary structure: Domains, folding, denaturation and renaturation, overview of methods to determine 3D structures. Quaternary structure: Modular nature, formation of complexes. Computer exercise on the above aspects. **CO3**

UNIT IV: 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 and Enzymes: Serine proteases, understanding catalytic design by engineering trypsin, chymotrypsin and elastase, substrate-assisted catalysis other commercial applications. Computer exercise on the above aspects. **CO4**

UNIT V: PROTEOMICS **9**

Introduction to the concept of proteome, components of proteomics, proteomic analysis, importance of proteomics in biological functions, protein-protein interactions and methods to study it: protein arrays, cross linking methods, affinity methods, yeast hybrid systems and protein arrays. Computer exercise on the above aspects. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Branden C. and Tooze J., “Introduction to Protein Structured” 2nd Edition, Garland Publishing, 1999.
2. Creighton T.E. “Proteins” 2nd Edition. W.H. Freeman, 1993.
3. Pennington, S.R and M.J. Dunn, “Proteomics: Protein Sequence to Function”. Viva Books, 2002.
4. Liebler, “Introduction to Proteomics” Humana Press, 2002.

REFERENCES:

1. Voet D. and Voet G., “Biochemistry”. 3rd Edition. John Wiley and Sons, 2008.
2. Haggerty, Lauren M.“Protein Structure: Protein Science and Engineering”. Nova Science Publications, 2011. 3. Williamson, Mike “How Proteins Work”. Garland Science, 2012.

COURSE OUTCOMES

Upon completion of the course,

CO1	Students will learn and understand about the basic of protein architecture in a protein molecule.
CO2	Students will educate about the structural fold and basic tools used to identify the protein sequence & structure.
CO3	Students will know how to identify the higher hierarchy of protein fold with the advanced tools & also to know the protein – protein interaction
CO4	Students will know about the basic structural & functional relationship to gain a knowledge on protein utilisation for modern applications.
CO5	Students will understand the various advancement and wide requirement of informatics tools towards the medical diagnostic purposes.

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	-	1	-	3	-	-	2	-	-	-	-	1	2	3	2
CO2	-	1	-	2	-	-	-	-	-	-	-	-	2	3	2
CO3	1	2	-	3	1	2	-	-	-	-	-	-	1	3	-
CO4	1	-	-	1	2	-	-	-	-	-	-	1	3	2	1
CO5	-	3	2	-	-	1	2	-	-	-	-	1	2	3	1

BT1507 **BIOPROCESS LABORATORY I** **L T P C**
0 0 4 2

OBJECTIVES:

- To train the students on enzyme kinetics and parameters which influence enzyme activity.
- To train the students on enzyme immobilization and medium optimization methods.
- To train on methods to investigate the growth of microorganisms in different systems under different conditions.

LIST OF EXPERIMENTS

1.Enzyme kinetics – Determination of Michaelis - Menten parameters
2. Enzyme activity – Effect of Temperature and Deactivation Kinetics
3. Enzyme activity – Effect of pH
4. Enzyme inhibition kinetics
5. Enzyme immobilization – Gel entrapment method
6. Enzyme immobilization –Cross-linking method
7. Enzymatic conversion in Packed bed Column Reactor
8. Growth of Bacteria – Estimation of Biomass, Calculation of Specific Growth Rate and Yield Coefficient
9. Optimization of medium by Plackett Burman Design
10. Optimization by of medium Response Surface Methodology

Required Equipment:

1. Autoclave,
2. Hot Air Oven,
3. Incubators,
4. Light Microscopes,
5. Incubator Shaker,
6. Colorimeter,
7. Laminar Flow Chamber

TOTAL PERIODS: 60

REFERENCES:

1Bailey and Ollis, " Biochemical Engineering Fundamentals", McGraw Hill (2nd Ed.), 1986.
2. Shuler and Kargi, " Bioprocess Engineering ", Prentice Hall, 1992.
3. Pauline Doran, Bioprocess Engineering Calculation, Blackwell Scientific Publications.
4. Peter F. Stanbury, Stephen J. Hall & A. Whitaker, Principles of Fermentation Technology,
5. Science & Technology Books.

COURSE OUTCOMES

Upon completion of the course, the students will gain knowledge on

CO1 Explain about Enzyme kinetics and parameters involved in enzyme activities.

CO2 Understand and have thorough knowledge in methods adopted for enzyme immobilization

CO3 Evaluate the growth kinetics of microorganisms and become adept with medium optimization techniques

CO4 Understand about the fundamentals involved in operation a reactor system

CO5 Evaluate the value of inhibition kinetics and their effect on enzyme activities

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2	3	-	1	-	-	-	-	-	-	-	2	2	3
CO2	1	2	3	-	3	-	-	-	-	-	-	-	1	2	3
CO3	1	2	2	1	1	-	-	-	-	-	-	-	2	2	3
CO4	3	1	2	2	1	-	-	-	-	-	-	-	3	2	2
CO5	2	1	3	1	2	-	-	-	-	-	-	-	1	2	3

BT1508 **ANALYTICAL METHODS AND INSTRUMENTATION LAB** **L T P C**

0 0 4 2

OBJECTIVES:

To train the students

- To have a practical hands on experience on Absoprtion Spectroscopic methods
- To acquire experience in the purification by performing chromatography
- To validate and analysis using spectrometric and microscopic techniques

LIST OF EXPERIMENTS

1. Precision and validity in an experiment using absorption spectroscopy .
2. Validating Lambert-Beer's law using $KMnO_4$
3. Finding the molar absorbtivity and stoichiometry of the Fe (1,10 phenanthroline)3 using absorption spectrometry.
4. Finding the pKa of 4-nitrophenol using absorption spectroscopy.
5. UV spectra of nucleic acids.

6. Chemical actinometry using potassium ferrioxolate.
7. Estimation of SO_4^{2-} by nephelometry.
8. Estimation of Al^{3+} by Flourimetry.
9. Limits of detection using aluminium alizarin complex.
10. Chromatography analysis using TLC.
11. Chromatography analysis using column chromatography.

Requirements:
Equipment Needed for 20 Students

1. Colorimeter 2,
2. Glassware,
3. Chemicals as required

TOTAL PERIODS: 60

REFERENCES:

1. Skoog, D.A. F. James Holler, and Stanky, R.Crouch “Instrumental Methods of Analysis”. 6th Edition, Cengage Learning , 2016.
2. Willard, Hobart, etal., “Instrumental Methods of Analysis”. 7th Edition, CBS, 1986.
3. Braun, Robert D. “Introduction to Instrumental Analysis”. Pharma Book Syndicate, 1987.
4. Ewing,G.W. “Instrumental Methods of Chemical Analysis”, 5th Edition, McGraw-Hill, 1985.

COURSE OUTCOMES

Upon completion of the course, the students

CO1 Would have a fundamental knowledge on the principles and types of bioanalytical instruments.

CO2 Would have gained knowledge about the use of the instrumental methods (spectroscopy) in biological sample analysis.

CO3 Would have developed knowledge about the chromatographic method principle and resolving a compound using it.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	1	3	-	-	2	-	-	-	-	3	3	2
CO2	3	-	-	1	3	-	-	2	-	-	-	-	3	3	3
CO3	3	-	-	1	3	-	-	2	-	-	-	-	3	3	3

VI SEMESTER

BT1601	COMPUTATIONAL BIOLOGY	L	T	P	C
		3	0	2	4

OBJECTIVES:

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

UNIT I: INTRODUCTION **9+6**

Introduction to Operating systems, Linux commands, File transfer protocols ftp and telnet, Introduction to Bioinformatics and Computational Biology, Biological sequences, Biological databases, Genome specific databases, Data file formats, Data life cycle, Database management system models, Basics of Structured Query Language (SQL). **CO1**

UNIT II: SEQUENCE ALIGNMENT **9+6**

Sequence Analysis, Pair wise alignment, Dynamic programming algorithms for computing edit distance, string similarity, shotgun DNA sequencing, end space free alignment. Multiple sequence alignment, Algorithms for Multiple sequence alignment, Generating motifs and profiles, Local and Global alignment, Needleman and Wunsch algorithm, Smith Waterman algorithm, BLAST, PSIBLAST and PHIBLAST algorithms. **CO2**

UNIT III: PHYLOGENETIC METHODS **9+6**

Introduction to phylogenetics, Distance based trees UPGMA trees, Molecular clock theory, Ultrametric trees, Parsimonious trees, Neighbour joining trees, trees based on morphological traits, Bootstrapping. Structural genomics. Applications of informatics techniques in genomics and proteomics: Assembling the genome, STS content mapping for clone contigs and other mapping techniques. **CO3**

UNIT IV: PROTEIN STRUCTURE ANALYSIS **9+6**

Protein Secondary structure and tertiary structure prediction methods, Homology modeling, ab initio approaches, Threading, Critical Assessment of Structure Prediction. Machine learning techniques: Artificial Neural Networks in protein secondary structure prediction, Hidden Markov Models for gene finding, Decision trees, Support Vector Machines. Introduction to Systems Biology and Synthetic Biology, Microarray analysis, DNA computing, Bioinformatics approaches for drug discovery. Functional annotation, Peptide mass fingerprinting. **CO4**

UNIT V: PERL PROGRAMMING **9+6**

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. **CO5**

TOTAL PERIODS: 45+30 = 75

TEXT BOOKS:

1. Introduction to Bioinformatics by Arthur K. Lesk , Oxford University Press.
2. Algorithms on Strings, Trees and Sequences by Dan Gusfield, Cambridge University Press.
3. Biological Sequence Analysis Probabilistic Models of proteins and nucleic acids by R.Durbin, S.Eddy, A.Krogh, G.Mitchison.
4. Bioinformatics Sequence and Genome Analysis by David W. Mount, Cold Spring HarborLaboratory Press.

5. Beginning Perl for Bioinformatics: An introduction to Perl for Biologists by James Tindall, O'Reilley Media

REFERENCES:

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

COURSE OUTCOMES

Upon completion of the course, the students will

CO1	Understand the fundamentals of operating systems, biological sequences and sequence databases.
CO2	Gain knowledge about the sequence alignment programs and its importance in Bioinformatics.
CO3	Understand about phylogenetic trees and mapping techniques.
CO4	Understand the principle behind molecular modelling and drug designing related advanced techniques.
CO5	Gain knowledge in programming language and to develop bioinformatics related tools with programming skills.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	2	3	2	2	3	2	2	2	2	2	1	1	2
CO2	3	3	3	2	2	2	2	1	2	2	2	3	2	2	2
CO3	3	2	3	2	3	2	2	1	2	2	2	3	3	3	3
CO4	2	2	3	3	3	2	2	2	1	2	3	3	2	3	3
CO5	2	2	2	2	2	2	1	1	2	2	3	3	2	2	3

BT1602 APPLIED CHEMICAL REACTION ENGINEERING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To provide the basic concepts of types of reactions, variable affecting the rate of reaction, predicting the rate equations for different types of reactions.
- To provide the information about different reactor systems, deriving the performance equations and predicting the rate equations in chemical reaction engineering system.

UNIT I: SCOPE OF CHEMICAL KINETICS & CHEMICAL REACTION ENGINEERING **9**

Broad outline of chemical reactors, rate equations; concentration and temperature dependence; development of rate equations for different homogeneous reactions. Industrial scale reactors. **CO1**

UNIT II:	**IDEAL REACTORS**	**9**
Isothermal batch, flow, semi-batch reactors; performance equations for single reactors; multiple reactor systems; multiple reactions.		**CO2**
UNIT III:	**GAS-SOLID, GAS-LIQUID REACTIONS**	**9**
RTD in non-ideal flow; non-ideal flow models; reactor performance with non-ideal flow.		**CO3**
UNIT IV:	**GAS-SOLID, GAS-LIQUID REACTIONS**	**9**
Resistances and rate equations; heterogeneous catalysis; reactions steps; resistances and rate equations.		**CO4**
UNIT V:	**FIXED BED AND FLUID BED REACTORS**	**9**
G/L reactions on solid catalysis; trickle bed, slurry reactors; three phase-fluidized beds; reactors for fluid-fluid reactions; tank reactors.		**CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Levenspiel O. Chemical Reaction Engineering. IIIrd Edition. John Wiley.2006.
2. Fogler H.S. Elements Of Chemical Reaction Engineering. Prentice Hall India.2002.

REFERENCES:

1. Missen R.W., Mims C.A., Saville B.A. Introduction to Chemical Reaction Engineering and Kinetics. John Wiley.1999
2. Dawande, S.D., “Principles of Reaction Engineering”, Ist Edition, Central Techno Publications, 2001.
3. Richardson, J.F. and Peacock, D.G., “Coulson Richardson - Chemical Engineering”,Vol.III, IIIrd Edition, Butterworth- Heinemann- Elsevier, 2006.

COURSE OUTCOMES

Upon completion of the course, the students will gain knowledge on

CO1	Calculating the conversions, concentrations and rates in a reaction and identify, formulate and solve chemical engineering problems.
CO2	Designing reactors for heterogeneous reactions and optimizing operating conditions.
CO3	Demonstrating experimental data using standard statistical methods to establish quantitative results.
CO4	Understanding fluid – solid reactions and the resistances encountered during reactions.
CO5	Designing a reactor for bio based products to achieve production and yield specifications.

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	1	2	2	3	1	-	-	-	-	-	-	-	1	2	2
CO2	1	2	3	3	1	1	-	-	-	-	-	-	1	2	3
CO3	1	2	3	3	1	1	-	-	-	-	-	-	1	2	3
CO4	2	2	2	3	1	1	-	-	-	-	-	-	1	2	3
CO5	2	2	3	3	1	1	-	-	-	-	-	-	1	2	3

BT1603 **GENETIC ENGINEERING** **L T P C**
3 0 0 3

OBJECTIVES:

- To discuss the gene cloning methods, tools and techniques involved in gene cloning, genome analysis and genomics.
- To explain the heterologous expression of cloned genes in different hosts.

UNIT I: BASICS OF RECOMBINANT DNA TECHNOLOGY **9**

Manipulation of DNA – Restriction and Modification enzymes, Design of linkers and adaptors. Characteristics of cloning and expression vectors based on plasmid and bacteriophage, Vectors for insect, yeast and mammalian system, Prokaryotic and eukaryotic host systems, Introduction of recombinant DNA in to host cells and selection methods. **CO1**

UNIT II: DNA LIBRARIES **9**

Construction of genomic and cDNA libraries, Artificial chromosomes – BACs and YACs,Chromosomal walking and jumping, Screening of DNA libraries using nucleic acid probes and antisera. **CO2**

UNIT III: SEQUENCING AND AMPLIFICATION OF DNA **9**

Maxam Gilbert's and Sanger's methods of DNA sequencing. PCR & Variants of PCR: Inverse PCR, Nested PCR, AFLP PCR, Allele specific PCR, Assembly PCR, Asymmetric PCR, Hot start PCR, inverse PCR, Colony PCR, single cell PCR, Real-time PCR/qPCR – SYBR green assay, Taqman assay, Molecular beacons. Site directed mutagenesis. **CO3**

UNIT IV: ORGANIZATION AND STRUCTURE OF GENOMES **9**

Organization and structure of genomes, Genome sequencing methods, Conventional and shotgun genome sequencing methods, Next generation sequencing technologies , Ordering the genome sequence, Genetic maps and Physical maps, STS content based mapping, Restriction Enzyme Finger Printing, Hybridization mapping, Radiation Hybrid Maps, Optical mapping. ORF finding and functional annotation. **CO4**

UNIT V: CURRENT STATUS OF GENOME SEQUENCING PROJECTS 9

Current status of genome sequencing projects, Introduction to Functional genomics, Microarrays,Serial Analysis of Gene expression (SAGE), Subtractive hybridization, DIGE, TOGA, Yeast Twohybrid System, Comparative Genomics, Proteogenomics, Web resources for Genomics,Applications of genome analysis and genomics. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Old RW, Primrose SB, "Principles Of Gene Manipulation, An Introduction To GeneticEngineering ", Blackwell Science Publications, 1993.
2. Principles of Genome Analysis and Genomics by S.B.Primrose and R.M.Twyman, 3rd Ed.(Blackwell Publishing)

REFERENCES:

1. Ansubel FM, Brent R, Kingston RE, Moore DD, "Current Protocols In Molecular Biology"Greene Publishing Associates, NY, 1988.
2.Berger Sl, Kimmer AR, "Methods In Enzymology", Vol 152, Academic Press

COURSE OUTCOMES

Upon completion of the course, the students will gain knowledge on

CO1	Cloning aspects and enzymes involved in creating rDNA for producing commercially important genes.
CO2	Knowledge about library creation and current techniques used for screening of libraries
CO3	Knowledge about recent PCR techniques used in amplification of DNA
CO4	Awareness of current techniques used in gene and genome sequencing.
CO5	Awareness about microarrays, Analysis of Gene expression and proteomics.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	3	-	2	-	1	1	-	-	-	-	3	2	1
CO2	1	-	2	-	3	-	-	-	-	-	-	-	2	2	3
CO3	3	1	2	1	3	-	-	-	-	-	-	-	1	3	2
CO4	2	2	2	1	3	-	-	-	-	-	-	-	2	3	3
CO5	2	2	2	1	3	-	-	-	-	-	-	-	2	2	3

BT1607 **BIOPROCESS LABORATORY II** **L T P C**
0 0 4 2

OBJECTIVES:

- The course applies earlier learned knowledge on bioreactors and sterilization kinetics.
- Skills and knowledge gained is useful by analogy when solving problems typical for the bioindustry or for research

LIST OF EXPERIMENTS:

1. Estimation of Mixing Time in reactor
2. Residence time distribution
3. Estimation of K_La – Power Correlation Method
4. Estimation of K_La – Sulphite Oxidation Method
5. Estimation of K_La – Dynamic Gassing-out method,
6. Estimation of Overall Heat Transfer Coefficient
7. Batch Sterilization kinetics
8. Batch cultivation with exhaust gas analysis.
9. Fed batch cultivation and Total cell retention cultivation
10. Photo bioreactor

TOTAL PERIODS: 60

EQUIPMENT NEEDED FOR 30 STUDENTS

1. Reactors 6
2. Incubators 1
3. Incubator Shaker 1
4. Spectrophotometer 1
5. Laminar Flow Chamber 1
6. Glassware, Chemicals, Media as required

REFERENCES:

1. Anton Moser, “Bioprocess Technology, Kinetics and Reactors”, , Springer Verlag.
2. James E. Bailey & David F. Ollis, Biochemical Engineering Fundamentals, McGraw Hill.
3. James M. Lee, Biochemical Engineering, PHI, USA.
4. Atkinson, Handbook of Bioreactors,
5. Harvey W. Blanch, Douglas S. Clark, BiochemicalEngineering, Marcel Decker Inc.

COURSE OUTCOMES

Upon completion of the course, the students will be able

CO1 To understand and design the different modes of bioreactor

CO2 To estimate the heat transfer and oxygen transfer coefficient

CO3 To estimate the residence time and the mixing time in the bioreactor

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	1	2	1	2	1	2	-	-	-	-	-	3	2
CO2	-	-	2	2	2	1	1	2	-	-	-	-	-	3	2
CO3	-	-	2	1	1	3	2	2	-	-	-	-	-	3	2

BT1608 **GENETIC ENGINEERING LABORATORY** **L T P C**

0 0 4 2

OBJECTIVES:

- Provide hands-on experience in performing basic recombinant DNA techniques.
- Introduce students to the theory behind in each techniques and to describe common applications of each methodology in biological research.

LIST OF EXPERIMENTS

1.Preparation of plasmid DNA
2. Elution of DNA from agarose gels
3. Restriction digestion
4. Ligation of DNA into expression vectors
5. Transformation & Selection of recombinants – Blue white screening assay
6. Optimisation of time of inducer for recombinant protein expression
7. Expression of protein profiling by SDS - PAGE
8. Blotting Techniques : Western and Southern blotting methods
9. PCR - Amplification of genes
10. Colony lysate PCR.

Required Equipments:

1. Electrophoresis Unit, Glassware , PCR, Laminar Flow Chamber, Incubators and Incubator Shaker, Gel Documentation, Spectrophotometer, Cooling Centrifuge and Gel Rocker

TOTAL PERIODS: 60

REFERENCES:

1.Sambrook, J. and Russsel, D.W., “Molecular cloning – A laboratory manual”, Third edition, Cold Spring Harbor Laboratory Press, Cold Spring harbor, New York, USA, 2001.
2. Old RW, Primrose SB, “Principles Of Gene Manipulation, An Introduction To Genetic Engineering “, Blackwell Science Publications, 1993.
3. Ansubel FM, Brent R, Kingston RE, Moore DD, “Current Protocols In Molecular Biology “, Greene Publishing Associates, NY, 1988.
4. Berger Sl, Kimmer AR, “Methods In Enzymology”, Vol 152, Academic Press, 1987

COURSE OUTCOMES

Upon completion of the course, the students will be able

CO1 Describe the main principles, methods for preparation and cloning of DNA in various organisms.

CO2 Express clearly about the gene amplification and methods for analysis of DNA, such as hybridization,restriction analysis and gene expressions.

CO3 Use genetic and biotechnological techniques to manipulate genetic materials and develops new and improved living organisms.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	2	2	3	1	1	1	-	-	-	-	2	2	3
CO2	2	1	2	2	3	-	-	-	-	-	-	-	2	3	3
CO3	2	1	2	2	3	1	1	1	-	-	-	-	3	2	3

BVA001	ADVANCEMENTS IN DRUG DESIGNING	L	T	P	C
		1	0	2	2

OBJECTIVES:

- To understand the basics of drug designing
- To understand genetic makeup of the individual to have better approach on health care
- To characterize a drug for its pharmacokinetics and metabolism
- To understand advanced drug designing techniques
- To understand the methods to immunize test animals and to raise anti-sera

UNIT I: FUNDAMENTALS OF DRUG DESIGNING **3+6**

Introduction to bioinformatics and understanding of biological databases; Introduction to pharmacogenomics and their applications in drug discovery research **CO1**

UNIT II: PERSONALIZED MEDICINES **3+6**

Omics and personalized medicine; Pharmacist role and their new challenges in personalized medicine; Ethical, legal, economical and social issues in pharmacogenomics **CO2**

UNIT III: PHARMACEUTICAL ANALYSIS AND MODELLING **3+6**

Protein modelling; Protein databank; Alignment of protein sequences; Mutational analysis using multiple sequence alignment; Gene expression using genome scan and gene mark **CO3**

UNIT IV: ADVANCED DRUG DESIGNING TECHNIQUES **3+6**

Secondary structure prediction – hydropathic index; Active site prediction – activity pockets; Ligand modelling – pharmacophore redesigning; Denova designing; Virtual screening – drug likeness and toxicology **CO4**

UNIT V: TARGETED DELIVERY AND CANCER TREATMENT **3+6**

Lecture on raising and harvesting monoclonal antibodies; biomarkers screening for cancer – targeted delivery and bioimaging; commercial products and research application in cancer therapy **CO5**

TOTAL PERIODS: 45

COURSE OUTCOMES

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

CO1 Understand the basics of drug designing.

CO2 Understand the importance of personalized medicine and its futuristic applications.

CO3 Characterize a drug for its pharmacokinetics and metabolism.

CO4 Understand the mechanism behind drug designing using online tools.

CO5 Understand the product development and bioimaging for targeted delivery.

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	3	2	3	2	2	2	1	2	2	2	2	3	3
CO2	2	2	2	3	3	2	1	2	2	2	2	2	2	2	3
CO3	3	3	3	3	3	1	2	1	2	2	2	1	2	2	3
CO4	3	3	3	3	3	2	2	1	2	2	3	2	2	3	3
CO5	3	3	3	2	3	2	2	2	2	2	3	3	3	3	3

VII SEMESTER

BT1701	TOTAL QUALITY MANAGEMENT FOR BIOTECHNOLOGISTS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To facilitate the understanding of Quality Management principles and process.
- To apply the tools and techniques in bioproduct industry for product quality **i**mprovement
- To familiarize with the concepts of quality management system and Biosafety levels

UNIT I: INTRODUCTION **9**

Introduction - Need for quality - Evolution of quality - Definitions of quality - Dimensions of product and service quality - Basic concepts of TQM - TQM Framework - Contributions of Deming, Juran and Crosby - Barriers to TQM - Customer focus - Customer orientation, Customer satisfaction, Customer complaints, Customer retention. **CO1**

UNIT II: TQM PRINCIPLES **9**

Leadership - Quality Statements, Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement - PDCA cycle, 5S, Kaizen - Supplier partnership - Partnering, Supplier selection, Supplier Rating. **CO2**

UNIT III: TQM TOOLS AND TECHNIQUES I **9**

The seven traditional tools of quality - New management tools - Six sigma: Concepts, Methodology, applications to manufacturing, service sector including Bioproduct industries - Bench marking - Reason to bench mark, Bench marking process - FMEA - Stages, Types. **CO3**

UNIT IV: TQM TOOLS AND TECHNIQUES II **9**

Quality Circles - Cost of Quality - Quality Function Deployment (QFD) - Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures **CO4**

UNIT V: QUALITY MANAGEMENT SYSTEM **9**

Introduction—to ISO 9000 Series of Standards—Benefits of ISO Registration- Internal audits Sector Specific Standards—Requirements and benefits -ISO 22000- Food safety Management - HACCP and Elements of Biosafety Levels **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Dale H.Besterfiled, Carol B.Michna,Glen H. Besterfield,Mary B.Sacre,Hemant Urdhwareshe and Rashmi Urdhwareshe, “Total Quality Management”, Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression, 2013.

REFERENCES:

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8 th Edition, First Indian Edition, Cengage Learning, 2012.
2. Janakiraman. B and Gopal .R.K., "Total Quality Management - Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006.
3. Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006.
4. https://www.researchgate.net/publication/339711956
5. ISO9001-2015 standards - https://www.iso.org/standards.html

COURSE OUTCOMES

Upon completion of the course, the students will be able

CO1	To understand the basic concepts of total quality management principles and importance of customer
CO2	To comprehend the knowledge on principles and philosophies of quality management
CO3	To realize the importance in applying the tools and techniques in bioproduct industries
CO4	To apply the tools and techniques of quality management to manufacturing and services processes.
CO5	To understand the importance of ISO and safety level regulations in Bioproduct industries

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	-	-	-	1	1	2	1	2	2	1	2	2	1	-	1
CO2	-	-	-	-	2	2	1	2	3	2	2	2	-	1	3
CO3	1	2	2	1	3	1	-	1	2	1	3	1	-	-	2
CO4	1	2	3	2	2	-	-	1	-	-	1	1	1	1	1
CO5	-	1	-	-	2	2	1	1	1	1	1	2	-	-	1

BT1702 **DOWNSTREAM PROCESSING** **L T P C**
3 0 0 3

OBJECTIVES:

- To enable the students to understand the methods to obtain pure proteins, enzymes and bioproducts in general.
- Have depth knowledge on downstream processes required in multi-factorial manufacturing environment in a structured and logical fashion.

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. Pretreatment and stabilisation of bioproducts. **CO1**

UNIT II: PHYSICAL METHODS OF SEPARATION **9**

Unit operations for solid-liquid separation: Filtration - types of filtration, constant rate and constant pressure filtration, filtration equipments. Centrifugation – types of centrifugation, centrifugation equipment, scale-up of centrifuges. **CO2**

UNIT III: ISOLATION OF PRODUCTS **9**

Precipitation of proteins,adsorption, liquid-liquid extraction, aqueous two-phase extraction, membrane separation operations for product isolation. **CO3**

UNIT IV: PRODUCT PURIFICATION **9**

Chromatography – principles, instruments and practice. Adsorption, reverse phase, ion exchange, size exclusion, hydrophobic interaction, and affinity chromatographic techniques. **CO4**

UNIT V: PRODUCT POLISHING AND FORMULATION **9**

Drying, lyophilization and Crystallization in final product formulation. **CO5**

TOTAL PERIODS: 45

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
2. “Product Recovery in Bioprocess Technology”. (BIOTOL – Biotechnology by Open Learning Series). Butterworth – Heinmann / Elsevier, 2004.

COURSE OUTCOMES

Upon completion of the course, the students will gain knowledge on

CO1 The product recovery, unit operations involved and factors affecting bioseparation of bioproducts and recombinant products.

CO2 Selection and design of filtration and centrifugation operation for bioseparation.

CO3 To identify a suitable unit operation for isolation and concentration for the given bioproduct.

CO4 To select a suitable chromatographic operation for purification of given bioproducts.

CO5 Design of various bioproducts polishing methods and purification of various bioproducts/recombinant products.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	3	2	2	3	1	-	1	-	2	-	1	1	-
CO2	1	1	2	1	2	3	1	-	-	-	2	-	-	2	-
CO3	3	1	2	1	1	1	1	-	-	-	1	-	3	-	-
CO4	1	3	3	3	3	1	1	-	-	-	1	-	-	-	2
CO5	1	3	2	1	1	1	1	-	-	-	1	3	1	-	3

BT1703	IMMUNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To discuss the structure, functions and integration of immune system.
- To explain the antigen-antibody interactions and how the immune system is protecting the body from foreign pathogens/germs.
- To explain various techniques of monoclonal and engineered antibodies (important therapeutic molecules) production, for treating most of the human diseases.

UNIT I: INTRODUCTION TO IMMUNE SYSTEM **9**

Organisation and classification of immune system – immune cells and organs; innate and acquired immunity; classification of antigens – chemical and molecular nature; haptens, adjuvants; antigen presenting cells **CO1**

UNIT II: HUMORAL AND CELLULAR IMMUNITY **9**

Development, maturation, activation, regulation, differentiation and classification of T-cells and B-cells, antigen processing and presentation, theory of clonal selection, TCR; antibodies: structure and functions; antibodies: genes and generation of diversity; antigen-antibody reactions **CO2**

UNIT III: IMMUNITY AGAINST PATHOGENS AND TUMORS **9**

Inflammation; protective immune responses to virus, bacteria, fungi and parasites; cytokines; complement pathway, tumor antigens, tumor immune response, tumor diagnosis, tumor immunotherapy **CO3**

UNIT IV: IMMUNE TOLERANCE AND HYPERSENSITIVITY **9**

Immune tolerance, Immunodeficiencies; Major Histocompatibility Complex; Transplantation – genetics of transplantation; laws of transplantation; Allergy and hypersensitivity – Types of hypersensitivity, Autoimmunity, Autoimmune disorders and diagnosis **CO4**

UNIT V: APPLIED IMMUNOLOGY **9**

Monoclonal antibodies, engineering of antibodies; Classification of Vaccines-Active and Passive immunization, protein based vaccine, DNA vaccine, edible vaccine, immunodiagnostic methods (Immuno diffusion, ELISA, FACS, Cr5I release assay) **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Peter J Delves, Seamus J Martin, Dennis R Burtn and Ivan M Roitt., Roitts Essentia lImmunology, 13th Edition, Wiley –Blackwell, 2016.
2. Judith a Owen, Jenni Punt and Sharon A Stranford, Kuby Immunology, Macmillan Internation, 7th Edition, 2012
3. Ashim K. Chakravarthy, Immunology, Tata McGraw-Hill, 2006

REFERENCE:

1. Coico, Richard “Immunology: A Short Course” VIth Edition. John Wiley, 2008.
2. Khan, Fahim Halim “Elements of Immunology” Pearson Education, 2009.

COURSE OUTCOMES

Upon completion of the course,

CO1 Students would have a fundamental knowledge about the various organs involved in immune response and the types of antigen invading the immune system.

CO2 Students would have developed knowledge about development, maturation, activation and regulation of T cells, B cells and also about the application of antigen-antibody reaction.

CO3 Students would have gained knowledge about the mechanism by which the body interacts with pathogenic microorganisms and in tumor immunology.

CO4 After completing this course, students get familiar about the laws of transplantation, autoimmunity, allergy and have gained the knowledge in immunodeficiency disorders

CO5 At the end of the course the student would acquire knowledge on various techniques of monoclonal, engineered antibodies, immunodiagnostic method and have gained the knowledge about the basic criteria for designing a vaccine

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	-	-	-	-	-	-	-	-	-	-	2	1	-
CO2	1	2	-	-	-	1	-	-	-	-	-	-	1	1	-
CO3	-	-	-	2	1	2	-	-	-	-	-	-	1	2	3
CO4	-	-	-	2	2	2	-	-	-	-	-	-	1	2	2
CO5	-	-	2	2	2	1	-	-	-	-	-	-	1	1	2

BT1707 DOWNSTREAM PROCESSING LABORATORY

L	T	P	C
0	0	4	2

OBJECTIVES:

- To provide hands on training in downstream processing through simple experimentations in the laboratory. This will be a pre-requisite for project work.
  The objectives of this course is to practice the students
- To understand various methods for end product isolation, concentration, purification and stabilization.
- To design processes for the recovery and subsequent purification of target biological products.

LIST OF EXPERIMENTS:

1. Solid liquid separation – centrifugation
2. Solid liquid separation - microfiltration
3. Cell disruption techniques –ultrasonication
4. Cell disruption techniques –French press or Dynomill
5. Precipitation – ammonium sulphite precipitation
6. Aqueous two phase extraction of biological product
7. Adsorption of protein
8. High resolution purification – affinity chromatography
9. High resolution purification – ion exchange chromatography
10. Product polishing – spray drying or freeze drying

TOTAL PERIODS: 60

LIST OF EQUIPMENT FOR 30 STUDENTS

1. Centrifuge 1
2. Microfiltration set up 1
3. Sonicator 1
4. French press or Dynomill 1
5. Spray dryer or Freeze dryer 1
6. Chromatography kits and other class wares and chemicals.

REFERENCES:

1. P.A. Belter, E.L. Cussler And Wei-Houhu – Bioseparations – Downstream Processing For Biotechnology, Wiley Interscience Pun. (1988).
2. R.O. Jenkins, (Ed.) – Product Recovery In Bioprocess Technology – Biotechnology ByOpen Learning Series, Butterworth-Heinemann (1992).
3. J.C. Janson And L. Ryden, (Ed.) – Protein Purification – Principles, High ResolutionMethods And Applications, VCH Pub. 1989.

COURSE OUTCOMES

Upon completion of the course, the students will gain knowledge on

CO1 The separation of whole cells and other insoluble ingredients from the culture broth.

CO2 Cell disruption techniques to release intracellular products

CO3 Various techniques like evaporation, extraction, precipitation, membrane separation for concentrating biological products

CO4 Basic principles and techniques of chromatography to purify the biological products

CO5 The methods of formulation of biological products for end uses

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	1	2	-	-	-	-	-	-	-	-	-	3	2
CO2	-	-	2	2	-	-	-	-	-	-	-	-	-	3	2
CO3	-	-	2	3	-	-	-	-	-	-	-	-	-	3	2
CO4	-	-	1	2	2	-	-	-	-	-	-	-	-	3	2
CO5	-	-	1	2	2	-	1	-	-	-	-	-	-	3	2

BT1708 **IMMUNOLOGY LABORATORY** **L T P C**
0 0 4 2

OBJECTIVES:

- To give practical training in the functioning of immune system.
- To give laboratory training in different immunological and immunotechnological techniques.

EXPERIMENTS

1. Identification of immune cells in a blood smear
2. Identification of blood group
3. Testing for typhoid antigens by Widal test
4. Immunodiffusion – Ouchterlony Double Diffusion
5. Immunoelectrophoresis – Rocket or Counter Current immune electrophoresis
6. Enzyme Linked ImmunoSorbent Assay (ELISA)
7. Isolation of peripheral blood mononuclear cells
8. Isolation of monocytes from blood
9. Immunofluorescence
10. Identification of t cells by T-cell rossetting using sheep RBC.

TOTAL PERIODS: 60

Equipment Needed for 20 Students

1. Elisa reader -1
2. Microscopes -8
3. Microwave owen-1
4. Hot plate -4
5. Vortex mixer -4
6. Table top refrigerated Centrifuge- 1
7. Fluorescent microsope- 1

REFERENCE:

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.

COURSE OUTCOMES

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

CO1 Handle different types of animals and to immunize the animals and raise antisera.

CO2 Identify the blood grouping, cells and to isolate the mononuclear cells.

CO3 Identify the Typhoid antigen

CO4 Determine the antigen and antibody concentration.

CO5 Identify and analyse the antigen.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	-	3	-	2	2	-	3	1	-	-	1	-	-	-
CO2	1	-	3	-	2	2	-	3	1	-	-	1	-	-	-
CO3	-	-	1	1	2	-	-	1	-	-	-	1	-	-	-
CO4	1	-	1	2	3	-	-	1	-	-	-	1	-	-	-
CO5	1	-	1	2	3	-	-	1	-	-	-	1	-	-	-

SEMESTER VIII

BT1807	PROJECT WORK	L	T	P	C
		0	0	20	10

COURSE OUTCOMES

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

CO1 Identify their field of interest

CO2 Search and think about logical solutions

CO3 Formulate and analyze a problem

CO4 Plan experiments to find solutions in a logical manner

CO5 Analyze the results, interpret and communicate in an effective manner

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	1	1	2	-	2	1	2	-	2	1	1	-
CO2	2	2	2	1	1	2	-	2	2	2	-	2	1	3	1
CO3	2	2	1	1	1	1	1	2	2	2	1	2	1	3	2
CO4	2	1	2	2	2	1	2	3	3	2	2	3	1	3	2
CO5	3	2	3	3	2	2	2	3	3	3	2	3	1	2	2

PROFESSIONAL ELECTIVE - I

BT1001	BIOPHYSICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

To enable the students

- To gain structural knowledge of biological systems.
- To understand transport and dynamic properties of biological systems.

UNIT I: MOLECULAR STRUCTURE OF BIOLOGICAL SYSTEMS **9**

Intramolecular bonds – covalent – ionic and hydrogen bonds – biological structures –general features – water structure – hydration – interfacial phenomena and membranes – self assembly and molecular structure of membranes. **CO1**

UNIT II: CONFORMATION OF NUCLEIC ACIDS **9**

Primary structure – the bases – sugars and the phosphodiester bonds- double helical structure – the a b and z forms – properties of circular DNA – topology – polymorphism and flexibility of DNA – structure of ribonucleic acids – hydration of nucleic acids. **CO2**

UNIT III: CONFORMATION OF PROTEINS **9**

Conformation of the peptide bond – secondary structures – Ramachandran plots – use of potential functions – tertiary structure – folding – hydration of proteins – hydropathy index. **CO3**

UNIT IV: CELLULAR PERMEABILITY AND ION – TRANSPORT **9**

Ionic conductivity – transport across ion channels – mechanism - ion pumps- proton transfer – nerve conduction – techniques of studying ion transport and models. **CO4**

UNIT V: ENERGETICS & DYNAMICS OF BIOLOGICAL SYSTEMS **9**

Concepts in thermodynamics – force and motion – entropy and stability – analyses of fluxes – diffusion potential – basic properties of fluids and biomaterials – laminar and turbulent flows. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Biophysics ; R. Glaser, Springer Verlag , 2000.
2. Biophysics: Molecules In Motion ; R. Duane. Academic Press , 1999

REFERENCES:

1. Cantror, Charles R. and Paul R. Schimmel “Biophysical Chemistry” . 1-3 Vols. W.H.Freeman& Co.,1980

COURSE OUTCOMES

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

CO1 Understand the forces in biomolecules.

CO2 Understand configurational determinants and stabilizing factors of nucleic acids.

CO3 Understand configurational determinants and stabilizing factors of proteins.

CO4 Gain the knowledge of cellular permeability and ion transport.

CO5 Understand the energetics and dynamics of biological systems.

MAPPING OF COs WITH POs AND PSOs															
COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	1	-	-	-	-	-	-	-	3	3	-	-
CO2	3	2	-	1	-	-	-	-	-	-	-	2	3	-	-
CO3	3	2	-	1	-	-	-	-	-	-	-	2	3	-	-
CO4	3	2	1	2	-	-	-	-	-	-	-	3	3	-	1
CO5	3	2	1	2	-	-	-	-	-	-	-	3	3	-	2

BT1002 PRINCIPLES OF FOOD PROCESSING

L	T	P	C
3	0	0	3

OBJECTIVES:

To enable the students

- To know about the constituents and additives present in the food.
- To gain knowledge about the microorganisms, which spoil food and food borne diseases.
- To know different techniques used for the preservation of foods.

UNIT I: FOOD AND ENERGY **9**

Constituents of food – carbohydrates, lipids, proteins, water, vitamins and minerals, dietarysources, role and functional properties in food, contribution to organoleptic and textural characteristics.

UNIT II: FOOD ADDITIVES **9**

Classification, intentional and non-intentional additives, functional role in food processing and preservation; food colourants – natural and artificial; food flavours; enzymes as food processing aids.

UNIT III: MICROORGANISMS ASSOCIATED WITH FOOD **9**

Bacteria, yeasts and molds – sources, types and species of importance in food processing and preservation; fermented foods and food chemicals, single cell protein.

UNIT IV: FOOD BORNE DISEASES **9**

Classification – food infections – bacterial and other types; food intoxications and poisonings –bacterial and non-bacterial; food spoilage – factors responsible for spoilage, spoilage of vegetable, fruit, meat, poultry, beverage and other food products

UNIT V: FOOD PRESERVATION **9**

Principles involved in the use of sterilization, pasteurization and blanching, thermal death curves of microorganisms, canning; frozen storage-freezing characteristics of foods, microbial activity at low temperatures, factors affecting quality of foods in frozen storage; irradiation preservation of foods.

TOTAL PERIODS: 45

REFERENCE:

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

COURSE OUTCOMES

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

CO1 Know different constituents present in food and microorganisms involved in processing of food.

CO2 Understand Roles and regulatory levels of food additives during food processing.

CO3 Gain knowledge on principles and different preservations techniques of food can also be known.

CO4 Know about diseases associated with the toxic effects of spoiled food.

CO5 Know the importance of Unit operations in modern food processing and impact of the process on food quality

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	1	1	-	3	-	1	1	-	-	-	-	-	2	2	2
CO2	1	1	-	3	-	2	2	-	-	-	-	-	2	2	3
CO3	1	1	-	3	-	2	2	-	-	-	-	-	2	2	3
CO4	1	1	-	3	-	2	2	-	-	-	-	-	2	2	3
CO5	1	1	-	3	-	2	2	-	-	-	-	-	2	2	3

CE1025 **DISASTER MANAGEMENT** **L T P C**
3 0 0 3

OBJECTIVES:

- To provide students an exposure to disasters, their significance and types.
- To ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention and risk reduction
- To gain a preliminary understanding of approaches of Disaster Risk Reduction (DRR)
- To enhance awareness of institutional processes in the country
- To develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity

UNIT I: INTRODUCTION TO DISASTERS **9**

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Disasters: Types of disasters – Earthquake, Landslide, Flood, Drought, Fire etc – Classification, Causes, Impacts including social, economic, political, environmental, health, psychosocial, etc.- Differential impacts- in terms of caste, class, gender, age, location, disability – Global trends in disasters: urban disasters, pandemics, complex emergencies, Climate change- Dos and Don'ts during various types of Disasters. **CO1**

UNIT II: APPROACHES TO DISASTER RISK REDUCTION (DRR) **9**

Disaster cycle – Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj Institutions/Urban Local Bodies (PRIs/ULBs), States, Centre, and other stake-holders- Institutional Processess and Framework at State and Central Level- State Disaster Management Authority(SDMA) – Early Warning System – Advisories from Appropriate Agencies. **CO2**

UNIT III: INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT **9**

Factors affecting Vulnerabilities, differential impacts, impact of Development projects such as dams, embankments, changes in Land-use etc.- Climate Change Adaptation- IPCC Scenario and Scenarios in the context of India – Relevance of indigenous knowledge, appropriate technology and local resources. **CO3**

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. **CO4**

UNIT V: DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES AND FIELD WORKS **9**

Landslide Hazard Zonation: Case Studies, Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Singhal J.P. Disaster Management, Laxmi Publications, 2010.
2. Tushar Bhattacharya, Disaster Science and Management, McGraw Hill India Education Pvt. Ltd., 2012.
3. Gupta Anil K, Sreeja S. Nair. Environmental Knowledge for Disaster Risk Management, NIDM, New Delhi, 2011
4. Kapur Anu Vulnerable India: A Geographical Study of Disasters, IIAS and Sage Publishers, New Delhi, 2010.

REFERENCES:

1. Govt. of India: Disaster Management Act , Government of India, New Delhi, 2005
2. Government of India, National Disaster Management Policy,2009.

COURSE OUTCOMES

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

CO1	Differentiate the types of disasters, causes and their impact on environment and society
CO2	Assess vulnerability and various methods of risk reduction measures as well as mitigation
CO3	Enhance awareness of institutional processes in the country
CO4	Develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity

CO5 Draw the hazard and vulnerability profile of India, Scenarios in the Indian context, Disaster damage assessment and management.

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	-	-	-	2	2	1	3	-	1	2	-	1	3
CO2	3	2	-	-	-	2	2	1	2	-	2	1	-	1	3
CO3	3	2	-	-	-	1	2	1	2	-	1	2	-	2	2
CO4	3	2	-	-	-	1	1	1	1	-	1	3	-	1	2
CO5	3	2	-	-	-	1	2	1	3	-	1	3	-	1	2

BT1004 **MARINE BIOTECHNOLOGY** **L T P C**
3 0 0 3

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 divisons of the sea – history of marine biology – bioecochemical cycles – food chain and food web. **CO1**

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. **CO2**

UNIT III: MARINE ENVIRONMENTAL BIOTECHNOLOGY **9**

Marine pollution – biology indicators (marine micro , algae) – biodegradation and bioremediation – marine fouling and corrosion. **CO3**

UNIT IV: MARINE PHARMACOLOGY **9**

Medicinal compound from marine flora and fauna – marine toxins , antiviral and antimicrobial agents. **CO4**

UNIT V: AQUACULTURE TECHNOLOGY **9**

Important of coastal aquaculture – marine fishery resources – common fishing crafts and gears – aquafarm design and construction **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

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

COURSE OUTCOMES

Upon completion of the course,

CO1 Students will be able to study the interrelationship between marine organism and its environment

CO2 Students will be able to classify various marine organisms and their adaptations

CO3 Students will acquire knowledge about combating environmental issues using marine organisms as indicators

CO4 Students will be able to formulate medicinal components derived from marine organisms

CO5 Students will gain knowledge about design and construction of aquaculture and usage of its technology

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	1	-	-	2	-	-	-	-	1	1	-	-
CO2	1	1	-	1	2	1	1	-	-	-	-	-	-	-	-
CO3	2	2	2	2	2	1	3	1	1	-	-	1	2	3	2
CO4	1	1	2	1	2	1	1	2	1	-	-	1	2	2	2
CO5	1	1	1	1	2	1	1	1	1	-	1	1	-	-	1

PROFESSIONAL ELECTIVE –II

BT1005	ANIMAL BIOTECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To provide the fundamentals of animal cell culture, details of the diseases and therapy
- To offer the knowledge about the micromanipulation and transgenic animals

UNIT I: ANIMAL CELL CULTURE **9**

Introduction to basic tissue culture techniques; chemically defined and serum free media; animal cell cultures, their maintenance and preservation; various types of cultures suspension cultures, continuous flow cultures, immobilized cultures; somatic cell fusion; cell cultures as a source of valuable products; organ cultures. **CO1**

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

Bacterial and viral diseases in animals; monoclonal antibodies and their use in diagnosis; molecular diagnostic techniques like PCR, in-situ hybridization; northern and southern blotting; RFLP. **CO2**

UNIT III: THERAPY OF ANIMAL DISEASES **9**

Recombinant cytokines and their use in the treatment of animal infections; monoclonal antibodies in therapy; vaccines and their applications in animal infections; gene therapy for animal diseases. **CO3**

UNIT IV: MICROMANIPULATION OF EMBRYO'S **9**

What is micromanipulation technology; equipments used in micromanipulation; enrichment of x and y bearing sperms from semen samples of animals; artificial insemination and germ cell manipulations; in vitro fertilization and embryo transfer; micromanipulation technology and breeding of farm animals. **CO4**

UNIT V: TRANSGENIC ANIMALS **9**

Concepts of transgenic animal technology; strategies for the production of transgenic animals and their importance in biotechnology; stem cell cultures in the production of transgenic animals **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Ranga M.M. Animal Biotechnology. Agrobios India Limited, 2002
2. Ramadass P, Meera Rani S. Text Book Of Animal Biotechnology. Akshara Printers, 1997.

REFERENCE:

1. Masters J.R.W. Animal Cell Culture: Practical Approach. Oxford University Press.2000

COURSE OUTCOMES

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

CO1 Understand the basic of animal Tissue culture, Maintenance and its preservation along with different culture techniques

CO2 Learn various viral and bacterial disease and different molecular biology Techniques.

CO3 Develop vaccines by understanding the Recombinant cytokines and their use in the treatment of animal infections.

CO4 Learn about micromanipulation technology of Embryos for the enrichment of X and Y bearing sperms for artificial insemination and embryo transfer

CO5 Appreciate the concepts of transgenic animal technology and choose among the strategies for the production of transgenic animals

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	1	2	3	3	1	2	1	-	-	-	-	3	2	2
CO2	3	1	3	3	3	2	2	-	-	-	-	1	3	3	3
CO3	2	1	1	1	3	2	2	1	-	-	-	1	2	3	2
CO4	3	1	1	2	3	3	2	2	-	-	-	1	2	3	3
CO5	2	1	2	2	3	3	3	2	1	-	-	1	3	2	3

BT1006 **SYSTEMS BIOLOGY** **L T P C**
3 0 0 3

OBJECTIVES:

- To provide a quantitative basis, based on thermodynamics, enzyme kinetics, for the understanding of metabolic networks in single cells and at the organ level.
- To enable the students to utilize the bioinformatic tools to design and develop biological complex data models.

UNIT I: INTRODUCTION **9**

Introduction to Systems Biology, Systems level understanding of biological systems. Basic concepts in Systems modeling: Model Scope, Model Statements, System state, Variables, parameters and constants, Model behavior, classification and steady state. Merits of computational modeling **CO1**

UNIT II: KINETIC MODELING **9**

Kinetic modeling of biochemical reactions, describing dynamics with ODEs, rate equations, deriving a rate equation, incorporating regulation of enzyme activity by effectors, E-cell platform and erythrocyte modeling. **CO2**

UNIT III: FLUX BALANCE ANALYSIS **9**

Introduction to Flux balance analysis, Construction of stoichiometric matrices, Constraint based models. Network basics, examples of mathematical reconstruction of transcriptional networks and signal transduction networks. **CO3**

UNIT IV: NETWORK MOTIFS AND MODELS **9**

Network motifs, Feed forward loop network motif. Gene circuits, robustness of models, Chemotaxis model, Integration of data from multiple sources: Building genome scale models. **CO4**

UNIT V: RESOURCES AND SBML **9**

Tools and databases for modeling: Pathway databases KEGG, EMP, Metacyc, Enzyme kinetics database BRENDA, Gene expression databases, Biomodels database, Basics of Systems Biology Markup Language (SBML), SBML editors. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. EddaKlipp, Wolfram Liebermeister, ChristophWierling ,Systems Biology a Textbook by Wiley-BlackWell Publications (2009 Edition).
2. Uri Alon , An introduction to Systems Biology: Design Principles of Biological Circuits, (Chapman and Hall / CRC 2007 Edition)
3. EddaKlipp, Ralf Herwig, Axel kowald, ChristophWierling, Hans Lehrach ,Systems Biology in practice: concepts, implementation and application. (Wiley – VCH 2005)

REFERENCES:

1. Foundations of Systems Biology Edited by Hiroaki Kitano (MIT Press)
2. Systems Biology: Definitions and perspectives by Lilia Albhergina (Springer Publications 2008)

COURSE OUTCOMES

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

CO1 Understand basic, advanced principles of systems biology and biological networks

CO2 Apply kinetics principles to develop systems level mathematical models in biology

CO3 Learn stoichiometry and energetics of metabolism.

CO4 Understand networks behaviour and emergent properties of biological networks/ systems

CO5 Apply computational based solutions for modeling biological perspectives

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	3	-	1	-	1	-	-	-	-	3	-	-
CO2	3	3	3	3	3	-	-	-	-	-	-	-	3	3	1
CO3	3	2	2	3	1	-	-	-	-	-	-	-	3	1	1
CO4	3	3	3	3	-	-	-	2	-	-	-	-	3	2	-
CO5	3	3	3	3	3	-	-	-	1	-	-	-	3	2	3

BT1007 BIOLOGICAL SPECTROSCOPY **L T P C**
3 0 0 3

OBJECTIVES:

- To deliver the knowledge of spectroscopic techniques and its functions
- To provide the technical information of spectroscopy for biological applications.

UNIT I: OPTICAL ROTATORY DISPERSION **9**

Polarized light – optical rotation – circular dichroism – circular dichroism of nucleic acids and proteins. **CO1**

UNIT II: TYPES OF NUCLEAR MAGNETIC RESONANCE **9**

Chemical shifts – spin – spin coupling – relaxation mechanisms – nuclear overhauser effect – ESR multidimensional nmr spectroscopy – determination of macromolecular structure by NMR – magnetic resonance imaging. **CO2**

UNIT III: TYPES OF MASS SPECTROMETRY **9**

Introduction on sources sample introduction – mass analyzers and ion detectors – bimolecular mass spectrometry – peptide and protein analysis – carbohydrates and small molecules – specific applications. **CO3**

UNIT IV: X-RAY DIFFRACTION **9**

Scattering by x- rays – diffraction by a crystal – measuring diffraction pattern – Bragg reflection – unit cell – phase problem – anomalous diffraction – determination of crystal structure – electron and neutron diffraction. **CO4**

UNIT V: SPECIAL TOPICS AND APPLICATIONS **9**

Electron microscopy – transmission and scanning electron microscopy – scanning tunnelling and atomic force microscopy – combinatorial chemistry and high throughput screening methods. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Banwell, Colin N. and E.M. McCash. “Fundamentals of Molecular Spectroscopy” 4th Edition, Tata McGraw-Hill, 2017.
2. Aruldas, G. “Molecular Structure and Spectroscopy”. 2nd Edition, Prentice Hall of India, 2007.
3. Pavia, D.L., G.M. Lampman and G.S. Kriz. “ Introduction to Spectroscopy:” 3rd Edition, Thomson, Brooks/ Cole, 2001.
4. Williams, Dudley H. and Ian Fleming. ”Spectroscopic Methods in Organic Chemistry”. 6th Edition, Tata McGraw-Hill, 2007.

REFERENCES:

1. Siuzdak, Gary. “Mass Spectrometry for Biotechnology ”. Academic Press / Elsevier,1996.
2. Hammes, Gordon G. “Spectroscopy for the Biological Sciences”. John Wiley, 2005.
3. Campbell I.D and Dwek R.A., “ Biological Spectroscopy “, Benjamin Cummins and Company, 1986.
4. Atkins P.W., “Physical Chemistry “,10th Edition, Oxford University Press India, 2014.

COURSE OUTCOMES

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

CO1 Know the basics and biological applications of optical rotatory dispersion methods.

CO2 Predict the structure of biological macromolecule using nuclear magnetic resonance spectroscopy.

CO3 Analyze the peptide and protein molecules by mass spectrometry.

CO4 Understand the principle of X-ray diffraction and its applications.

CO5 Gain knowledge on advanced microscopic techniques and its applications.

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	-	-	2	3	-	-	-	-	-	-	-	3	2	3
CO2	3	-	-	2	3	-	-	-	-	-	-	2	3	2	3
CO3	3	-	-	2	3	-	-	-	-	-	-	2	3	2	3
CO4	3	-	-	2	3	-	-	-	-	-	-	2	3	2	3
CO5	3	-	-	1	3	-	-	-	-	-	-	2	3	2	3

GE1001 **INTELLECTUAL PROPERTY RIGHTS** **L T P C**
3 0 0 3

OBJECTIVES:

- To introduce fundamental aspects of Intellectual Property Rights (IPR) and its components.
- To disseminate knowledge on patents, patent regime in India and abroad and registration aspects
- To disseminate knowledge on copyrights, trademarks and registration aspects
- To disseminate knowledge on Design, Geographical Indication (GI), Plant Variety and Layout Design Protection and their registration aspects
- To aware about enforcement in IPR and government steps in fostering IPR

UNIT I: **INTRODUCTION** **9**

Introduction to IPRs: Basic concepts and need for Intellectual Property, Patents, Copyrights, Geographical Indications, IPR in India and Abroad – Genesis and Development – The way from WTO to WIPO –TRIPS, Nature of Intellectual Property, Industrial Property, Technological Research, Inventions and Innovations – Important examples of IPR. **CO1**

UNIT II: **REGISTRATION OF IPRs** **10**

Meaning and practical aspects of registration of Copy Rights, Trademarks, Patents, Geographical Indications, Trade Secrets and Industrial Design registration in India and Abroad **CO2**

UNIT III: **AGREEMENTS AND LEGISLATIONS** **10**

International Treaties and Conventions on IPRs, TRIPS Agreement, PCT Agreement, Patent Act of India, Patent Amendment Act, Design Act, Trademark Act, Geographical Indication Act. **CO3**

UNIT IV: **DIGITAL PRODUCTS AND LAW** **9**

Digital Innovations and Developments as Knowledge Assets – IP Laws, Cyber Law and Digital Content Protection – Unfair Competition – Meaning and Relationship between Unfair Competition and IP Laws – Case Studies. **CO4**

UNIT V: ENFORCEMENT OF IPRs **7**

Infringement of IPRs, Enforcement Measures, Emerging issues – Case Studies. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. V. ScopleVinod, Managing Intellectual Property, Prentice Hall of India pvt Ltd,2014.
2. S. V. Satakar, "Intellectual Property Rights and Copy Rights, EssEss Publications, New Delhi, 2003.
3. Ahuja, V K, Law relating to Intellectual Property Rights. India, LexisNexis, 2017.

REFERENCES:

1. Deborah E. Bouchoux, "Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets", Cengage Learning, Third Edition,2017.
2. PrabuddhaGanguli, "Intellectual Property Rights: Unleashing the Knowledge Economy", McGraw Hill Education,2011.
3. Edited by Derek Bosworth and Elizabeth Webster, The Management of Intellectual Property, Edward Elgar Publishing Ltd., 2013.

COURSE OUTCOMES

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

CO1 Get an adequate knowledge on patent and copyright for their innovative research works

CO2 Get idea about the registration process of IPR

CO3 Study various agreements and Acts regarding IPR

CO4 Inculcate the knowledge on innovations, developments and IP laws

CO5 Gain awareness about the knowledge of enforcement and current issues

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	1	2	1	1	2	2	2	3	2	2	-
CO2	3	2	2	2	1	2	1	1	2	2	2	3	2	-	-
CO3	3	2	2	2	1	2	1	1	2	2	2	3	2	-	-
CO4	3	2	2	2	1	2	1	1	2	2	2	3	2	-	-
CO5	3	2	2	2	1	2	1	1	2	2	2	3	2	-	-

PROFESSIONAL ELECTIVE – III

BT1009	CANCER BIOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

To enable the students to understand

- Basic biology of cancer
- Impact of antibodies against cancer in the human body leading to more effective treatments
- Enhanced immunology based detection methods and imaging technique

Development of cell based and cytokine based immunotherapy against cancer.

UNIT I: FUNDAMENTALS OF CANCER BIOLOGY **9**

Regulation of cell cycle, mutations that cause changes in signal molecules, effects on receptor, signal switches, tumour suppressor genes, modulation of cell cycle in cancer, different forms of cancers, diet and cancer. Cancer screening and early detection, Detection using biochemical assays, tumor markers, molecular tools for early diagnosis of cancer. **CO1**

UNIT II: PRINCIPLES OF CARCINOGENESIS **9**

Theory of carcinogenesis, Chemical carcinogenesis, metabolism of carcinogenesis, principles of physical carcinogenesis, x-ray radiation-mechanisms of radiation carcinogenesis. **CO2**

UNIT III: PRINCIPLES OF MOLECULAR CELL BIOLOGY OF CANCER **9**

Signal targets and cancer, activation of kinases; Oncogenes, identification of oncogenes, retroviruses and oncogenes, detection of oncogenes. Oncogenes/proto oncogene activity. Growth factors related to transformation. Telomerases. **CO3**

UNIT IV: PRINCIPLES OF CANCER METASTASIS **9**

Clinical significances of invasion, heterogeneity of metastatic phenotype, metastatic cascade, basement membrane disruption, three step theory of invasion, proteinases and tumour cell invasion. **CO4**

UNIT V: NEW MOLECULES FOR CANCER THERAPY **9**

Different forms of therapy, chemotherapy, radiation therapy, detection of cancers, prediction of aggressiveness of cancer, advances in cancer detection. Use of signal targets towards therapy of cancer; Gene therapy. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Weinberg, R.A. “The Biology of Cancer” Garland Science, 2007
2. McDonald, F etal., “ Molecular Biology of Cancer” IInd Edition. Taylor & Francis, 2004.

REFERENCES:

1. King, Roger J.B. “Cancer Biology” Addison Wesley Longman, 1996.
2. Ruddon, Raymond W. “ Cancer Biology” IIIrd Edition . Oxford University Press, 1995.

COURSE OUTCOMES

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

CO1 Understand the fundamentals of cancer biology such as cell cycle, molecular diagnostic assays and molecular markers.

CO2 Understand the basic principles involved in creating carcinogenesis and mechanism of carcinogenesis.

CO3 Have depth knowledge in Oncogenic genes molecular mechanism and importance of growth factors

CO4 Have awareness on cancer metastasis and its clinical significance

CO5 Have awareness on medical applications of cytokines and immune cells against cancer

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	1	1	2	3	-	-	-	-	-	-	-	-	3	2	2
CO2	1	2	1	1	3	-	-	3	-	-	-	-	1	2	3
CO3	1	-	3	2	3	-	-	-	-	-	-	-	2	2	3
CO4	1	1	1	3	3	-	-	3	-	-	-	-	2	3	2
CO5	1	1	3	1	3	-	-	1	-	-	-	-	3	2	1

BT1010 BIOPHARMACEUTICAL TECHNOLOGY

L	**T**	**P**	**C**
3	**0**	**0**	**3**

OBJECTIVES:

- The aim of the course is to give strong foundation and advanced information on biopharmaceutical aspects in relation to drug development.
- This course provides core responsibilities for the development and monitoring of the drug and the preparation of medicines according to the norms.
- To gain knowledge in physicochemical properties, pharmacology and the formulation of commonly used biopharmaceuticals.

UNIT I: INTRODUCTION **9**

Pharmaceutical industry & development of drugs ; types of therapeutic agents and their uses; economics and regulatory aspects . **CO1**

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

Mechanism of drug action; physico-chemical principles of drug metabolism; radioactivity; pharmacokinetics. **CO2**

UNIT III: MANUFACTURE OF DRUGS, PROCESS AND APPLICATIONS 9

Types of reaction process and special requirements for bulk drug manufacture. **CO3**

UNIT IV: PRINCIPLES OF DRUG MANUFACTURE 9

Compressed tablets; dry and wet granulation; slugging or direct compression; tablet presses; coating of tablets; capsule preparation; oval liquids – vegetable drugs – topical applications; preservation of drugs; analytical methods and other tests used in drug manufacture; packing techniques; quality management; GMP. **CO4**

UNIT V: BIOPHARMACEUTICALS 9

Various categories of therapeutics like vitamins, laxatives, analgesics, contraceptives, antibiotics, hormones and biologicals. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Finkel, Richard, etal., "Lippincott's Illustrated Reviews Pharmacology" IVth Edition. Wolters Kluwer / Lippincott Williams & Wilkins, 2009.

REFERENCES:

1. Gareth Thomas. Medicinal Chemistry. An introduction. John Wiley. 2000.
2. Katzung B.G. Basic and Clinical Pharmacology, Prentice Hall of Intl. 1995.
3. Ansel's Pharmaceutical Dosage Forms and Drug Delivery Systems, Eleventh Edition .Loyd V. Allen, Jr. ,Wolters Kluwer, 2017.

COURSE OUTCOMES

Upon completion of the course

CO1 Students would have a fundamental knowledge about the various phases and the regulatory aspects involved in the drug development.

CO2 Students would have gained knowledge about mechanism of action of drug on a human body and how a body responds to a drug.

CO3 Students would have developed knowledge about chemical reactions and processes involved in manufacturing a drug product.

CO4 Students get familiar about the preparation of various dosage forms of drug and its quality control.

CO5 Student would acquire knowledge on different types of biopharmaceuticals.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	-	2	1	2	2	1	1	-	-	-	1	-	2	-
CO2	2	-	2	1	-	1	1	1	-	-	-	1	-	-	-
CO3	1	1	1	1	2	1	1	2	-	-	1	-	2	-	-
CO4	1	1	1	1	3	1	-	1	-	-	-	-	-	-	2
CO5	1	1	1	1	3	1	1	1	-	-	-	-	2	-	-

BT1011	MOLECULAR PATHOGENESIS OF DISEASES	L	T	P	C
		3	0	0	3

OBJECTIVES:

To enable the students

- To understand about the microbial toxins and modern molecular pathogenesis
- To know about the host pathogen interaction and identifying virulence factors
- To control pathogens by modern approaches.

UNIT I: OVERVIEW **5**

Historical perspective - discovery of microscope, Louis Pasteur's contributions, Robert Koch's postulates, early discoveries of microbial toxins, toxic assays, vaccines, antibiotics and birth of molecular genetics and modern molecular pathogenesis studies, Various pathogen types and modes of entry. **CO1**

UNIT II: HOST-DEFENSE AGAINST PATHOGENS AND PATHOGENIC STRATEGIES **8**

Attributes & components of microbial pathogenesis, Host defense: skin, mucosa, cilia, secretions, physical movements, limitation of free iron, antimicrobial compounds, mechanism of killing by humoral and cellular defense mechanisms, complements, inflammation process, general disease symptoms, Pathogenic adaptations to overcome the above defenses. **CO2**

UNIT III: MOLECULAR PATHOGENESIS (WITH SPECIFIC EXAMPLES) **16**

Virulence, virulence factors, virulence- associated factors and virulence lifestyle factors, molecular genetics and gene regulation in virulence of pathogens, Vibrio Cholerae: Cholera toxin, co-regulated pili, filamentous phage, survival E.coli pathogens: EnterotoxigenicE.coli (ETEC), labile & stable toxins, Entero- pathogenic E.coli (EPEC), type III secretion, cytoskeletal changes, intimate attachment; EnterohaemerrohogicE.coli (EHEC), mechanism of bloody diarrhoea and Hemolytic Uremic Syndrome, EnteroaggregativeE.coli (EAEC). Shigella: Entry, macrophage apoptosis, induction of macropinocytosis, uptake by epithelial cells, intracellular spread, inflammatory response, tissue damage Plasmodium: Life cycle, erythrocyte stages, transport mechanism and processes to support the rapidly growing schizont, parasitiparous vacuoles, and knob protein transport, Antimalarials based on transport processes. Influenza virus: Intracellular stages, Neuraminidase & Haemagglutinin in entry, M1 & M2 proteins in assembly and disassembly, action of amantidine. **CO3**

UNIT IV: EXPERIMENTAL STUDIES ON HOST-PATHOGEN INTERACTIONS **8**

Virulence assays: adherence, invasion, cytopathic, cytotoxic effects. Criteria & tests in identifying virulence factors, attenuated mutants, molecular characterization of virulence factors, signal transduction & host responses **CO4**

UNIT V: APPROACHES TO CONTROL PATHOGENS **8**

Classical approaches based on serotyping. Modern diagnosis based on highly conserved virulence factors, immune & DNA-based techniques. New therapeutic strategies based on recent findings on molecular pathogenesis of a variety of pathogens, Vaccines - DNA, subunit and cocktail vaccines. **CO5**

TOTAL PERIODS: 45

REFERENCES:

1. Iglewski B.H and Clark V.L "Molecular basis of Bacterial Pathogenesis", Academic Press, 1990.
2. Peter Williams, Julian Ketley & George Salmond, "Methods in Microbiology: Bacterial Pathogenesis, Vol. 27", Academic Press, 1998.
3. Recent reviews in Infect. Immun., Mol. Microbiol., Biochem. J., EMBO etc
4. Nester, Anderson, Roberts, Pearsall, Nester, "Microbiology: A Human Perspective", McGraw Hill, 3rd Edition, 2001.
5. Eduardo A. Groisman, Principles of Bacterial Pathogenesis, Academic Press, 2001.

COURSE OUTCOMES

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

CO1 Gain knowledge in understanding the basic about the historical perspective in molecular Pathogenesis and various pathogen types and mode of entry

CO2 Develop knowledge in host-defense mechanism against pathogen and pathogenic strategy

CO3 Gain knowledge in various bacterial and viral pathogens along with their virulence factor and gene regulation

CO4 Develop knowledge in various virulence assay and understand molecular characterization of virulence factor

CO5 Acquire knowledge to control the pathogens and to diagnose various pathogens in immunological and molecular level

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	-	-	-	-	1	-	-	-	-	-	1	2	1	-
CO2	1	-	-	-	-	-	-	-	-	-	-	1	2	1	-
CO3	1	-	-	-	-	1	-	-	-	-	-	1	2	2	-
CO4	-	2	2	1	1	1	-	-	-	-	-	1	2	2	2
CO5	1	2	2	2	2	2	-	-	-	-	-	2	2	2	2

BT1012 BIO-ENTREPRENEURSHIP

L	T	P	C
3	0	0	3

OBJECTIVES:

- To learn the basics of entrepreneur skills and apply in developing business plan
- To identify suitable locations and market in the business
- To understand the basics of finance and its management, legal, social aspect of business

UNIT I: **9**

Should You Become an Entrepreneur? What Skills Do Entrepreneurs Need?, Identify and Meet a Market Need, Entrepreneurs in a Market Economy, Select a Type of Ownership **CO1**

UNIT II: **9**

Develop a Business Plan **CO2**

UNIT III: **9**

Choose Your Location and Set Up for Business, Market Your Business, Hire and Manage a Staff **CO3**

UNIT IV: **9**

Finance, Protect and Insure Your Business, Record Keeping and Accounting, Financial Management **CO4**

UNIT V: **9**

Meet Your Legal, Ethical, Social Obligations, Growth in Today's Marketplace. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:
Entrepreneurship Ideas in Action—South-Western, 2000.

REFERENCES:
Handbook of Bioentrepreneurship: 4 (International Handbook Series on Entrepreneurship), by Holger Patzelt , Thomas Brenner

COURSE OUTCOMES

Upon completion of the course,

CO1 Students will be able to understand the fundamentals of Entrepreneurship and will be able to understand and analyze Market.

CO2 Students will be able to plan and develop a Business plan.

CO3 Students will be able to learn, understand setting up a business and also the basics of leadership quality, customer relationship and team work.

CO4 Students will be able to learn, understand, calculate and analyze finance.

CO5 Students will be able to define and apply the ethical rights and also forecast and estimate the global issues.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	1	1	-	2	-	3	2	2	2	1	1	1	-
CO2	-	-	-	1	-	1	-	2	2	3	1	2	-	2	-
CO3	-	-	-	-	-	3	2	2	3	3	3	2	3	-	-
CO4	-	-	-	-	-	1	1	2	1	2	3	2	-	-	2
CO5	-	-	-	-	-	3	3	3	1	1	2	2	1	-	2

PROFESSIONAL ELECTIVE – IV

BT1013	BIOETHICS	L	T	P	C
		3	0	0	3

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.

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. **CO1**

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. **CO2**

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. **CO3**

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 files and essential documents; Data management. **CO4**

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. **CO5**

TOTAL PERIODS: 45

REFERENCES:

1. Lee, Chi-Jen; etal., “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.

COURSE OUTCOMES

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

CO1 Gain knowledge on the fundamental aspects of clinical trials, legal standards and GCP.

CO2 Acquire knowledge on the regulatory approvals and legislative requirements of clinical trials.

CO3 Understand the principles of project management , ethical system in clinical trials and research.

CO4 Understand the perspectives of informed consent , data protection and management systems.

CO5 Understand and appreciate the procedures of quality control assurance & governance in clinical trials.

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	-	1	2	2	-	-	-	2	2	1	2	2	1	2	-
CO2	-	1	2	2	1	-	-	2	1	2	1	1	1	-	-
CO3	--	-	-	1	-	2	-	3	2	1	2	1	-	1	-
CO4	-	-	-	1	-	1	-	2	2	1	2	1	-	-	2
CO5	-	-	-	1	1	1	-	2	2	2	2	2	-	-	1

GE1004 **FUNDAMENTALS OF NANOSCIENCE** **L T P C**
3 0 0 3

OBJECTIVES:

- To learn about basis of nanomaterial science, preparation method, types and application

UNIT I: INTRODUCTION **8**

Nanoscale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering-Classifications of nanostructured materials- quantum dots, nano wires-ultra-thin films multi layered materials. Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties. Introduction to properties and motivation for study (qualitative only). **CO1**

UNIT II: GENERAL METHODS OF PREPARATION **9**

Bottom-up Synthesis-Top-down Approach: Co-Precipitation, Ultrasonication, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE. **CO2**

UNIT III: NANOMATERIALS **12**

Nanoforms of Carbon - Buckminster fullerene- graphene and carbon nanotube, Single wall carbon Nanotubes (SWCNT) and Multi wall carbon nanotubes (MWCNT)- methods of synthesis(arc-growth, laser ablation, CVD routes, Plasma CVD), structure-property Relationships applications-Nanometal oxides-ZnO, TiO2,MgO, ZrO2, NiO, nanoalumina, CaO, AgTiO2, Ferrites, Nanoclays functionalization and applications-Quantum wires, Quantum dots-preparation, properties and applications. **CO3**

UNIT IV: CHARACTERIZATION TECHNIQUES **9**

Nano InfoTech: Information storage- nanocomputer, molecular switch, super chip, nanocrystal, Nano biotechlogy: nanoprobes in medical diagnostics and biotechnology, Nano medicines, Targetted drug delivery, Bioimaging - Micro Electro Mechanical Systems (MEMS), Nano Electro Mechanical Systems (NEMS)- Nanosensors, nano crystalline silver for bacterial inhibition, Nanoparticles for sunbarrier products - In Photostat, printing, solar cell, battery. **CO4**

UNIT V: APPLICATIONS **7**

NanoInfoTech: Information storage- nanocomputer, molecular switch, super chip, nanocrystal, Nanobiotechlogy: nanoprobes in medical diagnostics and biotechnology, Nano medicines, Targetted drug delivery, Bioimaging - Micro Electro Mechanical Systems (MEMS), Nano Electro Mechanical Systems (NEMS)- Nanosensors, nano crystalline silver for bacterial inhibition, Nanoparticles for sunbarrier products - In Photostat, printing, solar cell, battery. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. A.S. Edelstein and R.C. Cammearata, eds., “Nanomaterials: Synthesis, Properties and Applications”, Institute of Physics Publishing, Bristol and Philadelphia, 1996.
2. N John Dinardo, “Nanoscale Charecterisation of surfaces & Interfaces”, 2nd edition, Weinheim Cambridge, Wiley-VCH, 2000.

REFERENCES:

1. G Timp, “Nanotechnology”, AIP press/Springer, 1999.
2. Akhlesh Lakhtakia,“The Hand Book of Nano Technology, Nanometer Structure, Theory, Modeling and Simulations”. Prentice-Hall of India (P) Ltd, New Delhi, 2007.

COURSE OUTCOMES

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

CO1 Understand the concept of Nano scale Science and Technology and various types of nano materials.

CO2 Acquire knowledge in general methods of preparation of nano materials.

CO3 Understand the Nano forms of Carbon and methods of synthesis

CO4 Acquire knowledge in characteristic nanomaterial on various technique.

CO5 Gain knowledge on various application of nano materials.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	3	1	2	1	1	2	1	1	3	2	1	1
CO2	3	2	3	3	1	2	1	1	2	1	1	3	2	3	3
CO3	3	3	3	3	1	2	1	1	2	1	1	3	3	3	3
CO4	3	3	3	3	1	2	1	1	2	1	2	3	3	3	3
CO5	3	2	3	3	1	2	1	1	2	1	2	3	3	3	3

BT1015	GENOMICS AND PROTEOMICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To provide the students a broader knowledge on the structure and function of genomes, the technologies developed for genomics, functional genomics and proteomics.

UNIT I: INTRODUCTION **9**

Introduction to genome, transcriptome, and proteome; Overview of genomes of bacteria, archae, and eukaryote; Genomes of organelles. **CO1**

UNIT II: GENOME MAPPING AND SEQUENCING **9**

Genetic and physical mapping, Linkage analysis, RFLP, SNP, SSLP, Restriction mapping, STS mapping, FISH, Top-down and bottom-up sequencing strategies, Whole genome sequencing, Gap closure, Pooling strategies. **CO2**

UNIT III: FUNCTIONAL GENOMICS **9**

Genome annotation, ORF and functional prediction, Gene finding, Substractive DNA library screening, Differential display and Representational difference analysis, SAGE,TOGA, Introduction to DNA microarray. **CO3**

UNIT IV: TECHNIQUES IN PROTEOMICS **9**

In-vitro and in vivo-labeling of proteins, One and two-dimensional gel electrophoresis, Detection of proteins on SDS gels, Protein cleavage, Edman protein microsequencing, Mass spectrometry-principles of MALDI-TOF, Peptide mass fingerprinting. **CO4**

UNIT V: PROTEIN PROFILING **9**

Large-scale protein profiling using proteomics, Post-translational modifications, Phosphoprotein and glycoprotein analyses; Analysis of protein-protein interactions, Protein microarrays. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Suhai, Sandor “Genomics and Proteomics: Functional and Computational Aspects”. Springer, 2000
2. Pennington, S.R. and M.J. Dunn “Proteomics: From Protein Sequence to Function”. VivaBooks Pvt. Ltd., 2002.
3. O’Connor, C.D. and B.D.Hames. “ Proteomics”. Scion Publishing, 2008.
4. Primrose, S.B. and Twyman. “Principles of Genome Analysis and Genomics”. 7th Edition, Blackwell Publishing, 2006

REFERENCES:

1. Cantor, Charles R. and Cassandra L. Smith. “Genomics: The Science and Technology Behind the Human Genome Project”. John Wiley & Sons, 1999.
2. Liebler, R.C. “Introduction to Proteomics”. Humana Press, 2002.
3. Hunt, Stephen P. and Frederick J. Livesey. “Functional Genomics”. Oxford University Press,2000.
4. Conard, Edward. “Genomics”. Apple Academics, 2010

COURSE OUTCOMES

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

CO1 Understand the fundamentals of Genomics and Proteomics
CO2 Acquire knowledge on various genome mapping and sequencing methods and genomic markers
CO3 Gain knowledge about microarray technology and methods used in functional genomics
CO4 Gain knowledge about current techniques involved in protein analysis
CO5 Acquire knowledge on various techniques used for protein filing and post translational modification

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	1	1	2	-	-	-	-	-	-	-	-	3	2	1
CO2	2	2	1	-	3	-	-	-	-	-	-	-	2	2	2
CO3	3	1	2	1	3	-	-	-	-	-	-	-	2	1	3
CO4	1	2	1	-	3	-	-	-	-	-	-	-	2	2	3
CO5	2	1	1	2	1	-	-	-	-	-	-	-	2	2	2

BT1016 **LIFESTYLE DISEASES** **L T P C**
3 0 0 3

UNIT I: INTRODUCTION **9**

Lifestyle diseases – Definition ; Risk factors – Eating, smoking, drinking, stress, physical activity, illicit drug use ; Obesity, diabetes, cardiovascular diseases, respiratory diseases, cancer; Prevention – Diet and exercise. **CO1**

UNIT II: CANCER **9**

Types - Lung cancer, Mouth cancer, Skin cancer, Cervical cancer, Carcinoma oesophagus; Causes Tobacco usage, Diagnosis – Biomarkers, Treatment **CO2**

UNIT III: CARDIOVASCULAR DISEASES **9**

Coronoary atherosclerosis – Coronary artery disease; Causes -Fat and lipids, Alcohol abuse – Diagnosis - Electrocardiograph, echocardiograph, Treatment, Exercise and Cardiac rehabilitation **CO3**

UNIT IV: DIABETES AND OBESITY **9**

Types of Diabetes mellitus; Blood glucose regulation; Complications of diabetes – Paediatric and adolescent obesity – Weight control and BMI **CO4**

UNIT V: RESPIRATORY DISEASES **9**

Chronic lung disease, Asthma, COPD; Causes - Breathing pattern (Nasal vs mouth), Smoking – Diagnosis - Pulmonary function testing **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. R.Kumar&Meenal Kumar, “Guide to Prevention of Lifestyle Diseases”, Deep & Deep Publications, 2003
2. Gary Eggar et al, “Lifestyle Medicine”, 3rd Edition, Academic Press, 2017

REFERENCES:

1. James M.R, “Lifestyle Medicine”, 2nd Edition, CRC Press, 2013
2. Akira Miyazaki et al, “New Frontiers in Lifestyle-Related Disease”, Springer, 2008

COURSE OUTCOME

Upon completion of the course,

CO1 Students would have a fundamental knowledge about the various diseases related to their lifestyle and methods to prevent through diet and exercise

CO2 After completing this course, students get familiar about the various forms of cancer and methods to diagnose and treat

CO3 Students will be able to gain extensive knowledge on cardiovascular diseases and know the usage of diagnose these diseases

CO4 Students would have gained knowledge and the various types of diabetes and know about the consequence of obesity

CO5 At the end of the course the student would acquire knowledge on respiratory diseases and the effect of smoking and tobacco usage

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	-	1	-	1	-	2	-	1	-	2	1	-	1
CO2	2	1	-	-	-	-	-	1	-	-	-	1	2	-	2
CO3	1	1	-	-	-	1	-	1	-	1	-	1	2	-	2
CO4	2	1	-	-	-	1	-	2	-	1	-	2	1	-	2
CO5	2	1	-	-	-	1	-	1	-	1	-	1	1	-	1

PROFESSIONAL ELECTIVE - V

BT1017	Plant Biotechnology	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To give the details of plant cells and its functions
- To provide the basics of Agrobacterium and applications of plant biotechnology

UNIT I: ORGANIZATION OF GENETIC MATERIAL **9**

Genetic material of plant cells – nucleosome structure and its biological significance; junk and repeat sequences; outline of transcription and translation. **CO1**

UNIT II: CHLOROPLAST & MITOCHONDRIA **9**

Structure, function and genetic material; rubisco synthesis and assembly, coordination, regulation and transport of proteins. Mitochondria: Genome, cytoplasmic male sterility and import of proteins. **CO2**

UNIT III: NITROGEN FIXATION **9**

Nitrogen cycle, importance of symbiotic and nonsymbiotic organisms, nodulation- bacteroids, nod genes, nod factors, Nitrogenase activity, and nif genes. **CO3**

UNIT IV: AGROBACTERIUM & VIRAL VECTORS **9**

Pathogenesis, crown gall disease, genes involved in the pathogenesis, Ti plasmid – t-DNA, importance in genetic engineering. Viral Vectors: Gemini virus, cauliflower mosaic virus, viral vectors and its benefits. **CO4**

UNIT V: APPLICATION OF PLANT BIOTECHNOLOGY **9**

Outline of plant tissue culture, transgenic plants, herbicide and pest resistant plants, molecular pharming, therapeutic products. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1.Gamburg OL, Philips GC, Plant Tissue & Organ Culture fundamental Methods, Narosa Publications. 1995.
2. Singh BD. Text Book of Biotechnology, Kalyani Publishers. 1998

REFERENCES:

1. Heldt HW. Plant Biochemistry & Molecular Biology, Oxford University Press. 1997.
2. Ignacimuthu .S, Applied Plant Biotechnology, Tata McGraw Hill. 1996.

COURSE OUTCOMES

Upon completion of the course, the students will be able

CO1 To understand the fundamentals of plant cells, structure and functions

CO2 To know the importance of chloroplast and mitochondria & its function

CO3 To learn the nitrogen fixation mechanism and significance of viral vectors

CO4 To gain the knowledge about the plant tissue culture and transgenic plants

CO5 To develop therapeutic products using plants

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	1	2	2	2	3	2	2	1	-	-	-	1	2	2	2
CO2	2	2	3	2	3	2	2	2	1	-	-	1	2	2	3
CO3	2	3	3	3	3	2	2	2	-	-	-	1	3	2	2
CO4	2	2	3	3	3	2	3	2	2	-	2	-	3	3	3
CO5	2	2	3	3	3	2	3	2	2	1	2	2	3	3	3

BT1018 **METABOLIC ENGINEERING** **L T P C**
3 0 0 3

OBJECTIVES:

- To provide a quantitative basis, based on thermodynamics, enzyme kinetics, for the understanding of metabolic networks in single cells and at the organ level.
- To enable the students to use organisms to produce valuable substances on an industrial scale in cost effective manner.

UNIT I: **INTRODUCTION TO EXAMPLES OF PATHWAY MANIPULATION - QUALITATIVE TREATMENT** **9**

Enhancement of Product Yield and Productivity, Extension of substrate Range, Extension of Product spectrum and Novel products, Improvement of Cellular properties, Xenobiotic degradation. **CO1**

UNIT II: **MATERIAL BALANCES AND DATA CONSISTENCY** **9**

Comprehensive models of cellular reactions; stoichiometry of cellular reactions, reaction rates, dynamic mass balances, yield coefficients and linear rate equations, analysis of over determined systems- identification of gross measurement errors. Introduction to MATLAB® **CO2**

UNIT III: **METABOLIC FLUX ANALYSIS** **9**

Theory, overdetermined systems, underdetermined systems- linear programming, sensitivity analysis, methods for the experimental determination of metabolic fluxes by isotope labeling, applications of metabolic flux analysis **CO3**

UNIT IV: **METABOLIC CONTROL ANALYSIS** **9**

Fundamentals of Metabolic Control Analysis, control coefficients and the summation theorems, Determination of flux control coefficients, MCA of linear pathways, branched pathways, theory of large deviations **CO4**

UNIT V: **ANALYSIS OF METABOLIC NETWORKS** **9**

Control of flux distribution at a single branch point, Grouping of reactions, case studies, extension of control analysis to intermetabolite, optimization of flux amplifications, consistency tests and experimental validation. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Gregory N. Stephanopoulos ,Aristos A. Aristidou, Jens Nielsen, Metabolic Engineering: Principles and Methodologies ,Academic Press 1998.
2. Sang Yup Lee E. Terry Papoutsakis Marcel Dekker, Metabolic Engineering.inc 1998
3. Nielsen J and Villadsen J. (1994) Bioreaction Engineering Principles. New york: Plenum Press

REFERENCES:

1. Computational Analysis of Biochemical Systems: A Practical Guide for Biochemists and Molecular Biologists by Eberhard O. Voit Cambridge University Press 2000
2. Applications of Plant Metabolic Engineering. R. Verpoorte, A. W. Alfermann and T. S. Johnson (eds). Springer, P.O. Box 17, 3300 AA Dordrecht, The Netherlands. 2007.
3. Systems Modeling in Cellular Biology: From Concepts to Nuts and Bolts Edited by ZoltanSzallasi, JorgStelling and VipulPeriwal MIT Press Cambridge 2006

COURSE OUTCOMES

Upon completion of the course,

CO1 Students would have gained knowledge on regulation, manipulation and synthesis of metabolic pathways

CO2 Students would have acquired knowledge on data consistency and how to solve material balances

CO3 Students would have developed knowledge about analysis and methods for the metabolic flux

CO4 After completing this course, students get familiar with the application of metabolic flux analysis.

CO5 Students would have learnt to analyse and optimise metabolic flux networks.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	-	-	2	2	-	-	-	-	-	-	2	2	1
CO2	1	2	-	-	-	1	-	-	-	-	-	-	2	2	1
CO3	2	1	-	-	2	2	-	-	-	-	-	-	2	2	1
CO4	2	1	-	-	2	2	-	-	-	-	-	-	2	2	1
CO5	2	1	-	-	2	2	-	-	-	-	-	-	2	-	1

BT1019 **GENETICS** **L T P C**
3 0 0 3

OBJECTIVES:

- To give an understanding on the fundamentals of conventional genetics and its relevance in disease and therapy
- To describe various genetic laws, learn the chromosome structure function and understand methodologies for cytogenetic applications

UNIT I: BACTERIAL GENETICS **9**

Transformation, Transduction, Conjugation – mapping, fine structure mapping in merozygotes- plasmids and episomes **CO1**

UNIT II: CLASSICAL GENETICS **9**

Mendel's principles and experiments, segregation, multiple alleles – Independent Assortments, Genotypic interactions, epistasis and Sex chromosomes, Sex determination, Dosage compensation, sex linkage and pedigree analysis **CO2**

UNIT III: APPLIED GENETICS **9**

Chromosome organization, structure and variation in prokaryotes and eukaryotes, Giant chromosomes – polytene and lampbrush, deletion, inversion, translocation, duplication. variation in chromosomal numbers – aneuploidy, euploidy, polyploidy, Ames test, karyotyping, Linkage, Crossing over – cytological basis of crossing over, chromosome mapping – two and three factor cross – interference, somatic cell hybridization **CO3**

UNIT IV: POPULATION GENETICS **9**

Hardy-Weinberg equilibrium, Extensions of Hardy- Weinberg equilibrium, non random mating, population analysis, Models for population genetics. Mutation and Migration size, Genetic variation and Sociobiology **CO4**

UNIT V: GENETIC DISEASES **9**

Inborn errors of metabolism, Sickle cell, hemochromatosis, cystic fibrosis, hypogonadotropichypogonadism, Gaucher's disease, achondroplasia, phenylketonuria, Huntington's Disease, Cystic fibrosis, hemoglobinopathies, Age-related macular degeneration, Obesity, Type 2 diabetes, Psychiatric disease, including missing heritability, autism **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Tamarin, R.H., "Principles of Genetics", Tata McGraw Hill, New Delhi, 2002
2. De Robertis, E. D. P. and De Robertis, E. M. F., "Cell and Molecular Biology", 8th Edition,Lippincott Williams & Wilkins, New York, USA, 2001.

REFERENCES:

1. Gardner, E.J, Simmons, M.J, and Snustad, D.P., "Principles of Genetics",8th Edition, JohnWiley& Sons, Singapore, 2003.
2. Strickberger, M.W., "Genetics", 3rd Edition, Prentice Hall of India, New Delhi, 2008.
3. Klug, W.S. and Cummings, M.R., "Concepts of Genetics", Pearson Education, New Delhi 2003.

COURSE OUTCOMES

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

CO1 Gain knowledge about basic techniques involved in Gene transfer methods

CO2 Gain depth knowledge about principles involved in Classical genetics

CO3 Understand about the methods involved in mapping and hybridisation

CO4 Familiar with population genetics and genetic variations

CO5 Have awareness about genetically transferred diseases and its analysis

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	1	-	2	-	3	-	1	1	-	-	-	-	2	2	1
CO2	3	2	2	1	-	-	-	-	-	-	-	-	3	2	1
CO3	2	2	1	1	3	-	1	1	-	-	-	-	2	3	1
CO4	1	-	-	-	-	-	1	1	-	-	-	1	2	2	2
CO5	2	2	1	2	3	-	-	-	-	-	-	-	3	2	1

BT1020 **CLINICAL TRIALS** **L T P C**
3 0 0 3

OBJECTIVES:

- To highlight the epidemiologic methods, study design, protocol preparation
- To gain knowledge in the basic bio-statistical techniques involved in clinical research.
- To describe the principles involved in ethical, legal and regulatory issues in clinical trials.

UNIT I: ROLE OF CLINICAL TRIALS IN NEW DRUG DEVELOPMENT **9**

Drug Discovery, regulatory guidance and governance, pharmaceutical manufacturing, nonclinical research, clinical trials, post-marketing surveillance, ethical conduct during clinical trials. **CO1**

UNIT II: FUNDAMENTALS OF TRIAL DESIGN **9**

Randomised clinical trials, uncontrolled trials. Protocol development, endpoints, patient selection, source and control of bias, randomization, blinding, sample size and power. **CO2**

UNIT III: ALTERNATE TRIAL DESIGNS **9**

Crossover design, factorial design, equivalence trials, bioequivalence trials, non-inferiority trials, cluster randomized trials, multi-center trials. **CO3**

UNIT IV: BASICS OF STATISTICAL ANALYSIS **9**

Types of data and normal distribution, significance tests and confidence intervals, comparison of means, comparison of proportions, analysis of survival data, subgroup analysis, regression analysis, missing data. **CO4**

UNIT V: REPORTING OF TRIALS **9**

Overview of reporting, trial profile, presenting baseline data, use of tables, figures, critical appraisal of report, meta-analysis. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Fundamentals of Clinical Trials, Lawrence M. Friedman, Springer Science & Business Media, 2010
2. Textbook of Clinical Trials, David Machin, Simon Day, Sylvan Green, John Wiley & Sons, 2007
3. Clinical Trials: A Practical Approach, Stuart J. Pocock, John Wiley & Sons, 17-Jul-2013

REFERENCES:

1. Clinical trials, A practical guide to design, analysis and reporting. Duolao Wang and AmeetBakhai. Remedica. 2006.
2. Introduction to statistics in pharmaceutical clinical trials. T.A. Durham and J Rick Turner. Pharmaceutical Press.
3. Clinical Trials: Study Design, Endpoints and Biomarkers, Drug Safety, and FDA and ICH Guidelines, Tom Brody, Academic Press, 2016.

COURSE OUTCOMES

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

CO1 The student will be able to study the epidemiologic methods, study design, protocol preparation

CO2 To gain knowledge in the basics of fundamentals of trial design

CO3 The student will be able to explain key concepts in the design of clinical trials.

CO4 The student will be able to study designs used, identify key issues in data management for clinical trials.

CO5 The student will be able to describe the roles of regulatory affairs in clinical trials.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	2	2	2	-	-	-	-	1	-	-	1	-	1
CO2	1	2	2	1	2	-	-	-	2	2	-	-	2	-	2
CO3	1	2	1	1	2	2	-	-	2	2	-	-	2	-	2
CO4	2	1	1	2	2	2	2	1	2	2	-	1	1	-	2
CO5	2	1	3	2	3	1	1	1	1	3	-	1	1	-	1

PROFESSIONAL ELECTIVE – VI

BT1021	TISSUE ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

To enable the students

- To learn the fundamentals of tissue engineering and tissue repairing
- To acquire knowledge on clinical applications of tissue engineering
- To understand the basic concept behind tissue engineering focusing on the stem cells, biomaterials and its applications

UNIT I: INTRODUCTION **9**

Introduction to tissue engineering: Basic definition; current scope of development; use intherapeutics, cells as therapeutic agents, cell numbers and growth rates, measurement of cellcharacteristics morphology, number viability, motility and functions. Measurement of tissue characteristics, appearance, cellular component, ECM component, mechanical measurements and physical properties. **CO1**

UNIT II: TISSUE ARCHITECTURE **9**

Tissue types and Tissue components, Tissue repair, Basic events of wound healing, Engineering wound healing and its sequential events. Applications of growth factors: VEGF/angiogenesis, Basic properties,Cell-Matrix& Cell-Cell Interactions, telomeres and Self-renewal, Control of cell migration in tissue engineering. **CO2**

UNIT III: BIOMATERIALS **9**

Biomaterials: Types of biomaterials, biological and synthetic materials,Biopolymers, Properties of biomaterials ,Surface, bulk, mechanical and biological properties.Scaffolds & tissue engineering, Applications of biomaterials, Modifications of Biomaterials, Role of Nanotechnology. **CO3**

UNIT IV: BASIC BIOLOGY OF STEM CELLS **9**

Stem Cells: Introduction, hematopoietic differentiation pathway,Potency and plasticity of stemcells, sources, embryonic stem cells, hematopoietic and mesenchymal stem cells, Stem Cellmarkers, FACS analysis, Differentiation,Stem cell systems- Liver, neuronal stem cells, Types &sources of stem cell with characteristics: embryonic, adult, haematopoetic, fetal, cord blood,placenta, bone marrow, primordial germ cells, cancer stem cells induced pleuripotent stem cells. **CO4**

UNIT V: CLINICAL APPLICATIONS **9**

Stem cell therapy, Molecular therapy, In vitro organogenesis, Neurodegenrative diseases, spinalcord injury, heart disease, diabetes, burns and skin ulcers, muscular dystrophy,orthopedicapplications, Stem cells and Gene therapy. Physiological models, tissue engineeredtherapies, product characterization, components, safety, efficacy. Preservation – freezing anddrying. Patent protection and regulation of tissue-engineered products, ethical issues. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1.Bernhard O.Palsson, SangeetaN.Bhatia, ”Tissue Engineering” Pearson Publishers 2009.
2. Meyer, U.; Meyer, Th.; Handschel, J.; Wiesmann, H.P. .Fundamentals of TissueEngineering and Regenerative Medicine.2009.

REFERENCES:

1. Bernard N. Kennedy (editor). Stem cell transplantation, tissue engineering, and cancerapplications, Nova Science Publishers, 2008.109
2. Raphael Gorodetsky, Richard Schäfer..Stem cell-based tissue repair. RSC Publishing,2011.
3. R. Lanza, I. Weissman, J. Thomson, and R. Pedersen, Handbook of Stem Cells, Two-Volume, Volume 1-2: Volume 1-Embryonic Stem Cells; Volume 2-Adult & Fetal Stem Cells,Academic Press, 2004.
4. R. Lanza, J. Gearhart etal (Eds), Essential of Stem Cell Biology, Elsevier Academicpress,2006.
5. J. J. Mao, G. Vunjak-Novakovic et al (Eds), Translational Approaches In TissueEngineering &Regenrative Medicine" Artech House, INC Publications, 2008.
6. Naggy N. Habib, M.Y. Levicar, , L. G. Jiao,.andN. Fisk, Stem Cell Repair andRegeneration, volume-2, Imperial College Press,2007.

COURSE OUTCOMES

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

CO1 Understand the components of the tissue architecture and fundamental properties of cells and tissues

CO2 Gain depth knowledge in wound healing and growth factors

CO3 Be Aware about the properties and broad applications of biomaterials

CO4 Opportunity to get familiarized with the stem cell characteristics and their relevance in medicine

CO5 Overall exposure to the role of tissue engineering and stem cell therapy in Organogenesis

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	2	-	-	-	-	-	-	-	-	3	2	1
CO2	2	2	1	1	2	-	-	-	-	-	-	-	3	2	2
CO3	2	2	2	2	-	1	-	2	-	-	-	-	3	3	2
CO4	2	2	2	2	3	1	2	3	-	-	-	1	3	2	3
CO5	2	2	2	2	3	1	2	3	-	-	-	2	3	2	3

BT1022 BIOSAFETY AND HAZARD MANAGEMENT

L	T	P	C
3	0	0	3

OBJECTIVES:

- To introduce awareness on the importance of plant safety and risk analysis
- Students learn about implementation of safety procedures, risk analysis and assessment, hazard identification

UNIT I: INTRODUCTION **9**

Need for safety in industries; Safety Programmes – components and realization; Potential hazards-extreme operating conditions, toxic chemicals; safe handling **CO1**

UNIT II: QUALITY CHECKS **9**

Implementation of safety procedures – periodic inspection and replacement; Accidents – identification and prevention; promotion of industrial safety **CO2**

UNIT III: RISK ANALYSIS **9**

Overall risk analysis--emergency planning-on site & off site emergency planning, risk management ISO 14000, EMS models case studies. Quantitative risk assessment – rapid and comprehensive risk analysis; Risk due to Radiation, explosion due to over pressure, jet fire-fire ball. **CO3**

UNIT IV: SAFETY AUDITS **9**

Hazard identification safety audits, checklist, what if analysis, vulnerability models event tree analysis fault tree analysis, Hazan past accident analysis Fixborough-Mexico-Madras-VizagBopal analysis. **CO4**

UNIT V: HAZARDOUS OPERATIONS **9**

Hazop-guide words, parameters, derivation-causes-consequences-recommendation-coarse Hazop study-case studies-pumping system-reactor-mass transfer system. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Fawatt, H.H. and Wood, W.S., "Safety and Accident Prevention in Chemical Operation", Wiley Interscience, 1965.
2. Marcel, V.C., Major Chemical Hazard- Ellis Harwood Ltd., Chi Chester, UK, 1987.
3. Skeleton, B., Process Safety Analysis: An introduction, Institution of chemical Engineers, U.K., 1997.
4. Hyatt, N., Guidelines for process hazards analysis, hazards identification & risk analysis, Dyadem Press, 2004.

REFERENCES:

1. Handley, W., "Industrial Safety Hand Book ", 2nd Edn., McGraw-Hill Book Company,1969.
2. Heinrich, H.W. Dan Peterson, P.E. and Rood, N., "Industrial Accident Prevention", McGraw-Hill Book Co., 1980.
3. Chemical Process Safety: Fundamentals with Applications, Daniel A. Crowl, J.F. Louvar, Prentice Hall, NJ, 1990.
4. Taylor, J.R., Risk analysis for process plant, pipelines and transport, Chapman and Hall, London, 1994.

COURSE OUTCOMES

Upon completion of the course, the students will be able

CO1 To understand the need for safety programmes and potential hazards in industries.

CO2 To know and implement the safety procedures and quality checks in industries.

CO3 To perform risk assessment and emergency planning in industries.

CO4 To carry out safety audit- Hazid and event /fault tree analysis.

CO5 To perform Hazop - Hazan and identify the consequences.

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	-	-	-	-	-	1	1	1	2	2	1	1	-	-	1
CO2	-	-	1	-	-	1	1	1	2	2	1	2	-	-	1
CO3	-	-	-	-	1	1	1	2	2	2	1	2	-	-	1
CO4	-	-	-	-	1	1	1	2	2	2	1	1	-	1	1
CO5	-	-	-	-	-	1	1	2	2	2	1	1	-	-	1

BT1023 **STEM CELL TECHNOLOGY** **L T P C**
3 0 0 3

OBJECTIVES:

- The course objectives are imparting the basic knowledge of students about stem cell, culturing and its clinical applications.

UNIT I: STEM CELLS AND TYPES **9**

Stem cells: Definition, Classification, Sources and Properties –Types of stem cells: methods of isolation, study of stem cells and their viability IPSCs, embryonic stem cells, cancer stem cells. – Preservations of Stem cell. Embryonic stem cell: Isolation, Culturing, Differentiation, Properties – Adult stem cell: Isolation, Culturing, Differentiation, Trans-differentiation, Plasticity, and Properties **CO1**

UNIT II: STEM CELLS IN PLANTS AND ANIMALS **9**

Stem cell and founder zones in plants –particulary their roots – stem cells of shoot meristems of higher plants. Skeletal muscle stem cell – Mammary stem cells – intestinal stem cells – keratinocyte stem cells of cornea – skin and hair follicles –tumour stem cells. **CO2**

UNIT III: STEM CELLS DIFFERENTIATION **9**

Factors influencing proliferation, physical, chemical and molecular methods for differentiation of stem cells – hormonal role in differentiation. **CO3**

UNIT IV: REGENERATION AND EXPERIMENTAL METHODS **9**

Germ cells, hematopoietic organs, and kidney, cord blood transplantation, donor selection, HLA matching, patient selection, peripheral blood and bone marrow transplantation, - Stem cell Techniques: fluorescence activated cell sorting (FACS), time lapse video, green fluorescent protein tagging **CO4**

UNIT V: APPLICATION AND ETHICAL ISSUES **9**

Stem cell Therapy for neurodegenerative diseases, spinal cord injury, heart disease, diabetes, burns, skin ulcers, muscular dystrophy and orthopaedic applications. Stem cell policy and ethics, stem cell research: Hype, hope and controversy. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Stem cells by C.S Potten., Elsevier, 2006.
2. Essentials of Stem Cell Biology by Robert Lanza., fourth edition. Elsevier 2014.

REFERENCES:

1. Stem cell biology and Gene Therapy by Peter Quesenberry., First Edition, Wiley-Liss, 1998.
2. Embryonic Stem cells – Protocols by KursadTurksen., Second Edition Humana Press, 2002.
3. Stem Cells: From Bench to Bedside by AriffBongso, EngHinLee., World Scientific Publishing Company, 2005.
4. Stem cells in clinic and Research by Ali Gholamrezanezhad., Intech, 2013

COURSE OUTCOMES

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

CO1 Understand the cell sources and basic properties involved stem cells isolation and development

CO2 Understand the role and applications of stem cells plants and animals

CO3 Understand the fundamental properties of stem cells differentiation

CO4 Gain knowledge about the current techniques used in characterization of stem cells

CO5 Gain knowledge about the applications of stems cells and moral ethics involved in implementation of the technology

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	2	2	-	-	-	-	-	-	-	3	2	1
CO2	3	2	1	3	2	-	1	2	-	-	-	3	3	2	2
CO3	2	1	1	2	2	-	-	-	-	-	-	-	2	2	1
CO4	2	1	1	-	3	-	2	3	-	-	-	-	2	2	2
CO5	2	1	1	-	3	-	2	3	-	-	-	3	2	2	3

BT1024 IMMUNOTECHNOLOGY

L	T	P	C
3	0	0	3

OBJECTIVES:

The students who would have learnt the science of immunology will now be able to apply the science for the development of relevant immunotechnology.

UNIT I: INTRODUCTION **9**

Cells of the immune system and their development; primary and secondary lymphoid organs; humoral immune response; cell mediated immune responses; complement.

CO1

UNIT II: ANTIBODIES **10**

Monoclonal antibodies and their use in diagnostics; ELISA; Agglutination tests; Antigen detection assay; Plaque Forming Cell Assay. **CO2**

UNIT III: CELLULAR IMMUNOLOGY **12**

PBMC seperation from the blood; identification of lymphocytes based on CD markers; FACS; Lymphoproliferation assay; Mixed lymphocyte reaction; Cr51 release assay; macrophage cultures; cytokine bioassays- IL2, gamma IFN, TNF alpha.; HLA typing. **CO3**

UNIT IV: VACCINE TECHNOLOGY **6**

Basic principles of vaccine development; protein based vaccines; DNA vaccines; Plant based vaccines; recombinant antigens as vaccines; reverse vaccinology **CO4**

UNIT V: DEVELOPMENT OF IMMUNOTHERAPEUTICS **5**

Engineered antibodies; catalytic antibodies; idiotypic antibodies; combinatorial libraries for antibody isolation. **CO5**

TOTAL PERIODS: 45

REFERENCES:

1. Roitt, Ivan. Essential Immunology, 9th ed., Blackwell Scientific, 1997
2. Roitt I., Brostoff J. and Male D. Immunology, 6th ed. Mosby, 2001
3. Goldsby , R.A., Kindt, T.J., Osbome, B.A. and Kerby J. Immunology, 5th ed., W.H. Freeman, 2003
4. Weir, D.M. and Stewart, J. Immunology, 8th ed., Cheerchill, Linvstone, 1997

COURSE OUTCOMES

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

CO1 Understand fundamental knowledge about the various organs involved in immune response, immune responses and complement systems.

CO2 Developed knowledge about the production and application of producing monoclonal antibodies and will have knowledge in various immunological techniques.

CO3 Gain knowledge in the separation and identification of lymphocytes and various CD markers. They also gain knowledge in cytokine assay.

CO4 Gain the knowledge about the basic principles and application of various vaccine development

CO5 Acquire knowledge on development aspects in engineering antibodies and gain knowledge in combinatorial libraries for antibody isolation.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	-	-	-	-	-	-	-	-	-	-	2	1	-
CO2	-	-	2	2	2	1	-	-	-	-	-	-	1	1	2
CO3	-	-	3	3	2	1	-	-	-	-	-	-	2	2	2
CO4	-	1	2	2	2	1	-	-	-	-	-	1	2	2	2
CO5	1	2	2	2	2	2	-	-	-	-	-	-	2	2	2

OPEN ELECTIVE - I

OCE101	AIR POLLUTION AND CONTROL	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To impart knowledge on the principle and design of control of Indoor/ particulate/ gaseous air pollutant and its emerging trends.

UNIT I: AIR QULALITY MONITORING **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 – Analysis of Particulate and Gaseous Pollutants. **CO1**

UNIT II: EFFECT OF ATMOSPHERIC DISPERSION **9**

Effects of meteorology on Air Pollution - Fundamentals, Atmospheric stability, Inversion, Wind profiles and stack plume patterns- Atmospheric Diffusion Theories – Dispersion models, Plume rise **CO2**

UNIT III: PARTICULATE CONTAMINANTS **9**

Gas Particle Interaction – Working principle, Gravity Separators, Centrifugal separators Fabric filters, Particulate Scrubbers, Electrostatic Precipitators – Operational Considerations- Factors affecting Selection of Control Equipment. **CO3**

UNIT IV: GASEOUS CONTAMINANTS **9**

Working principle, Adsorption, condensation, Incineration, Bio scrubbers, Bio filters – Process control and Monitoring – Operational Considerations- Factors affecting Selection of Control Equipment –CO_2 capturing. **CO4**

UNIT V: INDOOR AIR QUALITY MONITORING **9**

Sources types and control of indoor air pollutants, sick building syndrome types –Sources and Effects of Noise Pollution– Standards–Control and Preventive measures. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Lawrence K. Wang, Norman C. Pareira, Yung Tse Hung, Air Pollution Control Engineering, Tokyo, 2004.
2. Noel de Nevers, Air Pollution Control Engineering, Mc Graw Hill, New York, 1995.
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

COURSE OUTCOMES

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

CO1	Understand the chemistry of atmosphere, characterize the air pollutants , know the effects of air pollution, identify the criteria air pollutants and know about NAAQS
CO2	Apply the knowledge of mathematics and science fundamentals to understand the concept of meteorology, air pollution dispersion and Gaussian plume dispersion model
CO3	Select suitable method and design the particulate pollutant control equipment
CO4	Select appropriate method for control of gaseous pollutant by due consideration of sources of emission
CO5	Understand the source of indoor air pollution, effects and control methods as well as to identify the source of noise, and select suitable method for control of noise pollution

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	1	-	-	-	-	-	-	-	-	-	-	1	-	3
CO2	2	1	-	-	-	-	-	-	-	-	-	-	1	-	3
CO3	3	2	-	-	-	1	-	-	-	-	-	-	1	-	3
CO4	3	2	-	-	-	1	-	-	-	-	-	-	1	-	3
CO5	3	2	-	-	-	1	-	-	-	-	-	-	1	-	3

OME101 **AUTOMOTIVE SYSTEMS** **L T P C**
3 0 0 3

OBJECTIVES:

- To understand the construction and working principle of various parts of an automobile.
- To have the practice for assembling and dismantling of engine parts and transmission system

UNIT I: AUTOMOTIVE ENGINE AUXILIARY SYSTEMS **9**

Automotive engines- External combustion engines –Internal combustion engines -classification of engines- SI Engines- CI Engines- two stroke engines -four stroke engines- construction and working principles - IC engine components- functions and materials -valve timing –port timing diagram- Injection system -Unit injector system- Rotary distributor type - Electronically controlled injection system for SI engines-CI engines-Ignition system - Electronic ignition system -Transistorized ignition system, capacitive discharge ignition system. **CO1**

UNIT II: VEHICLE FRAMES AND STEERING SYSTEM **9**

Vehicle construction and different Chassis layouts –classifications of chassis- types of frames- frameless chassis construction –articulated vehicles- vehicle body - Vehicle aerodynamics-various resistances and its effects - steering system –conventional – sophisticated vehicle- and types of steering gear box-Power Steering- Steering geometry-condition for true rolling motion-Ackermann's-Devi's steering system - types of stub axle – Types of rear axles. **CO2**

UNIT III: TRANSMISSION SYSTEMS **9**

Clutch-types and construction, gear boxes- manual and automatic, gear shift mechanisms, Over drive, transfer box, fluid flywheel, torque converter, propeller shaft, slip joints, universal joints –- Hotchkiss Drive and Torque Tube Drive- rear axle- Differential-wheels and tyres. **CO3**

UNIT IV: SUSPENSION AND BRAKES SYSTEMS **9**

Suspension Systems- conventional Suspension Systems -independent Suspension Systems – leaf spring – coil spring –taper-lite - eligo,s spring Types of brakes -Pneumatic and Hydraulic Braking Systems, Antilock Braking System (ABS), electronic brake force distribution (EBD) and Traction Control. Derive the equation of Forces acting while applying a brakes on plain surface - inclined road-gradient. **CO4**

UNIT V: ALTERNATIVE ENERGY SOURCES **9**

Use of Natural Gas, Liquefied Petroleum Gas, Bio-diesel, Bio-ethanol, Gasohol and Hydrogen in Automobiles- Engine modifications required –Performance, Combustion and Emission Characteristics of SI and CI engines with these alternate fuels - Electric and Hybrid Vehicles, Fuel Cell. Turbo chargers -Engine emission control by three way catalytic converter system. Note: Practical Training in dismantling and assembling of Engine parts and Transmission Systems should be given to the students. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Ganesan V. "Internal Combustion Engines", Third Edition, Tata McGraw-Hill, 2012.
2. Jain K.K. and Asthana .R.B, "Automobile Engineering" Tata McGraw Hill Publishers, New Delhi, 2002.
3. Kirpal Singh, "Automobile Engineering", Vol 1 & 2, Seventh Edition, Standard Publishers, New Delhi, 2020

REFERENCES:

1. Heinz Heisler, "Advanced Engine Technology," SAE International Publications USA, 1998.
2. Joseph Heitner, "Automotive Mechanics," Second Edition, East-West Press, 2004.
3. Martin W, Stockel and Martin T Stockle , "Automotive Mechanics Fundamentals," The Good heart – Will Cox Company Inc, USA , 2007.
4. Newton, Steeds and Garrett, "Motor Vehicles", Butterworth Publishers, 2001.

COURSE OUTCOMES

Upon completion of the course, the students will be able

CO1 To identify the different components in automobile Engineering.

CO2 To understand the different types of vehicle frames and steering mechanism.

CO3 To have clear understanding on different auxiliary and transmission systems usual.

CO4 To understand the vehicle suspension and different types of brakes systems.

CO5 To understand the alternative energy used for vehicle.

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	3	2	2	1	-	-	-	-	1	1	3	2	1
CO2	3	2	3	2	2	1	-	-	-	-	1	1	3	2	1
CO3	3	2	3	2	2	1	-	-	-	-	1	1	3	2	1
CO4	3	2	3	2	2	1	-	-	-	-	1	1	3	2	1
CO5	1	3	-	-	1	3	3	1	-	-	-	1	3	2	1

OEI103 BASICS OF BIOMEDICAL INSTRUMENTATION

L	**T**	**P**	**C**
3	**0**	**0**	**3**

OBJECTIVES:

- To Introduce Fundamentals of Biomedical Engineering
- To study the communication mechanics in a biomedical system with few examples
- To study measurement of certain important electrical and non-electrical parameters
- To understand the basic principles in imaging techniques
- To have a basic knowledge in life assisting and therapeutic devices

UNIT I: HUMAN BODY SUBSYSTEM AND TRANSDUCERS **9**

Brief description of muscular, cardiovascular and respiratory systems; their electrical, mechanical and chemical activities. Principles and classification of transducers for Bio-medical applications. Electrode theory, different types of electrodes; Selection criteria for transducers and electrodes **CO1**

UNIT II: NON ELECTRICAL PARAMETERS MEASUREMENT **9**

Measurement of blood pressure - Cardiac output - Heart rate - Heart sound - Pulmonary function measurements – spirometer – Blood Gas analysers, pH of blood – Measurement of blood pCO2, pO2. **CO2**

UNIT III: ELECTRICAL PARAMETERS MEASUREMENT AND ELECTRICAL SAFETY **9**

ECG – EEG – EMG – ERG – Lead systems and recording methods – Typical waveforms - Electrical safety in medical environment, shock hazards – leakage current - Instruments for checking safety parameters of biomedical equipments. **CO3**

UNIT IV: IMAGING MODALITIES AND BIO-TELEMETRY **9**

Diagnostic X-rays - Computer tomography – MRI – Ultrasonography – Endoscopy – Thermography – Different types of biotelemetry systems. **CO4**

UNIT V: LIFE ASSISTING AND THERAPEUTIC DEVICES **9**

Pacemakers – Defibrillators – Ventilators – Nerve and muscle stimulators - Heart Lung machine – Dialysers - Diathermy – Lithotripsy. **CO5**

TOTAL PERIODS:45

TEXT BOOKS:

1. Leslie Cromwell, Biomedical Instrumentation and Measurement, Prentice hall of India, New Delhi, 2007.
2. Joseph J.carr and John M. Brown, Introduction to Biomedical Equipment Technology, John Wiley and sons, New York, 4th Edition, 2012.
3. Khandpur R.S, Handbook of Biomedical Instrumentation, , Tata McGraw-Hill, New Delhi, 2nd Edition, 2003.

REFERENCES:

1. John G. Webster, Medical Instrumentation Application and Design, John Wiley and sons, New York, 1998.
2.Duane Knudson, Fundamentals of Biomechanics, Springer, 2nd Edition, 2007.
3.Suh, Sang, Gurupur, Varadraj P., Tanik, Murat M., Health Care Systems, Technology and Techniques, Springer, 1st Edition, 2011.
4.Ed. Joseph D. Bronzino, The Biomedical Engineering Hand Book, Third Edition, Boca Raton, CRC Press LLC, 2006.
5.M.Arumugam, 'Bio-Medical Instrumentation', Anuradha Agencies, 2003

COURSE OUTCOMES

Upon completion of the course, the students will gain knowledge on

CO1 Understand the physiological systems and the various components of a biomedical system.

CO2 Understand the techniques and instruments used to measure blood pressure, cardiac output, blood pH and various pulmonary function measurements.

CO3 Understand the working of different electrodes used to sense bio signals; know about the electrical safety in biomedical measurement, and about electrical parameter acquisition.

CO4 Understand the techniques for imaging such as CT scan, MRI, Ultrasonography, fluoroscopic, and radiographic techniques.

CO5 Understand the working of various life assisting, therapeutic and robotic devices.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	-	2	2	2	2	2	2	2	2	2	3	2	2	2
CO2	2	-	2	2	2	2	2	2	2	2	2	3	2	2	2
CO3	2	-	1	2	2	2	2	2	2	2	2	3	2	2	2
CO4	2	-	2	2	2	2	2	2	2	2	2	3	2	2	2
CO5	1	-	1	2	1	2	1	2	2	2	2	3	2	2	2

OCS103	INTRODUCTION TO CLOUD COMPUTING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To have the fundamental ideas behind Cloud Computing, the evolution of the paradigm, its applicability, benefits, as well as current and future challenges
- To have knowledge on the various virtualization techniques that serve in computation and storage services on the cloud
- To understand the technologies, architecture and applications of cloud computing
- To understand the key security and compliance challenges of cloud computing

UNIT I INTRODUCTION **9**

Introduction to Cloud Computing – Roots of Cloud Computing- Parallel and Distributed Computing, Mainframe and Grid Computing, Desired Features and benefits of Cloud Computing – Challenges and Risks of Cloud Computing **CO1**

UNIT II VIRTUALIZATION **9**

Introduction to Virtualization Technology – Load Balancing and Virtualization – Understanding Hypervisor and its types, Types of Virtualizations – Hardware, OS, Memory, Application Virtualization, Levels of Virtualization **CO2**

UNIT III CLOUD ARCHITECTURE, SERVICES AND STORAGE **9**

NIST Cloud Computing Reference Architecture, Layered Cloud Architecture, Architectural Design Challenges – Deployment models of cloud, Services of cloud – Cloud Storage. **CO3**

UNIT IV RESOURCE MANAGEMENT AND SECURITY IN CLOUD **9**

Inter Cloud Resource Management – Resource Provisioning Methods – Security Overview – Cloud Security Architecture-Cloud Security Challenges – Data Security –Application Security – Virtual Machine Security. **CO4**

UNIT V CASE STUDIES **9**

CO5

Google App Engine (GAE) – GAE Architecture – Functional Modules of GAE – Amazon Web Services (AWS) – GAE Applications – Cloud Software Environments – Bio-data Platform & Bio Cloud

TOTAL : 45 PERIODS

TEXT BOOKS

1. Buyya R., Broberg J., Goscinski A., “Cloud Computing: Principles and Paradigm”, First Edition, John Wiley & Sons, 2011.
2. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.
3. Rittinghouse, John W., and James F. Ransome, “Cloud Computing: Implementation, Management, And Security”, CRC Press, 2017.

REFERENCE BOOKS

1. Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, “Mastering Cloud Computing”, Tata Mcgraw Hill, 2013.
2. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing - A Practical Approach”, Tata Mcgraw Hill, 2009.
3. George Reese, "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud: Transactional Systems for EC2 and Beyond (Theory in Practice)”, O'Reilly, 2009.

COURSE OUTCOMES

Upon completion of the course, the students will

CO1	Articulate the main concepts, key technologies, strengths, and limitations of cloud computing and the possible applications for state-of-the-art cloud computing
CO2	Understanding of fundamentals and technological aspects of virtualization along with various terminologies used in Cloud Computing
CO3	Identify the architecture and infrastructure of cloud computing, including SaaS, PaaS, IaaS, public cloud, private cloud, hybrid cloud, etc.
CO4	Enlighten the core issues of cloud computing such as security, privacy, and interoperability.
CO5	Be familiarization with areas of cloud technologies and working experience in several of them

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	1	-	-	-	1	-	-	-	-	-	-	2	1	-
CO2	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	2	1	-	-	-	-	-	-	-	-	-	-	-	-	1
CO4	1	-	-	-	-	-	2	1	-	-	-	2	-	-	1
CO5	2	1	1	-	2	2	-	-	2	-	-	3	2	2	2

OCH103 **ENVIRONMENT AND AGRICULTURE** **L T P C**
3 0 0 3

OBJECTIVES:

To emphasize on the importance of environment and agriculture on changing global scenario and the emerging issues connected to it.

UNIT I: ENVIRONMENTAL CONCERNS **8**

Environmental basis for agriculture and food – Land use and landscape changes – Water quality issues – Changing social structure and economic focus – Globalization and its impacts – Agro ecosystems. **CO1**

UNIT II: ENVIRONMENTAL IMPACTS **9**

Irrigation development and watersheds – mechanized agriculture and soil cover impacts – Erosion and problems of deposition in irrigation systems – Agricultural drainage and downstream impacts – Agriculture versus urban impacts. **CO2**

UNIT III: CLIMATE CHANGE **8**

Global warming and changing environment – Ecosystem changes – Changing blue-green-grey water cycles – Water scarcity and water shortages – Desertification. **CO3**

UNIT IV: ECOLOGICAL DIVERSITY AND AGRICULTURE **10**

Ecological diversity, wild life and agriculture – GM crops and their impacts on the environment – Insets and agriculture – Pollination crisis – Ecological farming principles – Forest fragmentation and agriculture – Agricultural biotechnology concerns. **CO4**

UNIT V: EMERGING ISSUES **10**

Global environmental governance – alternate culture systems – Mega farms and vertical farms – Virtual water trade and its impacts on local environment – Agricultural environment policies and its impacts – Sustainable agriculture. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. M.Lakshmi Narasaiah, Environment and Agriculture, Discovery Pub. House, 2006.
2. Arvind Kumar, Environment and Agriculture, ABH Publications, New Delhi, 2005.

REFERENCES:

1. T.C. Byerly, Environment and Agriculture, United States. Dept. of Agriculture. Economic Research Service, 2006.
2. Robert D. Havener, Steven A. Breth, Environment and agriculture: rethinking development issues for the 21st century : proceedings of a symposium, Winrock International Institute for Agricultural Development, 1994
3. Environment and agriculture: environmental problems affecting agriculture in the Asia and Pacific region; World Food Day Symposium, Bangkok, Thailand. 1989

COURSE OUTCOMES

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

CO1 To gain knowledge on the issues of environmental concerns

CO2 To understand the environmental impacts on agriculture and watershed.

CO3 To gain knowledge on the basic concepts of Climate Change, Water scarcity and water knowledge

CO4 To understand the ecosystem, ecological diversity

CO5 To understand the global and local emerging issues on agriculture and biotechnology

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	1	-	2	2	1	-	-	1	2	2	2	2
CO2	2	1	2	1	2	2	2	1	-	-	1	2	2	2	2
CO3	3	3	3	1	-	3	3	1	-	-	1	3	3	3	3
CO4	2	1	2	1	-	2	2	1	-	-	1	2	2	2	2
CO5	3	1	2	1	-	2	2	1	-	-	1	2	2	3	3

OEI101	SENSORS AND TRANSDUCERS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- 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.

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. **CO1**

UNIT II: MOTION, PROXIMITY AND RANGING SENSORS **9**

Motion Sensors – Potentiometers, Resolver, Encoders – Optical, Magnetic, Inductive, Capacitive, LVDT – RVDT – Synchro, Accelerometer.,– GPS, Bluetooth, Range Sensors – RF beacons, Ultrasonic Ranging, Reflective beacons, Laser Range Sensor (LIDAR). **CO2**

UNIT III: FORCE, MAGNETIC AND HEADING SENSORS **9**

Strain Gage, Load Cell, Magnetic Sensors –types, principle, requirement and advantages: Variable reluctance transducers, Magneto resistive – Hall Effect – Current sensor Heading Sensors – Compass, Gyroscope, Inclinometers **CO3**

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. **CO4**

UNIT V: SIGNAL CONDITIONING and DAQ SYSTEMS **9**

Amplification – Filtering – A/D converter - Sample and Hold circuits – Data Acquisition: Single channel and multi channel data acquisition – Digital recording systems - Data logging - applications - Automobile, Aerospace, Home appliances, Manufacturing, Environmental monitoring. **CO5**

TOTAL PERIODS: 45

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.

4. Ian Sinclair, Sensors and Transducers, 3rd Edition, Elsevier, 2012

COURSE OUTCOMES

Upon completion of the course, the students will gain knowledge on

CO1 Understand various calibration techniques, error analysis and signal types for sensors.

CO2 Gain knowledge about motion, proximity and ranging sensors.

CO3 Ability to understand force, magnetic and heading sensors.

CO4 Study the basic principles of optical, pressure and temperature sensors.

CO5 Implement the DAQ systems along with signal conditioning circuits.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	1	2	2	1	-	1	1	2	3	3	3
CO2	3	3	3	3	1	2	2	1	-	1	1	2	3	3	3
CO3	3	3	3	3	1	2	2	1	-	1	1	2	3	3	3
CO4	3	3	3	3	1	1	2	1	-	1	1	2	3	3	3
CO5	3	3	3	3	1	2	2	1	-	1	1	2	3	3	3

OPEN ELECTIVE - II

OME102	DESIGN OF EXPERIMENTS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To demonstrate knowledge and understanding of Classical Design of Experiments (DOE).
- To demonstrate knowledge and understanding of Taguchi's approach.
- To develop skills to design and conduct experiments using DOE and Taguchi's approach.
- To develop competency for analysing the data to determine the optimal process parameters that optimize the process.

UNIT I: FUNDAMENTALS OF EXPERIMENTAL DESIGNS **9**

Hypothesis testing – single mean, two means, dependant/ correlated samples – confidence intervals, Experimentation – need, Conventional test strategies, Analysis of variance, F-test, terminology, basic principles of design, steps in experimentation – choice of sample size – Normal and half normal probability plot – simple linear and multiple linear regression, testing using Analysis of variance. **CO1**

UNIT II: SINGLE FACTOR EXPERIMENTS **9**

Completely Randomized Design- effect of coding the observations- model adequacy checking - estimation of model parameters, residuals analysis- treatment comparison methods- Duncan's multiple range test, Newman- Keuel's test, Fisher's LSD test, Tukey's test- testing using contrasts- Randomized Block Design – Latin Square Design- Graeco Latin Square Design – Applications. **CO2**

UNIT III: FACTORIAL DESIGNS **9**

Main and Interaction effects - Two and three factor full factorial designs- Fixed effects and random effects model - Rule for sum of squares and Expected Mean Squares- 2K Design with two and three factors- Yate's Algorithm- fitting regression model- Randomized Block Factorial Design - Practical applications. **CO3**

UNIT IV: SPECIAL EXPERIMENTAL DESIGN **9**

Blocking and Confounding in 2K Designs- blocking in replicated design- 2K Factorial Design in two blocks- Complete and partial confounding- Confounding 2K Design in four blocks- Two level Fractional Factorial Designs- one-half fraction of 2K Design, design resolution, Construction of one-half fraction with highest design resolution, one-quarter fraction of 2K Design- introduction to response surface methods, central composite design. **CO4**

UNIT V: TAGUCHI METHODS **9**

Design of experiments using Orthogonal Arrays, Data analysis from Orthogonal experiments- Response Graph Method, ANOVA- attribute data analysis- Robust design- noise factors, Signal to noise ratios, Inner/outer OA design- case studies. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Douglas C. Montgomery, “Design and Analysis of Experiments”, John Wiley & sons, 2012.

REFERENCES:

1. Box, G. E., Hunter,W.G., Hunter, J.S., Hunter,W.G., “Statistics for Experimenters: Design, Innovation, and Discovery”, 2nd Edition, Wiley, 2005.
2. Krishnaiah K, and Shahabudeen P, “Applied Design of Experiments and Taguchi Methods”, PHI, India, 2011.
3. Phillip J. Ross, “Taguchi Techniques for Quality Engineering”, Tata McGraw-Hill, India, 2005.

COURSE OUTCOMES

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

- **CO1** Understand the basic principle of DOEs and ANOVA.
- **CO2** Understand the various single factor experiments
- **CO3** Learn full and fraction factorial experiment design.
- **CO4** Design various resolution using 2^k.
- **CO5** Understand the Taguchi Orthogonal Arrays.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	-	-	-	-	-	-	2	2	1	2	1
CO2	2	2	2	3	-	-	-	-	-	-	2	2	1	2	1
CO3	1	1	1	2	-	-	-	-	-	-	2	2	1	2	1
CO4	1	1	1	2	-	-	-	-	-	-	2	2	-	1	-
CO5	1	1	1	2	-	-	-	-	-	-	2	2	-	1	-

OCE104 **GREEN BUILDING DESIGN** **L T P C**

3 0 0 3

OBJECTIVES

- The course aims to develop skills of the students in the area of Civil Engineering with emphasis in environmental implications of buildings and comforts in building
- This will enable the students to perform calculations pertaining to processes and operations.

UNIT I ENVIRONMENTAL IMPLICATIONS OF BUILDINGS **9**

Energy use, carbon emissions, water use, waste disposal; Building materials: sources, methods of production and environmental Implications. Embodied Energy in Building Materials: Transportation Energy for Building Materials; Maintenance Energy for Buildings. **CO1**

UNIT II IMPLICATIONS OF BUILDING TECHNOLOGIES EMBODIED ENERGY OF BUILDINGS **9**

Framed Construction, Masonry Construction. Resources for Building Materials, Alternative concepts. Recycling of Industrial and Buildings Wastes. Biomass Resources for buildings. **CO2**

UNIT III COMFORTS IN BUILDING **9**

Thermal Comfort in Buildings- Issues; Heat Transfer Characteristic of Building Materials and Building Techniques. Incidence of Solar Heat on Buildings-Implications of Geographical Locations **CO3**

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. **CO4**

UNIT V GREEN COMPOSITES FOR BUILDINGS **9**

Concepts of Green Composites. Water Utilization 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. **CO5**

TOTAL : 45 PERIODS

COURSE OUTCOMES

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

CO1 Understand core building science fundamentals

CO2 Perform some building sustainability concepts

CO3 Understand energy efficiency in relation to cost performance, ROI, etc

CO4 Understand and perform some building performance testing and be exposed to different agencies involved in the testing.

CO5 Understand and perform some weatherization fundamentals.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	-	3	3	3	3	-	-	-	3	2	1	-	3
CO2	3	3	-	3	3	3	3	-	-	-	3	2	1	-	3
CO3	3	3	-	3	3	3	3	-	-	-	3	2	1	-	3
CO4	3	3	-	3	3	3	3	-	-	-	3	2	1	-	3
CO5	3	3	-	3	3	3	3	-	-	-	3	2	1	-	3

OCH101	HOSPITAL MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- 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.

UNIT I: OVERVIEW OF HOSPITAL ADMINISTRATION **9**

Distinction between Hospital and Industry, Challenges in Hospital Administration – Hospital Planning- Equipment Planning – Functional Planning **CO1**

UNIT II: HUMAN RESOURCE MANAGEMENT IN HOSPITAL **9**

Principles of HRM – Functions of HRM – Profile of HRD Manager –Human Resource Inventory – Manpower Planning. **CO2**

UNIT III: RECRUITMENT AND TRAINING **9**

Different Departments of Hospital, Recruitment, Selection, Training Guidelines – Methods of Training – Evaluation of Training – Leadership grooming and Training, Promotion – Transfer. **CO3**

UNIT IV: SUPPORTIVE SERVICES **9**

Medical Records Department – Central Sterilization and Supply Department – Pharmacy – Food Services - Laundry Services **CO4**

UNIT V: COMMUNICATION AND SAFETY ASPECTS IN HOSPITAL **9**

Purposes – Planning of Communication, Modes of Communication – Telephone, ISDN, Public Address and Piped Music – CCTV.Security – Loss Prevention – Fire Safety – Alarm System – Safety Rules. **CO5**

TOTAL PERIODS: 45

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.

COURSE OUTCOMES

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

CO1 To explain the principles of hospital administration.

CO2 To identify the importance of human resource management.

CO3 To list various marketing research techniques.

CO4 To identify information management systems and its uses.

CO5 To understand safety procedures followed in hospitals

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	1	1	2	1	1	-	1	2	1	2	1	1	1	-	-
CO2	1	1	1	-	1	-	-	2	3	2	3	1	1	-	1
CO3	1	2	2	1	1	-	1	2	3	2	3	1	1	-	-
CO4	1	2	2	1	1	-	1	2	3	2	3	1	1	-	-
CO5	1	2	2	1	1	1	1	2	3	2	3	2	1	1	1

OIE102 **ROBOTICS** **L T P C**
3 0 0 3

OBJECTIVES:

- To understand the functions of the basic components of a Robot.
- To study the use of various types of End of Effectors and Sensors
- To impart knowledge in Robot Kinematics and Programming
- To learn Robot safety issues and economics.

UNIT I: FUNDAMENTALS OF ROBOT **6**

Robot - Definition - Robot Anatomy - Co ordinate Systems, Work Envelope Types and Classification- Specifications-Pitch, Yaw, Roll, Joint Notations, Speed of Motion, Pay Load- Robot Parts and their Functions-Need for Robots-Different Applications. **CO1**

UNIT II: ROBOT DRIVE SYSTEMS AND END EFFECTORS **9**

Pneumatic Drives-Hydraulic Drives-Mechanical Drives-Electrical Drives-D.C. Servo Motors, Stepper Motors, A.C. Servo Motors-Salient Features, Applications and Comparison of all these Drives, End Effectors-Grippers-Mechanical Grippers, Pneumatic and Hydraulic- Grippers, Magnetic Grippers, Vacuum Grippers; Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers; Selection and Design Considerations. **CO2**

UNIT III: SENSORS AND MACHINE VISION **12**

Requirements of a sensor, Principles and Applications of the following types of sensors- Position sensors - Piezo Electric Sensor, LVDT, Resolvers, Optical Encoders, pneumatic Position Sensors, Range Sensors Triangulations Principles, Structured, Lighting Approach, Time of Flight, Range Finders, Laser Range Meters, Touch Sensors ,binary Sensors., Analog Sensors, Wrist Sensors, Compliance Sensors, Slip Sensors, Camera, Frame Grabber, Sensing and Digitizing Image Data- Signal Conversion, Image Storage, Lighting Techniques, Image Processing and Analysis-Data Reduction, Segmentation, Feature Extraction, Object Recognition, Other Algorithms, Applications- Inspection, Identification, Visual Serving and Navigation. **CO3**

UNIT IV: ROBOT KINEMATICS AND ROBOT PROGRAMMING **13**

Forward Kinematics, Inverse Kinematics and Difference; Forward Kinematics and Reverse Kinematics of manipulators with Two, Three Degrees of Freedom (in 2 Dimension), Four Degrees of freedom (in 3 Dimension) Jacobians, Velocity and Forces-Manipulator Dynamics, Trajectory Generator, Manipulator Mechanism Design-Derivations and problems. Lead through Programming, Robot programming Languages-VAL Programming-Motion Commands, Sensor Commands, End Effector commands and simple Programs. **CO4**

UNIT V: IMPLEMENTATION AND ROBOT ECONOMICS **5**

RGV (Rail Guided Vehicle), AGV (Automatic Guided Vehicle); Implementation of Robots in Industries-Various Steps; Safety Considerations for Robot Operations, Hazards of robot, Economic Analysis of Robots- Payback, EUAC, ROI Method. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Klafter R.D., Chmielewski T.A and Negin M., “Robotic Engineering - An Integrated Approach”, Prentice Hall, 2003.
2. Groover M.P., “Industrial Robotics -Technology Programming and Applications”, McGraw Hill, 2001.

REFERENCES:

1. Craig J.J., “Introduction to Robotics Mechanics and Control”, Pearson Education, 2008.
2. Deb S.R., “Robotics Technology and Flexible Automation” Tata McGraw Hill Book Co., 1994.
3. Koren Y., “Robotics for Engineers", Mc Graw Hill Book Co., 1992.
4. Fu.K.S.,Gonzalz R.C. and Lee C.S.G., “Robotics Control, Sensing, Vision and Intelligence”, McGraw Hill Book Co., 1987.
5. Janakiraman P.A., “Robotics and Image Processing”, Tata McGraw Hill, 1995.
6. Rajput R.K., “Robotics and Industrial Automation”, S.Chand and Company, 2008.
7. Surender Kumar, “Industrial Robots and Computer Integrated Manufacturing”, Oxford and IBH Publishing Co. Pvt. Ltd., 1991.

COURSE OUTCOMES

Upon completion of the course, the students will gain knowledge on

CO1	To learn concepts of Robotic system, its components and instrumentation and control related to robotics.
CO2	To improve skills on hardware drives and interfacing aspects.
CO3	To enhance basics of different sensors and machine vision interaction.
CO4	To develop student's skills in performing kinematics analysis of robot systems.
CO5	To provide the student with some knowledge and skills associated with robot economics control.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	3	1	2	-	-	-	-	-	-	-	3	2	1
CO2	2	3	2	2	2	-	-	-	-	-	-	-	3	2	1
CO3	2	2	3	2	3	2	-	-	-	-	-	-	3	2	1
CO4	2	2	2	3	3	2	-	1	-	-	1	-	3	2	1
CO5	1	3	1	2	1	3	2	2	-	1	3	2	3	2	1

OCS101 **INTRODUCTION TO C PROGRAMMING** **L T P C**

3 0 0 3

OBJECTIVES

- To understand the basic concepts in C Programming Language.
- To understand Input and Output Statements.
- To enhance analyzing and problem solving skills and use the same for writing programs in C.
- To familiarize the basic syntax in arrays and pointers
- To provide exposure to problem-solving through programming

UNIT I **INTRODUCTORY CONCEPTS & C FUNDAMENTALS** **9**

Introduction to Computers - Computer Characteristics - Modes of Operation - Types of Programming Languages - Introduction to C - Some Simple C Programs - Desirable Program Characteristics - The C Character Set - Identifiers and Keywords - Data Types - Constants - Variables and Arrays - Declarations - Expressions - Statements - Symbolic Constants. **CO1**

UNIT II **OPERATORS, EXPRESSIONS, DATA INPUT & OUTPUT AND CONTROL STATEMENTS** **9**

Arithmetic Operators - Unary Operators - Relational and Logical Operators - Assignment Operators - The Conditional Operator - Library Functions - getchar, putchar, scanf, printf, gets and puts Functions - Preliminaries - Branching: The if else Statement - Looping: The while Statement - do while Statement - for Statement - Nested Control Structures - The switch Statement - The break Statement - The continue Statement - The Comma Operator - The goto Statement **CO2**

UNIT III **FUNCTIONS & PROGRAM STRUCTURE** **9**
CO3

Defining a Function - Accessing a Function - Function Prototypes - Passing Arguments to a Function – Recursion - Storage Classes - Automatic Variables - External (Global) Variables - Static Variables - Multifile Programs - More About Library Functions

UNIT IV **ARRAYS & POINTERS** **9**
CO4

Defining an Array - Processing an Array - Passing Arrays to Functions - Multidimensional Arrays - Arrays and Strings - Fundamentals - Pointer Declarations - Passing Pointers to Functions - Pointers and One-Dimensional Arrays - Dynamic Memory Allocation - Operations on Pointers - Pointers and Multidimensional Arrays - Arrays of Pointers - Passing Functions to Other Functions

UNIT V **STRUCTURES, UNIONS & DATA FILES** **9**
CO5

Defining a Structure - Processing a Structure - User-Defined Data Types (typedef) - Structures and Pointers - Passing Structures to Functions - Self-Referential Structures – Unions - Opening and Closing a Data File - Creating a Data File - Processing a Data File - Unformatted Data Files

TOTAL : 45 PERIODS

TEXT BOOKS

1. Byron Gottfried - Schaum's Outline of Programming with C, 2nd Edition, McGraw-Hill, 1996.

REFERENCE BOOKS

1. The C Programming Language by Brian Kernighan and Dennis Ritchie 2nd Edition.
2. Let Us C Yashavant kanetkar, BPB

COURSE OUTCOMES

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

CO1 Identify situations where computational methods and computers would be useful.

CO2 Demonstrate the use of operators, input and output statements and control statements

CO3 Identify solution to a problem and apply control structures and user defined functions for solving the problem

CO4 Demonstrate the use of numeric arrays and pointers

CO5 Demonstrate the ability to design creative solutions to real life problems faced by the industry.

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	2	2	2	-	-	-	2	2	2	1	1	1
CO2	3	3	3	2	2	2	-	-	-	2	2	2	1	1	1
CO3	3	3	3	2	2	2	-	-	-	2	2	2	1	2	1
CO4	3	3	3	2	2	2	-	-	-	2	2	2	1	2	1
CO5	3	3	3	2	2	2	-	-	-	2	2	2	-	-	1

OMB102 LOGISTICS AND SUPPLY CHAIN MANAGEMENT

L	**T**	**P**	**C**
3	**0**	**0**	**3**

OBJECTIVES:

- To provide an insight on the fundamentals of supply chain networks, tools and techniques.

UNIT I: INTRODUCTION **9**

Role of Logistics and Supply chain Management: Scope and Importance- Evolution of Supply Chain - Decision Phases in Supply Chain - Supply chain and competitive Strategies – Drivers of Supply Chain Performance and Obstacles. **CO1**

UNIT II: SOURCING AND NETWORK DESIGN **9**

Role of sourcing supply chain - Outsourcing – Make Vs buy -Sourcing strategy - Supplier Selection and Contract Negotiation. Building strategic partnerships and trust within a supply chain -Role of Distribution in Supply Chain – Factors influencing Distribution network design – Design options for Distribution Network Distribution Network in Practice-Role of network Design in Supply Chain – Framework for network Decisions. **CO2**

UNIT III: LOGISTICS IN SUPPLY CHAIN **9**

Introduction to logistics – Role of logistics in Competitive strategy– Value added logistics services – Roleof transportation in supply chain – factors affecting transportations decision – Design option for transportation network – Tailored transportation – Routing and scheduling in transportation **CO3**

UNIT IV: TRANSPORTATON AND PACKAGING **9**

Transportation System – Evolution, Infrastructure and Networks. Freight Management– Containerization; Modal Characteristics - Inter-modal Operators and Transport Economies; International Logistics-objectives, importance in global economy, Characteristics of global supply chains; Packaging - Design considerations – Logistics outsourcing **CO4**

UNIT V: IT IN SUPPLY CHAIN **9**

The role IT in supply chain- Supply Chain Integration – Agile Supply chain – Green Supply chain – Reverse Supply chain – E-logistics –future of IT in supply chain – E-Business in supply chain – Supply chain analytics - Blockchain **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Sunil Chopra, Peter Meindl and Kalra, “Supply Chain Management, Strategy, Planning, and Operation”, Pearson Education, 2010.

REFERENCES:

1. Jeremy F.Shapiro, “Modeling the Supply Chain”, Thomson Duxbury, 2002.
2. Srinivasan G.S, “Quantitative models in Operations and Supply Chain Management, PHI, 2010
3. David J.Bloomberg , Stephen Lemay and Joe B.Hanna, “Logistics”, PHI 2002.
4. James B.Ayers, “Handbook of Supply Chain Management”, St.Lucle press, 2000.

COURSE OUTCOMES

Upon completion of the course, the students will be able

CO1 To understand the basics of Supply chain, the strategic role of SCM and the drivers of supply chain performance.

CO2 To understand the different distribution networks in Supply chain, the factors influencing design of these networks and to develop a framework of network for distribution.

CO3 To understand about the logistic part of supply chain management and the methods to identify the optimized route for transportation.

CO4 To understand about sourcing, selection of suppliers and supply chain coordination

CO5 To understand the role of IT in Supply chain management.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	3	3	1	2	1	1	1	3	-	-	2
CO2	3	3	1	2	3	1	3	2	1	1	1	1	-	-	2
CO3	3	3	2	1	3	2	3	3	1	1	2	3	-	-	2
CO4	2	1	2	3	3	1	3	3	3	1	2	1	-	-	2
CO5	2	3	3	2	2	3	1	2	3	1	3	3	-	-	2

AUDIT COURSES

AD1001	CONSTITUTION OF INDIA	L	T	P	C
		2	0	0	0

OBJECTIVES:

- Teach history and philosophy of Indian Constitution.
- Describe the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- Summarize powers and functions of Indian government.
- Explain emergency rule.
- Explain structure and functions of local administration.

UNIT I: INTRODUCTION **9**

History of Making of the Indian Constitution-Drafting Committee- (Composition & Working) - Philosophy of the Indian Constitution-Preamble-Salient Features **CO1**

UNIT II: CONTOURS OF CONSTITUTIONAL RIGHTS & DUTIES **9**

Fundamental Rights-Right to Equality-Right to Freedom-Right against Exploitation Right to Freedom of Religion-Cultural and Educational Rights-Right to Constitutional Remedies Directive Principles of State Policy-Fundamental Duties **CO2**

UNIT III: ORGANS OF GOVERNANCE **9**

Parliament-Composition-Qualifications and Disqualifications-Powers and Functions-Executive President-Governor-Council of Ministers-Judiciary, Appointment and Transfer of Judges, Qualifications Powers and Functions **CO3**

UNIT IV: EMERGENCY PROVISIONS **9**

Emergency Provisions - National Emergency, President Rule, Financial Emergency **CO4**

UNIT V: LOCAL ADMINISTRATION **9**

District's Administration head- Role and Importance-Municipalities- Introduction- Mayor and role of Elected Representative-CEO of Municipal Corporation-Pachayati raj- Introduction- PRI- Zila Pachayat-Elected officials and their roles- CEO ZilaPachayat- Position and role-Block levelOrganizational Hierarchy (Different departments)-Village level- Role of Elected and Appointed officials-Importance of grass root democracy **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Basu D D, Introduction to the Constitution of India, Lexis Nexis, 2015.
2. Busi S N, Ambedkar B R framing of Indian Constitution, 1st Edition, 2015.
3. Jain M P, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. The Constitution of India (Bare Act), Government Publication,1950

COURSE OUTCOMES

Upon completion of the course, the students will be

CO1 Able to understand history and philosophy of Indian Constitution.

CO2 Able to understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.

CO3 Able to understand powers and functions of Indian government.

CO4 Able to understand emergency rule.

CO5 Able to understand structure and functions of local administration.

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRA M OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO2	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO3	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO4	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO5	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-

AD1002 **VALUE EDUCATION** **L T P C**
2 0 0 0

OBJECTIVES:

- Develop knowledge of self-development
- Explain the importance of Human values
- Develop the overall personality through value education
- Overcome the self destructive habits with value education
- Interpret social empowerment with value education

UNIT I: INTRODUCTION TO VALUE EDUCATION **9**

Values and self-development –Social values and individual attitudes, Work ethics, Indian vision of humanism, Moral and non- moral valuation, Standards and principles, Value judgments **CO1**

UNIT II: IMPORTANCE OF VALUES **9**

Importance of cultivation of values, Sense of duty, Devotion, Self-reliance, Confidence, Concentration, Truthfulness, Cleanliness. Honesty, Humanity, Power of faith, National Unity,Patriotism, Love for nature, Discipline **CO2**

UNIT III: INFLUENCE OF VALUE EDUCATION **9**

Personality and Behaviour development - Soul and Scientific attitude. Positive Thinking, Integrityand discipline, Punctuality, Love and Kindness, Avoid fault Thinking, Free from anger, Dignity of labour, Universal brotherhood and religious tolerance, True friendship Happiness Vs suffering,love for truth. **CO3**

UNIT IV: REINCARNATION THROUGH VALUE EDUCATION **9**

Aware of self-destructive habits, Association and Cooperation, Doing best for saving natureCharacter and Competence –Holy books vs Blind faith, Self-management and Good health,Science of reincarnation **CO4**

UNIT V: VALUE EDUCATION IN SOCIAL EMPOWERMENT **9**

Equality, Non violence, Humility, Role of Women, All religions and same message,Mind your Mind, Self-control, Honesty, Studying effectively **CO5**

TOTAL PERIODS: 45

REFERENCE:

Chakroborty , S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press ,New Delhi

COURSE OUTCOMES

Upon completion of the course, the students will be

- **CO1** Gain knowledge of self-development
- **CO2** Learn the importance of Human values
- **CO3** Develop the overall personality through value education
- **CO4** Overcome the self destructive habits with value education
- **CO5** Interpret social empowerment with value education

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	1	1	-	-	-	1	-	-	-
CO2	-	-	-	-	-	-	1	1	1	-	-	1	-	-	-
CO3	-	-	-	-	-	-	1	1	1	-	-	1	-	-	-
CO4	-	-	-	-	-	-	1	1	-	-	-	1	-	-	-
CO5	-	-	-	-	-	-	1	1	-	-	-	1	-	-	-

AD1003	PEDAGOGY STUDIES	L	T	P	C
		2	0	0	0

OBJECTIVES:

- Understand the methodology of pedagogy.
- Compare pedagogical practices used by teachers in formal and informal classrooms in developing countries.
- Infer how can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy.
- Illustrate the factors necessary for professional development.
- Identify the Research gaps in pedagogy.

UNIT I: INTRODUCTION AND METHODOLOGY **9**

Aims and rationale, Policy background, Conceptual framework and terminology - Theories oflearning, Curriculum, Teacher education - Conceptual framework, Research questions - Overviewof methodology and Searching. **CO1**

UNIT II: THEMATIC OVERVIEW **9**

Pedagogical practices are being used by teachers in formal and informal classrooms in developingcountries - Curriculum, Teacher education. **CO2**

UNIT III: EVIDENCE ON THE EFFECTIVENESS OF PEDAGOGICAL PRACTICES **9**

Methodology for the in depth stage: quality assessment of included studies - How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? - Theory of change - Strength and nature of the body of evidence for effective pedagogical practices - Pedagogic theory and pedagogical approaches - Teachers' attitudes and beliefs and Pedagogic strategies. **CO3**

UNIT IV: PROFESSIONAL DEVELOPMENT **9**

Professional development: alignment with classroom practices and follow up support - Peersupport - Support from the head teacher and the community - Curriculum and assessment – Barriers to learning: limited resources and large class sizes **CO4**

UNIT V: RESEARCH GAPS AND FUTURE DIRECTIONS **9**

Research design – Contexts – Pedagogy - Teacher education - Curriculum and assessment - Dissemination and research impact. **CO5**

TOTAL PERIODS: 45

REFERENCES:

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.

COURSE OUTCOMES

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

CO1 Understand the methodology of pedagogy

CO2 Understand Pedagogical practices used by teachers in formal and informal classrooms in developing countries.

CO3 Find how can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy.

CO4 Know the factors necessary for professional development.

CO5 Identify the Research gaps in pedagogy.

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-

AD1004 **STRESS MANAGEMENT BY YOGA** **L T P C**
2 0 0 0

OBJECTIVES:

- Develop healthy mind in a healthy body thus improving social health also improve efficiency
- Invent Do's and Don't's in life through Yam
- Categorize Do's and Don't's in life through Niyam
- Develop a healthy mind and body through Yog Asans
- Invent breathing techniques through Pranayam

UNIT I: **INTRODUCTION TO YOGA** **9**

Definitions of Eight parts of yog.(Ashtanga) **CO1**

UNIT II: **YAM** **9**

Do`s and Don't's in life.Shaucha, santosh, tapa, swadhyay, ishwarpranidhan **CO2**

UNIT III: **NIYAM** **9**

Do`s and Don't's in life. Ahinsa, satya, astheya, bramhacharya and aparigraha **CO3**

UNIT IV: ASAN **9**

Various yog poses and their benefits for mind & body **CO4**

UNIT V: PRANAYAM **9**

Regularization of breathing techniques and its effects-Types of pranayam **CO5**

TOTAL PERIODS: 45

REFERENCES:

1. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata
2. 'Yogic Asanas for Group Tarining-Part-I" : Janardan Swami Yogabhyasi Mandal, Nagpur

COURSE OUTCOMES

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

CO1 Develop healthy mind in a healthy body thus improving social health also improve efficiency

CO2 Learn Do's and Don't's in life through Yam

CO3 Learn Do's and Don't's in life through Niyam

CO4 Develop a healthy mind and body through Yog Asans

CO5 Learn breathing techniques through Pranayam

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	1	1	-	-	-	1	-	-	-
CO2	-	-	-	-	-	-	1	1	-	-	-	1	-	-	-
CO3	-	-	-	-	-	-	1	1	-	-	-	1	-	-	-
CO4	-	-	-	-	-	-	1	1	-	-	-	1	-	-	-
CO5	-	-	-	-	-	-	1	1	-	-	-	1	-	-	-

AD1005 **PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS** **L T P C**

2 0 0 0

OBJECTIVES:

- Develop basic personality skills holistically
- Develop deep personality skills holistically to achieve happy goals
- Rewrite the responsibilities
- Reframe a person with stable mind

UNIT I: NEETISATAKAM-HOLISTIC DEVELOPMENT OF PERSONALITY - I **9**

Verses- 19,20,21,22 (wisdom) - Verses- 29,31,32 (pride & heroism) – Verses- 26,28,63,65 (virtue) **CO1**

UNIT II: NEETISATAKAM-HOLISTIC DEVELOPMENT OF PERSONALITY - II **9**

Verses- 52,53,59 (dont's) - Verses- 71,73,75,78 (do's) **CO2**

UNIT III: ORGANS OF GOVERNANCE **9**

Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48 - Chapter 3-Verses 13, 21, 27, 35 Chapter6-Verses 5,13,17,23, 35 - Chapter 18-Verses 45, 46, 48 **CO3**

UNIT IV: EMERGENCY PROVISIONS **9**

Statements of basic knowledge - Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68 Chapter12 -Verses 13, 14, 15, 16,17, 18 **CO4**

UNIT V: LOCAL ADMINISTRATION **9**

Chapter2-Verses 17, Chapter 3-Verses 36,37,42 - Chapter 4-Verses 18, 38,39 Chapter18 –Verses 37,38,63 **CO5**

TOTAL PERIODS:45

REFERENCES:

1. Gopinath,Rashtriya Sanskrit Sansthanam P,Bhartrihari's ThreeSatakam ,Nitisringarvairagya, Delhi,2010
2. Swami Swarupananda , Srimad Bhagavad Gita, Advaita Ashram,Publication Department, Kolkata,2016.

COURSE OUTCOMES

Upon completion of the course, the students will be

- **CO1** To develop basic personality skills holistically
- **CO2** To develop deep personality skills holistically to achieve happy goals
- **CO3** To rewrite the responsibilities
- **CO4** To reframe a person with stable mind, pleasing personality and determination
- **CO5** To awaken wisdom in students

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO2	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO3	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO4	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO5	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-

AD1006	UNNAT BHARAT ABHIYAN	L	T	P	C
		2	0	0	0

Objectives

- To engage the students in understanding rural realities
- To identify and select existing innovative technologies, enable customization of technologies, or devise implementation method for innovative solutions, as per the local needs.
- To leverage the knowledge base of the institutions to devise processes for effective implementation of various government programmes
- To understand causes for rural distress and poverty and explore solutions for the same
- To apply classroom knowledge of courses to field realities and thereby improve quality of learning

UNIT - I QUALITY OF RURAL LIFE IN VILLAGES AND UNNAT BHARAT ABHIYAN **9**

Introduction to Unnat Bharat Abhiyan - concept, scope and objectives, rural life, rural society, cast and gender relations, rural values with respect to community, nature and resources, elaboration of "Soul of India lies in villages" – (Gandhi Ji), Rural infrastructure, problems in rural area. **CO1**

Assignment: Prepare a map (Physical , visual and digital) of the village you visited and write an essay about inter-family relation in that village.

UNIT - II RURAL ECONOMY AND LIVELIHOOD **9**

Agriculture, farming, land ownership pattern, water management, animal husbandry, non-farm livelihoods and artisans, rural entrepreneurs, rural market . **CO2**

Assignment: Describe your analysis of rural household economy, it's challenges and possible pathways to address them. Group discussion in class- (4) Field visit 3.

UNIT - III RURAL INSTITUTIONS **9**

History of Rural Development, Traditional rural organizations, Self Help Groups, Gram Swaraj and 3-Tier Panchayat Raj Institutions (Gram Sabha, Gram Panchayat, Standing Committee), local civil society, local administration. Introduction to Constitution, Constitutional Amendments in Panchayati Raj – Fundamental Rights and Directive Principles. **CO3**

Assignment: Panchayati Raj institutions in villages? What would you suggest to improve their effectiveness? Present a case study (written or audio-visual). Field Visit – 4.

UNIT - IV RURAL DEVELOPMENT PROGRAMMES **9**

National programmes - Sarva Shiksha Abhiyan, Beti Bachao, Beti Padhao, Ayushman Bharat, Swatchh Bharat, PM Awass Yojana, Skill India, Gram Panchayat Decentralised Planning, NRLM, MNREGA, etc.

Written Assignment: Describe the benefits received and challenges faced in the delivery of one of these programmes in the rural community, give suggestions about improving implementation of the programme for the rural poor. **CO4**

UNIT - V FIELD WORK **9**

Each student selects one programme for field visit Field based practical activities:

- Interaction with SHG women members, and study of their functions and challenges; planning for their skill building and livelihood activities
- Visit MGNREGS project sites, interact with beneficiaries and interview functionaries at the work site
- Field visit to Swachh Bharat project sites, conduct analysis and initiate problem solving measures
- Conduct Mission Antyodaya surveys to support under Gram Panchayat Development Plan(GPDP)
- Interactive community exercise with local leaders, panchayat functionaries, grass-root officials and local institutions regarding village development plan preparation and resource mobilization
- Visit Rural Schools I mid-day meal centres, study Academic and infrastructural resources and gaps
- Participate in Gram Sabha meetings, and study community participation
- Associate with Social audit exercises at the Gram Panchayat level, and interact with programme beneficiaries

CO5

- Attend Parent Teacher Association meetings, and interview school drop outs
- Visit local Anganwadi Centre and observe the services being provided
- Visit local NGOs, civil society organisations and interact with their staff and beneficiaries.
- Organize awareness programmes, health camps, Disability camps and cleanliness camps o Conduct soil health test, drinking water analysis, energy use and fuel efficiency surveys
- Raise understanding of people's impacts of climate change, building up community's disaster preparedness
- Organise orientation programmes for farmers regarding organic cultivation, rational use of irrigation and fertilizers and promotion of traditional species of crops and plants
- Formation of committees for common property resource management, village pond maintenance and fishing.

Total Periods: 45

Text Books:

1. Singh, Katar, Rural Development Principles, Policies and Management, Sage Publications, New Delhi, 2015
2. A Hand book on Village Panchayat Administration, Rajiv Gandhi Chair for Panchayati Raj Studies, 2002
3. United Nations, Sustainable Development Goals, 2015 un.org/sdgs

Reference Books:

1. M.P.Boraian, Best Practices in Rural Development, Shanlax Publishers
2. Unnat Bharat Abhiyan Website : www.unnatbharatabhiyan.gov.in

COURSE OUTCOMES

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

CO1 Understand of rural life, culture and social realities

CO2 Understand the concept of measurement by comparison or balance of parameters.

CO3 Develop a sense of empathy and bonds of mutuality with local community

CO4 Appreciate significant contributions of local communities to Indian society and economy

CO5 Value the local knowledge and wisdom of the community

CO6 Understand of rural life, culture and social realities

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO2	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO3	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO4	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO5	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-

AD1007 ESSENCE OF INDIAN KNOWLEDGE TRADITION

L	**T**	**P**	**C**
2	**0**	**0**	**0**

OBJECTIVES:

The course will introduce the students to

- Get a knowledge about Indian Culture
- Know Indian Languages and Literature religion and philosophy and the fine arts in India
- Explore the Science and Scientists of Ancient, Medieval and Modern India
- Understand education systems in India

UNIT I: INTRODUCTION TO CULTURE **9**

Culture, civilization, culture and heritage, general characteristics of culture, importance of culture in human literature, Indian Culture, Ancient India, Medieval India, Modern India **CO1**

UNIT II: INDIAN LANGUAGES AND LITERATURE **9**

Indian Languages and Literature – I: Languages and Literature of South India, – Indian Languagesand Literature – II: Northern Indian Languages & Literature **CO2**

UNIT III: RELIGION AND PHILOSOPHY **9**

Major religions practiced in India and Understanding their Philosophy – religious movements in Modern India (Selected movements only) **CO3**

UNIT IV: FINE ARTS IN INDIA (ART, TECHNOLOGY& ENGINEERING) 9

Indian Painting, Indian handicrafts, Music, divisions of Indian classic music, modern Indian music, Dance and Drama, Indian Architecture (ancient, medieval and modern), Science and Technology in India, development of science in ancient, medieval and modern India **CO4**

UNIT V: EDUCATION SYSTEM IN INDIA 9

Education in ancient, medieval and modern India, aims of education, subjects, languages, Scienceand Scientists of Ancient India, Science and Scientists of Medieval India, Scientists of Modern India **CO5**

TOTAL PERIODS: 45

REFERENCES:

1. Kapil Kapoor, "Text and Interpretation: The India Tradition",ISBN: 81246033375, 2005
2. "Science in Samskrit", Samskrita Bharti Publisher, ISBN 13: 978-8187276333, 2007
3. NCERT, "Position paper on Arts, Music, Dance and Theatre", ISBN 81-7450 494-X, 200
4. Narain, "Examinations in ancient India", Arya Book Depot, 1993
5. Satya Prakash, "Founders of Sciences in Ancient India", Vijay Kumar Publisher, 1989
6. M. Hiriyanna, "Essentials of Indian Philosophy", Motilal Banarsidass Publishers, ISBN 13: 978-8120810990, 2014

COURSE OUTCOMES

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

- **CO1** Understand philosophy of Indian culture.
- **CO2** Distinguish the Indian languages and literature.
- **CO3** Learn the philosophy of ancient, medieval and modern India.
- **CO4** Acquire the information about the fine arts in India.
- **CO5** Know the contribution of scientists of different eras.
- **CO6** Understand education systems in India

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	1	1	-	1	-	-	-
CO2	-	-	-	-	-	-	-	-	1	1	-	1	-	-	-
CO3	-	-	-	-	-	-	-	-	1	1	-	1	-	-	-
CO4	-	-	-	-	-	-	-	-	1	1	-	1	-	-	-
CO5	-	-	-	-	-	-	-	-	1	1	-	1	-	-	-
CO6	-	-	-	-	-	-	-	-	1	1		1	-	-	-

AD1008	SANGA TAMIL LITERATURE APPRECIATION	L	T	P	C
		2	0	0	0

OBJECTIVES:

The main learning objective of this course is to make the students an appreciation for:

1. Introduction to Sanga Tamil Literature.
2. ‘Agathinai’ and‘Purathinai’ in SangaTamil Literature.
3. ‘Attruppadai’ in SangaTamil Literature.
4. ‘Puranaanuru’ in SangaTamil Literature.
5. ‘Pathitrupaththu’ in SangaTamil Literature.

UNIT I: SANGA TAMIL LITERATURE – AN INTRODUCTION **9**

CO1

Introduction to Tamil Sangam–History of Tamil Three Sangams–Introduction to Tamil SangamLiterature–Special Branches in Tamil Sangam Literature- Tamil Sangam Literature’s GrammarTamil Sangam Literature’s parables.

UNIT II: ‘AGATHINAI’AND‘PURATHINAI’ **9**

CO2

Tholkappiyar’s Meaningful Verses–Three literature materials–Agathinai’s message- History of Culture from Agathinai– Purathinai–Classification–Mesaage to Society from Purathinai.

UNIT III: ‘ATTRUPPADAI’. **9**

CO3

AttruppadaiLiterature–Attruppadaiin‘Puranaanuru’-Attruppadaiin‘Pathitrupaththu’-Attruppadaiin ‘Paththupaattu’.

UNIT IV: ‘PURANAANURU’ **9**

CO4

Puranaanuru on Good Administration, Ruler and Subjects–Emotion & its Effect in Puranaanuru.

UNIT V: ‘PATHITRUPATHTHU’ **9**

CO5

Pathitrupaththuin‘Ettuthogai’–Pathitrupaththu’sParables–
Tamildynasty:Valor,Administration,Charity in Pathitrupaththu- Mesaage to Society from Pathitrupaththu.

TOTAL PERIODS: 45

REFERENCES:

1. Sivaraja Pillai, The Chronology oftheEarlyTamils,SagwanPress,2018.
2. HankHeifetz andGeorgeL. Hart, The Purananuru,Penguin Books,2002.
3. Kamil Zvelebil, The Smile of Murugan: OnTamil Literature of South India, Brill Academic Pub,1997.
4. GeorgeL. Hart, Poetsof theTamil Anthologies: AncientPoemsofLove andWar, Princeton University Press,2015.
5. XavierS.Thani Nayagam, Landscape and poetry:a study of nature in classical Tamil poetry,Asia Pub.House, 1967.

COURSE OUTCOMES

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

CO1 Appreciate and apply the messages in Sanga Tamil Literature in their life.

CO2 Differentiate ‘Agathinai’ and ‘Purathinai’in their personal and societal life.

CO3 Appreciate and apply the messages in‘ Attruppadai’ in their personal and societal life.

CO4 Appreciate and apply the messages in‘ Puranaanuru’ in their personal and societal life.

CO5 Appreciate and apply the messages in‘ Pathitrupaththu’ in their personal and societal life.

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	-	-	-	-	-	-	-	-	1	1	-	1	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
CO3	-	-	-	-	-	-	-	-	1	1	-	1	-	-	-
CO4	-	-	-	-	-	-	-	-	1	1	-	1	-	-	-
CO5	-	-	-	-	-	-	-	-	1	1	-	1	-	-	-