Dr. M.G.R.
EDUCATIONAL AND RESEARCH INSTITUTE
(Deemed to be University)
Maduravoyal, Chennai - 600 095. Tamilnadu. India.
(An ISO 9001 : 2015 Certified Institution)

FACULTY OF ENGINEERING AND TECHNOLOGY

OUTCOME BASED EDUCATION

Curriculum and Syllabus

B.Tech (Chemical Engineering)
Full Time
Regulations - 2022

Department of Chemical Engineering

Dr. M.G.R.
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VISION

Generating knowledge and developing technology through quality research in frontier areas of chemical engineering and interdisciplinary fields.

MISSION

- **M1:** To provide high quality education experience that will prepare graduates to assure leadership position within chemical and associated industries.
- **M2:** To attain global recognition in research and train students for meeting the challenging needs of chemical industries and the society
- **M3:** Fostering industry – academic relationship for mutual benefits and growth.

QUALITY POLICY

We wish to foster a chemical engineering program coupled with research strength to acquire innovation and next generation techniques.

PROGRAM EDUCATIONAL OBJECTIVES [PEO's]

Graduates will be able to:

- **PEO 1**: Graduates pursue profession in chemical & allied engineering
- **PEO 2**: Graduates work in diversified team
- **PEO 3**: Graduates will pursue higher education & research

PROGRAM OUTCOMES

- **PO1 : Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
- **PO2: Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- **PO3: Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

- **PO4: Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- **PO5: Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
- **PO6: The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- **PO7: Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- **PO8: Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- **PO9: Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- **PO10: Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- **PO11: Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- **PO12: Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES [PSO's]

- **PSO 1 :** Graduates will apply knowledge in physics, chemistry and biology in the field of transfer processes for effective separation and purification of petrochemicals, pharmaceuticals and health care products
- **PSO 2 :** Graduates will automate and control processes by applying mathematics, process control, instrumentation, simulation and process modelling.
- **PSO 3 :** Graduates will design equipment for modern science applications

PEO WITH MISSION STATEMENT

	M1	M2	M3
PEO1	3	2	3
PEO2	3	3	3
PEO3	2	3	3

PEO-PO

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PEO1	3	3	3	3	2	3	3	2	3	2	2	-
PEO2	3	3	2	1	1	1	2	-	-	1	1	2
PEO3	3	3	3	3	1	1	3	2	3	2	3	3

PEO-PSO

	PSO1	PSO2	PSO3
PEO1	2	3	1
PEO2	3	2	1
PEO3	3	1	3

Program Components

• Basic Science (Mathematics) include according to program	
Program Core theory	15
Program Core Laboratory	10
Program Elective	5
Open Elective	2
Open Lab	1
Management paper	1
Foreign Language	1
Audit course	2
Universal Human values	1
Inter disciplinary theory	3
Inter disciplinary Lab	2
ETL	10
Technical Skills	3
Soft skill	2
Project /mini project	3

I SEMESTER							
Course Code	**Course Title**	**Ty/Lb/ETL/IE**	**L**	**T/SLr**	**P/R**	**C**	**Category**
EBEN22001	Technical English	Ty	2	0/0	0/0	2	HS
EBMA22001	Mathematics –I	Ty	3	1/0	0/0	4	BS
EBPH22ET1	Engineering Physics	ETL	2	0/0	2/0	3	BS
EBCH22ET1	Engineering Chemistry	ETL	2	0/0	2/0	3	BS
EBEE22ET1	Basic Electrical & Electronics Engineering	ETL	2	0/0	2/0	3	ES
PRACTICALS*							
EBCC22I01	Orientation to Entrepreneurship & Project lab	IE	1	0/0	1/0	1	HS
EBCS22ET1	C Programming and MS office tools	ETL	1	0/0	2/0	2	ID

Credits Sub Total: 18

II SEMESTER							
Course Code	**Course Title**	**Ty/Lb/ETL/IE**	**L**	**T/SLr**	**P/R**	**C**	**Category**
EBMA22003	Mathematics –II	Ty	3	1/0	0/0	4	BS
EBPH22003	Bio Materials	Ty	3	0/0	0/0	3	BS
EBCH22002	Industrial Chemistry	Ty	3	0/0	0/0	3	BS
EBCT22001	Introduction to Chemical Engineering	Ty	3	0/0	0/0	3	PC
EBME22001	Engineering Graphics	Ty	2	0/0	2/0	3	ES
PRACTICALS*							
EBCC22I02	Communicative English Lab	IE	1	0/0	1/0	1	HS
EBCS22ET2	Python Programming	ETL	1	0/0	2/0	2	ID
EBCC22I03	Environmental Science(Audit Course)	IE	1	0/0	1/0	0	BS

Credits Sub Total: 19

III SEMESTER							
Course Code	**Course Title**	**Ty/Lb/ETL/IE**	**L**	**T/SLr**	**P/R**	**C**	**Category**
EBMA22007	Mathematics III For Chemical Engineers	Ty	3	1/0	0/0	4	BS
EBCT22002	Mechanical Operations	Ty	3	1/0	0/0	4	PC
EBCT22003	Chemical Process Calculation	Ty	3	0/0	0/0	3	PC
EBCS22ID1	Computer Application In Chemical Engineering	Ty	3	0/0	0/0	3	ID
EBCE22ID4	Environmental Engineering	Ty	3	0/0	0/0	3	ID
PRACTICALS*							
EBCC22ET1	Universal human values :Understanding harmony	ETL	1	0/0	2/0	2	HS
EBCT22L01	Water Analysis Lab	Lb	0	0/0	3/0	1	PC
EBCT22L02	Mechanical Operation Lab	Lb	0	0/0	3/0	1	PC
EBCS22IL3	Computer Programming Lab	Lb	0	0/0	3/0	1	ID
EBCT22ET1	Fertilizer Technology	ETL	2	0/0	2/0	3	PC

Credits Sub Total: 25

IV SEMESTER							
Course Code	**Course Title**	**Ty/Lb/ETL/IE**	**L**	**T/SLr**	**P/R**	**C**	**Category**
EBCT22004	Chemical Technology I	Ty	3	1/0	0/0	4	PC
EBCT22005	Chemical Engineering Thermodynamics I	Ty	3	1/0	0/0	4	PC
EBCT22006	Fluid Mechanics	Ty	3	0/0	0/0	3	PC
EBBT22ID1	Bio-Chemical Principles	Ty	3	0/0	0/0	3	ID
EBCC22I04/ EBCC22I05	The Indian Constitution/ The Indian Traditional Knowledge (Audit Course)	IE	2	0/0	0/0	0	HS
PRACTICALS*							
EBCT22L03	Food Analysis Lab	Lb	0	0/0	3/0	1	PC
EBCT22L04	Fluid Mechanics Lab	Lb	0	0/0	3/0	1	PC
EBCE22IL1	Environmental Engineering Lab	Lb	0	0/0	3/0	1	ID
EBBT22IL1	Biochemical Lab For Chemical Engineers	Lb	0	0/0	3/0	1	ID
EBCT22I01	Technical Skill 1	IE	0	0/0	3/0	1	SC
EBCC22I06	Soft Skill I (Employability Skills)	IE	0	0/0	2/0	1	SC

Credits Sub Total: 20

V SEMESTER							
Course Code	**Course Title**	**Ty/Lb /ETL/ IE**	**L**	**T/SLr**	**P/R**	**C**	**Category**
EBCT22007	Mass Transfer I	Ty	3	1/0	0/0	4	PC
EBCT22008	Chemical Engineering Thermodynamics II	Ty	3	1/0	0/0	4	PC
EBCT22009	Chemical Technology II	Ty	3	0/0	0/0	3	PC
EBCT22EXX	Programme Elective I	Ty	3	0/0	0/0	3	PE
EBXX22OEX	Open Elective I	Ty	3	0/0	0/0	3	ID
EBOL22I01	Online Course (NPTEL/SWAYAM/any MOOC approved by AICTE/UGC)	IE	1	0/0	1/0	1	ID
PRACTICALS*							
EBCT22L05	Process Simulation Software Lab	Lb	0	0/0	3/0	1	PC
EBCT22L06	Mass Transfer Lab	Lb	0	0/0	3/0	1	PC
EBCT22I02	Technical Skill 2	IE	0	0/0	3/0	1	SC
EBCT22ET2	Polymer Technology	ETL	2	0/0	2/0	3	PC

Credits Sub Total: 24

VI SEMESTER							
Course Code	**Course Title**	**Ty/Lb/ ETL/IE**	**L**	**T/SLr**	**P/R**	**C**	**Category**
EBCT22010	Mass Transfer II	Ty	3	1/0	0/0	4	PC
EBCT22011	Heat Transfer	Ty	3	0/0	0/0	3	PC
EBCT22012	Chemical Reaction Engineering I	Ty	3	0/0	0/0	3	PC
EBCT22EXX	Programme Elective II	Ty	3	0/0	0/0	3	PE
EBXX22OEX	Open Elective II	Ty	3	0/0	0/0	3	ID
PRACTICALS*							
EBCT22L07	Chemical Reaction Engineering Lab	Lb	0	0/0	3/0	1	PC
EBCT22L08	Heat Transfer Lab	Lb	0	0/0	3/0	1	PC
EBCC22I07	Soft Skill II (Qualitative and Quantitative Skills)	IE	0	0/0	2/0	1	SC
EBCT22I03	Technical Skill 3	IE	0	0/0	3/0	1	SC
EBCT22I04	Mini Project/Internship	IE	0	0/0	3/0	1	SC

Credits Sub Total: 21

VII SEMESTER							
Course Code	**Course Title**	**Ty/Lb/ETL/IE**	**L**	**T/SLr**	**P/R**	**C**	**Category**
EBCT22013	Safety in Chemical Process Industries	Ty	3	1/0	0/0	4	PC
EBCT22014	Process Control And Dynamics	Ty	3	0/0	0/0	3	PC
EBCT22015	Chemical Reaction Engineering II	Ty	3	0/0	0/0	3	PC
EBCT22016	Chemical Process Equipment Design	Ty	3	0/0	0/0	3	PC
EBCT22EXX	Programme Elective III	Ty	3	0/0	0/0	3	PE
PRACTICALS*							
EBXX22OLX	Open Lab	Lb	0	0/0	3/0	1	ID
EBCT22L09	Process Control Lab	Lb	0	0/0	3/0	1	PC
EBCT22L10	Chemical Process Equipment Design &Drawing Lab	Lb	0	0/0	3/0	1	PC
EBCT22I05	Project Phase – 1	IE	0	0/0	3/3	2	P
EBFL22IXX	Foreign Language	IE	2	0/0	1/0	1	HS

Credits Sub Total: 22

VIII SEMESTER							
Course Code	**Course Title**	**Ty/Lb/ETL/IE**	**L**	**T/SLr**	**P/R**	**C**	**Category**
EBCC22ID3	Total Quality Management	Ty	3	0/0	0/0	3	ID
EBCT22EXX	Programme Elective IV	Ty	3	0/0	0/0	3	PE
EBCT22EXX	Programme Elective V	Ty	3	0/0	0/0	3	PE
PRACTICALS*							
EBCT22L11	Project Phase – II	Lb	0	0/0	12/12	8	P

Credits Sub Total: 17

Credit Summary

Semester : 1 : 18
Semester : 2 : 19
Semester : 3 : 25
Semester : 4 : 20
Semester : 5 : 24
Semester : 6 : 21
Semester : 7 : 22
Semester : 8 : 17

Total Credits : 166

PROGRAMME ELECTIVES I							
S.NO	**SUBJECT CODE**	**SUBJECT NAME**	**Ty / Lb/ ETL/IE**	**L**	**T/ SLr**	**P/R**	**C**
1	EBCT22E01	Food Technology	Ty	3	0/0	0/0	3
2	EBCT22E02	Industry Pollution Prevention and Control	Ty	3	0/0	0/0	3
3	EBCT22E03	Chemistry of Polymer and Composite Materials	Ty	3	0/0	0/0	3

PROGRAMME ELECTIVES II							
S.NO	**SUBJECT CODE**	**SUBJECT NAME**	**Ty/ Lb/ ETL/IE**	**L**	**T/ SLr**	**P/R**	**C**
1	EBCT22E04	Green Chemistry and Engineering	Ty	3	0/0	0/0	3
2	EBCT22E05	Modern Separation Processes	Ty	3	0/0	0/0	3
3	EBCT22E06	Renewable Energy Engineering	Ty	3	0/0	0/0	3

PROGRAMME ELECTIVES III							
S.NO	**SUBJECT CODE**	**SUBJECT NAME**	**Ty/ Lb/ ETL/IE**	**L**	**T/ SLr**	**P/R**	**C**
1	EBCT22E07	Computational Fluid Dynamics	Ty	3	0/0	0/0	3
2	EBCT22E08	Frontiers Of Chemical Engineering	Ty	3	0/0	0/0	3
3	EBCT22E09	Industrial Management	Ty	3	0/0	0/0	3

PROGRAMME ELECTIVES IV &V							
S.NO	**SUBJECT CODE**	**SUBJECT NAME**	**Ty/ Lb/ ETL/IE**	**L**	**T/ SLr**	**P/R**	**C**
1	EBCT22E10	Drugs And Pharmaceutical Technology	Ty	3	0/0	0/0	3
2	EBCT22E11	Professional Ethics In Engineering	Ty	3	0/0	0/0	3
3	EBCT22E12	Industrial Instrumentation	Ty	3	0/0	0/0	3
4	EBCT22E13	Process Optimization	Ty	3	0/0	0/0	3

Note:

Ty/Lb/ETL/IE: Theory/Lab/Embedded Theory and lab/Internal evaluation L/T/SLr/P/R/C: Lecture/Tutorials/Supervised Learning/Practical/Research/Credit HS:Humanities and Social Science,ES:Engg.Science.BS:Basic Science,PC:Program core, PE:Program Elective,OE:Open Elective,P:Project, SC: Skill Component

OPEN ELECTIVE OFFERED BY OTHER DEPARTMENT TO CHEMICAL ENGINEERING STUDENTS

COMPUTER SCIENCE AND ENGINEERING

S.NO	SUBJECT CODE	SUBJECT NAME	Ty/Lb/ETL	L	T/SLr	P/R	C
1	EBCS22OE1	Cyber security & Forensics	Ty	3	0/0	0/0	3
2	EBCS22OE2	Artificial Intelligence	Ty	3	0/0	0/0	3
3	EBCS22OE3	Data Base Concepts	Ty	3	0/0	0/0	3
4	EBCS22OE4	Software Engineering	Ty	3	0/0	0/0	3

INFORMATION TECHNOLOGY

S.NO	SUBJECT CODE	SUBJECT NAME	Ty/Lb/ETL	L	T/SLr	P/R	C
1	EBIT22OE1	Web Design	Ty	3	0/0	0/0	3
2	EBIT22OE 2	Digital Marketing	TY	3	0/0	0/0	3
3	EBIT22OE3	Cyber Security Essentials	Ty	3	0/0	0/0	3
4	EBIT22OE4	Introduction to Multimedia	Ty	3	0/0	0/0	3

ELECTRONICS AND COMMUNICATION ENGINEERING

S.NO	SUBJECT CODE	SUBJECT NAME	Ty/Lb/ETL	L	T/SLr	P/R	C
1	EBEC22OE1	Internet of Things and its Applications	Ty	3	0/0	0/0	3
2	EBEC22OE2	Cellular Mobile communication	Ty	3	0/0	0/0	3
3	EBEC22OE3	Satellite and its Applications	Ty	3	0/0	0/0	3
4	EBEC22OE4	Fundamentals of Sensors	Ty	3	0/0	0/0	3
5	EBEC22OE5	Microprocessor Based System Design	Ty	3	0/0	0/0	3
6	EBEC22OE6	Industry 4.0 Concepts	Ty	3	0/0	0/0	3

ELECTRICAL AND ELECTRONICS ENGINEERING

S.NO	SUBJECT CODE	SUBJECT NAME	Ty/Lb/ETL	L	T/SLr	P/R	C
1	EBEE22OE1	Electrical Safety for Engineers	Ty	3	0/0	0/0	3
2	EBEE22OE2	Energy Conservation Techniques	Ty	3	0/0	0/0	3
3	EBEE22OE3	Electric Vehicle Technology	Ty	3	0/0	0/0	3
4	EBEE22OE4	Biomedical Instrumentation	Ty	3	0/0	0/0	3
5	EBEE22OE5	Industrial Instrumentation	Ty	3	0/0	0/0	3
6	EBEE22OE6	Solar Energy Conversion System	Ty	3	0/0	0/0	3
7	EBEE22OE7	Wind Energy Conversion System	Ty	3	0/0	0/0	3
8	EBEE22OE8	Energy Storage Technology	Ty	3	0/0	0/0	3
9	EBEE22OE9	Electrical Machines	Ty	3	0/0	0/0	3

MECHANICAL ENGINEERING

S.NO	SUBJECT CODE	SUBJECT NAME	Ty/Lb/ ETL	L	T/ SL r	P/R	C
1	EBME22OE1	Industrial Engineering	Ty	3	0/0	0/0	3
2	EBME22OE2	Refrigeration and Air conditioning	Ty	3	0/0	0/0	3
3	EBME22OE3	Automobile Engineering	Ty	3	0/0	0/0	3
4	EBME22OE4	Industrial Robotics	Ty	3	0/0	0/0	3
5	EBME22OE5	Sustainable Energy	Ty	3	0/0	0/0	3
6	EBME22OE6	Composite Materials	Ty	3	0/0	0/0	3
7	EBME22OE7	Industry 4.0	Ty	3	0/0	0/0	3
8	EBME22OE8	Virtual and Augmented Reality	Ty	3	0/0	0/0	3

CIVIL ENGINEERING

S.NO	SUBJECT CODE	SUBJECT NAME	Ty/Lb/ETL	L	T/SLr	P/R	C
1	EBCE22OE1	Water Pollution and Its management	Ty	3	0/0	0/0	3
2	EBCE22OE2	Air Pollution Control	Ty	3	0/0	0/0	3
3	EBCE22OE3	Green Building and Vastu Concepts	Ty	3	0/0	0/0	3
4	EBCE22OE4	Climate Change and Sustainable Development	Ty	3	0/0	0/0	3
5	EBCE22OE5	Intelligent Transportation Systems	Ty	3	0/0	0/0	3
6	EBCE22OE6	Environment, Health and Safety in Industries	Ty	3	0/0	0/0	3
7	EBCE22OE7	Industrial Pollution Prevention and Cleaner Production	Ty	3	0/0	0/0	3
8	EBCE22OE8	Fundamentals of nanoscience	Ty	3	0/0	0/0	3

BIOTECHNOLOGY

S.NO	SUBJECT CODE	SUBJECT NAME	Ty/Lb/ETL	L	T/SLr	P/R	C
1	EBBT22OE1	Food and Nutrition	Ty	3	0/0	0/0	3
2	EBBT22OE2	Human Physiology	Ty	3	0/0	0/0	3
3	EBBT22OE3	Clinical Biochemistry	Ty	3	0/0	0/0	3
4	EBBT22OE4	Bioprocess Principles	Ty	3	0/0	0/0	3
5	EBBT22OE5	Biosensors and Biomedical Devices in Diagnostics	Ty	3	0/0	0/0	3
6	EBBT22OE6	Basic Bioinformatics	Ty	3	0/0	0/0	3

Dr APJ Abdul Kalam Center For Research

S.NO	SUBJECT CODE	SUBJECT NAME	Ty/Lb/ETL	L	T/SLr	P/R	C
1	EBMG22OE1	Technical Entrepreneurship	Ty	3	0/0	0/0	3
2	EBMG22OE2	Advanced Program in Entrepreneurship	Ty	3	0/0	0/0	3

OPEN LAB OFFERED BY OTHER DEPARTMENT TO CHEMICAL ENGINEERING STUDENTS

COMPUTER SCIENCE AND ENGINEERING

S.NO	SUBJECT CODE	SUBJECT NAME	Ty/Lb /ETL	L	T/S Lr	P/R	C
1	EBCS22OL1	Artificial Intelligence Lab	Lb	0	0/0	3/0	1
2	EBCS22OL2	PHP/My SQL Programming Lab	Lb	0	0/0	3/0	1
3	EBCS22OL3	Database Lab	Lb	0	0/0	3/0	1

INFORMATION TECHNOLOGY

S.NO	SUBJECT CODE	SUBJECT NAME	Ty/Lb /ETL	L	T/SL r	P/R	C
1	EBIT22OL1	Visual Programming Lab	Lb	0	0/0	3/0	1
2	EBIT22OL2	Web Design Lab	Lb	0	0/0	3/0	1
3	EBIT22OL3	Digital content creation Lab	Lb	0	0/0	3/0	1
4	EBIT22OL4	Computer Network Lab	Lb	0	0/0	3/0	1
5	EBIT22OL5	PHP/My SQL Programming Lab	Lb	0	0/0	3/0	1

ELECTRONICS AND COMMUNICATION ENGINEERING

S.NO	SUBJECT CODE	SUBJECT NAME	Ty/ Lb/ ETL	L	T/S Lr	P/R	C
1	EBEC22OL1	Sensors and IoT Lab	Lb	0	0/0	3/0	1
2	EBEC22OL2	Robotics Control Lab	Lb	0	0/0	3/0	1
3	EBEC22OL3	Basics of MATLAB	Lb	0	0/0	3/0	1

ELECTRICAL AND ELECTRONICS ENGINEERING

S.NO	SUBJECT CODE	SUBJECT NAME	Ty/ Lb/ ETL	L	T/S Lr	P/R	C
1	EBEE22OL1	Transducer Lab	Lb	0	0/0	3/0	1
2	EBEE22OL2	PLC and SCADA Lab	Lb	0	0/0	3/0	1
3	EBEE22OL3	Electrical Maintenance Lab	Lb	0	0/0	3/0	1
4	EBEE22OL4	Power Electronics Lab	Lb	0	0/0	3/0	1
5	EBEE22OL5	Bio Medical Instrumentation Lab	Lb	0	0/0	3/0	1
6	EBEE22OL6	Electrical Machines Lab	Lb	0	0/0	3/0	1

MECHANICAL ENGINEERING

S.NO	SUBJECT CODE	SUBJECT NAME	Ty/Lb /ETL	L	T/S Lr	P/R	C
1	EBME22OL1	Internal Combustion Engines and Steam Lab	Lb	0	0/0	3/0	1
2	EBME22OL2	Computer Aided Design and Simulation Lab	Lb	0	0/0	3/0	1
3	EBME22OL3	Engineering Metrology Lab	Lb	0	0/0	3/0	1
4	EBME22OL4	Automation Lab	Lb	0	0/0	3/0	1
5	EBME22OL5	Virtual and Augmented Reality Lab	Lb	0	0/0	3/0	1

CIVIL ENGINEERING

S.NO	SUBJECT CODE	SUBJECT NAME	Ty/ Lb/ ETL	L	T/S Lr	P/R	C
1	EBCE22OL1	Building Drawing Practice using Auto CADD	Lb	0	0/0	3/0	1
2	EBCE22OL2	Geographical Information System And Mapping Lab	Lb	0	0/0	3/0	1
3	EBCE22OL3	Environmental Engineering Laboratory	Lb	0	0/0	3/0	1

BIOTECHNOLOGY

S.NO	SUBJECT CODE	SUBJECT NAME	Ty/Lb/ETL	L	T/S Lr	P/R	C
1	EBBT22OL1	Basic Biochemistry Lab	Lb	0	0/0	3/0	1
2	EBBT22OL2	Basic Bioprocess Lab	Lb	0	0/0	3/0	1
3	EBBT22OL3	Basic Microbiology Lab	Lb	0	0/0	3/0	1
4	EBBT22OL4	Basic Bioinformatics Lab	Lb	0	0/0	3/0	1

OPEN LABS OFFERED TO OTHER DEPARTMENT STUDENTS

OPEN LAB							
S.NO.	**SUBJECT CODE**	**SUBJECT NAME**	**Ty/ Lb/ ETL/IE**	**L**	**T/ SLr**	**P/R**	**C**
1	EBCT22OL1	Chemical Separation Lab	Lb	0	0/0	3/0	1
2	EBCT22OL2	Chemical Composition Analysis Lab	Lb	0	0/0	3/0	1
3	EBCT22OL3	Alternate Fuel Lab	Lb	0	0/0	3/0	1
4	EBCT22OL4	Food Testing Laboratory	Lb	0	0/0	3/0	1

OPEN ELELCTIVES OFFERED TO OTHER DEPARTMENT STUDENTS

OPEN ELECTIVES							
S.NO.	**SUBJECT CODE**	**SUBJECT NAME**	**Ty/ Lb/ ETL/IE**	**L**	**T/ SLr**	**P/R**	**C**
1.	EBCT22OE1	Fundamentals of Nanoscience	Ty	3	0/0	0/0	3
2.	EBCT22OE2	Electrochemical Engineering	Ty	3	0/0	0/0	3
3.	EBCT22OE3	Alternative Fuels And Energy System	Ty	3	0/0	0/0	3
4.	EBCT22OE4	Petrochemical Unit Processes	Ty	3	0/0	0/0	3
5.	EBCT22OE5	Principles of Desalination Technologies	Ty	3	0/0	0/0	3
6.	EBCT22OE6	Piping Design Engineering	Ty	3	0/0	0/0	3
7.	EBCT22OE7	E- Waste Management	Ty	3	0/0	0/0	3

FOREIGN LANGUAGE							
S.NO.	**SUBJECT CODE**	**SUBJECT NAME**	**Ty/ Lb/ ETL/IE**	**L**	**T/ SLr**	**P/R**	**C**
1	EBFL22I01	FRENCH	IE	2	0/0	1/0	1
2	EBFL22I02	GERMAN	IE	2	0/0	1/0	1
3	EBFL22I03	JAPANESE	IE	2	0/0	1/0	1
4	EBFL22I04	ARABIC	IE	2	0/0	1/0	1
5	EBFL22I05	CHINESE	IE	2	0/0	1/0	1
6	EBFL22I06	RUSSIAN	IE	2	0/0	1/0	1
7	EBFL22I07	SPANISH	IE	2	0/0	1/0	1

Table 1:Credit Distribution Format

Components of Curriculum and Credit distribution for E&T Programmes

Course Component	Description	No. of Courses	Credits	Total	Credit Weightage (%)	Contact hours
Basic Science	Theory	5	18	24	15	390
	Lab	1	0			
	ETL	2	6			
Engineering Science	Theory	1	3	6	4	220
	Lab	0	0			
	ETL	1	3			
Humanities and Social Science	Theory	1	2	9	5	195
	Lab	3	5			
	ETL	1	2			
Program Core	Theory	16	55	71	42	1055
	Lab	10	10			
	ETL	2	6			
Program Electives		5	15	15	9	225
Open Elective	Theory	2	6			
	Lab	1	1	7	4	105
Inter-disciplinary	Theory	5	13			
	Lab	3	3	21	12	255
	ETL	2	4			
Skill Component		6	6	6	3	95
Internship/Project		2	10	10	6	250
Others if any		-	-	-	-	
	TOTAL	**68**	**166**	**166**	**100**	**2790**

Table 2:

Revision/modification done in syllabus content:

S.No	Course(Subject) Code	Course (Subject) Name	Concept/ topic if any, removed in current curriculum	Concept/topic added in the new curriculum	% of Revision/ Modification done
1.	EBCH22002	Industrial Chemistry	Engineering Chemistry - I	Added in the semester I	90%
2.	EBCS22ET1	C Programming and MS office tools	Basic Engineering Workshop	Added in the semester I	90%
3.	EBCT22001	Introduction to Chemical Engineering	Engineering Chemistry - II	New programme core is introduce in the semester II as Introduction to Chemical Engineering to impart basic knowledge of Chemical Engineering	100%
4.	EBPH22003	Biomaterials	Engineering Physics	Introduced specifically for department of Chemical Engineering and Biotechnology	100%
5.	EBCT22L01	Water Analysis Lab	Technical Analysis Lab I	Water Analysis Lab has been in introduce in semester III	100%
6.	EBCT22L03	Food Analysis Lab	Technical Analysis II	Introduced in semester IV	100%
7.	EBOL22I01	Online Course (NPTEL/SWAYAM/any MOOC approved by AICTE/UGC).	-	Added has Inter Disciplinary subject with internal evaluation	100%
8.	EBCT22L05	Process Simulation Software Lab	CADCHEM	Any advanced Chemical engineering software will be imparted	100%
9.	Elective EBCT22E05/ EBCT22E04/ EBCT22E07/ EBCT22E12/	Modern Separation Processes, Green Chemistry and Engineering, Computational Fluid Dynamics, Industrial Instrumentation newly added			20%

Table3:
List of New courses/ value added courses//life skills/Electives/interdisciplinary /courses focusing on employability/entrepreneurship/skill development.

S. No	New courses(Subjects)	Value added courses	Life skill	Electives	Inter Disciplinary	Focus on employability/entrepreneurship/skill development.
1	BCT22008/ Basic Chemical Engineering	BES22L01/ C Programming and MS office tools	BEN22ET1/ Communication Lab	-	BES22ET3/ Orientation to Entrepreneurship	Employability
2		BES22L02/ Python Programming	BEN22SK1/ Soft Skill I (Career & Confidence Building)	-	BPH22003/ Bio Materials	Employability
3		BHS20ET5/ Human Value	BEN22SK2/ Soft Skill II (Qualitative and Quantitative Skills)	-		Skill development

SEMESTER - I

Subject Code	Subject Name :TECHNICAL ENGLISH	Ty/Lb/ETL/IE	L	T/SLr	P/R	C
EBEN22001	Prerequisite : Higher Sec.English	Ty	2	0/0	0/0	2

C: Credits, L: Lecture, T: Tutorial, SLr: Supervised Learning, P: Problem / Practical
R: Research, Ty/Lb/ETL/IE: Theory /Lab/Embedded Theory and Lab/Internal Evaluation

OBJECTIVES

To refresh and stimulate students' English learning through Content Integrated Language Learning to have an in-depth understanding of the components of English language and its use in communication that they are competent in inter-personal and academic communication for a successful career.

COURSE OUTCOMES (Cos)

Students completing this course were able to

CO1	Refresh and stimulate their English learning through Content Integrated Language Learning
CO2	Have an in-depth understanding of the components of English language and its use in communication.
CO3	Strengthen their vocabulary and syntactic knowledge for use in academic and technical communication
CO4	Learn to negotiate meaning in inter-personal and academic communication for a successful career
CO5	Engage in organized academic and professional writing for life-long learning and research

Mapping of Course Outcome with Program Outcome (POs)

Cos/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	-	1	1	3	1	1	2	3	3	1	3
CO2	-	1	-	2	3	2	1	1	3	3	-	3
CO3	1	1	1	1	2	1	-	2	3	3	1	3
CO4	1	2	1	1	3	-	1	-	2	2	1	2
CO5	1	2	1	-	2	1	-	1	3	3	1	3

COs/PSOs	PSO1	PSO2	PSO3	PSO4	
CO1	3	-	1	1	
CO2	3	-	1	1	
CO3	3	2	1	1	
CO4	3	2	1	1	
CO5	3	2	1	1	

3/2/1 Indicates Strength Of Correlation, 3 – High, 2- Medium, 1- Low

Category	Basic Science	Engineering Science	Humanities and social Science	Program Core	Program elective	Open Elective	Inter Disciplinary	Skill Component	Practical /Project
			√						

Subject Code	Subject Name : TECHNICAL ENGLISH	Ty/Lb/ ETL/IE	L	T/SLr	P/R	C
EBEN22001	Prerequisite : Higher Sec.English	Ty	2	0/0	0/0	2

UNIT I VOCABULARY DEVELOPMENT **6Hrs**

Affixes: prefixes and suffixes and word formation–synonyms and antonyms-nominal compounds, expanding using numbers and approximation - preposition, prepositional phrases, preposition + relative pronoun-adjective: degrees of comparison, formation of adjectives, irregular comparatives- Infinitive and Gerunds

UNIT II GRAMMAR **6Hrs**

Tenses- auxiliary and modal –voice: active, passive and impersonal passive - Questions: Wh-pattern, Yes/no questions, tag questions – adverbs and adverbial clauses- 'If' clause, 'cause and effect','purpose'- Concord: subject-verb agreement

UNIT III READING **6Hrs**

Comprehension: extracting relevant information from the text, by skimming and scanning and inferring, identifying lexical and contextual meaning for specific information, identifying the topic sentence and its role in each paragraph, comprehension exercises - Note - making - Précis writing-instructions, suggestions and recommendations.

UNIT IV WRITING **6Hrs**

Jumbled sentences- paragraph writing coherence devices- discourse markers.Essay writing- Letter writing, Informal and formal: seeking permission to undergo practical training, letter to an editor of a newspaper complaining about civic problems and suggesting suitable solutions

UNIT V VISUAL AIDS IN COMMUNICATION **6Hrs**

Interpretation of diagrams - tables, flow charts, pie charts and bar charts, and their use in Business reports

Total no. of Periods: 30Hrs

TEXT BOOK

1. *Panorama_: Content Integrated Language Learning for Engineers, M. Chandrasena Rajeswaran&R.Pushkala,, Vijay Nicole Imprints Pvt. Ltd., Chennai*

REFERENCES

1. *Bhatnagar & Bhatnagar, Communicative English for Engineers and Professionals, Pearson*
2. *Wren and Martin: Grammar and Composition, Chand & Co, 2006*
3. *https://learnenglish.britishcouncil.org*
4. *www.better-english.com/grammar/preposition.*

Subject Code: EBMA22001	Subject Name :MATHMATICS-I	Ty/Lb/ETL/IE	L	T/S.Lr	P/R	C
	Prerequisite: Higher secondary Mathematics	Ty	3	1/0	0/0	4

L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits
Ty/Lb/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES :

- Apply the Basic concepts in Algebra
- Use the Basic concepts in Matrices
- Identify and solve problems in Trigonometry
- Understand the Basic concepts in Differentiation
- Apply the Basic concepts in Functions of Several variables

COURSE OUTCOMES (COs) :

CO1	Find the summation of given series of binomial ,exponential and logarithmic
CO2	Transform a non-diagonal matrix into an equivalent diagonal matrix using orthogonal transformation
CO3	Find the expansion of trigonometric function into an infinite series and separate real and imaginary parts
CO4	Find the maxima and minima of the given function
CO5	Evaluate the partial/total differentiation and maxima/minima of function of several variable

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	2	1	2	2	3	3	1	3
CO2	3	3	1	2	3	2	1	2	3	1	2	3
CO3	3	3	1	2	2	3	1	1	2	3	2	1
CO4	3	2	2	2	1	2	2	2	2	3	2	2
CO5	3	3	1	2	1	1	2	1	2	2	1	3

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3
CO2	3	3	3	3
CO3	3	3	3	3
CO4	3	3	3	3
CO5	3	3	3	3

3/2/1 Indicates Strength Of Correlation, 3 – High, 2- Medium, 1- Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical /Project			
	√											

Subject Code : UBMA22001	Subject Name : MATHEMATICS – I	Ty/Lb/ETL/IE4	L	T/SLr	P/R	C
	Prerequisite : None	Ty	3	1/0	0/0	4

UNIT I ALGEBRA 12Hrs

Binomial, Exponential, Logarithmic Series (without proof of theorems) – Problems on Summation, Approximation and Coefficients.

UNIT II MATRICES 12Hrs

Characteristic equation – Eigen values and Eigen vectors of a real matrix – Properties of Eigen values – Cayley - Hamilton theorem(without proof) – Orthogonal reduction of a symmetric matrix to Diagonal form.

UNIT III TRIGONOMETRY 12Hrs

Expansions of Sin n□, Cos n□ in powers of Sin□ and Cos□ – Expansion of Tan n□ – Expansions of Sin^n□ and Cos^n□ in terms of Sines and Cosines of multiples of □ – Hyperbolic functions – Separation into real and imaginary parts.

UNIT IV DIFFERENTIATION 12Hrs

Basic concepts of Differentiation – Elementary differentiation methods – Parametric functions – Implicit function –Leibnitz theorem(without proof) – Maxima and Minima – Points of inflection.

UNIT V FUNCTIONS OF SEVERAL VARIABLES 12Hrs

Partial derivatives – Total differential – Differentiation of implicit functions – Taylor's expansion – Maxima and Minima by Lagrange's Method of undetermined multipliers – Jacobians.

Total no. of Hours: 60Hrs

TEXT &REFERENCE BOOKS:

1) *Kreyszig E., Advanced Engineering Mathematics (10^{th} ed.), John Wiley & Sons, (2011).*

2) *Grewal B.S., Higher Engineering Mathematics, Khanna Publishers, (2012).*

3) *John Bird, Basic Engineering Mathematics (5^{th} ed.), Elsevier Ltd, (2010).*

4) *Veerarajan T., Engineering Mathematics (for first year), Tata McGraw Hill Publishing Co., (2008).*

5) *P.Kandasamy, K.Thilagavathy and K. Gunavathy, Engineering Mathematics Vol. I (4^{th} Revised ed.),S.Chand& Co., Publishers, New Delhi (2000).*

6) *John Bird, Higher Engineering Mathematics (5^{th} ed.), Elsevier Ltd, (2006).*

Subject Code EBPH22ET1	Subject Name :ENGINEERING PHYSICS	Ty/Lb/ ETL/IE	L	T/SLr	P/R	C
	Prerequisite :Higher Sec. Physics	ETL	2	0/0	2/0	3

C: Credits, L: Lecture, T: Tutorial, SLr: Supervised Learning, P: Problem / Practical
R: Research, Ty/Lb/ETL/IE: Theory /Lab/Embedded Theory and Lab/Internal Evaluation

OBJECTIVES

- Outline the relation between Science, Engineering & Technology.
- Demonstrate competency in understanding basic concepts.
- Apply fundamental laws of Physics in Engineering & Technology.
- To identify & solve problems using physics concepts.
- Produce and present activities associated with the course through effective technical communication

COURSE OUTCOMES (Cos)

Students completing this course were able to

CO1	Demonstrate competency in understanding basic concepts.
CO2	Utilize scientific methods for formal investigations & demonstrate competency with experimental methods and verify the concept to content knowledge.
CO3	Identify and provide solutions for engineering problems.
CO4	Relate the technical concepts to day to day life and to practical situations.
CO5	Think analytically to interpret concepts.

Mapping of Course Outcome with Program Outcome (POs)

Cos/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1	2	2	2	1		1	2		1
CO2	3	3	2	2	2	2	1		2	2	1	1
CO3	3	3	3	2	2	2	1	1	1	2	1	2
CO4	3	3	2	2	1	2	2	1	2	2	1	2
CO5	3	3	2	1	1	2	1	2	1	2	1	1

COs/PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	1
CO2	3	2	1	1
CO3	3	2	1	1
CO4	3	2	1	1
CO5	3	2	1	1

3/2/1 Indicates Strength Of Correlation, 3 – High, 2- Medium, 1- Low

Category	Basic Science	Engineering Science	Humanities and social Science	Program Core	Program elective	Open Elective	Inter Disciplinary	Skill Component	Practical /Project
	√								

Subject Code EBPH22ET1	Subject Name : ENGINEERING PHYSICS	Ty/Lb/ ETL/IE	L	T/ SLr	P/R	C
	Prerequisite : Higher Sec. Physics	ETL	2	0/0	2/0	3

UNIT I PROPERTIES OF MATTER 12Hrs

Shafts – Solid & Hollow Shafts – Bending moment – Youngs Modulus Determination -I form of girders. viscosity - flow of liquid through a narrow tube: Poiseuille's law - Ostwald`s viscometer – Lubrication

Lab Component – 1. Torsional Pendulum – Determination of Rigidity Modulus

2. Coefficient of Viscosity determination using Poiseuille's Method

UNIT II ACOUSTICS & ULTRASONICS 12Hrs

Fundamentals of acoustics - reverberation- reverberation time - factors affecting acoustics. Ultrasonics -Production of ultrasonic waves - detection of ultrasonic waves+ - acoustic grating - application of ultrasonic waves.

Lab Component – 3. Ultrasonic Velocity Determination

UNIT III WAVE OPTICS 12Hrs

Huygen`s principle - interference of light – wave front splitting and amplitude – air wedge - Newton`s rings - Michelson interferometer and its applications - Fraunhofer diffraction from a single slit - diffraction grating

Lab Component – 4. Spectrometer – Grating

UNIT IV LASER 12Hrs

Laser principle and characteristics - amplification of light by population inversion - properties of laser beams: mono-chromaticity, coherence, directionality and brightness - different types of lasers - Ruby laser-Nd-YAG laser-He-Ne laser-CO_2 laser - semiconductor laser - applications of lasers in science, engineering and medicine.

Lab Component – 5. Determination of Wavelength of the given Laser source

UNIT V FIBER OPTIC COMMUNICATION 12Hrs

Total Internal Reflection – Propagation of Light in Optical Fibers – Numerical aperture and Acceptance Angle – Types of Optical Fibers (material, refractive index, mode) – Fiber Optical Communication system (Block diagram) – Attenuation–Transmitter, Receiver, Dispersion, Modulation/Demodulation Advantages of Fiber Optical Communication System – IMT, PMT, Wavelength Modulated & Polarization Modulated Sensors – Endoscope Applications.

Lab Component – 6. Determination of Numerical Aperture of Optical Fiber

.

Total No of Hours: 60Hrs

TEXT BOOKS

1. *Brijlal, M. N. Avadhanulu & N. Subrahmanyam, Text Book of Optics, S. Chand Publications, 25th edition, 2012*
2. *R. Murugeshan, Electricity and Magnetism, S.Chand Publications, 10th edition, 2017*
3. *R. Murugeshan & Kiruthiga Sivaprasath, Modern Physics, S.Chand Publications, 2016*

REFERENCE BOOKS

1. Dr. Senthil Kumar Engineering Physics I VRB Publishers, 2016
2. N Subrahmanyam & Brijlal, Waves and Oscillations, Vikas Publications, New Delhi,1988
3. N Subrahmanyam & Brijlal, Properties of Matter, S. Chand Co., New Delhi, 1982
4. N Subrahmanyam & Brijlal, Text book of Optics, S. Chand Co., New Delhi, 1989
5. R. Murugeshan, Electricity and Magnetism, S. Chand & Co., New Delhi, 1995
6. Thygarajan K & Ajay Ghatak, Laser Theory and Applications, Macmillan, New Delhi, 1981
7.

Subject Code EBCH22ET1	Subject Name ENGINEERING CHEMISTRY	Ty/Lb/ ETL/IE	L	T/SLr	P/R	C
	Prerequisite :Higher Sec. Chemistry	ETL	2	0/0	2/0	3

C: Credits, L: Lecture, T: Tutorial, SLr: Supervised Learning, P: Problem / Practical
R: Research, Ty/Lb/ETL/IE: Theory /Lab/Embedded Theory and Lab/Internal Evaluation

OBJECTIVES

- To deduce practical application of theoretical concepts
- To provide and insight into fundamental concepts of chemical thermodynamics
- To articulate the water treatment methods
- To impart the knowledge in electrical conductance and EMF
- To create awareness about the modern Nano composites along with concepts of polymers
- To introduce analytical tools for characterization techniques.

COURSE OUTCOMES (Cos)

Students completing this course were able to

CO1	Apply relevant instrumentation techniques to solve complex problems
CO2	Recall the fundamentals and demonstrate by understanding the first principles of Engineering sciences.
CO3	Examine the appropriate techniques to interpret data to provide valid conclusion
CO4	Demonstrate the collaboration of science and Engineering to recognize the need for life long learning.
CO5	Analyse the impact of contextual knowledge to access the health and society issues.

Mapping of Course Outcome with Program Outcome (POs)

Cos/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3		3	3	3				2			
CO2	3	3				3						3
CO3	3		2	3								
CO4	3	3		3				3				3
CO5	3					2	3	2				3

COs/PSOs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	-	3	3	
CO2	3	-	2	3	
CO3	3	-	3	3	
CO4	3	-	3	3	
CO5	3	-	3	3	

3/2/1 Indicates Strength Of Correlation, 3 – High, 2- Medium, 1- Low

Category	Basic Science	Engineering Science	Humanities and social Science	Program Core	Program elective	Open Elective	Inter Disciplinary	Skill Component	Practical /Project
	√								

Subject Code : EBCH22ET1	Subject Name : ENGINEERING CHEMISTRY	Ty/Lb /ETL/IE	L	T/ SLr	P/R	C
	Prerequisite : None	ETL	2	0/0	2/0	3

UNIT –I CHEMICAL THERMODYNAMICS 12Hrs

Introduction, Terminology in thermodynamics –System, Surrounding, State and Path functions, Extensive and intensive properties. Laws of thermodynamics – I and II laws-Need for the II law. Enthalpy, Entropy, Gibbs free energy, Helmholtz free energy - Spontaneity and its criteria. Maxwell relations, Gibbs -Helmholtz equation (relating E & A) and (relating H & G).

UNIT -II TECHNOLOGY OF WATER 12Hrs

Water quality parameters – Definition and expression. Analysis of water – alkalinity, hardness and its determination (EDTA method only). Boiler feed water and Boiler Troubles-Scales and sludges, Caustic embrittlement, Priming and Foaming and Boiler corrosion. Water softening processes – Internal conditioning,external conditioning – Demineralization methods. Desalination processes-RO and Electrodialysis.

Lab Component-1. Analyze the water quality parameters for the given water sample.

UNIT -III ANALYTICAL AND CHARACTERIZATION TECHNIQUES 12Hrs

Chromatographic techniques – column, thin layer and paper. Instrumentation-working with block diagram- UV-Visible Spectroscopy , IR Spectroscopy , Scanning electron microscope ,Transmission electron microscope.

Lab Component-2.Determination of Rf values of various components using thin layer chromatography.

3. Compute and interpret the structures of the given molecules using Chem Draw.

UNIT – IV ELECTROCHEMISTRY 12Hrs

Conductance – Types of conductance and its Measurement. Electrodes and electrode potential, Nernst equation – EMF measurement and its applications-Electrochemical series- Types of electrodes- Reference electrodes-Standard hydrogen electrode- Saturated calomel electrode-Determination of P^H using these electrode.

Lab Component-4. Studies on acid-base conductometric titration.

5. Determination of redox potentials using potentiometry

UNIT –V POLYMERS AND NANO COMPOSITES 12Hrs

Polymers-Introduction-Monomers – Functionality – Degree of polymerization-Tacticity. Classification- Plastics – Thermoplastics and thermosetting plastics, Compounding of plastics – Compression moulding, injection moulding and extrusion processes. Nano composites:particulates,clay and carbon nano tubes.Graphene nano composites and its applications.

Lab Component-6.Polymeric analysis using capillary viscometer

Total No. of Hours: 60Hrs

REFERENCES

1. Jain &JainEngineering Chemistry 17th Edition, Dhanpat Rai Publishing Company
2. Vasant R. Gowariker,, N. V. Viswanathan, Jayadev Sreedhar, Polymer Science,New Age International, 1986
3. B.K. Sharma, Polymer Chemistry, Goel Publishing House
4. Y. R. Sharma ,Elementary Organic Spectroscopy, S.Chand& Company Ltd.
5. N.Krishnamurthy, K.Jeyasubramanian, P.Vallinayagam, Applied Chemistry, Tata McGraw-Hill Publishing Company Limited, 1999.
6.Chichester,polymer-clay-nano composites,Johnwiley(2000)

Subject Code EBEE22ET1	Subject Name :BASIC ELECTRICAL & ELECTRONICS ENGINEERING	Ty/Lb/ ETL/IE	L	T/SLr	P/R	C
	Prerequisite : None	ETL	2	0/0	2/0	3

C: Credits, L: Lecture, T: Tutorial, SLr: Supervised Learning, P: Problem / Practical
R: Research, Ty/Lb/ETL/IE: Theory /Lab/Embedded Theory and Lab/Internal Evaluation

OBJECTIVES

- Understand the concepts of circuit elements, circuit laws and coupled circuits.
- Gain information on measurement of electrical parameters.
- Acquire knowledge on conventional &non-conventional energy production.
- Identify basic theoretical principles behind the working of modern electronic gadgets.
- Demonstrate digital electronic circuits and assemble simple devices.

COURSE OUTCOMES (Cos)

Students completing this course were able to

CO1	Compute the electric circuit parameters for simple problems
CO2	Elaborate the concepts of Electrical machines and measurement principles
CO3	Identify conventional and Non-conventional Electrical power Generation, Transmission and Distribution
CO4	Analyze the working principles and characteristics of analog electronic devices
CO5	Understand basics of digital electronics and solving problems and design combinational circuits

Mapping of Course Outcome with Program Outcome (POs)

Cos/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3							2	1
CO2	3	3	3	2	2		2				2	
CO3	3	2	3	2	3		2		2			1
CO4	3	2		2			2				2	1
CO5	3	2	3	2	3				2		2	1

COs/PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	-	-	-
CO2	3	-	-	-
CO3	3	-	-	-
CO4	3	-	-	-
CO5	3	-	-	-

3/2/1 Indicates Strength Of Correlation, 3 – High, 2- Medium, 1- Low

Category	Basic Science	Engineering Science	Humanities and social Science	Program Core	Program elective	Open Elective	Inter Disciplinary	Skill Component	Practical /Project
		√							

Subject Code : EBEE22ET1	Subject Name : BASIC ELECTRICAL & ELECTRONICS ENGINEERING	Ty/Lb/ ETL/IE	L	T/ SL r	P/R	C
	Prerequisite : None	ETL	2	0/0	2/0	3

UNIT I ELECTRIC CIRCUITS 12Hrs

Electrical Quantities – Ohms Law – Kirchhoff's Law – Series and Parallel Connections – Current Division and Voltage Division Rule - Source Transformation – Wye (Y) – Delta (Δ) , Delta (Δ) – Wye (Y) Transformation – Rectangular to Polar and Polar to Rectangular

Lab Components – Measurement of Electrical Quantities

UNIT II MACHINES & MEASURING INSTRUMENTS 12Hrs

Construction & Principle of Operation of DC motor & DC Generator – EMF equation of Generator – Torque Equation of Motor – Construction & Principle of operation of Transformer –Operating principles and Types of measuring instruments – Moving coil, Moving iron – Principle of Energy meter

Lab Component – Measurement of Energy Using energy meter

UNIT III BASICS OF POWER SYSTEM 12Hrs

Generation of Electric Power (Thermal, Hydro, Wind and Solar) – Basic structure of Power system – Types of Transmission & Distribution Schemes – Representation of Substation.

Lab Component – Residential house wiring Stair case wiring

UNIT IV ELECTRON DEVICES 12Hrs

Semiconductor Materials: Silicon and Germanium – PN Junction Diode, Zener Diode – Characteristics and Applications – Bipolar Junction Transistor - JFET, SCR, MOSFET, IGBT –Characteristics and Applications – Operating principle - Rectifiers and Inverters

Lab Component – Resistor colour coding -Resistance Measurement

UNIT V DIGITAL SYSTEM 12Hrs

Number System – Binary, Decimal, Octal, Hexadecimal – Binary Addition, Subtraction, Multiplication & Division – Boolean Algebra – Reduction of Boolean Expressions – Logic Gates - De-Morgan's Theorem - Adder – Subtractor

Lab Component - Soldering practice, Logic Gates

Total no of Hours: 60Hrs

TEXT BOOKS:

1. *D P Kothari, I J Nagrath, 2017, Basic Electrical Engineering, Second Edition, Tata McGraw-Hill Publisher*
2. *A.K. Sawhney, 2015 A Course in Electrical and Electronic Measurements and Instrumentation, Dhanpat Rai & CO publisher*
3. *B.L. Theraja, A.K. Theraja, Text Book of Electrical Technology: Volume 3: Transmission, Distribution and Utilization, S. Chand publisher*
4. *Morris Mano, M, 2016 Digital Logic and Computer Design, Prentice Hall of India*
5. *Millman and Halkias 2015, Electronic Devices and Circuits, Tata McGraw Hill*

REFERENCE BOOKS:

1. *R. Muthusubramanian, S. Salivahanan, K A Muraleedharan, Basic Electrical, Electronics and Computer Engineering, Second Edition, Tata McGraw-Hill publisher*

SEMESTER I (PRACTICAL)

Subject Code EBCC22I01	Subject Name :ORIENTATION TO ENTREPRENEURSHIP & PROJECT LAB	Ty/Lb/ ETL/IE	L	T/SLr	P/R	C
	Prerequisite : None	IE	1	0/0	1/0	1

C: Credits, L: Lecture, T: Tutorial, SLr: Supervised Learning, P: Problem / Practical
R: Research, Ty/Lb/ETL/IE: Theory /Lab/Embedded Theory and Lab/Internal Evaluation

OBJECTIVES

- Understand how entrepreneurship Education transforms individuals into successful leaders.
- Identify individual potential &S have career dreams
- Understand difference between ideas & opportunities
- Identify components & create action plan.
- Use brainstorming in a group to generate ideas.

COURSE OUTCOMES (Cos)
Students completing this course were able to

CO1	Develop a Business plan & improve ability to recognize business opportunity
CO2	Do a self-analysis to build an entrepreneurial career.
CO3	Articulate an effective elevator pitch.
CO4	Analyze the local market environment & demonstrate the ability to find an attractive market
CO5	Identify the required skills for entrepreneurship & develop

Mapping of Course Outcome with Program Outcome (POs)

Cos/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		2	2	3	2	2	2		2	2	2	1
CO2	3	2		3	2	3	2	3	3	3	2	2
CO3		2	2	2		3		3	3	3		
CO4		3	2	2	2	2		3	2	2	3	
CO5		2	2	3	2	2	3	3	2	2	3	1

COs/PSOs	PSO1	PSO2	PSO3	PSO4	
CO1	2		3		
CO2	2		3		
CO3	2		3		
CO4	2		3		
CO5	2		3		

3/2/1 Indicates Strength Of Correlation, 3 – High, 2- Medium, 1- Low

Category	Basic Science	Engineering Science	Humanities and social Science	Program Core	Program elective	Open Elective	Inter Disciplinary	Skill Component	Practical /Project
								√	

Subject Code : EBCC22I01	Subject Name : ORIENTATION TO ENTREPRENEURSHIP & PROJECT LAB	Ty/Lb/ETL/IE	L	T/ SLr	P/R	C
	Prerequisite : None	IE	1	0/0	1/0	1

UNIT I CHARACTERISTICS OF A SUCCESSFUL ENTREPRENEUR 3Hrs

Introduction to entrepreneurship education – Myths about entrepreneurship – How has entrepreneurship changed the country – Dream it. Do it - Idea planes - Some success stories – Global Legends – Identify your own heroes –

UNITII ENTREPRENEURIAL STYLE 3Hrs

Entrepreneurial styles – Introduction, concept & Different types - Barrier to Communication – Body language speaks louder than words

UNIT III DESIGN THINKING 3Hrs

Introduction to Design thinking – Myth busters – Design thinking Process - Customer profiling – Wowing your customer – Personal selling – concept & process – show & tell concept – Introduction to the concept of Elevator Pitch

UNIT IV RISK MANAGEMENT 3Hrs

Introduction to risk taking & Resilience – Managing risks (Learning from failures, Myth Buster) – Understanding risks through risk takers – Why do I do? – what do I do ?

UNIT V PROJECT 3Hrs

How to choose a topic – basic skill sets necessary to take up a project – creating a prototype – Pitch your project – Project presentation.

IDEA GENERATION, EVALUATION & PROJECT PRESENTATION **15Hrs**

Total No. of Periods: 30Hrs

Reference Books& Website

1. Encyclopedia of Small Business (2011) – (e book)

2. Oxford Handbook of Entrepreneurship (2014)–(e book)

3. lms.learnwise.org

Subject Code: EBCS22ET1	Subject Name : C PROGRAMMING AND MS OFFICE TOOLS	Ty/Lb/ ETL/IE	L	T/ S.Lr	P/R	C
	Prerequisite: Nil	**ETL**	**1**	**0/0**	**2/0**	**2**

C: Credits, L: Lecture, T: Tutorial, SLr: Supervised Learning, P: Problem / Practical
R: Research, Ty/Lb/ETL/IE: Theory /Lab/Embedded Theory and Lab/Internal Evaluation

OBJECTIVES : The student should be made to:

- Learn a programming language.
- Learn problem solving techniques.
- Write programs in C and to solve the problems.
- Familiarize the students in preparation of documents and presentations with office automation tools.

COURSE OUTCOMES (COs) :After Completing the course, the student can be able to

CO1	Understand and trace the execution of programs written in C language.
CO2	Write the C code for a given algorithm.
CO3	Apply Arrays and Functions concepts to write Programs
CO4	Apply Structures and pointers concepts for writing Programs
CO5	To perform documentation , accounting operations and presentation skills

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	2	1	1	1	1	1	1	2	2
CO2	2	2	2	2	1	1	1	1	1	1	2	2
CO3	2	2	3	2	1	1	1	1	1	1	3	2
CO4	2	2	3	3	1	1	1	1	1	1	3	2
CO5	1	1	1	1	1	1	0	0	2	3	2	0

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	1	1	2	2
CO2	1	1	2	2
CO3	1	1	2	2
CO4	1	1	2	2
CO5	1	1	2	2

3/2/1 Indicates Strength Of Correlation, 3 – High, 2- Medium, 1- Low

Category	Basic Science	Engineering Science	Humanities and social Science	Program Core	Program elective	Open Elective	Inter Disciplinary	Skill Component	Practical /Project			
		✓										

Subject Code:	**C PROGRAMMING AND MS OFFICE TOOLS**	**Ty/Lb/ ETL/IE**	**L**	**T/ S.Lr**	**P/R**	**C**
EBCS22ET1	Prerequisite: Nil	**ETL**	**1**	**0/0**	**2/0**	**2**

UNIT I INTRODUCTION **3Hrs**

Basic Structure of C programme- Constants, Variables and data types, Keywords, Identifiers- Operators and expressions- executing a C Program

UNIT II DECISION MAKING STATEMENTS AND LOOPING STATEMENTS 3Hrs

Decision making with if statement, Simple if statement, else-if statement, Nesting if-else statement, The else if ladder,The switch statement, The goto statement, The while statement,, The do while statement, The for statement, jumps in loops

UNIT III ARRAYS AND FUNCTIONS **3Hrs**

Introduction to Arrays- One dimensional arrays, Two dimensional array, and Multidimensional array- Introduction to Functions- calling a function, category of functions- arguments with return values, argument with no return values- parameter passing Mechanism: Call by Value and Call by Reference. Recursion.

UNIT IV STRUCTURES& POINTERS **3Hrs**

Structures definition, giving values to members, Structure initialization, comparison of structure variables, Structure within structures,Understanding pointers, accessing the address of the variable, declaring and initializing pointer, accessing a variable through its pointer and arrays

UNIT V MS-OFFICE **3Hrs**

Introduction to MS-Word- Menus- Introduction to MS-Excel: features of MS- Excel, spread sheet/worksheet, parts of MS-excel window, functions in excel sheet, chart, Introduction to MS-Power point

Total No. of Hours: 15Hrs

TEXT BOOKS:

1. *E.Balaguruswamy, Programming in ANSI C*
2. *Padma Reddy ,Computer Concepts & 'C' Programming*
3. *ShobhaHangirke,Computer Application For Business*

List of Experiments : C PROGRAMMING ***30 periods***

1. *Find the factorial of a given positive number using function.*
2. *Calculate X raised to y using function.*
3. *Find GCD and LCM of two given integer numbers using function.*
4. *Find the sum of N natural numbers using function.*
5. *Book information using Structure.*
6. *Student information using Structure.*
7. *Print the address of a variable and its value using Pointer*
8. *Find area and perimeter of a circle*
9. *Check whether the given number is palindrome or not*
10. *Check whether the given number is prime or not*
11. *Calculate sum of the digits of the given number*
12. *Display Fibonacci series up to N terms*
13. *Check whether a given character is alphabetic, numeric or special character*
14. *Count vowels and consonants in a given string*
15. *Find product of two matrices*

MS-OFFICE

16. *Preparing a news letter:*
17. *To prepare a newsletter with borders, two columns text, header and footer and inserting a graphic image and page layout.*
18. *Creating and editing the table*

19. Printing envelopes and mail merge.
20. Using formulas and functions: To prepare a Worksheet showing the monthly sales of a company in different branch offices
21. Prepare a Statement for displaying Result of 10 students in 5 subjects

SEMESTER II

Subject Code: EBMA22003	Subject Name : MATHEMATICS-II	Ty/Lb/ ETL/IE	L	T/ S.Lr	P/R	C
	Prerequisite: Higher secondary Mathematics	Ty	3	1/0	0/0	4

C: Credits, L: Lecture, T: Tutorial, SLr: Supervised Learning, P: Problem / Practical
R: Research, Ty/Lb/ETL/IE: Theory /Lab/Embedded Theory and Lab/Internal Evaluation

OBJECTIVES :

The student should be made to:

- To be able to understand basic concepts in integration
- To understand the concepts in multiple integrals
- To use the basic concepts in ordinary differential equations
- To be able to apply concepts of analytical geometry
- To be able to understand the basic concept of vector calculus

COURSE OUTCOMES (COs) :

CO1	Integrate the given function by using methods of integration and to find the area under curve and the volume of a solid by revaluation
CO2	Evaluate the multiple integrals /area/volume and to change the order of integration
CO3	Apply concepts in Ordinary Differential equations and to solveeulers differential equation
CO4	Find equation of planes,lines and sphere and shortest distance between skew lines
CO5	Verify green/stokes/gauss divergence theorem

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	2	2	1	2	2	2	1	3
CO2	3	3	1	2	2	3	2	2	3	3	2	2
CO3	3	3	1	2	2	3	1	1	3	3	2	2
CO4	3	3	2	2	1	2	2	2	2	3	2	2
CO5	3	3	1	2	2	2	2	1	2	3	1	2

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	2
CO2	3	2	1	2
CO3	3	2	1	2
CO4	3	2	1	2
CO5	3	2	1	2

3/2/1 Indicates Strength Of Correlation, 3 – High, 2- Medium, 1- Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical /Project			
	✓											

Subject Code : EBMA22003	Subject Name : MATHEMATICS – II	Ty/Lb /ETL/IE	L	T/ SL r	P/R	C
	Prerequisite : Higher secondary Mathematics	Ty	3	1/0	0/0	4

UNIT I INTEGRATION **12Hrs**

Basic concepts of Integration – Methods of Integration– Integration by substitution – Integration by parts – Definite integrals– Properties of definite integrals – Problems on finding Area and Volume using single integrals (simple problems).

UNIT II MULTIPLE INTEGRALS **12Hrs**

Double integral in Cartesian and Polar Co-ordinates – Change of order of integration – Triple integral in Cartesian Co-ordinates – Spherical Polar Co-ordinates – Change of variables (simple problems).

UNIT III ORDINARY DIFFERENTIAL EQUATIONS **12Hrs**

First order differential equations – Second and higher order linear differential equations with constant coefficients and with RHS of the form: e^{ax}, x^n, Sin ax, Cos ax, $e^{ax}f(x)$, x f(x) where f(x) is Sin bx or Cos bx – Differential equations with variable coefficients (Euler's form) (simple problems).

UNIT IV THREE DIMENSIONAL ANALYTICAL GEOMETRY **12Hrs**

Direction Cosines and Ratios – Equation of a straight line – Angle between two lines – Equation of a plane – Co-planar lines – Shortest distance between skew lines – Sphere – Tangent plane.

UNIT V VECTOR CALCULUS **12Hrs**

Scalar and Vector functions – Differentiation – Gradient, Divergence and Curl – Directional derivatives – Irrotational and Solenoidal fields– Line, Surface and Volume integrals – Green's, Stoke's and Gauss divergence theorems (statement only) – Verification.

Total no. of Hours: 60Hrs

REFERENCE BOOKS:

1) *Kreyszig E., Advanced Engineering Mathematics (10th ed.), John Wiley & Sons, (2011).*
2) *Grewal B.S., Higher Engineering Mathematics, Khanna Publishers, (2012).*
3) *John Bird, Basic Engineering Mathematics (5th ed.), Elsevier Ltd, (2010).*
4) *Veerarajan T., Engineering Mathematics (for first year), Tata McGraw Hill Publishing Co., (2008).*
5) *P.Kandasamy, K.Thilagavathy and K. Gunavathy, Engineering Mathematics Vol. I (4th Revised ed.), S.Chand& Co., Publishers, New Delhi (2000).*
6) *John Bird, Higher Engineering Mathematics (5th ed.), Elsevier Ltd, (2006).*

Subject Code EBPH22003	Subject Name :BIO MATERIALS	Ty/Lb/ETL/IE	L	T/SLr	P/R	C
	Prerequisite :Engg.Physics	Ty	3	0/0	0/0	3

C: Credits, L: Lecture, T: Tutorial, SLr: Supervised Learning, P: Problem / Practical
R: Research, Ty/Lb/ETL/IE: Theory /Lab/Embedded Theory and Lab/Internal Evaluation

OBJECTIVES

- Design, conduct experiment and analyze data.
- Develop a Scientific attitude at micro and nano scale of materials
- Understand the concepts of Modern Physics
- Apply the science of materials to Engineering & Technology

COURSE OUTCOMES (Cos)

Students completing this course were able to

CO1	Analyze different types of Biomaterials and its classification and apply the concept of nanotechnology towards biomaterials use.
CO2	Identify significant gap required to overcome challenges and further development in metallic and ceramic materials
CO3	Identify significant gap required to overcome challenges and further development in polymeric materials
CO4	Create combinations of materials that could be used as a tissue replacement implant.

Mapping of Course Outcome with Program Outcome (POs)

Cos/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3											
CO2	3				1		2					
CO3	3	1										1
CO4	3		2	2		2						1

COs/PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3
CO2	2	3	2	3
CO3	3	3	3	3
CO4	3	2	1	3

3/2/1 Indicates Strength Of Correlation, 3 – High, 2- Medium, 1- Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical /Project
	√								

Subject Code EBPH22003	Subject Name :BIO MATERIALS	Ty/Lb/ ETL/IE	L	T/SLr	P/R	C
	Prerequisite :Engg.Physics	Ty	3	0/0	0/0	3

UNIT I INTRODUCTION TO BIO MATERIALS 9Hrs

Introduction to biomaterials and requirements for biomaterial. Classification of biomaterials: metallic, ceramic, synthetic and natural polymers. Surface, Physical, Mechanical & bulk Properties of biomaterials: Comparison of properties of some common biomaterials. Effects of physiological fluid on the properties of biomaterials.

UNIT II TYPES OF BIO MATERIALS 9Hrs

Metallic and Ceramic Materials - Metallic implants – Stainless steels, co-based alloys, Ti-based alloys, shape memory alloy, nanostructured metallic implants,– common types Polymeric implant materials - Biodegradable polymers for medical purposes, Biopolymers in controlled release systems. Synthetic polymeric membranes and their biological applications. Composite implant materials:

UNIT III SURFACE CHARACTERIZATION 9Hrs

Surface properties and adhesion, contact angle measurement, scanning electron microscopy (SEM), transmission electron microcopy (TEM), scanning tunneling microscopy and atomic force microscopy (AFM).Secondary ion mass spectrometry and confocal laser scanning microscopy.

UNIT IV TESTING OF BIOMATERIALS 9Hrs

Biocompatibility, blood compatibility and tissue compatibility tests, Toxicity tests, sensitization, carcinogenicity, mutagenicity and special tests, Invitro and Invivo testing; Sterilization of implants and devices: ETO, gamma radiation, autoclaving. Effects of sterilization.

UNIT V **BIOMATERIALS APPLICATIONS 9Hrs**

Materials for bone and joint replacement – stainless steel, titanium based materials and porous metals. Ceramics: alumina, zirconia, calcium phosphate and bioactive glass, bone cement. Polymers: PMMA and polyethylene, rubber and fluorocarbon polymers. Materials for oral and maxillofacial surgery, ophthalmology and intelligent textiles for medical applications. (examples for each).

Total no of Hours: 45Hrs

TEXT BOOKS & REFERENCE BOOKS

1.Biomaterials Science: An Introduction to Materials in Medicine, By Buddy D. Ratner, et. al. Academic Press, San Diego, 1996.
2. Sujata V. Bhat, Biomaterials, Narosa Publishing House, 2002.
3. J B Park, Biomaterials – Science and Engineering, Plenum Press, 1984.

Subject Code EBCH22002	Subject Name :INDUSTRIAL CHEMISTRY	Ty/Lb/ETL/IE	L	T/SLr	P/R	C
	Prerequisite : Engg. Chemistry	**Ty**	**3**	**0/0**	**0/0**	**3**

C: Credits, L: Lecture, T: Tutorial, SLr: Supervised Learning, P: Problem / Practical
R: Research, Ty/Lb/ETL/IE: Theory /Lab/Embedded Theory and Lab/Internal Evaluation

OBJECTIVES :

1. To understand and apply the basic concepts of fuels and combustion in automobiles.
2. To analyze the moisture and protein in food through physical and chemical methods.
3. To detect the industrial development aiming at job creators.
4. To demonstrate the operations of pulp and paper Industry.
5. To illustrate the fundamentals of industrial wastewater treatment.

COURSE OUTCOMES (Cos)

Students completing this course were able to

CO1	Reproduce the understanding of industry oriented chemical science
CO2	Analyze the solutions for industry based problems for sustainable development following professional ethics.
CO3	Apply appropriate techniques for industrial development as a resource of lifelong learning.
CO4	Develop the reasoning nature by the knowledge acquired to assess the health and safety issues.
CO5	Describe the tools used to apply the engineering knowledge

Mapping of Course Outcome with Program Outcome (POs)

Cos/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**3**	**-**	**-**	**-**	**-**	**3**	**-**	**-**	**-**	**-**	**-**
CO2	**3**	**-**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**
CO3	**3**	**-**	**-**	**-**	**-**	**2**	**3**	**-**	**-**	**-**	**-**	**3**
CO4	**3**	**-**	**3**	**-**	**-**	**-**	**-**	**3**	**-**	**-**	**-**	**2**
CO5	**3**	**-**	**-**	**-**	**3**	**-**	**3**	**-**	**-**	**-**	**-**	**3**

COs/PSOs	PSO1	PSO2	PSO3	PSO4
CO1	**3**	**-**	**3**	**3**
CO2	**3**	**-**	**3**	**3**
CO3	**3**	**-**	**3**	**3**
CO4	**3**	**-**	**3**	**3**
CO5	**3**	**-**	**3**	**3**

3/2/1 Indicates Strength Of Correlation, 3 – High, 2- Medium, 1- Low

Category	Basic Science	Engineering Science	Humanities and social Science	Program Core	Program elective	Open Elective	Inter Disciplinary	Skill Component	Practical /Project
	√								

Subject Code EBCH22002	Subject Name :INDUSTRIAL CHEMISTRY	Ty/Lb/ ETL/IE	L	T/SLr	P/R	C
	Prerequisite :Engineering Chemistry	**Ty**	**3**	**0/0**	**0/0**	**3**

UNIT – 1 FUELS & COMBUSTION **9Hrs**

Fuels - classification, calorific value, GCV, NCV, Solid fuels-coal – varieties and ranking, analysis – Proximate Carbonisation of coal, Coke –manufacture , Beehive coke oven method, Otto Hoffmann method – recovering by - products - Liquid fuels – petrol –refining-cracking- thermal & catalytic , Synthetic petrol – Hydrogenation of coal (Fischer Tropsch Process and Bergius process) – Polymerization, Knocking properties of Gasoline –octane number, cetane number – Ignition lag, Leaded petrol, Reforming, Gaseous fuels- manufacture and uses Combustion - Flue gas analysis – Orsatapparatus.Alternative fuel-Electric vehicles

UNIT2 FOOD ANALYSIS **9Hrs**

Food analysis-Introduction. Moisture Analysis-Introduction-Moisture content of foods-Sample collection and handling-Forms of water in foods- Distillation procedure-Reflux distillation with immiscible solvent,-Physical methods-Direct method-Hydrometer, -Refractometry –Chemical method-Karl Fischer titration-Protein analysis-Kjeldahl method-Dumas combustion method.

UNIT – 3 APPLICATIONS IN PAPER INDUSTRY **9Hrs**

Introduction-Manufacture of pulp-Mechanical process-Chemical process-Beating,Refining,Filling,Sizing and Colouring-Manufacture of paper-Calendering-Bagasse utilization in paper industry.

UNIT – 4 BUSINESS CHEMICALS **9Hrs**

Toiletry formulations-Soaps and detergent, shampoo, Shaving cream, production. Preparation of cosmetics- moisturizing cream, talcum powder, Nail enamel, Lipstick. Disinfectants- phenyl, hand sanitizer,bleach,causticsoda,naphthalene balls production.

UNIT – 5 INDUSTRIAL WASTES AND TREATMENT PROCESS **9Hrs**

Introduction-Characteristics of industrial waste-Types of industrial wastes-Solid industrial wastes-Principles of industrial waste treatment-Treatment and disposal of industrial waste-Sanitary-Chemical analysis of industrial effluents or sewage-Method of treating industrial sludge.

Total No. of Hours: 45Hrs

REFERENCES

1. *Rama Rao Nadendla,Principles of Organic Medicinal Chemistry, New Age International (P) Limited, Publishers.*
2. *H.D.Belitz, W.Grosch,P.Schieberle ,Food Chemistry Springer*
3. *Industrial chemistry by B.K.Sharma,KrisnaPrakashan Media(P) Ltd,Publishers.*
4. *Industrial Chemistry – C. S. Unnithan, T. Jayachandran & P. Udhayakala, Sree Lakshmi Publications - 2010*
5. *John A.Tyrell, Fundamentals of Industrial Chemistry , , Wiley.*
6. *Ernest M. Flick, Cosmetic and Toiletry Formulations, 2nd Edition, Volume 8, Noyes Publications, William Andrew Publishing, LLC.*

Subject Code: EBCT22001	Subject Name : Introduction to Chemical Engineering	Ty/Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: Nil	Ty	3	0/0	0/0	3

C: Credits, L: Lecture, T: Tutorial, SLr: Supervised Learning, P: Problem / Practical
R: Research, Ty/Lb/ETL/IE: Theory /Lab/Embedded Theory and Lab/Internal Evaluation

OBJECTIVE :

- To acquire molecular level understanding of matter
- To attain knowledge on application of Mathematics and software tools in chemical Engineering
- To understand the concepts of material and energy balance in chemical reactions
- To acquaint the students with the fundamentals of Chemical Engineering and to build their perspective in a wholesome manner

COURSE OUTCOMES (COs) : (3- 5)

Upon successful completion of the course, student should be able to:

CO1	Correlate day to day like with the principles of chemical Engineering
CO2	Assess the mass and energy involved in any chemical plant.
CO3	Have an insight into arears where Chemical Engineering plays major role.
CO4	Carry out modeling and simulation using software tools.
CO5	Identify their right future. Gain confidence and outline about the programme as a whole.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	1	2	3	2	-	-	2	3	-	1	2
CO2	3	3	2	3	2	2	2	2	2	1	-	1
CO3	-	2	1	2	3	2	2	2	2	1	3	3
CO4	2	2	2	3	2	2	2	2	2	1	1	3
CO5	1	1	-	-	2	3	3	3	3	3	-	-

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	1	2	3	-
CO2	3	1	2	-
CO3	2	2	1	-
CO4	2	3	2	-
CO5	-	-	-	-

H/M/L indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical /Project			

				√								

Subject Code: EBCT22001	Subject Name : Introduction to Chemical Engineering	Ty/Lb/ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Nil	Ty	3	0/0	0/0	3

UNIT I INTRODUCTION 9Hrs

Chemical Engineering in day to life with examples, Origin and growth of chemical Engineers in chemical process industries, unit operations and unit processes concepts, scaling up or down, units and dimensions, application of mathematics in chemical Engg, recent developments in chemical process industries.

UNIT II INTRODUCTION TO MATERIAL AND ENERGY BALANCES 9Hrs

Basic concepts of material and energy balances, energy and mass transport, and kinetics of chemical reactions. Introduction to heat and mass transfer. Process flow sheeting and symbols.

UNIT III FLUID FLOW 9Hrs

Nature of fluid, Viscosity, Flow field, Conservation of mass and energy. Frictional losses, pumping of fluids. Dimensional Analysis and Correlations.

UNIT IV CHEMICAL ENGINEERING COMPUTER SOFTWARE TOOLS AND APPLICATIONS 9Hrs

Introduction to Process Engineering Design Software (HYSYS and PRO II) , Computations Using Microsoft Excel, Computer-Aided Design & Drafting, Piping and Equipment Design Software.

UNIT V CAREER DIVERSITIES IN CHEMICAL ENGINEERING 9Hrs

Career Development Leading to Specialization, Chemical Engineering Job Titles/Options, Chemical and Process Engineers, Commissioning Engineer, Process Control/Automation Engineer, Process Safety Engineer, Research & Development Engineer Pharmaceutical Engineer/Pharmaceutical Process Engineer, Pipeline Engineer Chemical Manufacturing Engineer, Environment Engineer.

Total No.of Hours: 45Hrs

Text Books*:*

1. Anderson, L.B., Wenzel, L.A., "Introduction to Chemical Engineering", McGraw-Hill Book Company, Inc., New York (1961).
2. Pushpavanam, S., "Introduction to Chemical Engineering", PHI Learning Pvt. Ltd.(2012).
3. Ghosal, S.K., Sanyal, S.K., Datta, S., "Introduction to Chemical Engineering", Tata McGraw-Hill Publishing Company Ltd., New Delhi(1997).

References:

1. Rao, M.G., Sittig, M., "Dryden's Outlines of Chemical Technology", East-West Press (1997).
2. Perry, R.H., Green, D.W., "Perry's Chemical Engineers' Handbook", McGraw-Hill Book Company (2008).

Subject Code EBME22001	Subject Name : ENGINEERING GRAPHICS	Ty/Lb/ETL/IE	L	T/SLr	P/R	C
	Prerequisite : None	Ty	2	0/0	2/0	3

C: Credits, L: Lecture, T: Tutorial, SLr: Supervised Learning, P: Problem / Practical
R: Research, Ty/Lb/ETL/IE: Theory /Lab/Embedded Theory and Lab/Internal Evaluation

OBJECTIVES

- To acquire knowledge in geometrical drawing.
- To expose the students in computer aided drafting**.**

COURSE OUTCOMES (Cos)

Students completing this course were able to

CO1	Utilize the concept of Engineering Graphics Techniques to draft letters, Numbers, Dimensioning in Indian Standards
CO2	Demonstrate the drafting practice visualization and projection skills useful for conveying ideas in engineering applications.
CO3	Identify basic sketching techniques of engineering equipments
CO4	Demonstrate the projections of Points, Lines, Planes and Solids. And
CO5	Draw the sectional view of simple building drawing.

Mapping of Course Outcome with Program Outcome (POs)

Cos/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	2	2			3	3		3
CO2	3	3	3	2	2	2			3	3		3
CO3	3	3	3	1		2			2	2		2
CO4	3	3	2	2		3		2	3	3		3
CO5	3	3	3	2	3	1		2	3	3		3

COs/PSOs	PSO1	PSO2	PSO3	PSO4
CO1	-	2	-	-
CO2	-	2	-	-
CO3	-	2	-	-
CO4	-	2	-	-
CO5	-	2	-	-

3/2/1 Indicates Strength Of Correlation, 3 – High, 2- Medium, 1- Low

Category	Basic Science	Engineering Science	Humanities and social Science	Program Core	Program elective	Open Elective	Inter Disciplinary	Skill Component	Practical /Project
		√							

Subject Code EBME22001	Subject Name : ENGINEERING GRAPHICS	Ty/Lb/ ETL/IE	L	T/SLr	P/R	C
	Prerequisite : None	Ty	2	0/0	2/0	3

CONCEPTS AND CONVENTIONS (Not for examination) **5Hrs**

Introduction to drawing, importance and areas of applications – BIS standards – IS: 10711 – 2001 : Technical products Documentation – Size and layout of drawing sheets – IS 9606 – 2001: Technical products Documentation – Lettering – IS 10714 & SP 46 – 2003: Dimensioning of Technical Drawings – IS : 15021 – 2001 : Technical drawings – Projections Methods – drawing Instruments, Lettering Practice – Line types and dimensioning – Border lines, lines title blocks Construction of polygons – conic sections – Ellipse, Parabola, Hyperbola and cycloids.

UNIT I PROJECTION OF POINTS, LINES AND PLANE SURFACES **12Hrs**

Projection of points and straight lines located in the first quadrant – Determination of true lengths and true inclinations – projection of polygonal surface and circular lamina in simple position only.

UNIT II PROJECTION OF SOLIDS **10Hrs**

Projection of simple solids like prism, pyramid, cylinder and cone in simple position

Sectioning of above solids in simple vertical position by cutting plane inclined to any one of the reference plane and perpendicular to the other.

UNIT III DEVELOPMMENT OF SURFACES **9Hrs**

Development of lateral surfaces of simple and truncated solids – prisms, pyramids, cylinders, and cones.

UNIT IV ISOMETRIC PROJECTION **9Hrs**

Principles of isometric projection – isometric scale – isometric projections of simple solids, like prisms pyramids, cylinders and cones.

UNIT V ORTHOGRAPHICS PROJECTIONS **8Hrs**

Orthographic projection of simple machine parts – missing views

BUILDING DRAWING **7Hrs**

Building components – front, Top and sectional view of a security shed.

(Basic Auto CAD commands to be taught- not for Examinations)

Total No. of Hours: 60Hrs

Note: First angle projection to be followed.

TEXT BOOKS

1. *Bhatt, N.D. and Panchal, V.M. (2014) Engineering Drawing Charotar Publishing House*
2. *Gopalakrishnan, K.R. (2014) Engineering Drawing (Vol.I& II Combined) Subhas Stores, Bangalore.*
3. *Natrajan K.V., "A Text Book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2018.*
4. *Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited, 2008.*

SEMESTER II (PRACTICAL)

Subject Code EBCC22I02	Subject Name : COMMUNICATIVE ENGLISH LAB	Ty/Lb/ ETL/IE	L	T/SLr	P/R	C
	Prerequisite :Pass in Plus 2 English	IE	1	0/0	1/0	1

C: Credits, L: Lecture, T: Tutorial, SLr: Supervised Learning, P: Problem / Practical
R: Research, Ty/Lb/ETL/IE: Theory /Lab/Embedded Theory and Lab/Internal Evaluation

OBJECTIVES

- To engage students in meaningful oral English communication and organized academic and professional reading and writing for a successful career.

COURSE OUTCOMES (Cos)
Students completing this course were able to

CO1	Engage in meaningful oral communication in English with writing as a scaffolding activity.
CO2	Have an in-depth understanding of the components of English language and its use in oral communication.
CO3	Strengthen their vocabulary and syntactic knowledge for use in academic and technical communication
CO4	Learn to negotiate meaning in inter-personal and academic communication for a successful career.
CO5	Engage in organized academic and professional writing for life-long learning and research

Mapping of Course Outcome with Program Outcome (POs)

Cos/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	-	1	1	3	2	1	1	3	3	-	3
CO2	2	1	1	1	3	3	1	2	3	3	1	2
CO3	1	1	1	1	2	1	-	2	3	3	1	3
CO4	1	-	-	2	3	1	2	1	2	2	-	3
CO5	-	1	1	2	3	1	1	-	3	1	1	2

COs/PSOs	PSO1	PSO2	PSO3	PSO4
CO1	2		1	
CO2	2		1	
CO3	2		1	
CO4	2		1	
CO5	2		1	

3/2/1 Indicates Strength Of Correlation, 3 – High, 2- Medium, 1- Low

Category	Basic Science	Engineering Science	Humanities and social Science	Program Core	Program elective	Open Elective	Inter Disciplinary	Skill Component	Practical /Project
			√						

Subject Code EBCC22I02	Subject Name : COMMUNICATIIVE ENGLISH LAB	Ty/Lb/ ETL/IE	L	T/SLr	P/R	C
	Prerequisite :Pass in Plus 2 English	IE	1	0/0	1/0	1

UNIT I LISTENING 6Hrs

Authentic audios and videos

Prescribed Book: English Pronunciation in use – Mark Hancock,

UNIT II SPEAKING 6Hrs

Individual- Solo: Self introduction, Describing, anchoring, welcome address, vote of thanks,

Pair & Group: Role play- formal -informal, narrating stories, film review, analyzing newspaper headings and reports, interpreting Advertisement pamphlets

Group discussion, mock interviews, formal presentation, power point presentation

Prescribed Book: J. C. Richards with J. Hull &S.Proctor, Interchange, Cambridge University Press, 2015.

UNIT III READING 6Hrs

Extensive, focused reading,

Strategies for effective reading - Reading comprehensions – Note making- summarizing- paraphrasing, Review

Suggested reading: Short stories, news paper reports, film reviews

UNIT IV WRITING 6Hrs

Extensive writing practices – note taking, Cognitive and meta cognitive strategies to inculcate a sense of organizing ideas into coherent sentences and paragraphs, Formal letters, Business letters. Resume with covering letter

UNIT V NON VERBAL COMMUNICATION/ CHARTS, DIAGRAMS AND TABLE 6Hrs

Interpretation of charts Flow chart, pie chart, bar diagram, table, tree diagram, etc.

Total No. of Hours: 30Hrs

TEXT BOOK

1. *J. C. Richards with J. Hull &S.Proctor, Interchange, Level 2, Cambridge University Press, 2021.*
2. *M. Chandrasena Rajeswaran&R.Pushkala, English - Communication Lab Work book*

REFERENCE BOOK

1. *Hancock, Mark, English Pronunciation in Use; Cambridge Univ. Press, 2013.*
2. *Dutt, K, Rajeevan, G & Prakash, CLN 2008, A Course on Communication Skills, 1st edn, Cambridge University Press, Chennai*

Subject Code EBCS22ET2	Subject Name: PYTHON PROGRAMMING	T / L/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: C Programming and MS office tools	ETL	1	0/0	2/0	2

C: Credits, L: Lecture, T: Tutorial, SLr: Supervised Learning, P: Problem / Practical
R: Research, Ty/Lb/ETL/IE: Theory /Lab/Embedded Theory and Lab/Internal Evaluation

OBJECTIVE : The student should be made to:

- Develop a basic understanding of *programming* and the *Python programming* language
- Write programs in Python to solve real world problems
- See the value of *programming* in a variety of different disciplines,especially as it relates in engineering.

COURSE OUTCOMES (COs) :After Completing the course, the student can be able to

CO1	Remember the syntax and semantics of python programming language
CO2	Understand how functional and operations are to be utilized
CO3	Applythe fundamental programming constructs like variables, conditional logic, looping, and functions to build basic programs
CO4	design object-oriented programs with Python classes
CO5	Apply the knowledge to solve various real worldproblems

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	2	1	1	1	1	0	1	1
CO2	3	2	2	2	2	1	1	1	1	0	1	1
CO3	3	2	2	2	2	1	1	1	1	0	1	1
CO4	3	3	3	2	2	1	2	0	2	0	2	2
CO5	3	3	3	3	2	1	2	0	2	0	2	2

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	1	1	2	2
CO2	1	1	2	2
CO3	1	1	2	2
CO4	1	1	2	2
CO5	1	1	2	2

H/M/L indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical /Project			
				✓								

Subject Code EBCS22ET2	Subject Name: PYTHON PROGRAMMING	Ty/ Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: C Programming and MS office tools	**ETL**	**1**	**0/0**	**2/0**	**2**

UNIT I: INTRODUCTION **9Hrs**

History of Python, Need of Python Programming, Applications Basics of Python Programming Using the REPL(Shell), Running Python Scripts, Variables, Assignment, Keywords, Input-Output, Indentation.

UNIT II: TYPES, OPERATORS AND EXPRESSIONS **9Hrs**

Types - Integers, Strings, Booleans; Operators- Arithmetic Operators, Comparison (Relational) Operators, Assignment Operators, Logical Operators, Bitwise Operators, Membership Operators, Identity Operators, Expressions and order of evaluations Control Flow- if, if-elif-else, for, while, break, continue, pass.

UNIT III: FUNCTIONS **9Hrs**

Defining Functions, Calling Functions, Passing Arguments, Keyword Arguments, Default Arguments, Variable-length arguments, Anonymous Functions, Fruitful Functions (Function Returning Values), Scope of the Variables in a Function - Global and Local Variables.

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

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: selection sort, insertion sort, mergesort, histogram.

UNIT V: OBJECT ORIENTED PROGRAMMING OOP IN PYTHON **9Hrs**

Classes, 'self variable', Methods, Constructor Method, Inheritance, Overriding Methods, Data hiding.

Total No. of Hours: 45Hrs

TEXT BOOKS:

1. *Python Programming: A Modern Approach, VamsiKurama, Pearson.*
2. *Think Python:How to Think Like a Computer Scientist'', 2nd editionUpdated for Python 3, Shroff/O'Reilly Publishers,Allen B. Downey*
3. *Learning Python, Mark Lutz, Orielly.*

REFERENCE BOOKS:

1. *Core Python Programming, W.Chun, Pearson.*
2. *Introduction to Python, Kenneth A. Lambert, Cengage*.

Subject Code: EBCC22I03	Subject Name: ENVIRONMENTAL SCIENCE (AUDIT COURSE)	Ty/ Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: Engineering Chemistry	IE	1	0/0	1/0	0

C: Credits, L: Lecture, T: Tutorial, SLr: Supervised Learning, P: Problem / Practical
R: Research, Ty/Lb/ETL/IE: Theory /Lab/Embedded Theory and Lab/Internal Evaluation

OBJECTIVES:

- To acquire knowledge of the Environment and Ecosystem & Biodiversity
- To acquire knowledge of the different types of Environmental pollution
- To know more about Natural Resources
- To gain understanding of social issues and the Environment
- To attain familiarity of human population and Environment

COURSE OUTCOMES (COs): (3 – 5)

Students completing the course were able to

CO1	Know about Environment and Ecosystem & Biodiversity
CO2	Comprehend air, water, Soil, Marine, Noise, Thermal and Nuclear Pollutions and Solid Waste management and identify the importance of natural resources like forest, water, and food resources
CO3	Discover water conservation and watershed management
CO4	Identify its problems and concerns climate change, global warming, acid rain, ozone layer depletion etc.,
CO5	Explain family welfare programmes and role of information technology in human health and environment

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	2	3	2	-	-	-	1
CO2	-	-	-	-	-	2	3	-	-	2	-	1
CO3	-	-	-	-	-	2	3	2	-	-	-	1
CO4	-	-	-	-	-	2	3	2	-	2	-	1
CO5	-	-	-	-	-	2	3	-	-	2	-	1
COs / PSOs	PSO1	PSO2	PSO3	PSO 4								
CO1	3	2	1	0								
CO2	3	2	1	3								
CO3	2	3	2	1								
CO4	3	3	3	3								
CO5	3	2	1	3								

H/M/L indicates strength of correlation 3 – High, 2 – Medium, 1– Low

Category	Basic Sciences	Engg Sciences	Humanities & Social Sciences	Program core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical /Project
			√						

Subject Code: EBCC22I03	Subject Name : ENVIRONMENTAL SCIENCE (AUDIT COURSE)	Ty/Lb/ ETL/IE	L	T/ SLr	P/R	C
	Prerequisite : Engineering Chemistry	IE	1	0/0	1/0	0

UNIT I ENVIRONMENT AND ECOSYSTEM **3Hrs**

Definition, Scope and Importance of environment – need for public awareness – concept, structure and function of an ecosystem - producers, consumers and decomposers – energy flow in the ecosystem. Biodiversity at national and local levels – India

UNIT II ENVIRONMENT POLLUTION **3Hrs**

Definition – causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Nuclear hazards (g) E-Wastes and causes, effects and control measures

UNIT III NATURAL RESOURCES **3Hrs**

Forest resources: Use and over-exploitation, deforestation. Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems.

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT **3Hrs**

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 climate change, global warming, acid rain, ozone layer depletion, nuclear accidents ,central and state pollution control boards- Public awareness.

UNIT V HUMAN POPULATION AND THE ENVIRONMENT **3Hrs**

Population growth, variation among nations – population explosion, environment and human health – human rights – value education – HIV/AIDS – women and child welfare – role of information technology in environment and human health

(A) AWARENESS ACTIVITIES: **15Hrs**

i) small group meetings about water management, promotion of recycle use, generation of less waste, avoiding electricity waste ii) Slogan making event iii) Poster making event iv) Cycle rally v) Lectures from experts

(B) ACTUAL ACTIVITIES:

i) Plantation ii) Gifting a tree to see its full growth iii) Cleanliness drive iv) Drive for segregation of waste
v) To live some big environmentalist for a week or so to understand his work
vi) To work in kitchen garden for mess vii) To know about the different varieties of plants
viii) Shutting down the fans and ACs of the campus for an hour or so **Total : 30Hrs**

TEXT BOOKS

1. *Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, PearsonEducation (2004).*
2. *Benny Joseph, 'Environmental Science and Engineering', Tata McGrawHill,NewDelhi, (2006).*

REFERENCES

1. *Vairamani, S. and Dr. K. Sankaran.* ***Elements of Environmental and Health Science.*** *Karaikudi: KPSVPublications, 5th Edition, July, 2013.*
2. *Ifthikarudeen, Etal,* ***Environmental Studies****, Sooraj Publications,2005.*
3. *R.Murugesan,* ***Environmental Studies,*** *Millennium Publishers and Distributors, 2nd Edition, July, 2009.*

SEMESTER - III (THEORY)

Subject Code EBMA22007	Subject Name : Mathematics III for Chemical Engineers	Ty/Lb/ETL/IE	L	T/S.Lr	P/R	C
	Prerequisite: First year Engineering Mathematics	Ty	3	1/0	0/0	4

C : Credits L : Lecture T : Tutorial S.Lr : Supervised Learning P : Problem / Practical R : Research
T/L/ETP/IE : Theory/Lab/Embedded Theory and Practice/Internal evaluation.

OBJECTIVES :

The student should be made to:

- To be able to apply the concepts in Differential Equations
- To understand the concepts in Fourier series
- To analyze the Problems in wave and Heat equations
- To be able to understand the concepts in Analytic functions
- To be able to solve problems in Complex integration

COURSE OUTCOMES (COs) :

CO1	To understand the concepts of partial differential equations
CO2	To be able to find fourier series solutions
CO3	To be able to apply the concepts of PDE in wave and heat problems
CO4	To be able to apply the concepts of analytic function
CO5	To be able to solve problems in Complex Integration

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	2	3	2	1	2	2	3	1	1	2
CO2	3	3	1	2	1	2	1	2	2	2	1	3
CO3	3	2	1	2	2	3	3	1	1	2	1	3
CO4	2	3	1	2	1	2	2	1	1	2	1	3
CO5	2	3	1	3	1	2	3	1	1	2	2	3

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	0
CO2	3	2	1	3
CO3	2	3	2	1
CO4	3	3	3	3
CO5	3	2	1	3

3/2/1 Indicates Strength Of Correlation, 3 – High, 2- Medium, 1- Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical /Project			
	√											

Subject Code EBMA22007	Subject Name : Mathematics III for Chemical Engineers	Ty/Lb/ETL/IE	L	T/S.Lr	P/R	C
	Prerequisite: First year Engineering Mathematics	Ty	3	1/0	0/0	4

UNIT I PARTIAL DIFFERENTIAL EQUATIONS 12 Hrs

Formation – Solutions of standard types of first order equations – Lagrange's equation – Linear partial differential equations of second order and higher order with constant Coefficients.

UNIT II FOURIER SERIES 12 Hrs

Dirichlet's conditions – General Fourier series – Half range Sine & Cosine series – Complex form of Fourier series– Parseval's identity –Harmonic Analysis.

UNIT III APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS 12 Hrs

Classification of second order linear partial differential equations – Solutions of one-dimensional wave equation, one-dimensional heat equation – Steady state solution of two- dimensional heat equation (Cartesian coordinates only) – Fourier series solutions.

UNIT IV ANALYTIC FUNCTIONS 12 Hrs

Analytic functions – Cauchy Riemann equations in Cartesian and Polar form – Properties of analytic functions – Construction of analytic functions – Simple Transformations – Standard transformations : $w = z^2$, $w = e^z$, $w = \sin z$, $w = \cosh z$ – Bilinear transformations.

UNIT V COMPLEX INTEGRATION 12 Hrs

Cauchy's integral theorem (without proof) – Cauchy's integral formulae (without proof) – Taylor's and Laurent's series (without proof) – Singularities: Types – Residues – Cauchy's residue theorem (without proof) – Evaluation of real integrals by Contour Integration (excluding poles on real axis).

Total no. of Hours: 60Hrs

Reference Books:

1. *Veerarajan T., Engineering Mathematics (for first year), Tata McGraw Hill Publishing Co., (2008).*
2. *Veerarajan T., Engineering Mathematics (for semester III), Tata McGraw Hill Publishing Co., (2005).*
3. *Singaravelu, Transforms and Partial Differential Equations, Meenakshi Agency, (2017).*
4. *Kreyszig E., Advanced Engineering Mathematics (10^{th} ed.), John Wiley & Sons, (2011).*
5. *Grewal B.S., Higher Engineering Mathematics, Khanna Publishers, (2012).*

Subject Code:	Subject Name : Mechanical Operations	Ty/Lb/ETL/IE	L	T / S.Lr	P/ R	C
EBCT22002	Prerequisite: Unit operations and processes	Ty	3	1/0	0/0	4

C : Credits L : Lecture T : Tutorial S.Lr : Supervised Learning P : Problem / Practical R : Research
T/L/ETP/IE : Theory/Lab/Embedded Theory and Practice/Internal evaluation.

OBJECTIVE :

- To provide knowledge of particle size analysis, size reduction, storage of solids, particle mechanics, sedimentation and floatation, flow through packed beds, fluidization, filtration, fluid-solid conveying.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Ability to know about properties of solids.
CO2	To understand the process and equipment.
CO3	To select suitable size reduction equipment.
CO4	To determine the effectiveness and efficiency of separating equipments
CO5	To study design and construction of separating equipments

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	1	2	1	-	1	-	-	-	-	1
CO2	-	1	-	1	-	1	-	2	-	-	-	-
CO3	3	-	-	-	-	-	1	-	-	-	2	-
CO4	1	2	-	2	-	2	-	2	3	-	1	-
CO5	1	-	1	-	2	-	2	3	-	2	-	1

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	-
CO2	2	1	3	-
CO3	1	2	3	-
CO4	1	1	2	-
CO5	2	1	1	

H/M/L indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical /Project			
				√								

Subject Code:	Subject Name : Mechanical Operations	Ty/Lb/ETL/IE	L	T / S.Lr	P/ R	C
EBCT22002	Prerequisite: Unit operations and processes	Ty	3	1/0	0/0	4

UNIT I PARTICLE CHARACTERISTICS AND SIZE ANALYSIS 12Hrs

General characteristics of solids, their behavior under different external forces, agglomeration, techniques for size analysis.

UNIT II SIZE REDUCTION 12Hrs

Laws of size reduction classification of equipment, methods of size reduction, disintegration, preparation of colloids.

UNIT III MECHANICAL SEPARATIONS 12Hrs

Screening and Screening equipment, effectiveness of screens, gravity settling, sedimentation, thickening, centrifugal separation, impingement methods, industrial dust removing equipment with special reference to electrostatic and magnetic separators, heavy media separations, floatation.

UNIT IV FILTRATION, MIXING AND AGITATION 12Hrs

Theory of filtration, Batch and continuous filters, centrifuges, membrane and ultra filtration. Equipment for blending and kneading, dispersion, power for agitation, correlations.

UNIT V STORAGE AND CONVEYING OF SOLIDS 12Hrs

Conveyors, elevators, pneumatic conveying, Different methods for storage of solids.

Total No.of Hours: 60Hrs

TEXT BOOK:

1. *McCabe,W.L, Smith J.C and Harriot, P., " UNIT Operations in Chemical Engineering ", McGraw-Hill, Fourth Edition, 1984.*

REFERENCES:

1. *Coulson, J.M., Richardson, J.F., "Chemical Engineering ", Volume 2, Third Edition, Pergamon Press, 1977.*

Subject Code:	Subject Name : Chemical Process Calculations	Ty/Lb/ETL/IE	L	T/SLr	P/R	C
EBCT22003	Prerequisite: General Chemistry & basic chemical reactions	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL/IE : Theory/Lab/Embedded Theory and Lab/ Internal evaluation

OBJECTIVE:

- This course brings together the concepts of engineering and economics for chemical plant design and optimization and also composition of mixtures.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Units and dimensions.
CO2	Material balance and Energy balance calculation for all chemical processes.
CO3	Calculation for batch and continuous processes applied to solution of problems in chemical process industries.
CO4	Learn to perform energy balance calculation
CO5	Student will learn different problems related to process industries and come up with appropriate solution

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO 6	PO7	PO8	PO9	PO10	PO1 1	PO12
CO1	3	2	1	-	-	-	1	-	-	-	-	1
CO2	2	3	1	-	-	-	2	-	-	-	-	-
CO3	2	3	1	-	-	-	1	-	-	-	-	2
CO4	3	-	-	-	1	-	-	2	-	-	-	-
CO5	2	1	-	-	1	-	-	-	1	-	-	1

COs / PSOs	PSO1	PSO2	PSO3	PSO4				
CO1	3	3	2	2				
CO2	2	3	1	2				
CO3	3	1	2	2				
CO4	2	1	-	-				
CO5	1	2	2	-				

H/M/L indicates Strength of Correlation 3- High,2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical /Project			
				√								

Subject Code: EBCT22003	Subject Name : Chemical Process Calculations	Ty/Lb/ETL/IE	L	T/SLr	P/R	C
	Prerequisite: General Chemistry & basic chemical reactions	Ty	3	0/0	0/0	3

UNIT I UNITS, DIMENSIONS AND GAS CALCULATIONS 9Hrs

Basic and derived UNITs, use of model UNITs in calcualtions, Methods of expression, compositions of mixture and solutions. Ideal and real gas laws - Gas constant - calculations of pressure, volume and temperature using ideal gas law. Use of partial pressure and pure component volume in gas calculations, applications of real gas relationship in gas calculation.

UNIT II MATERIAL BALANCE 9Hrs

Stoichiometric principles, Application of material balance to UNIT operations like distillation, evaporation, crystallisation, drying etc., - Material balance with chemical reaction - Limiting and excess reactants - recycle - bypass and purging - Unsteady state material balances.

UNIT III HUMIDITY AND SATURATION 9Hrs

Calculation of absolute humidity, molal humidity, relative humidity and percentage humidity - Use of humidity in condensation and drying - Humidity chart, dew point.

UNIT IV FUELS AND COMBUSTION 9Hrs

Determination of Composition by orsat analysis of products of combustion of solid, liquid and gas fuels - Calculation of excess air from orsat technique, problems on sulphur and sulphur bearing compounds.

UNIT V THERMO PHYSICS AND THERMOCHEMISTRY 9Hrs

Heat capacity of solids, liquids, gases and solutions, use of mean heat capacity in heat calculations, problems involving sensible heat and latent heats, evaluation of enthalpy. Standard heat of reaction, heats of formation, combustion, solution, mixing etc., calculation of standard heat of reaction - Effect of pressure and temperature on heat of reaction - Energy balance for systems with and without chemical reaction. - unsteady state energy balances.

Total No of Hours: 45Hrs

TEXT BOOKS:

1. *Bhatt, B.L., Vora, S.M., " Stoichiometry ", Tata McGraw-Hill, 1976.*
2. *Himmelblau, D.M., " Basic Principles and Calculations in Chemical Engineering ",EEE Sixth Edition, Prentice Hall Inc., 2003 (with CD containing programmes and problems).*

REFERENCES*:*

1. *Process Calculation for Chemical Engineering, Second Revised Edition, Chemical Engineering Education Developement Centre, I.I.T., Madras, 1981*
2. *Process Calculations, Venkataramani, V and Anantharaman, N, Prentice Hall of India Pvt. Ltd. 2007*

Subject Code: EBCS22ID1	Subject Name : Computer Applications in Chemical Engineering	Ty/Lb/ETL /IE	L	T/SLr	P/R	C
	Prerequisite: Computer Fundamentals	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab/ Internal evaluation

OBJECTIVE:

- To gain knowledge based on various programming languages applied for chemical technology.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Select appropriate computer applications to store and retrieve data.
CO2	Disseminate given information in basic and advanced PC applications.
CO3	Identify and apply digital/computer fundamentals.
CO4	To analyze calculation of chemical engineering data
CO5	By using computer programming to manipulate simulation of chemical processing

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	1	-	-	-	-	1	1	-
CO2	3	3	-	-	3	-	3	-	-	1	3	-
CO3	1	1	-	-	3	-	-	-	-	2	1	-
CO4	3	-	2	2	-	3	-	-	2	-	-	2
CO5	2	2	-	-	2	-	3	1	-	1	2	-

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	2	1	2	1
CO2	2	1	2	1
CO3	1	2	1	2
CO4	3	2	1	2
CO5	1	2	2	1

H/M/L indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical /Project			
							√					

Subject Code: EBCS22ID1	Subject Name : Computer Applications in Chemical Engineering	Ty/Lb/ETL /IE	L	T/SLr	P/R	C
	Prerequisite: Computer Fundamentals	Ty	3	0/0	0/0	3

UNIT I INTRODUCTION TO PROGRAMMING LANGUAGES 9Hrs

Evaluation of Programming Languages - C, C++ and Java, Review on Windows operating system. Application Program: introduction to Word, Power point

UNIT II INTRODUCTION TO C PROGRAMMING 9Hrs

Introduction to C Programming - data types - constants - Variables - Expressions – Operators – input and output functions – Control Statements – Looping statements. Functions -Definition –Types of Function, Arrays - types of Array- Files handling.

UNIT III SPREAD SHEETS 9Hrs

Creating – opening and saving files – working with worksheets – entering data – editing – formatting – printing – formulae –Charts - Application in Density, molecular weight, mole and percentage compositions, Empirical and Molecular formula calculations, Heat of mixing, Gas laws, Vapour pressure, Chemical Kinetics calculations.

UNIT IV SPREAD SHEETS (DATA ANALYSIS) 9Hrs

Application in data processing, Statistical analysis of data, Regression. Analysis of variance, Interpolation, Graphical representations of various Chemical Engineering

UNIT V FORTRAN 9Hrs

Syntax – Mathematical and logical operation – Looping – Conditional statements – function – sub function – Simple application Programs.

Total No.of Hours: 45Hrs

TEXT BOOK

1. Ashok N.Kamthane ,Programming with ANSI and Turbo C , Pearson Education, 2006
2. E. Joseph Billo, "Excel® for Chemists- A Comprehensive Guide", John Wiley & Sons, 3rd Edition

REFERENCE BOOKS:

1. B.W. Kernighan and D.M.Ritchie, The C Programming Language, 2nd Edition, PHI, 1988
2. Kanetkar Y., Let us C, BPB Pub., New Delhi, 1999.
3. Jerry, O., Breneman, G.L. Spreadsheet Chemistry, Prentice Hall, Englewood Cliffs, 1991.

Subject Code: EBCE22ID4	Subject Name : Environmental Engineering	Ty/Lb/ETL/IE	L	T/SLr	P/R	C
	Prerequisite: None	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab/ Internal evaluation

OBJECTIVE :

- To impart knowledge in fundamental theory and design of conventional water treatment facilities.
- To impart knowledge in fundamental theory and design of conventional wastewater treatment facilities.
- To impart knowledge on the principles used to design advanced wastewater treatments.

COURSE OUTCOMES (COs) : (3- 5)

CO1	An insight into the structure of drinking water supply and waste water systems, including water transport, treatment and distribution.
CO2	An understanding of water quality and waste water criteria and standards, and their relation to public health.
CO3	The ability to design and evaluate water supply and waste water project alternatives on basis of chosen.
CO4	To develop students analytical, computational and research skills through assignments, weekly presentations and modeling software.
CO5	To inculcate among students sensitivity towards social and corporate responsibilities

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	-	-	1	-	-	-	2	-	1
CO2	3	2	-	-	-	-	-	-	-	2	-	-
CO3	3	2	1	-	-	2	-	-	-	1	-	3
CO4	2	-	-	-	1	-	-	-	2	-	-	1
CO5	-	1	-	-		-	-	-	-	1	-	-

COs / PSOs	PSO1	PSO2	PSO3	PO4
CO1	3	3	3	-
CO2	3	3	3	-
CO3	3	3	3	-
CO4	2	1	1	-
CO5	2	3	1	-

H/M/L indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Science	Engineering Science	Humanities and social Science	Program Core	Program elective	Open Elective	Inter Disciplinary	Skill Component	Practical /Project			
							√					

Subject Code: EBCE22ID4	Subject Name : Environmental Engineering	Ty/Lb/ETL/IE	L	T/SLr	P/R	C
	Prerequisite: None	Ty	3	0/0	0/0	3

UNIT I PLANNING FOR WATER SUPPLY SYSTEMS 9Hrs

Scope of environmental engineering – role of environmental engineer – Public water supply systems – objectives – design period – population forecasting – water demand – sources of water – sources selection – water quality – characterization – sources of wastewater –estimation of storm runoff.

UNIT II WATER TREATMENT 9Hrs

Screening - types of screening - plain sedimentation – sedimentation with coagulation – settling & flotation - filtration – disinfection.

UNIT II SEWAGE TREATMENT – PRIMARY TREATMENT 9Hrs

Objectives – unit operations & processes – principles, functions and design of screen, grit chambers and primary sedimentation tanks.

UNIT IV SEWAGE TREATMENT – SECONDARY TREATMENT 9Hrs

Secondary treatment – activated sludge process and trickling filter; other treatment methods – stabilization ponds and septic tanks – advances in sewage treatment.

UNIT V SEWAGE DISPOSAL AND SLUDGE MANAGEMENT 9Hrs

Methods – dilution – self purification of surface water bodies – oxygen sag curve – land disposal – sewage farming – deep well injection – soil dispersion system. Thickening – sludge digestion – biogas recovery - drying beds – conditioning and dewatering – sludge disposal.

Total No of Hours: 45Hrs

TEXT BOOKS:

1. *Garg, S.K., Environmental Engineering, Vols. I &II, Khanna Publishers, New Delhi, 1994*
2. *C.S.Shah, Water Supply And Sanitation, Galgotia Publishing Company, New Delhi, 1994*

REFERENCES:

1. *Manual on Water Supply And Treatment, Ministry Of Urban Development, Government Of India, New Delhi, 1999.*
2. *Manual on sewerage and sewage treatment, CPHEEO, Ministry Of Urban Development, Government Of India, New Delhi, 1993*
3. *H.S.Peavy, D.R.Rowe and George Tchobanoglous, Environmental Engineering, Mcgraw-Hill Book Company, New Delhi, 1995.*

SEMESTER III (PRACTICAL)

Subject Code: EBCC22ET1	Subject Name: UNIVERSAL HUMAN VALUES : UNDERSTANDING HARMONY	Ty/Lb/ETL/IE	L	T/SLr	P/R	C
	Prerequisite: None, UHV1 (Desirable)	**ETL**	**1**	**0/0**	**2/0**	**2**

L:LectureT :Tutorial SLr: Supervised Learning P:Project R:ResearchC:CreditsT/L/ETL/IE: Theory/Lab/Embedded Theory and Lab/ Internal evaluation

OBJECTIVES:

Human Values Courses: During the Induction Program, students would get an initial exposure to human values through Universal Human Values – I. This exposure is to be augmented by this compulsory full semester foundation course.

1. Development of a holistic perspective based on self- exploration about themselves (human being), family, society and nature/existence.
2. Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence
3. Strengthening of self-reflection.
4. Development of commitment and courage to act.

COURSEOUTCOMES(Cos) :(3–5) The students will be able to

CO1	Relate self and surroundings and identify responsibility in life
CO2	Associate human relationship and nature to handle problems and provide sustainable solutions
CO3	Develop critical ability and engage in reflective and independent Thinking
CO4	Show commitment towards understanding of values
CO5	Apply Human values in day to day setting in real life

Mapping of Course Outcomes with Program Outcomes(POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			**1**	**1**		**2**	**1**		**1**	**1**		**2**
CO2			**2**	**2**	**1**	**2**	**3**	**1**		**2**		**2**
CO3			**1**	**1**	**1**	**2**			**1**	**2**		**3**
CO4			**2**		**1**	**1**	**1**	**3**	**1**	**1**		**3**
CO5			**1**			**2**	**1**	**2**	**1**	**1**		**3**

Cos/PSOs	PSO1	PSO2	PSO3	PSO4
CO1	**3**	**2**	**1**	**-**
CO2	**2**	**3**	**2**	**-**
CO3	**3**	**3**	**-**	**-**
CO4	**2**	**1**	**-**	**-**
CO5	**3**	**-**	**2**	**3**

3/2/1indicatesstrengthofcorrelation 3 –High,2–Medium,1– Low

Category	Basic Sciences	Engg Sciences	Humanities &SocialSciences	Program	Program Electives	OpenElectives	Inter Disciplinary	Skill Component	Practical /Project
			√						

Subject Code: EBCC22ET1	Subject Name: UNIVERSAL HUMAN VALUES : UNDERSTANDING HARMONY	Ty/Lb/ETL/IE	L	T/SLr	P/R	C
	Prerequisite: None, UHV1 (Desirable)	**ETL**	**1**	**0/0**	**2/0**	**2**

UNIT I INTRODUCTION - NEED, BASIC GUIDELINES, CONTENT AND PROCESS FOR VALUEEDUCATION 12Hrs

PurposeandmotivationforthecourserecapitulationfromUniversal HumanValues-I - Self-Exploration–what is it? - Its content and process; 'Natural Acceptance'andExperientialValidation-astheprocessforself-exploration. - ContinuousHappinessandProsperity-AlookatbasicHuman Aspirations - Right understanding, Relationship and Physical Facility- the basic requirementsforfulfilmentofaspirationsofeveryhumanbeingwiththeir correctpriority - UnderstandingHappinessandProsperitycorrectly-Acriticalappraisalof the currentscenario - Methodtofulfiltheabovehumanaspirations:understandingandliving in harmony atvariouslevels. Include practice sessions to discuss natural acceptance in human being as the innate acceptance forliving with responsibility (living in relationship, harmony and co-existence) rather than asarbitrariness in choice based on liking-disliking.

UNIT II UNDERSTANDING HARMONY IN THE HUMAN BEING - HARMONY IN MYSELF 12Hrs

Understanding human being as a co-existence of the sentient 'I' and the material 'Body'.- Understanding the needs of Self ('I') and 'Body' - happiness and physical facility. - Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer). - Understanding the characteristics and activities of 'I' and harmony in 'I' - Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physicalneeds, meaning of Prosperity in detail - Programs to ensureSanyam and Health. Include practice sessions to discuss the role others have played in making material goods available tome. Identifying from one's own life.Differentiate between prosperity and accumulation. Discussprogram for ensuring health vs dealing with disease.

UNIT III UNDERSTANDING HARMONY IN THE FAMILY AND SOCIETY- HARMONY IN HUMAN-HUMANRELATIONSHIP
12Hrs

Understanding values in human-human relationship; meaning of Justice (nine universal values inrelationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect asthe foundational values of relationship - Understanding the meaning of Trust; Difference between intention and competence - Understanding the meaning of Respect, Difference between respect and differentiation; the othersalient values in relationship - Understanding the harmony in the society (society being an extension of family): Resolution,Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals - Visualizing a universal harmonious order in society- Undivided Society, Universal Order- fromfamily to world family. Include practice sessions to reflect on relationships in family, hostel and institute as extended family,real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal valuein relationships. Discuss with scenarios. Elicit examples from students' lives.

UNIT IV UNDERSTANDING HARMONY IN THE NATURE AND EXISTENCE - WHOLE EXISTENCE ASCOEXISTENCE
12Hrs

Understanding the harmony in the Nature - Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self-regulationin nature - Understanding Existence as Co-existence of mutually interacting units in all-pervasive space - Holistic perception of harmony at all levels of existence - Include practice sessions to

discuss human being as cause of imbalance in nature (film "Home" canbe used), pollution, depletion of resources and role of technology etc.

UNIT V IMPLICATIONS OF THE ABOVE HOLISTIC UNDERSTANDING OF HARMONY ON PROFESSIONALETHICS 12Hrs

Natural acceptance of human values - Definitiveness of Ethical Human Conduct - Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order - Competence in professional ethics: a. Ability to utilize the professional competence foraugmenting universal human order b. Ability to identify the scope and characteristics of peoplefriendlyand eco-friendly production systems, c. Ability to identify and develop appropriatetechnologies and management patterns for above production systems. - Case studies of typical holistic technologies, management models and production systems - Strategy for transition from the present state to Universal Human Order: ((a) At the level ofindividual: as socially and ecologically responsible engineers, technologists and managers, (b)Atthe level of society: as mutually enriching institutions and organizations - Sum up. Include practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions e.g.Todiscuss the conduct as an engineer or scientist etc.

Total No of Hours: 60Hrs

TEXT BOOK

1. *Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books,New Delhi, 2010*

REFERENCE BOOKS

1. *Jeevan Vidya: EkParichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.*
2. *Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.*
3. *The Story of Stuff (Book).*
4. *The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi.*
5. *Small is Beautiful - E. F Schumacher.*
6. *Slow is Beautiful - Cecile Andrews*
7. *Economy of Permanence - J C Kumarappa*
8. *Bharat Mein Angreji Raj - PanditSunderlal*
9. *Rediscovering India - by Dharampal*
10. *Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi*
11. *India Wins Freedom - Maulana Abdul Kalam Azad*
12. *Vivekananda - Romain Rolland (English)*
13. *Gandhi - Romain Rolland (English)*

Subject Code: EBCT22L01	Subject Name : Water Analysis Lab	Ty/Lb/ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: Chemical Technology	Lb	0	0/0	3/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research
C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab/ Internal evaluation

OBJECTIVE:

- To reduce the impurities to a certain level that does not cause harm to human health.
- To reduce the objectionable colour, odour, turbidty and hardness.
- To make water safe for drinking and usable application.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Sampling techniques and sample for the analysis at water components
CO2	Apply analytical techniques for specific test
CO3	Compare advance and conventional techniques for specific water sample
CO4	Apply a range at physical and chemical testing of the sample
CO5	Analysis interpret of report on result obtained in given formate

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	-	-	1	-	-	-	2	-	1
CO2	3	2	-	-	-	-	-	-	-	2	-	-
CO3	3	2	1	-	-	2	-	-	-	1	-	3
CO4	2	-	-	-	1	-	-	-	2	-	-	1
CO5	-	1	-	-		-	-	-	-	1	-	-

COs / PSOs	PSO1	PSO2	PSO3	PO4
CO1	3	3	3	-
CO2	3	3	3	-
CO3	3	3	3	-
CO4	2	1	1	-
CO5	2	3	1	-

H/M/L indicates Strength of Correlation 3- High, 2- Medium,1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical /Project			
				√					√			

Subject Code: EBCT22L01	Subject Name : Water Analysis Lab	Ty/Lb/ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: Chemical Technology	Lb	0	0/0	3/0	1

1. ALKALINITY, PHENOLPHTHALEIN
2. BICARBONATE
3. BIOCHEMICAL OXYGEN DEMAND
4. CHEMICAL OXYGEN DEMAND
5. CARBONATE CALCULATION FROM PH & ALKALINITY
6. EDTA TITRATION METHOD FOR CALCIUM ANALYSIS

Subject Code: EBCT22L02	Subject Name : Mechanical Operation Lab	Ty/Lb/ETL/IE	L	T/SLr	P/R	C
	Prerequisite: Mechanical operation theory	Lb	0	0/0	3/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab/ Internal Evaluation

OBJECTIVE:

- In this course, the students will learn characterization of solids, size reduction, techniques of solid – fluid separation and mixing.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Thermal conductivity of insulation powder
CO2	Determination of emissivity of a grey body
CO3	Determination of overall heat transfer coefficients for a composite wall
CO4	Determination of steban beltzman constant
CO5	Determination of efficiency of a pin-fin apparatus to find using based convection

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	3	-	-	-	3	-	-	1
CO2	2	-	2	-	3	-	-	-	3	-	-	2
CO3	2	-	-	-	1	-	-	-	3	-	2	-
CO4	3	-	-	1	-	-	-	3	-	-	1	-
CO5	2	-	-	-	1	2	2	-	-	-	-	2

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	2	2	1	-
CO2	3	1	-	-
CO3	1	2	1	-
CO4	3	2	1	-
CO5	4	2	1	1

H/M/L indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical /Project			
				√					√			

Subject Code: EBCT22L02	Subject Name : Mechanical Operation Lab	Ty/Lb/ETL/IE	L	T/SLr	P/R	C
	Prerequisite: Mechanical operation theory	Lb	0	0/0	3/0	1

1. Jaw crusher
2. Crushing rolls
3. Ball mill
4. Size analysis by sieving
5. Size analysis by sub-sieving
6. Filter press
7. Leaf filter
8. Cyclone separator
9. Sedimentation
10. Elutriator
11. Rotary Drum filter
12. Effectiveness of screens

*** Minimum 10 experiments shall be offered**

Subject Code: EBCS22IL3	Subject Name : Computer Programming Lab	Ty/Lb/ETL/IE	L	T/SLr	P/R	C
	Prerequisite: Computer application in chemical lab	Lb	0	0/0	3/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab/ Internal Evaluation

OBJECTIVE:

- To gain knowledge based on various programming languages applied for chemical technology.

COURSE OUTCOMES (COs) : (3- 5)

CO1	At the end of this practical course, the student would have a thorough understanding of skills in computerprograms.
CO2	To making the computer programming skill development
CO3	The chemical formula understand by using C,C+, C++ programme
CO4	Recent trend skill development by using fundamental programming knowledge.
CO5	To leaning advance technique from computer language

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	1	-	3	-	2	-	3	2	-	2
CO2	2	-	1	-	3	-	2	-	3	-	3	1
CO3	1	-	-	-	2	-	-	2	2	2	2	-
CO4	2	2	2	2	-	-	3	3	2	1	3	2
CO5	3	3	2	1	3	2	-	-	-	2	1	3

COs / PSOs	PSO1	PSO2	PSO3	PSO4				
CO1	2	2	2	2				
CO2	3	1	1	3				
CO3	3	2	1	3				
CO4	1	2	3	2				
CO5	2	1	2	1				

H/M/L indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical /Project			
							√		√			

Subject Code: EBCS22IL3	Subject Name : Computer Programming Lab	Ty/Lb/ETL/IE	L	T/SLr	P/R	C
	Prerequisite: Computer application in chemical lab	Lb	0	0/0	3/0	1

1. Operating Systems Commands (like Copy , ren, del, type, cd, md, rd,..)

2. Formatting the Word Document (Fonts, Header, Footer, page number, Tables,..)

i. Text Manipulations, Usage of Spell check, and Find & Replace
ii. Usage of Numbering, Bullets, Footer and Headers.
iii. Picture insertion and alignment.
iv. Creation of documents, using templates.
v. Mail Merge Concepts.

3. Power point Presentation (Slide Design, animation and effects.)

4. Working with Excel

i. Cell Editing, Usage of Formulae and Bulit-in Functions.
ii. using Spread sheet, Empirical and Molecular formula calculation
iii. using Spread sheet, Chemical Kinetics calculation

5. C- Programming

i. Write a C program to implement Single non-linear equation (Equation state such as Van der Waal, Peng Robinson, RKS, Friction factor equation, Ergun equation, Estimation of Drag coefficient etc)

ii. Write a C program to implement set of linear equation (Material balance of distillation column, multiple extraction unit, etc)

ii. Write a C program to find the

a. Density b. Molecular Weight c. Mole d. Percentage of Composition

Subject Code: EBCT22ET1	Subject Name : Fertilizer Technology	Ty/Lb/ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: Basic science	**ETL**	**2**	**0/0**	**2/0**	**3**

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
Ty/L/ETL : Theory/Lab/Embedded Theory and Lab/ Internal Evaluation

OBJECTIVE:

- To enable the students to learn the fertilizer manufacturing including new or modified fertilizer products and new techniques.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Use the proper micronutrients to improve fertility of soil.
CO2	Use relevant fertilizer on the basic of different properties
CO3	Select the relevant manufacturing process for phosphatic fertilizers
CO4	Select the relevant manufacturing process for potassic fertilizers
CO5	Select proper micro-nutrient to produce bio-fertilizer

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**2**	**3**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**3**	**-**
CO2	**2**	**3**	**-**	**2**	**-**	**2**	**-**	**-**	**-**	**-**	**3**	**1**
CO3	**-**	**-**	**1**	**-**	**1**	**2**	**1**	**-**	**1**	**3**	**1**	**-**
CO4	**1**	**-**	**-**	**-**	**2**	**-**	**2**	**-**	**-**	**1**	**-**	**1**
CO5	**2**	**-**	**2**	**1**	**-**	**2**	**1**	**-**	**-**	**-**	**1**	**1**

COs / PSOs	**PSO1**	**PSO2**	**PSO3**	**PSO4**				
CO1	**2**	**2**	**-**	**1**				
CO2	**3**	**1**	**2**	**1**				
CO3	**3**	**2**	**1**	**-**				
CO4	**2**	**1**	**2**	**2**				
CO5	**3**	**2**	**2**	**2**				

H/M/L indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical /Project			
				√					√			

Subject Code: EBCT22ET1	Subject Name : Fertilizer Technology	Ty/Lb/ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: Basic science	ETL	2	0/0	2/0	3

UNIT I NITROGENOUS FERTILISERS 12Hrs

Methods of production of nitrogenous fertilizer-ammonium sulphate, nitrate, urea and calciumammonium nitrate; ammonium chloride and their methods of production, characteristics and specifications, storage and handling.

UNIT II PHOSPHATIC FERTILISERS 12Hrs

Raw materials; phosphate rock, sulphur; pyrites etc., processes for the production of sulphuric and phosphoric acids; phosphates fertilizers – groundrock phosphate; bone meal-single superphosphate, triple superphosphate, triplesuperphosphate, thermal phosphates and their methods of production, characteristics and specifications.

UNIT III POTASSIC FERTILISERS 12Hrs

Methods of production of potassium chloride, potassium sulphatetheircharacteristics and specifications.

UNIT IV COMPLEX AND NPK FERTILISERS 12Hrs

Methods of production of ammonium phosphate, sulphated ammoniumphosphate, nitrophosphates, urea, ammonium phosphate, mono-ammonium phosphate and various grades of NPK fertilizers produced in the country.

UNIT V MISCELLANEOUS FERTILISERS 12Hrs

Mixed fertilizers and granulated mixtures; biofertilisers, nutrients, secondary nutrients and micro nutrients; fluid fertilizers, controlled release fertilizers,controlled release fertilizers.

Total No of Hours: 60Hrs

TEXT BOOKS:

1. *"Handbook of fertilizer technology", Association of India, New Delhi, 1977.*
2. *Menno, M.G.; "Fertilizer Industry - An Introductory Survey", HigginbothamsPvt. Ltd., 1973.*

REFERENCES:

1. *Sauchelli, V.; "The Chemistry and Technology of Fertilizers", ACSMONOGRAPH No. 148, Reinhold Publishing Cor. New York, 1980.*
2. *Fertiliser Manual, "UNITed Nations Industrial Development Organisation",UNITed Nations, New York, 1967.*
3. *Slack, A.V.; Chemistry and Technology of Fertilisers, Interscience, New York, 1966.*

PRACTICAL EXERCISE

1. Prepare chart for fertilizer classification with chemical formula and nutrient content.
2. Estimate nutrient content (% N, %P2O, % K2O) in different fertilizers from their chemical formula.
3. Estimate percentage of Nitrogen in Ammonium chloride by back titration.
4. Estimate percentage of Nitrogen in DAP by Kjeldhal's method.
5. Prepare potassium sulphate and potassium chloride.

SUGGESTED STUDENT ACTIVITIES

1. Following is the list of proposed student activities. These could be individual or group-based.
2. Prepare course/topic based presentations using internet .
3. Make a report on fertilizer plants in India/Tamil Nadu with their capacity of production and technology being used.
4. Participate in MCQ/Quiz.

SPECIAL INSTRUCTIONAL STRATEGY (IF ANY)

1. Show video/animation films about fertilizer production plants.
2. Arrange Visit to nearby fertilizer production plant.
3. Arrange expert lectures.

Arrange MCQ/Quiz arrange in normal term period.

SEMESTER IV (THEORY)

Subject Code: EBCT22004	Subject Name : Chemical Technology I	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: Engineering Chemistry – II	Ty	3	1/0	0/0	4

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab/ Internal Evaluation

OBJECTIVE:

- To introduce history, importance and components of chemical engineering, concepts of unit operations and unit processes. Currents scenario of chemical & allied process industries.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Student will be able to explain the basic history, current issues, and trends in process industries. This shall give them first hand information about the environment in industries and prepare them well for industries
CO2	The students are informed about some basic industries with the help of process diagrams, material of construction used, chemical and physical processes involved including the equipments used, their safety precautions in design and operation.
CO3	This shall give them first hand information about the environment in industries and prepare them well for industries.
CO4	Can describe various manufacturing processes used in chemical process industries
CO5	Can understand major engineering problems encountered in chemical process industries

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	-	2	-	-	-	-	2	-	1	-
CO2	3	2	-	-	-	-	-	-	3	-	-	-
CO3	1	3	-	-	-	1	-	-	3	-	-	2
CO4	2	1	-	1	-	-	-	2	-	-	2	-
CO5	1	-	1	-	-	-	-	1	-	-	1	-

COs /PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	1	1	1
CO2	2	1	3	3
CO3	1	3	2	1
CO4	2	2	1	2
CO5	2	3	1	1

H/M/L indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical /Project			
				√								

Subject Code: EBCT22004	Subject Name : Chemical Technology I	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: Engineering Chemistry – II	Ty	3	1/0	0/0	4

UNIT I INTRODUCTION 12Hrs

Chemical processing, the role of chemical engineers in process industries, importance of block diagrams and flow charts, UNIT operations, UNIT processes, process utilities sand economics, industrial safety and pollution, outline plant and equipment design, process control and instrumentation.

UNIT II FERTILIZER CHEMICALS 12Hrs

Growth elements, Function, Nitrogenous fertilizers, Ammonium sulfate, Ammonium Nitrate and Urea, Phosphatic fertilizers, single and triple superphosphate, Ammonium phosphate, Nitro phosphate, Potassium Fertilizers, Potassium Chloride, Potassium Nitrate and phosphate, Compound fertilizers and bio-fertilizers. PHOSPHORUS INDUSTRIES: Phosphate rock, benefaction, phosphoric acid-phosphate. NITROGEN INDUSTRIES: Synthesis ammonia and nitric acid. AGRICHEMICAL INDUSTRIES: Insecticides, pesticides, herbicides, plant nutrients and regulators

UNIT III INDUSTRIAL CHEMICALS I 12Hrs

EXPLOSIVES AND PROPELLANTS INDUSTRIES: Explosives, types and characteristics, industrial and military explosives, propellants for rockets. SURFACE COATING INDUSTRIES: Paints, pigments, varnishes, lacquers, industria, and marine coatings. PHOTOGRAPHIC CHEMICALS: Photographic chemicals, manufacture of films, plates and papers, recovery. INDUSTRIAL GASES: Synthetic gas, natural gas, carbon dioxide sulphur-di-oxide, acetylene, helium and argon, hydrogen, oxygen, nitrogen.

UNIT IV INDUSTRIAL CHEMICALS II 12Hrs

CHOLORO - ALKALI INDUSTRIES: Soda ash and sodium bicarbonate, Chlorine and caustic soda; bleaching powder and related bleaching agents, hydrochloric acid.SULPHUR AND SULPHURIC ACID INDUSTRIES: Mining and manufacturing of Sulphur, recovery of sulphur from polluting gases, sulphur trioxide and sulphuric acid.ELECTROLYTIC AND ELECTROTHERMAL INDUSTRIES: Abrasives, Carborondum, Calcium Carbide, Aluminium and Magnesium.

UNIT V INDUSTRIAL CHEMICALS III 12Hrs

WATER IN INDUSTRY: Role of water treatment methods for industrial and domestic use, recovery of waste water, water conditioning.MARINE CHEMICALS: Sodium chloride, By-products of common salt industry, value added product.NUCLEAR INDUSTRIES: Production of uranium, thorium and zirconium from ores and minerals, separation of isotopes, waste disposal.

Total No of Hours: 60Hrs

TEXT BOOKS

1.Austin, G.T. Shreve, " Chemical Process Industries ", Fifth Edition,McGraw Hill International Book Co., Singapore, 1984.Dryden, C.E., " Outlines of Chemicals Technology ", Edited andRevised by Gopala Rao, M. and Sitting, M., Second Edition,Affiliated East-West Press, 1993.

Subject Code:	Subject Name : Chemical Engineering Thermodynamics I	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
EBCT22005	**Prerequisite:** Classical thermodynamics	Ty	3	1/0	0/0	4

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab/ Internal Evaluation

OBJECTIVE:

- To understand the theory and applications of classical thermodynamics, thermodynamic properties, equations of state, methods used to describe and predict phase equilibrium.

COURSE OUTCOMES (COs) : (3- 5)

CO1	To understand and be able to use the first law of thermodynamics for open and closed systems, to set up energy balances for steady- and unsteady-state processes and to solve them for simple and classic cases.
CO2	To understand and be able to use the second law of thermodynamics, to set up entropy balances for steady- and unsteady-state processes and to solve them for simple and limiting cases to establish bounds for solutions to engineering problems.
CO3	Students, at the end of the course will be able to comprehend the fundamental concepts of enthalpy, entropy, internal energy and free energy.
CO4	Students, at the end of the course will be able to use volumetric equations of state to estimate saturation pressure of pure components.
CO5	Students, at the end of the course will be able to use the concept of thermodynamic consistency of vapor-liquid equilibrium data through Gibbs-Duhem equation and test consistency of data.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	-	2	-	-	-	-	2	-	1	-
CO2	3	2	-	-	-	2	-	-	3	-	-	2
CO3	2	1	1	-	-	-	-	2	-	2	2	1
CO4	3	-	1	-	2	-	-	3	-	-	1	-
CO5	2	2	-	2	1	1	1	-	1	1	-	2

COs / PSOs	PSO1	PSO2	PSO3	PSO4			
CO1	3	1	1	2			
CO2	2	1	3	3			
CO3	2	1	1	1			
CO4	3	2	1	1			
CO5	1	1	1	2			

H/M/L indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical /Project			
				√								

Subject Code:	Subject Name : Chemical Engineering Thermodynamics I	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
EBCT22005	**Prerequisite:** Classical thermodynamics	Ty	3	1/0	0/0	4

UNIT – I FUNDAMENTAL CONCEPTS IN THERMODYNAMICS 12Hrs

Introduction – systems – surrounding – thermodynamic property – heat – work – energy forms

UNIT – II FIRST LAW OF THERMODYNAMICS 12Hrs

First law of thermodynamics - batch systems – open systems – applications – chemical reactions

UNIT - III SECOND LAW OF THERMODYNAMICS 12Hrs

Second law -carnot's principle – reversible – irreversible processes – entropy –criterion for reversible – irreversible – entropy balance

UNIT - IV REFRIGERATION AND LIQUEFACTION 12Hrs

Heat engines – refrigeration – cycles.

UNIT – V THERMODYNAMIC PROPERTIES OF FLUIDS 12Hrs

Fluids – state equations – ideal gas – actual gas equations – application.

Total No of Hours: 60Hrs

TEXT BOOKS:

1. Smith, J.M., and Van Ness, H.C., "Introduction to Chemical Engineering Thermodynamics ", Kogakushai 1976.

2. Narayanan K.V" A text book of chemical engineering thermodynamics" Prentice Hall of India pvt. Ltd 2001

REFERENCES

1. Hougen, O.A., Watson, K.M., and Ragatz, R.A., " ChemicalProcess Principles Part II, Thermodynamics ", John Wiley 1970.

2. Dodge, B.F., " Chemical Engineering Thermodynamics ", McGraw-Hill, 1960.

3. Sandler, S.I., " Chemical and Engineering Thermodynamics 2nd edn. ",

4. Wiley, 1989.

***5.** Kyle, B.G., " Chemical and Process Thermodynamics 2nd edn. ", Prentice Hall of India Pvt.Ltd., 1990.*

Subject Code: EBCT22006	Subject Name : Fluid Mechanics	Ty/Lb/ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: chemical process industries	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab/ Internal Evaluation

OBJECTIVE:

- To understand basic concept of fluid flow and its application to chemical process industries including pipe flow, fluid machinery and agitation & mixing.

COURSE OUTCOMES (COs) : (3- 5)

CO1	To give fundamental knowledge of fluid, its properties and behavior under various conditions of internal and external flows.
CO2	To introduce fundamental aspects of fluid flow behavior
CO3	To identify derivation of basic equations of fluid mechanics and apply
CO4	Able to demonstrate boundary layer concepts
CO5	To estimate performance parameters of a given Centrifugal and Reciprocating pump.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	-	2	-	-	-	1	1
CO2	3	1	-	3	-	1	-	-	-	-	3	2
CO3	2	3	-	-	-	-	3	-	-	-	3	2
CO4	1	-	-	-	2	1	-	3	-	-	-	-
CO5	2	-	-	-	1	-	-	-	2	-	-	-

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	3
CO2	2	1	2	1
CO3	2	1	1	3
CO4	3	2	-	-
CO5	2	1	-	-

H/M/L indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical /Project			
				√								

Subject Code: EBCT22006	Subject Name : Fluid Mechanics	Ty/Lb/ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: chemical process industries	Ty	3	0/0	0/0	3

UNIT I INTRODUCTION 9Hrs

Concept of fluid - the fluid as a continuum - properties of a fluid –density -viscosity –surface tension – heat capacity – vapour pressure.

UNIT II FLUID STATICS 9Hrs

Application to manometry – Floatation – gravity settling – centrifugal separation – acceleration.

UNIT III FLOW OF FLUIDS 9Hrs

Bernoullis theorem and application – laminar flow – turbulent flow – pressure drop – Newtonian and non- newtonian flow.

UNIT IV COMPRESSIBLE FLUID FLOW 9Hrs

Mach no – nozzle flow – flow of fluid through packed bed – fluidization.

UNIT V INDUSTRIAL PIPING 9Hrs

Valves – fluid moving machinery – pumps – characteristics of centrifugal pump – other types of pumps – compressors – work – blowers of pumps

Total No of Hours: 45Hrs

TEXT BOOKS:

1. *Noel de Nevers, " Fluid Mechanics for Chemical Engineers ", Second Edition, McGraw-Hill, 1991.*
2. *McCabe,W.L, Smith J.C and Harriot .P.," UNIT Operations in Chemical Engineering ", McGraw-Hill, Sixth Edition 2000.*

REFERENCES:

1. *Chemical engineering hand book by Perry.*
2. *White, F.M., " Fluid Mechanics ", 4th Edition, McGraw-Hill Inc., 1999.*

Subject Code: EBBT22ID1	Subject Name : Bio-Chemical Principles	Ty/Lb/ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: Engineering mathematics, physics, stoichiometric concepts, chemistry	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab/ Internal Evaluation

OBJECTIVE:

- To understand the theory and applications of classical thermodynamics, thermodynamic properties, equations of state, methods used to describe and predict phase equilibria.
- To provide knowledge of thermodynamic properties of real fluids and mixtures to design chemical process plants.

COURSE OUTCOMES (COs) : (3- 5)

CO1	To impart knowledge on design and operation of fermentation processes with all its prerequisites.
CO2	To endow the students with the basics of microbial kinetics, metabolic stoichiometry, energetics and product formation involved in bioprocess technology
CO3	To apply engineering principles to systems containing biological catalysts to meet the needs of the society.
CO4	Convert the promises of molecular biology and genetic engineering into new processes to make bio-products in economically feasible way.
CO5	Discuss the significance of material and energy balance for bioprocess technology.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	2	-	-	3	-	-	-	-	1
CO2	2	-	2	-	-	-	1	-	-	2	-	-
CO3	3	1	1	-	-	-	-	2	-	-	1	-
CO4	2	-	-	-	1	-	-	-	2	-	-	1
CO5	2	2	3	-	-	-	2	-	1	-	1	-

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	2
CO2	2	1	1	2
CO3	3	1	1	2
CO4	2	1	2	1
CO5	2	1	2	1

H/M/L indicates Strength of Correlation 3- High, 4- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical /Project			
							√					

Subject Code: EBBT22ID1	Subject Name : Bio-Chemical Principles	Ty/Lb/ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: Engineering mathematics, physics, stoichiometric concepts, chemistry	Ty	3	0/0	0/0	3

UNIT I OVERVIEW OF FERMENTATION PROCESSES 9Hrs

Overview of fermentation industry, general requirements of fermentation processes, basic configuration of fermentor and ancillaries, main parameters to be monitored and controlled in fermentation processes.

UNIT II RAW MATERIALS AND MEDIA DESIGN FOR FERMENTATION PROCESS 9Hrs

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

UNIT III STERILIZATION KINETICS 9Hrs

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.

UNIT IV METABOLIC STOICHIOMETRY AND ENERGETICS 9Hrs

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.

UNIT V KINETICS OF MICROBIAL GROWTH AND PRODUCT FORMATION 9Hrs

Modes of operation - batch, fed batch and continuous cultivation. Simple unstructured kinetic models for microbial growth, Monod model, growth of filamentous organisms, product formation kinetics - leudeking- piret models, substrate and product inhibition on cell growth and product formation.

Total No. of Hours: 45Hrs

TEXT BOOKS:

1. Bailey and Ollis, " Biochemical Engineering Fundamentals", McGraw Hill (2nd Ed.), 1986.

2. Shule and Kargi, " Bioprocess Engineering ", Prentice Hall, 1992.

REFERENCES:

1. Pauline Doran, Bioprocess Engineering Calculation, Blackwell Scientific Publications.

2.Peter F. Stanbury, Stephen J. Hall & A. Whitaker, Principles of Fermentation Technology, Science & Technology Books.

3. Harvey W. Blanch, Douglas S. Clark, Biochemical Engineering, Marcel Dekker, Inc

Subject Code: EBCC22I04	Subject Name : The Indian Constitution (Audit Course)	Ty/Lb/ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: NIL	IE	2	0/0	0/0	0

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab/ Internal Evaluation

OBJECTIVES:

- To provide an overview of the history of the making of Indian Constitution
- To understand the preamble and the basic structures of the Constitution.
- To Know the fundamental rights, duties and the directive principles of state policy
- To understand the functionality of the legislature , the executive and the judiciary

COURSE OUTCOMES (COs) : After studying this course the student would be able to

CO1	To provide an overview of the history of the making of Indian Constitution
CO2	To understand the preamble and the basic structures of the Constitution.
CO3	To Know the fundamental rights, duties and the directive principles of state policy

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						3	1	1	1	1		
CO2						3	1	1	1	1		
CO3						3	1	1	2	1		

COs / PSOs	PSO1	PSO2	PSO3
CO1	1	1	2
CO2	1	1	2
CO3	1	1	2

H/M/L indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Science	Engineering Science	Humanities and social Science	Program Core	Program elective	Open Elective	Inter Disciplinary	Skill Component	Practical /Project	Basic Science	
			✓								

Subject Code:	Subject Name : The Indian Constitution(Audit Course)	Ty/Lb/ETL/IE	L	T / S.Lr	P/ R	C
EBCC22I04	Prerequisite: NIL	IE	2	0/0	0/0	0

UNIT 1 **3Hrs**

The History of the Making of Indian Constitution, Preamble and the Basic Structures

UNIT 2 **3Hrs**

Fundamental Rights and Duties, Directive Principles of State Policy

UNIT 3 **3Hrs**

Legislature, Executive and Judiciary

UNIT 4 **3Hrs**

Emergency Powers

UNIT 5 **3Hrs**

Special Provisions for Jammu and Kashmir, Nagaland and Other Regions, Amendments

Total no Hours: 15 Hrs

TEXT BOOKS:

1. D D Basu, Introduction to the Constitution of India, 20th Edn.,LexisnexisButterworths, 2012.

REFERENCE BOOKS:

1. *Rajeev Bhargava (ed), Ethics and Politics of the Indian Constitution, Oxford University Press, New Delhi, 2008.*
2. *Granville Austin, The Indian Constitution: Cornerstone of a Nation, Oxford University Press, Oxford, 1966.*
3. *Zoya Hassan, E. Sridharan and R. Sudarshan (eds), India's Living Constitution: Ideas, Practices, Controversies, Permanent Black, New Delhi, 2002.*
4. *Subhash C. Kashyap, Our Constitution, National Book Trust, New Delhi, 2011.*

Subject Code: EBCC22I05	Subject Name : The Indian Traditional Knowledge(Audit Course)	T / L/ ETL/IE	L	T/SLr	P/R	C
	Prerequisite: NIL	Ty	2	0/0	0/0	0

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab/ Internal Evaluation

OBJECTIVE :

- To understand the Pre- colonial and Colonial Period, Indian Traditional Knowledge System
- To understand the Traditional Medicine, Traditional Production and Construction Technology
- To Know the History of Physics and Chemistry, Traditional Art and Architecture and Vastu Shashtra, Astronomy and Astrology
- To understand the Origin of Mathematics, Aviation Technology in Ancient India, Crafts and Trade in Ancient India

COURSE OUTCOMES (COs) : (3- 5)

The Students will be able to

CO1	To understand the Pre- colonial and Colonial Period, Indian Traditional Knowledge System
CO2	To understand the Traditional Medicine, Traditional Production and Construction Technology
CO3	To understand the Origin of Mathematics, Aviation Technology in Ancient India, Crafts and Trade in Ancient India

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		3	3	1		3				3		1
CO2		3	3	1		3				3		1
CO3		3	3	1		3				3		1

COs / PSOs	PSO1	PSO2	PSO3
CO1	1	1	2
CO2	1	1	2
CO3	1	1	2

H/M/L indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Science	Engineering Science	Humanities and social Science	Program Core	Program elective	Open Elective	Inter Disciplinary	Skill Component	Practical /Project			
			✓									

Subject Code:	Subject Name : The Indian Traditional Knowledge(Audit Course)	T / L/ ETL/IE	L	T/SLr	P/R	C
EBCC22I05	Prerequisite: NIL	Ty	2	0/0	0/0	0

UNIT I **3Hrs**

Historical Background: TKS During the Pre- colonial and Colonial Period, Indian Traditional Knowledge System

UNIT II **3Hrs**

Traditional Medicine, Traditional Production and Construction Technology

UNIT III **3Hrs**

History of Physics and Chemistry, Traditional Art and Architecture and Vastu Shashtra, Astronomy and Astrology

UNIT IV **3Hrs**

Origin of Mathematics, Aviation Technology in Ancient India, Crafts and Trade in Ancient India

UNIT V **3Hrs**

TKS and the Contemporary World, TKS and the Indian Union, TKS and IT Revolution.

Total no.of Hours: 15 Hrs

TEXT BOOKS:

1. *Amit Jha (2009) , Traditional knowledge system in india, 1st Edition, Delhi University (North Campus)*
2. *Dr.A.K.Ghosh (2011), Traditional Knowledge of Household Products*

SEMESTER IV (PRACTICAL)

Subject Code: EBCT22L03	Subject Name : Food Analysis Lab	Ty/Lb/ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite:	Lb	0	0/0	3/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab/ Internal Evaluation

OBJECTIVE:

- Cooking programs are growing in popularity; however, an extensive review has not examined their overall impact.
- Therefore, this study reviewed previous research on cooking/home food preparation interventions and diet and health-related outcomes among adults and identified implications for practice and research.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Apply a techniques analysis the food materials
CO2	Analysis the physical and biological properties of food.
CO3	Analyzing food components form specific particular food sample.
CO4	Apply principles methodology and applications and technology of food analysis
CO5	Apply the sampling techniques to food materials having widely divence properties and volumes

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	3	-	-	-	-	-	-
CO2	1	-	-	3	-	1	-	-	-	1	-	-
CO3	-	-	1	-	-	2	-	-	-	1	-	-
CO4	-	-	1	1	1	1	-	-	-	-	-	-
CO5	-	1	-		-	1	1	-	-	-	-	

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	2	3	3	-
CO2	3	3	3	2
CO3	2	2	1	-
CO4	3	2	1	-
CO5	2	3	1	-

H/M/L indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical /Project			
				√					√			

Subject Code: EBCT22L03	Subject Name : Food Analysis Lab	Ty/Lb/ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite:	Lb	0	0/0	3/0	1

1. Moisture content –Lab Oven Method
2. Moisture content – Using Moisture meter
3. Ash- Total
4. Ash-Acid Insoluble
5. Crude Protein – Kjeldahi Method
6. Crude Fat –Soxhlet Apparatus Method
7. Total Carbohydrates
8. Crude Fiber
9. Cut out test for Canned Fishery Products
10. Detection of adulterants in different food product
11. Organochlorine Pesticides in water by Gas Chromatgraphic (GC) Method
12. N-Methylcarbamoyloximes and N-Methylcarbamates in Finished Drinking Water by High Performance Liquid Chromatography (HPLC)
13. Acesulfame K Detection and Detection and Determination in Sweets
14. Sensory Evaluation – General Concepts
15. Sensory Evaluation –Taste Intensity Tests
16. Sensory Evaluation – Preference Test –Paired Preference Test
17. Sensory Evaluation – Preference Test- Hedonic Rating Scale
18. Sensory Evaluation – Preference Test – Food Action / Attitude Rating Test
19. Sensory Evaluation – Preference Test - Preference Ranking Test
20. Sensory Evaluation – Difference Test – Paired Comparison Test

Subject Code: EBCT22L04	Subject Name : Fluid Mechanics Lab	Ty/Lb/ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: Fluid Mechanics	Lb	0	0/0	3/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab/ Internal Evaluation

OBJECTIVE:

- To learn experimentally to calibrate flow meters, find pressure loss for fluid flows and determine pump characteristics.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Understanding of basic physics of fluids.
CO2	Gaining knowledge to calculate and design engineering applications involving fluid.
CO3	Understanding of analyzing flow systems in terms of mass, momentum, and energy balance.
CO4	Having knowledge about current research topics about fluid mechanics.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	3	-	2	-	3	-	1	1	-
CO2	2	-	-	1	-	-	-	-	-	3	-	1
CO3	3	-	-	-	-	-	-	1	-	-	2	-
CO4	2	-	-	-	1	-	-	-	2	-	-	1

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	2	-	-
CO2	2	1	-	-
CO3	3	2	-	-
CO4	2	1	1	-

H/M/L indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical /Project			
				√					√			

Subject Code: EBCT22L04	Subject Name : Fluid Mechanics Lab Prerequisite: Fluid Mechanics	Ty/Lb/ETL/IE Lb	L 0	T / S.Lr 0/0	P/ R 3/0	C 1

1. Calibration of constant and variable Head meters
2. Calibration of Weirs
3. Drag reduction studies
4. Flow through straight pipe
5. Flow through Vertical concentric pipe
6. Pressure drop studies in packed column
7. Fluidization
8. Open drum orifice and draining time
9. Flow through helical coil and spiral
10. Characteristic curves of centrifugal pump
11. Viscosity measurement of non Newtonian fluids
12. Flow of air thro' orifice using Air compressor

*** Minimum 10 experiments shall be offered.**

Subject Code: EBCE22IL1	Subject Name: Environmental Engineering Lab	Ty/Lb/ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: Environmental Engineering	Lb	0	0/0	3/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab/ Internal Evaluation

OBJECTIVE:

- To provide technical expertise in Environmental Engineering. This will enable them to have a career and professional accomplishment in the public or private sector.

COURSE OUTCOMES (COs) : (3- 5)

CO1	The students would understand the importance of environmental, concepts behind the methodologies to control pollution.
CO2	To develop environmental scientists and engineers and sensitize them towards environmental issues
CO3	To acquire analytical skills in assessing environmental impacts through a multidisciplinary approach.
CO4	To inculcate among students sensitivity towards social and corporate responsibilities.
CO5	To improve the communication and writing skill so as to face the competitive world

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	-	-	-	2	-	-	-	1	-	1
CO2	2	3	-	1	-	-	-	3	-	-	-	2
CO3	2	-	-	-	-	-	-	-	1	-	-	-
CO4	3	-	-	-	-	1	-	-	-	-	1	-
CO5	3	-	-	-		-	-	1	-	-	-	-

COs / PSOs	PSO1	PSO2	PSO3	PSO4			
CO1	2	2	-	-			
CO2	3	1	-	-			
CO3	2	1	-	-			
CO4	3	-	-	-			
CO5	2	-	2	-			

H/M/L indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical /Project			
							√		√			

Subject Code: EBCE22IL1	Subject Name: Environmental Engineering Lab	Ty/Lb/ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: Environmental Engineering	Lb	0	0/0	3/0	1

1. a) Determine of P^H

b) Determination of Turbidity.

2. Determination of Hardness.

3. Determination of Alkalinity.

4. Determination of Residual Chlorine.

5. Estimation of Chlorides.

6. Estimation of Ammonia Nitrogen.

7. Estimation of Sulphate.

8. Determination of optimum coagulant dose.

9. Determination of specific conductivity.

10. Estimation of available chlorine in Bleaching Powder.

11. Determination of dissolved Oxygen.

12. Determination of suspended settle able, volatile and fixed solids.

13. B.O.D. Test.

14. C.O.D. Test.

Total No of Hours: 30Hrs

*** Minimum 10 experiments shall be offered**

Subject Code: EBBT22IL1	Subject Name : Biochemical Lab For Chemical Engineers	Ty/Lb/ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: Chemistry	Lb	0	0/0	3/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab/ Internal Evaluation

OBJECTIVE:

- To enable the students to acquire a specialized knowledge on biomolecular concepts.
- To understand the selected aspect related to metabolism.

COURSE OUTCOMES (COs) : (3- 5)

CO1	To analyze bioprocess design and operations.
CO2	To acquire knowledge in the quantitative and qualitative estimation of biomolecules.
CO3	To develop familiarity with biochemical Laboratory techniques.
CO4	Understand the importance and applications of advanced biochemical instrumentation techniques.
CO5	Understand the basic principles involved in isolation of biomolecules from various biological sources.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	1	-	-	-	-	-	1	1	-
CO2	3	-	-	-	-	-	-	2	-	-	-	-
CO3	2	-	-	-	-	-	1	-	-	-	-	1
CO4	2	2	2	-	-	2	-	-	-	-	1	-
CO5	3	2	2	1	-	-	-	-	1	-	-	1

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3	-
CO2	2	1	2	-
CO3	3	2	3	-
CO4	2	-	2	-
CO5	3	-	2	-

H/M/L indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical /Project			
							√		√			

Subject Code: EBBT22IL1	Subject Name : Biochemical Lab For Chemical Engineers	Ty/Lb/ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: Chemistry	**Lb**	**0**	**0/0**	**3/0**	**1**

1. Buffer Preparation.

2. Qualitative analysis of Carbohydrate
   a. Monosaccharide
   b. Disaccharide
   c. Polysaccharide

3. Qualitative analysis of Protein
   Albumin
   b. Peptone
   c. Casein

4. Estimation of Carbohydrate by Benedict's method.

5. Estimation of Protein by Lowry's method.

6. Isolation of Protein from Milk.

7. Isolation of Starch from Potato.

8. Isolation of Cholesterol from Egg Yolk.

9. Paper Chromatography.

10. Thin layer Chromatography.

a. Density b. Molecular Weight c. Mole d. Percentage of Composition

Subject Code: EBCT22I01	Subject Name : Technical Skill I	Ty/Lb/ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: Nil	IE	0	0/0	3/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab/ Internal Evaluation

OBJECTIVE :

- To gain knowledge based on various programming languages applied for chemical technology

COURSE OUTCOMES (COs) : (3- 5)

CO1	Students should gain insight about mass and energy balances.
CO2	Students are able to know about the basics of heat exchanges and fired heaters and their application in chemical industry
CO3	Students will understand well about foul pumps/compressor and piping
CO4	Students should understand about the con struction and working of chemical Engineering equipments
CO5	Students should be equipped with basic simulation tools

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	3	3	2	2	3	2	3	2
CO2	3	3	2	3	3	3	2	2	3	3	3	3
CO3	3	3	3	-	2	-	-	-	3	-	3	-
CO4	2	-	-	1	-	2	-	2	1	-	2	-
CO5	1	-	2	-	-	-	-	-	1	-	1	-

COs / PSOs	PSO1	PSO2	PSO3	PSO4				
CO1	2	2	-	-				
CO2	3	1	-	-				
CO3	2	-	1	-				
CO4	3	2	1	-				
CO5	2	3	1	-				

H/M/L indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical /Project			
								√				

Subject Code: EBCT22I01	Subject Name : Technical Skill I	Ty/Lb/ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: Nil	IE	0	0/0	3/0	1

Students should acquire skill in the domain/inter disciplinary area from government/private training centers/industries /University for a minimum period of 15 calendar days. The training can be through off line, online or mixed mode. Students are supposed to prepare Technical skill report at the end of the training and submit the report along with the certificate in proof of the training, during the viva voce examination conducted by the examiners duly appointed by the head of the department.

Subject Code: EBCC22I06	Subject Name : Soft Skills I (Employability Skills)	Ty/Lb/ETL/ IE	L	T / S.Lr	P/ R	C
	Prerequisite: Plus 2 English	IE	0	0/0	2/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab/ Internal Evaluation

OBJECTIVE:

1. Become good listeners to get engaged in interactive communication for effective team building.
2. Develop assertive and adaptive behaviour to be leaders
3. Develop peer interaction for a successful lifelong learning.
4. Learn skills necessary for a cooperative living in academic and professional environments
5. Use soft skills for the purposes of research and follow ethics in society and profession.

COURSE OUTCOMES (COs) : (3- 5)

Students will be able to

CO1	Become good listeners to get engaged in interactive communication for effective team building.
CO2	Develop assertive and adaptive behavior to be leaders
CO3	Develop peer interaction for a successful lifelong learning.
CO4	Learn skills necessary for a cooperative living in academic and professional environments
CO5	Use soft skills for the purposes of research and follow ethics in society and profession

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	1	2	2	1	2	3	-	-	-
CO2	3	3	3	1	2	2	1	2	3	-	-	-
CO3	3	3	3	1	2	2	1	2	3	-	-	-
CO4	3	3	3	3	3	2	1	2	3	-	-	-
CO5	3	3	3	3	3	2	1	2	3	-	-	-

COs / PSOs	PSO1	PSO2	PSO3	PSO4				
CO1	3	2	2	2				
CO2	2	2	2	2				
CO3	3	2	2	2				
CO4	3	2	2	2				
CO5	3	2	2	2				

H/M/L indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical /Project			
								√				

Subject Code: EBCC22I06	Subject Name : Soft Skills I (Employability Skills)	Ty/Lb/ETL/ IE	L	T / S.Lr	P/ R	C
	Prerequisite: Plus 2 English	IE	0	0/0	2/0	1

Prefatory Note

This paper aims to equip students with skills essential for work place and global environment to which they will move on from the university, once they complete the course. As such, this paper provides students with a set of ten interlinked soft skills: Listening, team work, emotional intelligence, assertiveness, learning to learn, problem solving, attending interviews, adaptability, non-verbal communication and written communication. Students will get engaged in pair work, group work, role play, discussion, presentation, story telling, writing assignments etc.,

Unit -I

Listening, Speaking, Reading and Writing skills (LSRW)

Unit -II

Team work skills: adaptability, emotional intelligence, learning skills

Unit -III

Leadership Qualities: assertiveness, reasoning, compassion and compatibility

Unit -IV

Problem solving: willingness to learn, creative thinking, developing observation skills

Unit -V

Interview skills: employability skills, resume writing

Reference book:

1. S.P. Dhanavel, English and Soft Skills, Vol. 1, Orient BlackswanPvt. Ltd. 2010

SEMESTER V (THEORY)

Subject Code: EBCT22007	Subject Name : Mass Transfer-I	Ty/Lb/ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: Engineering mathematics, physics, stoichiometric concepts, chemistry	Ty	3	1/0	0/0	4

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab/ Internal Evaluation

OBJECTIVE:

- The purpose of this course istointroduce the undergraduate students with them Ostimportant separation equipments in the process industry.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Understand the basic concepts of diffusion in gases, liquids and solids
CO2	Apply principles of mass transfer to predict transfer coefficients
CO3	To determine NTU, HTU,HETP and height of packed bed used for Humidification operations
CO4	To find time required for drying and to understand the operation of various types of drying equipments
CO5	To estimate process of nuclei formation, theories and operation of crystallization

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	3	-	2	-	3	-	1	1	-
CO2	2	-	-	1	-	-	-	-	-	3	-	1
CO3	3	-	-	-	-	-	-	1	-	-	2	-
CO4	2	-	-	-	1	-	-	-	2	-	-	1
CO5	3	-	-	-	-	1	-	-	2	-	-	-

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	2	-	-
CO2	2	1	-	-
CO3	3	2	-	-
CO4	2	1	1	-
CO5	3	1	2	-

H/M/L indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical /Project			
				√								

EBCT22007	MASS TRANSFER-I	3	1/0	0/0	4

UNIT I DIFFUSION **12Hrs**

Molecular and eddy diffusion in gases and liquids, steady state diffusion under stagnant and laminar flow conditions Diffusivity measurement and prediction, multi-component diffusion, diffusion in solids and its applications.

UNIT II MASS TRANSFER COEFFICIENTS **12Hrs**

Concept of mass transfer coefficients, mass transfer under laminar and turbulent flow past solids, boundary layers, mass transfer at fluids surfaces correlation of mass transfer coefficients, JD,HTU,and NTU concepts, theories of mass transfer and their applications, interphase mass transfer and over all mass transfer coefficients in binary and multi-component systems, application to gas-liquid and liquid-liquid systems.

UNIT III HUMIDIFICATION AND AIR CONDITIONING **12Hrs**

Basic concepts, psychrometric chart construction, Humidification and dehumidification operations, design calculations, cooling tower principle and operation, types of equipment, design calculation. UNIT - IV DRYING 9Hrs Theory and mechanism of drying, drying characteristics of materials, batch and continuous drying, calculation for continuous drying, drying equipment, design and performance of various drying equipments.

UNIT IV DRYING **12Hrs**

Theory and mechanism of drying, drying characteristics of materials, batch and continuous drying, calculation for continuous drying, drying equipment, design and performance of various drying equipments

UNIT V CRYSTALLISATION **12Hrs**

Nuclei formation and crystal growth, theory of crystallisation, growth coefficients and the factors affecting these in crystallisation, batch and continuous industrial crystallisers, principle of design of equipment.

Total No of Hours: 60Hrs

TEXT BOOKS

1. Treybal, R.E., " Mass Transfer Operations ", McGraw-Hill Kogakusha, 1980.

2. McCabe, W.L., Smith, J.C., and Harriot, P., "UNIT Operations in Chemical Engineering ", McGrawHill Edn, 1993.

REFERENCES

1. *Roman Zarzytci, AndrzaiChacuk, " Absorption: Fundamentals and Application ", Pergamon Press, 1993.*
2. *skelland, A.H.P., " Diffusional Mass Transfer ", Krieger, Malabar FL (1985).Strigle (jr), R.F., " Packed Tower Design and Applications ", Second Edition, Gulf Publishing Company, USA., 1994.*
3. *Coulson, J.M., Richardson, J.F., "Chemical Engineering" Vol. I, Pergamon Press, 1977.*
4. *Foust, A.S.Wenzel, L.A., Clump, C.W.,Naus, L., and Anderson, L.B., "Principles of UNIT Operations",Second Edition, Wiley, 1980.*

Subject Code: EBCT22008	Subject Name : CHEMICAL ENGINEERING THERMODYNAMICS-II	Ty/Lb/ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: design chemical process plants.	Ty	3	1/0	0/0	4

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab/ Internal Evaluation

OBJECTIVE:

- To provide knowledge of thermodynamic properties of real fluids and mixtures to design chemical process plants.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Students, at the end of the course will be able to describe the concept of non-ideal behavior of mixtures, activity coefficients.
CO2	Students, at the end of the course will be able to use models for liquid phase non-ideality of mixtures with multiple levels of complexity and capability including predictive models.
CO3	Students, at the end of the course will be able to describe phase equilibria such as gas-liquid, liquid-liquid, solid-liquid with thermodynamic framework and correlate data and estimate properties.
CO4	Students, at the end of the course will be able to use the concept of chemical reaction equilibrium in ideal gas reactions in thermodynamic terms.
CO5	Students, at the end of the course will be able to describe nonideal gas, liquid, solid and multiphase chemical reaction equilibria and predict equilibrium conversions.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	2	1	1	3	-	-	1	-	1
CO2	2	-	2	-	2	-	1	-	2	2	-	2
CO3	1	1	-	1	2	-	-	-	2	-	3	-
CO4	2	2	2	-	-	2	-	2	3	2	-	1
CO5	3	1	3	2	-	1	2	1	-	1	2	1

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	-
CO2	2	3	1	1
CO3	1	2	1	2
CO4	1	2	3	1
CO5	2	1	1	2

H/M/L indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical /Project			
				√								

EBCT22008	CHEMICAL ENGINEERING THERMODYNAMICS-II	3	1/0	0/0	4

UNIT – I APPLICATION OF THERMODYNAMICS TO GAS EQUATIONS 12Hrs

Partial derivaties–exact differentials – Maxwells relations – thermodynamic – properties equation – application to actual gas equation.

UNIT - II FUGACITY CORRELATIONS 12Hrs

Residual properties – fugacity – fugacity coefficient - correlation

UNIT – III SOLUTION THERMODYNAMIC THERORY 12Hrs

Solutions – actual – ideals – excess free energy – activity – activity coefficients – correlations

UNIT - IV V.L.E FROM EQUATION OF STATES 12Hrs

V.L.E correlation – data generation – result – gas – liquid system – Henry's law – liquid – liquid , liquid – solid gas – solid equilibrium.

UNIT - V CHEMICAL REACTION EQUILIBRIA 12Hrs

Chemical reaction equilibrium – equilibrium constant – calculations

Total No of Hours: 60Hrs

TEXT BOOKS

1. *Smith , J.M., Van Ness, H.C., " Introduction to Chemical Engineering Thermodynamics ", Kogakushai 1976.*
2. *Kyle, B.G., "Chemical and Process Thermodynamics 2nd edn. "Prentice Hall of India Pvt.Ltd., 1990.*

REFERENCES

1. *Hougen, O.A., Watson, K.M., and Ragatz, R.A., "Chemical Process Principles Part II", Thermodynamics, John Wiley..*
2. *Dodge, B.F., "ChemicalEngineering Thermodynamics ", McGraw-Hill, 1*
3. *Sandler, S.I., "Chemical and Engineering Thermodynamics ", 2nd Edition., Wiley.*

Subject Code: EBCT22009	Subject Name : Chemical Technology II	Ty/Lb/ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: Chemical Technology I	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab/ Internal Evaluation

OBJECTIVE:

- To study process technologies of various organic and inorganic process industries.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Knowledge about pulp and paper technology.
CO2	Study of sugar,starch soap industries.
CO3	Study of petroleum and petrochemical industries.
CO4	Can determine process aspects like yield, byproducts formed, generation of waste
CO5	Can draw and explain process flow diagrams for a given process

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	2	1	1	3	-	-	1	-	1
CO2	2	-	2	-	2	-	1	-	2	2	-	2
CO3	1	1	-	1	2	-	-	-	2	-	3	-
CO4	2	2	2	-	-	2	-	2	3	2	-	1
CO5	3	1	3	2	-	1	2	1	-	1	2	1

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	-
CO2	2	3	1	1
CO3	1	2	1	2
CO4	1	2	3	1
CO5	2	1	1	2

H/M/L indicates Strength of Correlation 3- High,2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical /Project			
				√								

Subject Code: EBCT22009	Subject Name : Chemical Technology II	Ty/Lb/ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: Chemical Technology I	Ty	3	0/0	0/0	3

UNIT I PULP AND PAPER INDUSTRIES 9Hrs

Wood and Wood extracts – Wood Chemicals - Cellulose derivatives, Manufacture of pulp – different processes of pulping – Manufacture of paper – Manufacture of Boards.

UNIT II SUGAR, STARCH INDUSTRIES & OILS, FATS, SOAPS & DETERGEN INDUSTRIES 9Hrs

Raw and refined sugar by products of sugar industries, starch and starch derivatives. Vegetable oils and animal fats, their nature, analysis and extraction methods, hydrogenation of oils, fatty acids and alcohols, waxes, soaps, synthetic detergents.

UNIT III PETROLEUM AND PETROCHEMICAL INDUSTRIES 9Hrs

Petroleum refining, physical and chemical conversion products, lubricating oils, petrochemical precursors, methane, olefins, acetylenes and aromatics and products obtained from them by various UNIT processes.

UNIT IV RUBBER AND POLYMERS 9Hrs

Monomers – Thermosetting and Thermoplastic materials – General properties and applications of Resins – polymerization processes – different types - Natural rubber; Synthetic rubber such as SBR, NBR,CR - Fundamental methods of processing of synthetic Rubbers.

UNIT V SYNTHETIC FIBRE AND FILM INDUSTRIES 9Hrs

Natural and synthetic fibres – properties of - Poly amides – manufacture of Nylon 6. 6. Polyesters Fibers – manufacturer of – Cellulosic fibres – Viscose Rayon production manufacture of films - cellulose Acetate, PVC, Polyesters – polyethylene.

Total No.of Hours: 45Hrs

TEXT BOOKS:

1. *Austin, G.T., "Shreve's Chemical Process Industries ", Fifth Edition, McGraw-Hill International Book Co, Singapore, 1984.*
2. *Dryden, C.E., "Outlines of Chemical Technology ", Edited and Revised by Gopala Rao. M. and M.Sittig, Second edition, Affiliated East-West press, 1993.*

REFERENCES:

1. *Kent, J.A.(ed), " Riggel's Hand Book of Industrial Chemistry ", Van Nostrant Reinhold, 1974.*
2. *CHEMTECH 1-4, Chemical Engineering Education Development Centre I.I.T., Madras 1975-78*

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Subject Code: EBOL22I01	**Subject Name : Online Course (NPTEL/SWAYAM/any MOOC, approved by AICTE/UGC)**	**Ty/Lb/ETL/IE**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite:	**Ty**	**1**	**0/0**	**1/0**	**1**

Students should register for the online course with a minimum course duration of 4 weeks through the online portals such as NPTEL/SWAYAM/Any MOOC in the beginning of the semester.A mentor will be assigned by the department for monitoring the students.
Students are expected to attend the online classes regularly and submit the weekly assignments before the due dates. Students should appear for the online examination and submit the certificate at the end of the semester .Internal Examination will be conducted by the examiners duly appointed by the head of the department.

SEMESTER V (PRACTICAL)

Subject Code:	Subject Name : Process Simulation Software Lab	Ty / Lb/ETL/IE	L	T / S.Lr	P/ R	C
EBCT22L05	Prerequisite: General Chemistry & basic chemical reactions	Lb	0	0/0	3/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab/ Internal Evaluation

OBJECTIVE

- Supply of software on CD-ROM media.
- Technical support on telephone, fax and email.
- Has facility to regress physical and transport properties

COURSE OUTCOMES (COs) : (3- 5)

CO1	To understand graphical user interface
CO2	To apply vapor phase association data for important system
CO3	To apply different k values for different unit operations/trays
CO4	Several Examples from Chemical Engineering fields to be solved using self-developed programmes
CO5	Stagewise calculations for unit operations, dynamics of linear and non-linear systems, simulation of heat transfer equipment, optimisation of equipment, process and plant

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	-	-	-	1	-	-	-	-	1
CO2	2	3	1	-	-	-	2	-	-	-	-	-
CO3	2	3	1	-	1	-	1	-	-	1	-	2
CO4	3	2	1	-	-	1	2	-	2	2	-	1
CO5	2	1	-	-	-	-	-	-	-	1	1	1

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3	2
CO2	2	3	1	2
CO3	3	1	2	2
CO4	3	2	-	-
CO5	1	2	-	-

H/M/L indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical /Project			
									√			

Subject Code: EBCT22L05	Subject Name : Process Simulation Software Lab	Ty / Lb/ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: General Chemistry & basic chemical reactions	**Lb**	**0**	**0/0**	**3/0**	**1**

CC STEADY STATE	Steady state process simulation software for simulation/ Process design of continuous processes involving Distillation, Reactors, Absorbers, Pumps, Compressors, Piping, Control Value, Safety valves, liquid-liquid extraction, expanders etc.
CC SAFETYNET	For the design/analysis of emergency relief systems (in steady state or dynamic mode) using DIERS technology and complex piping systems. Can also be applied to any other (non-emergency) piping network or for utility distribution analysis
CC DYNAMICS	Dynamic Analysis of Distillation Columns and Kinetic data regression, reactor scale up and Dynamic Simulation of batch reactor and/or their associated equipment.
CC BATCH	Simulation for Batch Distillation Process.
CC THERM	Design/ Rating/ Simulation/ Fouling factor determination for Shell & tube, plate & frame, Air Cooled , and double pipe heat exchangers software

Subject Code:	Subject Name : Mass Transfer Lab	Ty/Lb/ETL/IE	L	T / S.Lr	P/ R	C
EBCT22L06	Prerequisite: Chemical engineering	Lb	0	0/0	3/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab/ Internal Evaluation

OBJECTIVE:

- To train the students to develop sound working knowledge on different types of mass transfer equipments.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Understand the basic operations of mass transfer.
CO2	Apply principles of mass transfer to predict transfer coefficients
CO3	Analyze working of various mass transfer equipment
CO4	Design mass transfer equipment.
CO5	Evaluate no. of stages required for given mass transfer problem.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	2	-	1	-	-	-	-	2	-	3
CO2	2	-	-	-	2	-	-	1	-	3	-	2
CO3	2	2	1	2	-	2	-	3	-	-	3	-
CO4	1	2	-	3	-	-	2	-	2	1	-	3
CO5	2	-	3	-	2	-	2	-	3	-	2	2

COs /PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	2	-	-
CO2	2	1	-	-
CO3	3	2	2	-
CO4	-	1	1	2
CO5	2	2	1	3

H/M/L indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical /Project			
				√					√			

Subject Code: EBCT22L06	Subject Name : Mass Transfer Lab	Ty/Lb/ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: Chemical engineering	Lb	0	0/0	3/0	1

1. Simple distillation
2. Steam distillation
3. Packed column distillation
4. Bubble cap distillation
5. Diffusivity measurements
6. Liquid-liquid extraction
7. Vacuum Dryer
8. Tray dryer
9. RDC
10. Adsorption
11. Surface Evaporation

Subject Code: EBCT22I02	Subject Name : Technical Skill II	Ty/Lb/ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: Chemistry	IE	0	0/0	3/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab/ Internal Evaluation

OBJECTIVE:

- To enable the students to acquire a specialized knowledge on bio molecular concepts.
- To understand the selected aspect related to metabolism.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Students should gain insight about mass and energy balances.
CO2	Students are able to know about the basics of heat exchanges and fired heaters and their application in chemical industry
CO3	Students will understand well about foul pumps/compressor and piping
CO4	Students should understand about the construction and working of chemical Engineering equipments
CO5	Students should be equipped with basic simulation tools

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	3	3	2	2	3	2	3	2
CO2	3	3	2	3	3	3	2	2	3	3	3	3
CO3	3	3	3	-	2	-	-	-	3	-	3	-
CO4	2	-	-	1	-	2	-	2	1	-	2	-
CO5	1	-	2	-	-	-	-	-	1	-	1	-

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	2	-
CO2	3	1	-
CO3	2	-	1
CO4	3	2	1
CO5	2	3	1

H/M/L indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical /Project			
								√				

Subject Code: EBCT22I02	Subject Name : Technical Skill II	Ty/Lb/ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: Chemistry	IE	0	0/0	3/0	1

Students should acquire skill in the domain/inter disciplinary area from government/private training centers/industries /University for a minimum period of 15 calendar days. The training can be through off line, online or mixed mode. Students are supposed to prepare Technical skill report at the end of the training and submit the report along with the certificate in proof of the training, during the viva voce examination conducted by the examiners duly appointed by the head of the department.

Subject Code: EBCT22ET2	Subject Name: Polymer Technology	Ty/Lb/ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: Engineering chemistry 1	ETL	2	0/0	2/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab/ Internal Evaluation

OBJECTIVE:

- To enable the students to compute molecular weight averages from the molecular weight distribution, Condensation polymerization and transition in polymers.

COURSE OUTCOMES (COs) : (3- 5)

CO1	At the end of this course, the student would be able to demonstrate knowledge and understanding on the principles related to the synthesis and characterization of polymers.
CO2	Understand the techniques and their characteristics/limitations of synthesis of polymers.
CO3	Understand the structure-processing-property relationship of polymers.
CO4	Understand and apply the various processing and manufacturing techniques.
CO5	Understand the basic issues involved in polymer blends, composites and nano-composites.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	2	-	1	-	-	-	-	2	-	3
CO2	2	-	-	-	2	-	-	1	-	3	-	2
CO3	2	2	1	2	-	2	-	3	-	-	3	-
CO4	1	2	-	3	-	-	2	-	2	1	-	3
CO5	2	-	3	-	2	-	2	-	3	-	2	2

COs /PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	2	-	-
CO2	2	1	-	-
CO3	3	2	2	-
CO4	-	1	1	2
CO5	2	2	1	3

H/M/L indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical /Project			
				√					√			

Subject Code: EBCT22ET2	Subject Name: Polymer Technology	Ty/Lb/ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: Engineering chemistry 1	ETL	2	0/0	2/0	3

UNIT I INTRODUCTION 12Hrs

History of Macromolecules – structure of natural products like cellulose, rubber,proteins – concepts of macro molecules – Staudinger's theory of macromolecules – difference between simple organic molecules and macromolecules.

UNIT II ADDITION POLYMERIZATION 12Hrs

Chemistry of Olefins and Dienes – double bonds – Chemistry of free radicals –monomers – functionality – Polymerization: Initiation – types of initiation – free radical polymerization – cationic polymerization – anionic polymerization – coordination polymerization – industrial polymerization – bulk, emulsion, suspension and solution polymerization techniques – Kinetics – Copolymerization concepts.

UNIT III CONDENSATION POLYMERIZATION 12Hrs

Simple condensation reactions – Extension of condensation reactions to polymer synthesis – functional group reactivity – polycondensation – kinetics of polycondensation- Carother's equation – Linear polymers by polycondensation– Interfacial polymerization – crosslinked polymers by condensation – gel point.

UNIT IV MOLECULAR WEIGHTS OF POLYMERS 12Hrs

Difference in molecular weights between simple molecules and polymers –number average and weight average molecular weights – Degree of polymerization and molecular weight – molecular weight distribution – Polydispersity – molecular weight determination. Different methods – Gel Permeation Chromatography – Osmometry, Light Scattering.

UNIT V TRANSITIONS IN POLYMERS 12Hrs

First and second order transitions – Glass transition, Tg – multiple transitions in polymers – experimental study – significance of transition temperatures –crystallinity in polymers – effect of crystallization – in polymers – factors affecting crystallization crystal nucleation and growth – relationship between Tg and Tm – Relationship between properties and crystalline structure.

Total No. of Hours: 60Hrs

TEXT BOOKS:

1. Billmeyer.F.W.,Jr, Text Book of Polymer Science, Ed. Wiley-Interscience,1984.
2. Seymour.R.B., and Carraher.C.E., Jr., Polymer Chemistry, 2nd Ed., Marcel Dekker, 1988.
3. Gowariker.V.T., Viswanathan.N.V., and Sreedar.J., Polymer Science, Wiley Eastern Ltd., 1988.

REFERENCES*:*

1. Joel,R.F Polymer Science and Technology, Eastern Economy Edition,1999.
2. Rodriguez, F., Cohen.C., Oberic.K and Arches, L.A., Principles of Polymer Systems, 5th edition, Taylor

SEMESTER VI (THEORY)

Subject Code: EBCT22010	Subject Name : Mass Transfer II	Ty/Lb/ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: Basic mathematics & energy & material balance	Ty	3	1/0	0/0	4

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab/ Internal Evaluation

OBJECTIVE:

- To teach the students different separation techniques and also to know the design of a distillation column.
- To understand the calculations involved In liquid-liquid extraction and solid liquid extraction.

COURSE OUTCOMES (COs) : (3- 5)

CO1	The concept of Equilibrium in all separation operations should be clear.
CO2	Able to design Distillation columns
CO3	Working of Extraction, adsorption, Leaching equipments
CO4	Able to choose Economical separation
CO5	Understand working & principles of membranes

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	3		-	-	3	1	2	-	-
CO2	3	-	-	-	-	-	-	2	1	1	-	2
CO3	3	2	3	-	-	-	1	-	-	-	2	-
CO4	3	3	2	2	-	-	-	2	-	-	3	-
CO5	2	-	-	1	-	2	-	3	-	1	-	2

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	3
CO2	3	1	3	3
CO3	2	1	2	2
CO4	3	1	2	3
CO5	3	3	2	1

H/M/L indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical /Project			
				√								

Subject Code: EBCT22010	Subject Name : Mass Transfer II	Ty/Lb/ETL /IE	L	T / S.Lr	P/ R	C
	Prerequisite: Basic mathematics & energy & material balance	Ty	3	1/0	0/0	4

UNIT I ABSORPTION **12Hrs**

Equilibrium and operating line concept in absorption calculations; types of contactors, design of packed and plate type absorbers; Operating characteristics of stagewise and differential contactors, concepts of NTU, HTU and overall volumetric mass transfer coefficients; multicomponent absorption; mechanism and model of absorption with chemical reaction; thermal effects in absorption process.

UNIT II DISTILLATION **12Hrs**

Vapour-liquid equilibria, Raoult's law and deviations from ideality, methods of distillation; fractionation of binary and multicomponent system; design calculations by McCabe-Thiele and ponchon-Savarit, methods; continuous contact distillation tower (packed tower) design; extractive and azeotropic; distillation low pressure distillation; steam distillation.

UNIT III LIQUID-LIQUID EXTRACTION **12Hrs**

Equilibrium in ternary systems; equilibrium stagewise contact calculations for batch and continuous extractors, differential contact extraction equipment - spray, packed and mechanically agitated contactors and their design calculations; pulsed extractors, centrifugal extractors.

UNIT IV SOLID-LIQUID EXTRACTION (LEACHING) **12Hrs**

Solid-liquid equilibria; leaching equipment-batch and continuous types; calculation of number of stages.

UNIT V ADSORPTION, ION EXCHANGEAND MISCELLANEOUS SEPARATION PROCESSES

` **12Hrs**

Theories of adsorption of gases and liquids; industrial adsorbents, adsorption equipment for batch and continuous operation; design calculation of ion-exchange resins; principle of ion-exchnage; industrial equipment. Membrane separation process; solid and liquid membranes; concept of osmosis; reverse osmosis; electrodialysis; their applications; foam separation process; Thermal and sweep diffusion process.

Total No. of Hours: 60Hrs

TEXT BOOKS

1.R.E.Treybal, " Mass Transfer Operations ", McGraw-Hill, Kogakusha, 1980.

2.W.L McCabe J.C.Smith, and Harriot. P., " UNIT Operations of Chemical Engineering ", sixth edition McGraw- Hill. International Edition, 2001.

REFERENCES

1, C.Judson King " Separation Processes ", Tata McGraw-Hill 1974.

2. A.H.P.Skelland, " Diffusional Mass Transfer ", Krieger, Malapur, FL (1985).

3. Roman Zarfyki and Andrzej Chacuk, " Absorption Fundamentals and Applications", Pergamon Press, 1993.

4. P.Wankat" Equilibrium Stage Separations ", Prentice Hall, 1993.

5. R.F.Strigle (jr), Packed Tower Design and Application, 2nd Edn Gulf Publishing company U.S.A. 1994.

Subject Code: EBCT22011	Subject Name : Heat Transfer	Ty/Lb/ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: Basic maths & material energy balance	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab/ Internal Evaluation

OBJECTIVE:

- To understand the fundamentals of heat transfer mechanisms in fluids and solids and their applications in various heat transfer equipment in process industries.

COURSE OUTCOMES (COs) : (3- 5)

CO1	To impart knowledge on heat conduction, convection and radiation phenomena.
CO2	To impart knowledge on application of heat transfer principles in heat exchanger design.
CO3	To impart knowledge on the principles of evaporation and evaporator design.
CO4	Design double pipe heat exchangers, shell and tube heat exchangers, plate heat exchangers
CO5	Solve problems in various heat transfer heat equipment such as evaporators, furnace.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	-	-	3	-	-	-	-	-	2	2
CO2	1	2	-	-	-	-	2	-	-	-	3	2
CO3	2	3	-	-	1	-	-	-	-	-	3	2
CO4	3	1	1	2	-	-	-	1	-	2	3	3
CO5	3	3	-	-	-	-	-	2	-	-	2	1

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	3
CO2	1	2	3	2
CO3	3	2	1	3
CO4	2	1	2	3
CO5	3	2	1	-

H/M/L indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical /Project			
				√								

Subject Code: EBCT22011	Subject Name : Heat Transfer	Ty/Lb/ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: Basic maths & material energy balance	Ty	3	0/0	0/0	3

UNIT I BASIC PRINCIPLES AND CONDUCTION 9Hrs

Importance of heat transfer in Chemical Engineering operations - Modes of heat transfer - Mean temperature difference. Concept of heat conduction - Fourier's law of heat conduction - one dimensional steady state heat conduction equation for flat plate, hollow cylinder, hollow sphere - Heat conduction through a series of resistances - Analogy between flow of heat and flow of electricity - Thermal conductivity measurement; effect of temperature on thermal conductivity; conduction through liquids.

UNIT II FILM COEFFICIENTS AND THEIR APPLICATION 9Hrs

Individual and overall heat transfer coefficients and the relationship between them - Conduction with heat source - Two dimensional steady state conduction - Analytical and graphical methods - Transient heat conduction.

UNIT III CONVECTION 9Hrs

Concept of heat transfer by convection - Natural and forced convection - Application of dimensional analysis for convection - Equations for forced convection under laminar, transition and turbulent conditions - Equations for natural convection - Heat transfer from condensing vapours, heat transfer to boiling liquids - Influence of boundary layer on heat transfer - Heat transfer to molten metals - Heat transfer in packed and fluidised beds.

UNIT IV HEAT EXCHANGERS 9Hrs

Parallel and counter flow heat exchangers - Log mean temperature difference - Single pass and multipass heat exchangers; plate heat exchangers; use of correction factor charts; heat exchangers effectiveness; number of transfer UNIT - Chart for different configurations - Fouling factors and wilson's plot - Design of various types of heat exchangers - Design of furnaces - Design of condensers, - Design of tubular reactors.

UNIT V RADIATION AND EVAPORATION 9Hrs

Concept of thermal radiations - Black body concept - Stefan Boltsman's law -concept of grey body – radiation between surfaces. Types of evaporation - single effect and multiple effect evaporation - Design calculation for single and multiple effect evaporation.

Total No of Hours: 45Hrs

TEXT BOOKS:

1. *McCabe, W.L., Smith, J.C., and Harriot, P., "UNIT Operations in Chemical Engineering ", McGraw-Hill Recent Edn.*
2. *BinayK.Dutta "Heat Transfer Principles and Applications", Prentice Hall of India, 2001.*
3. *Kern, D.Q., " Process Heat Transfer ", McGraw-Hill - Revised adition.*

REFERENCES*:*

1. *Coulson, J.M., Richardson, J.F., "Chemical Engineering ", Vol.I.,Pergamon and ECBPRACTICAL*

Subject Code:	Subject Name : Chemical Reaction Engineering I	Ty/Lb/ETL/IE	L	T / S.Lr	P/ R	C
EBCT22012	Prerequisite: Equations thermodynamics	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab/ Internal Evaluation

OBJECTIVE:

- To apply knowledge from calculus, differential equations thermodynamics, general chemistry, and material and energy balances to solve reactor design problems.
- To examine reaction rate data to determine rate laws, and to use them to design chemical reactors
- To simulate several types of reactors in order to choose the most appropriate reactor for a given need.
- To design chemical reactors with associated cooling/heating equipment

COURSE OUTCOMES (COs) : (3- 5)

CO1	Basic concept for thermodynamics and first law can be understood, PVT behavior of fluids and ideal gas processes can be analysed.
CO2	Develop rate laws for homogeneous reactions
CO3	Design of ideal reactors for single and complex reactions
CO4	Develop skills to choose the right reactor among single, multiple, recycle reactor, etc. schemes.
CO5	Design of non-isothermal reactors and the heat exchange equipment required.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	-	3	3	-	3	3	-	2	1	-	3
CO2	2	2	-	-	2	-	1	-	2	-	1	3
CO3	3	-	2	-	-	1	-	2	-	-	3	-
CO4	2	1	-	1	-	2	-	2	-	3	1	1
CO5	3	-	-	-	3	-	-	3	-	-	1	-

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	-
CO2	2	1	-	1
CO3	2	-	2	1
CO4	2	3	3	-
CO5	2	1	1	3

H/M/L indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical /Project			
				√								

Subject Code: EBCT22012	Subject Name : Chemical Reaction Engineering I	Ty/Lb/ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: Equations thermodynamics	Ty	3	0/0	0/0	3

UNIT – I REACTION KINETICS 9Hrs

Law of mass action, rate equation, elementary, non-elementary reactions and their mechanisms, theories of reaction rate and temperature dependency, analysis of experimental reactor data, evaluation of rate equation, integral and differential analysis for constant variable volume system, fitting of data complex reaction mechanism.

UNIT – II IDEAL REACTORS 9Hrs

Design for homogeneous systems, batch, stirred tank and tubular flow reactor, design of reactors for multiple reactions, combination reactor system, size comparison of reactors.

UNIT - III CHOICE OF REACTORS 9Hrs

Factors affecting choice, optimum yield and conversion, selectivity, reactivity and yield problems, consecutive, parallel and mixed reactions, recycle.

UNIT - IV HEAT EFFECTS IN REACTORS 9Hrs

Isothermal and non isothermal homogeneous reactor systems, adiabatic reactors, rates of heat exchanges for different reactors, design for constant rate heat input and constant heat transfer coefficient, operation, batch and continuous reactors, optimum temperature progression.

UNIT - V REACTOR STABILITY AND REACTION EQUILIBRIA 9Hrs

Criteria for stability of reactors, limit cycles and oscillating reaction, parameter sensitivity. Equilibrium in chemically reactive systems, evaluation of reaction equilibrium constant, effect of temperature on equilibrium, application to system involving gaseous components, computation of equilibrium composition.

Total No of Hours: 45Hrs

TEXT BOOKS:

1. Smith.J.M.,"Chemical Engineering Kinetics ", McGraw-Hill Third Edition.

REFERENCES:

1. Levenspiel.O, "Chemical Reaction Engineering ", John Wiley, Second Edition.

SEMESTER VI (PRACTICAL)

Subject Code: EBCT22L07	Subject Name : Chemical Reaction Engineering Lab	Ty/Lb/ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Chemical Reaction Engineering	Lb	0	0/0	3/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab/ Internal Evaluation

OBJECTIVE:

- To impart knowledge on design of reactors.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Students would get a sound working knowledge on different types of reactors.
CO2	Design chemical reactors optimally, using minimum amount of data
CO3	Design experiments in a judicious way to get the required data, if not available
CO4	Fix some problems related to operability and productivity
CO5	Maintain and operate a process in a safe manner, Increase capacity and/or selectivity and/or safety by improving/changing the reactor type/sequence

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	3	-	1	-	-	-	2	-	-	3
CO2	2	3	-	3	-	-	3	-	3	-	2	-
CO3	1	-	-	-	-	2	-	-	2	-	-	3
CO4	3	-	1	-	-	-	1	1	-	-	-	1
CO5	2	2	-	-	2	1	1	1	-	2	1	1

COs / PSOs	PSO1	PSO2	PSO3	PSO4				
CO1	2	2	1	-				
CO2	3	1	2	1				
CO3	2	1	2	1				
CO4	3	1	1	2				
CO5	2	2	2	1				

H/M/L indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical /Project			
				√					√			

Subject Code: EBCT22L07	Subject Name : Chemical Reaction Engineering Lab	Ty/Lb/ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Chemical Reaction Engineering	Lb	0	0/0	3/0	1

1. Kinetic studies in a batch reactor
2. Kinetics in a plug flow reactor
3. Kinetics in a PFR followed by a CSTR
4. RTD in a PFR
5. RTD in a packed bed
6. RTD in CSTRs in series
7. Combined Reactor
8. Packed Bed Reactor
9. Adiabatic Reactor
10. Catalytic Reactor
11. Kinetics in Semi-batch Reactor

***Minimum 10 experiments shall be offered.**

Subject Code: EBCT22L08	Subject Name : Heat Transfer Lab Prerequisite: Transfer by conduction	Ty/Lb/ETL/IE Lb	L 0	T / S.Lr 0/0	P/ R 3/0	C 1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab/ Internal Evaluation

OBJECTIVE:

- To enable the students to learn heat transfer by conduction, convection and radiation and heat transfer equipments like evaporator and heat exchanger.

COURSE OUTCOMES (COs) : (3- 5)

CO1	At the end of this course, the students would have knowledge in various heat transfer methodology in process engineering and to design heat transfer equipments such as furnace, boilers, heat exchangers evaporation.
CO2	Determine the overall heat transfer coefficient for a composite slab
CO3	Estimate heat transfer coefficients in condensation, boiling and effectiveness of heat pipe
CO4	Estimate heat transfer coefficients in forced convection, free convection and determine effectiveness of heat exchangers

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	3	-	-	1	-	-	3	2	1
CO2	2	-	3	3	-	-	3	3	3	-	-	-
CO3	1	-	-	2	-	-	-	-	-	--	1	-
CO4	2	3	-	-	-	-	-	-	-	-	-	2

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	2	-	-
CO2	2	1	-	-
CO3	2	1	3	-
CO4	3	2	1	-

H/M/L indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical /Project			
				√					√			

Subject Code: EBCT22L08	Subject Name : Heat Transfer Lab	Ty/Lb/ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: Transfer by conduction	Lb	0	0/0	3/0	1

1. Thermal Conductivity measurement
2. Emissivity mesurement
3. Stefan-Boltzmann Constant verification
4. Thermocouple calibration
5. Natural Convection
6. Forced Convection
7. Parallel Flow Double Pipe Heat Exchanger
8. Counter Flow Double Pipe Heat Exchanger

.

Subject Code: EBCC22I07	Subject Name : Soft Skill II (Qualitative And Quantitative Skills)	Ty/Lb/ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: Technical English	IE	0	0/0	2/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab/ Internal Evaluation

OBJECTIVE:

- To understand the Basic concepts in Logical Reasoning
- To understand the Basic concepts in Arithmetical Reasoning
- To understand the Basic concepts in Data Interpretation

COURSE OUTCOMES (COs) : (3- 5)

CO1	Understand the basic concepts of Logical Statements and Arguments
CO2	Understand the concept of Logical conclusions
CO3	Understand the Basic concepts in Number system
CO4	Understand the basic concepts of Permutations and Combinations
CO5	Learn how to analyze the data using Pictorial representation

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	3	3	2	1	2	3	-	**3**	**1**
CO2	2	3	2	3	3	2	1	2	2	-	-	-
CO3	3	2	3	2	3	1	2	1	3	-	-	-
CO4	3	1	2	3	2	3	3	2	2	-	**1**	-
CO5	3	2	3	2	3	2	1	2	3	-	-	-

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3	-
CO2	2	3	3	-
CO3	3	2	3	-
CO4	2	3	3	-
CO5	3	2	3	-

H/M/L indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical /Project			
								√				

Subject Code: EBCC22I07	Subject Name : Soft Skill II (Qualitative And Quantitative Skills)	Ty/Lb/ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: Technical English	**IE**	**0**	**0/0**	**2/0**	**1**

UNIT I LOGICAL REASONING I **4Hrs**

Logical Statements – Arguments – Assumptions – Courses of Action.

UNIT II LOGICAL REASONING II **4Hrs**

Logical conclusions – Deriving conclusions from passages – Theme detection.

UNIT III ARITHMETICAL REASONING I **4Hrs**

Number system – H.C.F & L.C.M – Problem on ages – Percentage – Profit & Loss – Ratio & Proportion – Partnership.

UNIT IV ARITHMETICAL REASONING II **4Hrs**

Time & Work – Time & Distance – Clocks – Permutations & Combinations – Heights & Distances – Odd man out and Series.

UNIT V DATA INTERPRETATION **4Hrs**

Tabulation – Bar graphs – Pie graphs – Line graphs.

Total No of periods: 20Hrs

REFERENCE BOOK:

1. R.S.Agarwal, A modern approach to Logical Reasoning, S.Chand & Co., (2017).
2. R.S.Agarwal, A modern approach to Verbal and Non verbal Reasoning, S.Chand & Co., (2017).
3. R.S.Agarwal, Quantitative Aptitude for Competitive Examinations, S.Chand & Co., (2017).
4. A.K.Gupta, Logical and Analytical Reasoning, Ramesh Publishing House, (2014).
5. B.S.Sijwali, Indu sijwali, A new approach to Reasoning (Verbal and Non verbal), Arihant Publishers, (2014).

Subject Code: EBCT22I03	Subject Name : Technical Skill III	Ty/Lb/ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: Chemical Reaction Engineering	**IE**	**0**	**0/0**	**3/0**	**1**

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab Internal Evaluation

OBJECTIVE:

- To impart knowledge on design of reactors.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Students should gain insight about mass and energy balances.
CO2	Students are able to know about the basics of heat exchanges and fired heaters and their application in chemical industry
CO3	Students will understand well about foul pumps/compressor and piping
CO4	Students should understand about the construction and working of chemical Engineering equipments
CO5	Students should be equipped with basic simulation tools

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	3	3	2	2	3	2	3	2
CO2	3	3	2	3	3	3	2	2	3	3	3	3
CO3	3	3	3	-	2	-	-	-	3	-	3	-
CO4	2	-	-	1	-	2	-	2	1	-	2	-
CO5	1	-	2	-	-	-	-	-	1	-	1	-

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	2	2	-	-
CO2	3	1	-	-
CO3	2	-	1	-
CO4	3	2	1	-
CO5	2	3	1	-

H/M/L indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical /Project			
								√				

Subject Code: EBCT22I03	Subject Name : Technical Skill III	Ty/Lb/ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: Chemical Reaction Engineering	IE	0	0/0	3/0	1

Students should acquire skill in the domain/inter disciplinary area from government/private training centers/industries /University for a minimum period of 15 calendar days. The training can be through off line, online or mixed mode. Students are supposed to prepare Technical skill report at the end of the training and submit the report along with the certificate in proof of the training, during the viva voce examination conducted by the examiners duly appointed by the head of the department.

Subject Code: EBCT22I04	Subject Name : Mini Project/ Internship	Ty/Lb/ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: Nil	IE	0	0/0	3/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab/ Internal Evaluation

OBJECTIVE:

- The main objective of the Inplant training is to provide a short-term work experience in an Industry/ Company/ Organization.

COURSE OUTCOMES (COs) : (3- 5)

CO1	To get an insight of an industry / organization/company pertaining to the domain of study.
CO2	To acquire skills and knowledge for a smooth transition into the career. To gain field experience and get linked with the professional network.
CO3	Analyze the problem, formulation and solution of the selected project
CO4	Develop solutions for contemporary problems using modern tools for sustainable development.
CO5	Demonstrate ethical and professional sustainability while working in a team and communicate effectively for the benefit of the society.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO11	PO12
CO1	2	1	1	1	1	3	3	3	3	3	3	3
CO2	3	2	3	3	2	3	3	3	3	3	3	2
CO3	3	3	3	2	3	-	1	1	3	3	3	-
CO4	3	3	3	1	-	1	1	3	2	3	1	-
CO5	3	1	2	1	-	-	-	-	-	1	2	3

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	3
CO2	3	3	2	3
CO3	2	3	1	-
CO4	2	1	2	-
CO5	1	-	1	2

H/M/L indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical /Project			
									√			

Subject Code: EBCT22I04	Subject Name : Mini Project/ Internship	Ty/Lb/ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: Nil	IE	0	0/0	3/0	1

MINI PROJECT

Students will have an opportunity to expose their knowledge and talent to make an innovative project. Students are supposed to do innovative projects useful to industries/society in the area of relevant Engineering, inter and multi-disciplinary areas, under the guidance of a staff member. They have to prepare a project report and submit to the department.

At the end of the semester Viva-Voce examination will be conducted by the internal Examiner duly appointed by the Head of the department and the students will be evaluated.

INTERNSHIP

Students are supposed to undergo internship in related Industries for a minimum period of 30days cumulatively during the semester. They have to prepare a report on the Internship with a certificate in proof from competent authority in the industry. At the end of the semester Viva-Voce examination will be conducted by the Examiners duly appointed by the Head of the department and the students will be evaluated.

SEMESTER VII (THEORY)

Subject Code: EBCT22013	Subject Name : Safety In Chemical Process Industries	Ty/Lb/ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: Chemical Reaction Engineering	Ty	3	1/0	0/0	4

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab/ Internal Evaluation

OBJECTIVE:

- To study process technologies of various organic and inorganic process industries.

COURSE OUTCOMES (COs) : (3- 5)

CO1	To impart the principles of safety in chemical process operations.
CO2	To educate the students the importance of safety procedures and safety regulations in chemical industries.
CO3	Ability to understand the manufacturing of various inorganic and organic chemicals
CO4	Ability to understand the process flow diagram and various process parameters
CO5	Ability to identify and solve engineering problems during production

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	2	1	1	1	1	3	3	2	1
CO2	1	1	1	1	2	2	2	1	2	1	2	1
CO3	2	1	1	1	3	2	3	1	2	1	1	2
CO4	2	1	2	1	1	1	2	2	2	1	2	2
CO5	1	1	1	2	2	1	2	1	2	1	2	3

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	2	1	2	2
CO2	1	1	1	-
CO3	1	1	2	2
CO4	1	2	2	1
CO5	2	2	2	1

H/M/L indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical /Project			
				√								

Subject Code: EBCT22013	Subject Name : Safety In Chemical Process Industries	Ty/Lb/ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: Chemical Reaction Engineering	Ty	3	1/0	0/0	4

UNIT I INTRODUCTION 12Hrs

Safety in industries – need for development – importance of safety consciousness in Indian Chemical Industry – social environmental setup – Tolerance limit of the society – Psychological attitude towards safety programmes.

UNIT II SAFETY PROGRAMMES 12Hrs

Elements of safety programmes – Effective realization – Economic and social benefits – Effective communication training at various levels of production and operation.

UNIT III SAFETY PERFORMANCE 12Hrs

Appraisal – Effective steps to implement safety procedures – Periodic inspection and study of plant layout and constant maintenance – Periodic advice and checking to follow safety procedures – proper selection and replacement of handling equipments – personal protective equipment.

UNIT IV ACCIDENTS 12Hrs

Industrial accidents – accident costs – identification of accident spots – remedial measure – identification and analysis of causes of injury to men and machines – accident prevention – accident proneness – vocational guidance, fault free analysis – Fire prevention and fire protection.

UNIT V HEALTH HAZARDS AND LEGAL ASPECTS 12Hrs

Health hazards – occupational – Industrial health hazards – health Standards and rules – safe working environments – parliamentary legislation – Factories act – Labor Welfare Act – ESI Act – Workmen Compensation Act.

Total No of Hours: 60Hrs

TEXT BOOK

1. *William Handley, Industrial Safety Hand Book, Mc Graw-Hill Book Company, 2nd edition, 1969.*
2. *Fawatt, H.H and Wood, W.S., Safety and Accident Prevention in Chemical operation, Interscience, 1965.*

REFERENCE

1. Heinrich, H.W, Dan Perterson, P.E and Nester Rood, Industrial Accident Prevention, McGraw- Hill, 1980.
2. Blake, R.P., Industrial Safety, PHI, III ed, 1963.

Subject Code:	Subject Name : Process Control And Dynamics	Ty/Lb/ETL/IE	L	T / S.Lr	P/ R	C
EBCT22014	Prerequisite: Engineering Chemistry I & II, Engineering Mathematics III & IV	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab/ Internal Evaluation

OBJECTIVE:

- To gain the knowledge of process instruments & understand dynamic modeling of a physical process using first principles.
- To design various control schemes and to apply the control system in various processes.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Develop fundamental and empirical models for dynamic processes & Implement dynamic models with or without controllers.
CO2	Analyse PID controllers and more advanced controllers to achieve desired performance & Understand various controller designs, and methods of controller tuning.
CO3	Design a control strategy for key unit operations (reactor, distillation column, etc)
CO4	Understand working principles of basic instruments available for flow, pressure, level and temperature measurement
CO5	Design of feedback control systems using frequency response techniques.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	2	-	-	2	-	3	1	-	1
CO2	2	-	-	3	-	3	-	-	3	1	-	2
CO3	3	2	3	2	-	-	-	-	2	-	2	3
CO4	2	1	2	-	-	-	-	2	-	-	2	3
CO5	3	3	3	-	-	2	2	-	3	3	3	-

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	1
CO2	2	1	3	3
CO3	3	3	2	-
CO4	2	3	2	-
CO5	2	1	3	2

H/M/L indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical /Project			
				√								

Subject Code:	Subject Name : Process Control And Dynamics	Ty/Lb/ETL/IE	L	T / S.Lr	P/ R	C
EBCT22014	Prerequisite: Engineering Chemistry I & II, Engineering Mathematics III & IV	Ty	3	0/0	0/0	3

UNIT I RESPONSE OF FIRST ORDER SYSTEM 9Hrs

Laplace transformation, transform of standard functions, derivatives and integrals, inversion, theorems in Laplace transformation, application. Open-loop systems, first order systems and their transient response for standard input functions, first order systems in series, linearization and its application in process control, second order systems and their dynamics, transfer function for chemical reactors and dynamics.

UNIT II THE CONTROL SYSTEM 9Hrs

Closed loop control systems, development of block diagram for feed-back control systems, servo and regulator problems, Transfer function for controllers and final control element, principles of pneumatic and electronic controllers, transportation lag, transient response of closed-loop control systems and their stability.

UNIT III CLOSED LOOP TRANFER FUNCTIONS 9Hrs

Introduction to frequency response of closed-loop systems, control system design by frequency, Bode diagram, stability criterion, Nyquist diagram; Tuning of controller settings.

UNIT IV CONTROLSYSTEM DESIGN BY FREQUENCY RESPON 9Hrs

Controller mechanism, introduction to advanced control systems, cascade control, feed forward control, control of distillation towers and heat exchangers, introduction to microprocessors and computer control of chemical processe

UNIT V ADVANCED CONTRO SYSTEM 9Hrs

Principles of measurements and classification of process control instruments, measurements of temperature, pressure, fluid flow, liquid weight and weight flow rate, viscosity and consistency, p^H, concentration, electrical and thermal conductivity, humidity of gases, composition by physical and chemical properties and spectroscopy.

Total No of Hours: 45Hrs

TEXT BOOKS:

1. *Patranabis .D, Principles of Process control, II edition, Tata McGraw Hill Publishing Co Ltd., 1981.*
2. *PeterHarriott, Processcontrol, Tata McGraw Hill Publishing Co., Reprint 2004.*

REFERENCES:

1. *Thomas, E.Marlin, Process Control, 2nd Edn, McGraw Hills International Edn 2000.George Stephanopoulos, Chemical Process Control, Prentice Hall of India 2003.*
2. *Norman H.CEAGLSKE, Automatic process control for chemical engineers, John Wiley & Sons, Japan*

Subject Code: EBCT22015	Subject Name : Chemical Reaction Engineering II	Ty/Lb/ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: Basic maths, chemistry & material energy balance	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: CreditsT/L/ETL : Theory/Lab/Embedded Theory and Lab/ Internal Evaluation

OBJECTIVE:

- To apply the knowledge of material energy balances, mass transfer and chemical reaction engineering for solving problems involving heterogeneous reaction systems.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Ability to distinguish between various RTD curves and predict the conversion from a non-ideal reactor using tracer information.
CO2	Design of ideal reactors for single and complex reactions
CO3	Develop rate laws for heterogeneous reaction
CO4	Design of reactors for non-catalytic and catalytic reactions.
CO5	Design of towers for gas–liquid operations with and without chemical reaction

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	-	1	1	-	1	-	1
CO2	1	3	-	3	-	-	2	3	-	-	2	-
CO3	2	1	1	-	-	-	-	-	-	1	-	-
CO4	2	-	-	-	-	2	-	-	-	3	-	-
CO5	1	-	2	-	-	-	-	1	-	-	-	1

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	2	3	1	2
CO2	3	2	1	3
CO3	2	1	2	3
CO4	3	1	2	1
CO5	3	1	1	2

H/M/L indicates Strength of Correlation 3- High,2 - Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical /Project			
				√								

Subject Code: EBCT22015	Subject Name : Chemical Reaction Engineering II	Ty/Lb/ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: Basic maths, chemistry & material energy balance	Ty	3	0/0	0/0	3

UNIT - I NON-IDEAL REACTORS 9Hrs

The residence time distribution as a factor performance; residence time functions and relationship between themin reactor; basic models for non-ideal flow; conversion in non-ideal reactors.

UNIT - II HETEROGENEOUS PROCESS AND SOLID CATALYSIS 9Hrs

Rate equations for heterogeneous reactions nature of catalysis, adsorption isothermal and rates of adsorption, desorption and surface reaction analysis of rate equation and rate controlling steps, surface area and pore-volume distribution, catalyst preparation.

UNIT - III GAS-SOLID CATALYTIC REACTORS 9Hrs

Diffusion within catalyst particle effective thermal conductivity mass and heat transfer within catalyst pellets; Effective factors, Thiele Modulus, fixed bed reactors.

UNIT - IV GAS-SOLID NON-CATALYTIC REACTORS 9Hrs

Models for explaining the kinetics; volume and surface models; controlling resistances and rate controlling steps; time for complete conversion for single and mixed sizes, fluidised and static reactors.

UNIV – V GAS-LIQUID REACTIONS 9Hrs

Absorption combined with chemical reactions; mass transfer coefficients and kinetic constants; application of film penetration and surface renewal theories; Hatta number and enhancement factor for first order reaction, tower reactor design.

Total No of Hours: 45Hrs

TEXT BOOK

1. Fogler. H.S., "Elements of Chemical reaction engineering" 3rd edition, Prentice Hall of India Pvt. Ltd., 1999 (Indians Reprint 2003)

REFERENCES

1. Levenspiel , O; " Chemical Reaction Engineering ", 2nd Edition, John Wiley, 1972.
2. Smith J.M., "Chemical Engineering Kinetics", 3rd edition, McGraw-Hill, New York, 1981.

Subject Code: EBCT22016	Subject Name : Chemical Process Equipment Design	Ty/Lb/ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite:	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab/ Internal evaluation

OBJECTIVE:

- To acquire basic understanding of design parameter, complete knowledge of design procedures for commonly used process equipment and their attachments (e.g. internal and external pressure vessels, tall vessels, high pressure vessels, supports etc.), and different types of equipment testing methods.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Knowledge of basics of process equipment design and important parameters of equipment design
CO2	Ability to design internal pressure vessels and external pressure vessels
CO3	Ability to design special vessels (e.g. tall vessels) and various parts of vessels (e.g. heads)
CO4	Knowledge of equipment fabrication and testing methods
CO5	Design batch and continuous reactors

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	3	-	1	-	-	-	2	-	-	3
CO2	2	3	-	3	-	-	3	-	3	-	2	-
CO3	2	-	-	-	-	2	-	-	3	-	-	3
CO4	3	-	-	3	-	-	3	-	-	-	1	3
CO5	2	2	2	2	-	-	-	-	-	-	-	2

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	2	2	-	-
CO2	3	1	-	-
CO3	2	1	-	3
CO4	3	2	1	-
CO5	2	1	-	-

H/M/L indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical /Project			
				√								

Subject Code: EBCT22016	Subject Name : Chemical Process Equipment Design	Ty/Lb/ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite:	Ty	3	0/0	0/0	3

UNIT – I **9Hrs**

Design of storage vessels for non-volatile and volatile fluids – design of pressure vessels – design of vessel supports.

UNIT – II **9Hrs**

Design of Heat Exchangers – Double pipe – shell & tube – finned tube – plate heat exchangers – design of evaporators – single & multi effect.

UNIT – III **9Hrs**

Design of mass transfer operation equipment – Absorber – Distillation column – Plate and packed columns.

UNIT – IV **9Hrs**

Design of Dryers – Rotary – Spray dryers – cooling towers

UNIT – V **9Hrs**

Design of Agitated vessels – filters – cyclones

Total No. of Hours: 45Hrs

TEXT BOOKS:

1. M.V.Joshi and V.V. Mahajan, "Process Equipment Design", MacMillan India Ltd.
2. S.D.Dawande, "Process Design of Equipments", Central Techno Publications, Nagpur, 2000.

REFERENCES:

1. Indian Standard Specifications IS-803, 1962; IS-4072, 1967; IS-2825, 1969. Indian Standards Institution, New Delhi.
2. R.H. Perry, "Chemical Engineers' Handbook", McGraw Hill.
3. W.L.McCabe, J.C.Smith and Harriet, "Unit Operation of Chemical Engineering", McGraw Hill.
4. Robert Treybal, "Mass Transfer Operations", McGraw Hill.
5. J.M. Coulson and J.Richardson, "Chemical Engineering", vol. 6, Asian Books Printers Ltd.

SEMESTER VII (PRACTICAL)

Subject Code:	Subject Name : Process Control Lab	Ty/Lb/ETL/IE	L	T / S.Lr	P/ R	C
EBCT22L09	Prerequisite: Process control and dynamics	Lb	0	0/0	3/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab/ Internal Evaluation

OBJECTIVE:

- To determine experimentally the methods of controlling the processes including measurements using process simulation techniques.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Students would have knowledge on the development and use of right type of control dynamics for process control Under different operative conditions.
CO2	An ability to design process control system components to meet desired needs within realistic constraints.
CO3	An ability to apply engineering science and mathematical knowledge of to designing and conducting experiments as well as to analyze and interpret data
CO4	An ability to use the techniques, skills and tools to identify formulate and solve engineering problems.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	-	2	-	3	-	-	-	1	-	3	-
CO2	3	-	-	-	2	-	2	-	-	-	-	2
CO3	2	1	3	-	-	-	-	2	-	-	2	3
CO4	3	-	-	-	2	-	2	-	-	-	-	2

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	2	1	-	-
CO2	2	2	-	-
CO3	3	2	1	-
CO4	2	2	-	-

H/M/L indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical /Project			
				√					√			

Subject Code: EBCT22L09	Subject Name : Process Control Lab	Ty/Lb/ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: Process control and dynamics	Lb	0	0/0	3/0	1

1. Response of first order system

2. Response of second order system

3. Response of Non-Interacting level System

4. Response of Interacting level System

5. Open loop study on a thermal system

6. Closed loop study on a level system

7. Closed loop study on a flow system

8. Closed loop study on a thermal system

9. Tuning of a level system

10. Tuning of a pressure system

11. Tuning of a thermal system

12. Flow co-efficient of control valves

13. Characteristics of different types of control valves

14. Closed loop study on a pressure system

15. Tuning of pressure system

16. Closed loop response of cascade control system

***Minimum 10 experiments shall be offered**.

Subject Code:	Subject Name : Chemical Process Equipment Design & Drawing Lab	Ty/Lb/ETL/IE	L	T / S.Lr	P/ R	C
EBCT22L10	Prerequisite: Chemical Process Equipment Design	Lb	0	0/0	3/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab/Internal Evaluation

OBJECTIVE: To study the design principles of various chemical process equipments and to draw them with appropriate dimensions.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Review the standard flow sheet symbols and construct a flow sheet using the symbols
CO2	Design a suitable heat exchanger for a given problem specification
CO3	Design single and multiple effect evaporators
CO4	Design a distillation column and an absorber for a separation problem
CO5	Design a centrifugal pump and a batch reactor

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	1	-	-	3	-	-	3
CO2	2	-	3	-	-	-	3	-	-	1	-	3
CO3	3	-	-	-	2	-	-	-	-	2	-	-
CO4	3	-	-	2	-	-	2	-	-	3	-	-
CO5	2	2	-	-	3	3	-	-	1	-	1	1

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	-
CO2	3	1	-	-
CO3	2	1	3	-
CO4	3	3	1	-
CO5	4	2	1	-

H/M/L indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical /Project			
				√					√			

Subject Code:	Subject Name : Chemical Process Equipment Design & Drawing Lab	Ty/Lb/ETL/IE	L	T / S.Lr	P/ R	C
EBCT22L10	Prerequisite: Chemical Process Equipment Design	Lb	0	0/0	3/0	1

UNIT – I **9Hrs**

Design of storage vessels for non-volatile and volatile fluids – design of pressure vessels – design of vessel supports.

UNIT – II **9Hrs**

Design of Heat Exchangers – Double pipe – shell & tube – finned tube – plate heat exchangers – design of evaporators – single & multi effect.

UNIT – III **9Hrs**

Design of mass transfer operation equipment – Absorber – Distillation column – Plate and packed columns.

UNIT – IV **9Hrs**

Design of Dryers – Rotary – Spray dryers – cooling towers

UNIT – V **9Hrs**

Design of Agitated vessels – filters – cyclones

Total No of periods: 45Hrs

Subject Code:	Subject Name : PROJECT PHASE -I	Ty/Lb/ETL/IE	L	T / S.Lr	P/ R	C
EBCT22I05	Prerequisite: Practical Knowledge of Basic Chemical Engineering Concepts	IE	0	0/0	3/3	2

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE:

- The objective of the Main Project is to culminate the academic study and provide an opportunity to explore a problem or issue, address through focused and applied research under the direction of a faculty mentor.
- The project demonstrates the student's ability to synthesize and apply the knowledge and skills acquired to real-world issues and problems.
- This project affirms the students to think critically and creatively, find an optimal solution, make ethical decisions and to present effectively.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Apply the knowledge and skills acquired in the course of study addressing a specific problem or issue.
CO2	To encourage students to think critically and creatively about societal issues and develop user friendly and reachable solutions.
CO3	To refine research skills and demonstrate their proficiency in communication skills
CO4	To take on the challenges of teamwork, prepare a presentation and demonstrate the innate talents.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	2	3	3	1	2	2	3	3
CO2	3	3	3	3	3	3	3	2	2	2	3	3
CO3	2	3	3	3	3	3	3	2	3	3	3	3
CO4	3	3	3	3	3	2	2	2	3	3	3	3

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	3
CO2	3	3	3	2
CO3	3	2	1	3
CO4	3	3	3	2

H/M/L indicates Strength of Correlation 3- High,2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical /Project			
				√					√			

Subject Code:	Subject Name : PROJECT PHASE -I	Ty/Lb/ETL/IE	L	T / S.Lr	P/ R	C
EBCT22I05	Prerequisite: Practical Knowledge of Basic Chemical Engineering Concepts	IE	0	0/0	3/3	2

Students are expected to do the Project in a group of 3 to 4 students. Theyshould identify the area/topic of the Project and should collect the literatures related to the project. Students intending to do Industrial projects will approach the industries with the support of the university, identify the industrial problem and finalize the project. In case of Industrial projects apart from Industry guide, a guide has to be appointed by the department. At the end of the Semester the students should submit their Project Phase - I report to the Department and Viva -Voce examination will be conducted by the examiners duly appointed by the Head of the department.

Subject Code:	Subject Name : Foreign Language	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
EBFL22IXX	Prerequisite: Nil	IE	2	0/0	1/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab/ Internal Evaluation

OBJECTIVE:

- To recognize the cultural values, practices, and heritage of the foreign country, communicate effectively in a foreign language and interact in a culturally appropriate manner with native speakers of that language.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Achieve functional proficiency in listening, speaking, reading, and writing.
CO2	Develop an insight into the nature of language itself, the process of language and culture acquisition. Decode, analyze, and interpret authentic texts of different genres.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	1	1	3	1	3	2	3	3	1
CO2	2	1	1	1	1	3	1	3	3	3	3	1

COs / PSOs	PSO1	PSO2	PSO3	PSO4			
CO1	2	1	2	2			
CO2	2	2	3	2			

H/M/L indicates Strength of Correlation 3- High,2- Medium,1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical /Project			
			√									

Subject Code:	Subject Name : Foreign Language	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
EBFL22IXX	Prerequisite: Nil	IE	2	0/0	1/0	1

Foreign language is introduced in the curriculum to make the students globally employable. Students should select and register for any one of the foreign languages from the given list. At the end of the course students should be able to read, write and converse the language in the basic level. At the end of the semester the assessment will be done through internal examination by the examiner duly appointed by the head of the department.

SEMESTER VIII (THEORY)

Subject Code:	Subject Name: Total Quality Management	T y/ Lb/ETL	L	T / SLr	P/ R	C
EBCC22ID3	Prerequisite: Nil	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE: The student will earn:

- To acquaint the students with the basic concept of Total Quality (TQ)
- To understand the customers' expectations and plan TQM accordingly
- To give understand International Quality Certification Systems – ISO 9000 and other standards
- To understand concepts related to quality of services in contemporary environment

COURSE OUTCOMES (COs) :

CO1	Understand the Quality Policies (Level 2)
CO2	Understand the Concepts of Total Quality Management (Level 2)
CO3	Apply Total Quality Management tools in Industry (Level 3)
CO4	Apply the Modern tools of Quality Control (Level 3)
CO5	Acquiring knowledge about Modern Trends and Concepts in Manufacturing Management(Level 2)

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	2	3	3	-	-	3	3	2	3	2
CO2	-	3	2	-	-	3	-	3	2	3	-	2
CO3	3	2	-	2	2	-	3	2	-	2	2	2
CO4	-	-	3	3	3	-	3	2	2	2	2	2
CO5	3	3	3	3	3	3	-	2	3	2	2	2

COs / PSOs	PSO1	PSO2	PSO3	PSO4				
CO1	-	2	3	3				
CO2	-	2	3	3				
CO3	-	2	3	3				
CO4	-	2	3	3				
CO5	-	2	3	3				

H/M/L indicates Strength of Correlation 3- High,2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical /Project			

Subject Code: EBCC22ID3	Subject Name: Total Quality Management	T y/ Lb/ETL	L	T / SLr	P/ R	C
	Prerequisite: Nil	Ty	3	0/0	0/0	3

UNIT– I QUALITY POLICY, PLANNING AND MANAGEMENT 9Hrs

Evolution of quality as a strategy- Definitions of quality, Quality Philosophies of Deming, Crosby and Miller, Service Vs product Quality, Customer focus, Quality and Business performance leadership for quality management, Quality planning, Designing for Quality and Manufacturing for Quality, Vision, Mission statements and Quality policy.

UNIT – II BASIC CONCEPTS F TOTAL QUALITY MANAGEMENT 9Hrs

Total Quality management- TQM models, human and system Components, Continuous Improvement Strategies, Deming wheel, Internal External Customer concept, Customer satisfaction Index, Customer retention, Team work and team building, Empowerment, TQM culture, Quality Circle, 5S principle, Top Management commitment.

UNIT – III QUALITY MANAGEMENT TOOLS 9Hrs

Quality management tools - Principles and applications of quality Function deployment, Failure Mode and Effect Analysis (FMEA), Taguichi Techniques, Basic tools- Statistical techniques and graphical tools and diagrams.

UNIT - IV VARIOUS CONCEPTS OF QC TECHNIQUES 9Hrs

Modern QC techniques - Japanese Production Related Techniques: Just in time (JIT) – Quality circles – Total productive maintenance (TPM) – Kaizen – Kanban – 5S concepts – Toyota production systems – JIDOKA – ANDON etc. Concepts on quality management systems (QMS – ISO 9000 – 2000) – Environmental Management Systems (EMS – ISO – 14000)

UNIT- V MODERN TREND AND CONCEPTS IN MANUFACTURING MANAGEMENT 9Hrs

Modern Trend and Concept in Manufacturing Management: Business processes reengineering (BPR) – Lean / flexible – manufacturing systems – Six sigma concepts. Quality Leadership- Quality Awards –Quality Tools- Quality Function Deployment.

Total No of Periods: 45Hrs

REFERENCES BOOKS:

1. *Jill A. Swift, Joel E.Ross and Vincent K.Omachonu, Peinciples of Total Quality, St.Lucie Press, US, 1998.*
2. *Samuel K.Ho, TQM, An integrated approach, kogan page India Pvt Ltd, 2002*
3. *Dale H.N Bester field et al, Total Quality management, Pearson Education Asia, 2001*
4. *RoseJ.E. Total Quality Management Kogan page India Pvt Ltd, 1993.*
5. *Mullar Max,' Essentials of Materail Management,Amacom*

SEMESTER VII (PRACTICAL)

Subject Code: EBCT22L11	Subject Name : Project Phase II	Ty/Lb/ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Project Phase – 1	Lb	0	0/0	12/12	8

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE:

- The objective of the project is to make use of the knowledge gained by the student at various stages of the degree course.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Apply the knowledge and skills acquired in the course of study addressing a specific problem or issue.
CO2	To encourage students to think critically and creatively about societal issues and develop user friendly and reachable solutions.
CO3	To refine research skills and demonstrate their proficiency in communication skills
CO4	To take on the challenges of teamwork, prepare a presentation and demonstrate the innate talents.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO 1	PO 2	PO3	PO 4	PO 5	PO 6	PO 7	PO8	PO 9	PO10	PO1 1	PO12
CO1	3	3	3	3	2	3	3	1	2	2	3	3
CO2	3	3	3	3	3	3	3	2	2	2	3	3
CO3	2	3	3	3	3	3	3	2	3	3	3	3
CO4	3	3	3	3	3	2	2	2	3	3	3	3

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	3
CO2	3	3	3	2
CO3	3	2	1	3
CO4	3	3	3	2

H/M/L indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical /Project			
				√					√			

Subject Code: EBCT22L11	Subject Name : Project Phase II	Ty/Lb/ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Project Phase – 1	Lb	0	0/0	12/12	8

To make the students to make use of the knowledge and skill developed during their four years of study and to apply them for making an innovative product/process for the development of society and industries.

Students are expected to do a Project work either in an Industry or at the University in the field of relevant Engineering /inter-disciplinary /multi-disciplinary area in a group of 3 or 4 students. The work to be carried out in Phase II should be continuation of Phase I. Each group will be allotted a guide based on the area of Project work. In case of industrial Project external guide has to be allotted from Industry. Inter disciplinary/multi-disciplinary project can be done with students of different disciplines as a group. Monthly reviews will be conducted during the semester to monitor the progress of the project by the project review committee. Students have to submit the Project thesis at the end of the semester and appear for the Project Viva-Voce examination conducted by the examiners duly appointed by the Controller of Examination. In case of industrial project certificate in proof has to be included in the report along with the bonofide certificate.

PROGRAMME ELECTIVES - I

Subject Code: EBCT22E01	**Subject Name: Food Technology**	**Ty / Lb/ ETL/IE**	**L**	**T / SLr**	**P/ R**	**C**
	Prerequisite: Chemistry and Microbiology	**Ty**	**3**	**0/0**	**0/0**	**3**

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE:

- To impart knowledge to the students about food processing and various unit operations involved in it, packaging, storing and preservation, food poisoning, food related hazards and safety, and transportation.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Understanding the various causes of food deterioration and food poisoning.
CO2	Identification of appropriate processing, preservation, and packaging method.
CO3	Analyze product quality and effect of processing technique on it.
CO4	Identify important species of pathogenic microbes and describe factors that affect their growth in various types of food.
CO5	Analysis of food related hazards and HACCP method.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**3**	**-**	**1**	**-**	**-**	**-**	**2**	**-**	**3**	**-**	**1**	**-**
CO2	**2**	**-**	**1**	**-**	**1**	**-**	**3**	**-**	**-**	**-**	**1**	**2**
CO3	**3**	**-**	**1**	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**1**	**-**
CO4	**2**	**-**	**1**	**-**	**1**	**-**	**3**	**-**	**-**	**-**	**1**	**2**
CO5	**3**	**-**	**1**	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**1**	**-**

COs / PSOs	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	**3**	**2**	**1**	**3**
CO2	**2**	**1**	**3**	**3**
CO3	**3**	**3**	**3**	**1**
CO4	**2**	**1**	**3**	**3**
CO5	**1**	**2**	**3**	**1**

H/M/L indicates Strength of Correlation 3- High, 2- Medium,1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical /Project			
					√							

Subject Code: EBCT22E01	Subject Name: Food Technology	Ty / Lb/ ETL/IE	L	T / SLr	P/ R	C
	Prerequisite: Chemistry and Microbiology	Ty	3	0/0	0/0	3

UNIT I AN OVERVIEW 9Hrs

General aspects of food industry world food needs and Indian situation.

UNIT II FOOD CONSTITUENTS, QUALITY AND DERIVATIVE FACTORS 9Hrs

Constituents of food quality and nutritive aspects food additives standards deteriorative factors and their control.

UNIT III GENERAL ENGINEERING ASPECTS AND PROCESSING METHODS 9Hrs

Preliminary processing methods conversion and preservation operations.

UNIT IV FOOD PRESERVATION METHODS 9Hrs

Preservation by heat and cold dehydration concentration drying irradiation microwave heating sterilization and pasteurization fermentation and pickling packing methods.

UNIT V P RODUCTION AND UTILISATION OF FOOD PRODUCTS 9Hrs

Cereal grains pulses vegetables; fruits; spices fats and oils bakery confectionery and chocolate productssoft and alcoholic beverages dairy products meat poultry and fish products.

Total No. of Hours: 45Hrs

TEXT BOOKS:

1. Heid J.L. Joslyn M.A., Fundamentals of Food Processing Operation, The AVI publishing Co., West port 1967.
2. Potter N.N., Food Science, The AVI publishing Co., Westport, 1963.

REFERENCES:

1. Heldman D.R., Food Process Engineering, The AVI publishing co., 1975.
2. Charm S.E., The Fundamentals of Foods Engineering, The AVI Publishing Co., Westport, 1966

Subject Code: EBCT22E02	Subject Name: Industry Pollution Prevention And Control	Ty / Lb/ ETL/IE	L	T / SLr	P/ R	C
	Prerequisite: Chemistry and Microbiology	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab/ Internal Evaluation

OBJECTIVE:

- To impart knowledge to the students about food processing and various unit operations involved in it, packaging, storing and preservation, food poisoning, food related hazards and safety, and transportation.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Understanding the various causes of food deterioration and food poisoning.
CO2	Identification of appropriate processing, preservation, and packaging method.
CO3	Analyze product quality and effect of processing technique on it.
CO4	Design gravity settling chamber, cyclones, electrostatic precipitator, fabric filters and absorbers for air pollution control.
CO5	Identify the best way to dispose, minimize or utilize haradous solid waste from chemical industries and understand the ethical issues and societal impact of releasing pollutants in environment.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	-	2	3	-	-	-	-	2
CO2	3	2	2	2	-	1	3	-	-	-	-	2
CO3	3	2	2	3	-	2	3	-	-	-	-	2
CO4	3	3	2	3	-	1	3	-	-	-	-	2
CO5	1	1	1	1	-	1	3	3	-	-	-	2

COs / PSOs	PSO1	PSO2	PSO3	PSO4				
CO1	3	2	1	3				
CO2	2	1	3	3				
CO3	2	3	3	1				
CO4	2	3	2	1				
CO5	3	2	1	3				

H/M/L indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical /Project			
					√							

Subject Code: EBCT22E02	Subject Name: Industry Pollution Prevention And Control	Ty / Lb/ ETL/IE	L	T / SLr	P/ R	C
	Prerequisite: Chemistry and Microbiology	Ty	3	0/0	0/0	3

UNIT I INTRODUCTION **9Hrs**

Industrial activity and environment, industrialization and sustainable development indicators of sustainability- sustainability strategies-Barriers to sustainability- Pollution prevention in achieving sustainability

UNIT II POLICIES AND REGULATIONS **9Hrs**

Prevention vs control of industrial pollution-Environment policies and Regulations to encourage pollution prevention 143 CHEM-Engg&Tech-SRM-2013

UNIT III ENVIRONMENTAL CONTAMINANTS **9Hrs**

Environment friendly chemical processes-Properties of environmental contaminants - Regulations for clean environment and implications for industries

UNIT IV LIFE CYCLE ASSESSMENT **9Hrs**

Life cycle assessment and pollution prevention economics-Design for the environment-International environmental standards-Environmental technology assessment.

UNIT V INDUSTRIAL APPLICATIONS OF POLLUTION PREVENTION **9Hrs**

Water,energy and reagent conservation-residuals management-Economic recovery and recycling of wastes. Industrial applications of pollution prevention, Life cycle assessment, waste audits and technology assessments

Total No. of Hours: 45Hrs

TEXT BOOK

1. Bishop .P, "Pollution Prevention: Fundamentals and Practice", McGraw Hill International Edn., McGraw Hill Book Co., Singapore, 2000.
2. Roy T.K. (Editor), "Chemical Technology for better Environment", Allied Publishers Ltd., Chennai, 1998.

REFERENCES

1. Freeman. H.M , "Industrial Pollution Prevention Hand Book", McGraw Hill, 1995. 2. James G. Mann and Y.A.Liu, "Industrial Water Reuse and Waste Water Minimization", McGraw Hill, 1999

Subject Code: EBCT22E03	Subject Name: Chemistry of Polymer And Composite Materials	Ty / Lb/ ETL/IE	L	T / SLr	P/ R	C
	Prerequisite: Chemistry	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab/ Internal evaluation

OBJECTIVE:

- To enable the students to understand the mechanism of polymerization, various techniques of polymerization, characterization of polymers by molecular weight, reactions and degradation of polymers.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Identify and understand the basic mechanical behaviour of composite materials and make sound prediction on the likely behaviour of new combinations of materials
CO2	Apply the choices made for using certain types of composites in certain applications with reference to composite properties.
CO3	Demonstrate a practical understanding of composite properties and fabrication techniques, and to be able to make realistic suggestions for the evaluation of composite behaviour, where appropriate.
CO4	Analyse the micromechanical properties of fibre reinforced composites.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	1	-	2	-	2	-	3	-	1	2
CO2	2	1	1	-	1	1	3	-	2	-	3	1
CO3	3	-	2	-	2	-	2	-	2	-	1	3
CO4	3	-	1	-	2	-	2	-	3	-	1	2

COs / PSOs	PSO1	PSO2	PSO3	PSO4				
CO1	3	2	1	3				
CO2	2	1	2	3				
CO3	2	3	3	1				
CO4	2	3	1	2				

H/M/L indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Science	Engineering Science	Humanities and social Science	Program Core	Program elective	Open Elective	Inter Disciplinary	Skill Component	Practical /Project			
					√							

Subject Code: EBCT22E03	Subject Name: Chemistry of Polymer And Composite Materials	Ty / Lb/ ETL/IE	L	T / SLr	P/ R	C
	Prerequisite: Chemistry	Ty	3	0/0	0/0	3

UNIT I FUNDAMENTAL CONCEPTS OF POLYMER **9Hrs**

Introduction, classification of polymer, nomenclature, trade and common name of polymer, monomers and functionality concept of monomers (with example), concept of cross linking and isomerism, general applications of polymer.

UNIT II SOLVENTS, FILLERS AND ADDITIVES **9Hrs**

Solvents: Introduction, Classification, types of solvents, types of solutions, method of finding chain length, demixing, flexible chains, particle size & shape, compatibility, phase transition, ternary systems.**Fillers**: Introduction, types of fillers, particle geometry, organic fillers, cellulosic, fibers, and inorganic fillers, applications.**Additives**: Introduction, plasticizers, classification, effect on chemical properties & stability, flexibilizers, release agents, antioxidants, applications.

UNIT III POLYMERIZATION PATHWAY **9Hrs**

Step polymerization, chain polymerization, anionic polymerization, cationic polymerization, free radical polymerization (with kinetics), and ring opening polymerization.

UNIT IV POLYMER SYNTHESIS **9Hrs**

Synthesis and applications of polystyrene, polyvinyl acetate, nylon-6, nylon-66, polyvinyl chloride, unsaturated polyvinyl chloride, chlorinated polyvinyl chloride, teflon, poly (3- hydroxybutyrate-co-3-hydroxyvalerate)(PHBV), polyethylene terephthalate, poly glyptal, polymethyl methacrylate, poly urethane, neoprene, phenol formaldehyde, urea formaldehyde, melamine formaldehyde, epoxy resins, poly propylene, High-density polyethylene, low- density polyethylene.

UNIT V COMPOSITE MATERIALS **9Hrs**

Introduction and industrial applications of composites, **Fiber Reinforced Composites (FRC):** introduction, importance and properties, manufacture of fiber fabric, manufacture of fiber preforms, Forming processes, Bladder moulding, Compression moulding, Autoclave and vacuum bag, Mandrel wrapping, Wet layup, Chopper gun, Filament winding, Pultrusion, Resin transfer moulding, Carbon fibre, Aramid fibre material, Kevlar.Introduction, example and application of Particle Reinforced Composites (PRC).

Total No. of Hours: 45Hrs

REFERENCE BOOKS:

1. *A Textbook of Polymers – Vol I & II, M. S. Bhatnagar, S. Chand Publication*
2. *Plastic Materials – John Brydson, Elsevier Publication*
3. *Polymer Science & Technology – Joel Fried, PHI*
4. *Introductory Polymer Chemistry, G. S. Misra, New Age International*
5. *Polymer Science, G. Govariker, New Age International*

PROGRAMME ELECTIVE - II

Subject Code: EBCT22E04	Subject Name: Green Chemistry and Engineering	Ty/Lb/ETL\ IE	L	T / S.Lr	P/ R	C
	Prerequisite: Nil	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab/ Internal Evaluation

OBJECTIVE:

- To make the students aware of global environmental issues, concepts behind pollution prevention, environmental risks, green chemistry, methods to evaluate environmental costs and life cycle assessments.

COURSE OUTCOMES (COs) :

CO1	Explain how Green chemistry and sustainability relates to problems of societal concern.
CO2	Analyze a process and identify how it may be made more environmentally friendly/sustainable/green.
CO3	Integrate, synthesize, and apply knowledge of the relationship between science and technology and societal issues in both focused and broad interdisciplinary contexts.
CO4	Utility and modification of processes to have green and better environmental protective aspect

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	3	-	-	-	-	-	2	-	-
CO2	3	2	1	-	3	-	3	-	-	-	-	1
CO3	2	3	3	3	1	-	-	-	3	-	-	-
CO4	3	-	2	-	2	-	-	-	-	-	-	-

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	2	1	3	3
CO2	3	3	2	1
CO3	3	2	1	1
CO4	3	3	2	1

H/M/L indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Science	Engineering Science	Humanities and social Science	Program Core	Program elective	Open Elective	Inter Disciplinary	Skill Component	Practical /Project			
					√							

Subject Code: EBCT22E04	Subject Name: Green Chemistry and Engineering	Ty/Lb/ETL\ IE	L	T / S.Lr	P/ R	C
	Prerequisite: Nil	Ty	3	0/0	0/0	3

UNIT I ENVIROMENTAL ISSUES 9Hrs

Overview of Major Environmental Issues, Global Environmental Issues. Air Quality Issues. Water Quality Issues, Ecology, Natural Resources, Description of Risk. Value of Risk Assessment in the Engineering Profession. Risk- Based Environmental Law. Risk Assessment Concepts. Hazard Assessment. Dose- Response. Risk Characterization.

UNIT II POLLUTION PRAVENTION 9Hrs

Pollution Prevention- Pollution Prevention Concepts and Terminology. Chemical Process Safety. Responsibilities for Environmental Protection. Environmental Persistence. Classifying Environmental Risks Based on Chemical Structure.Exposure Assessment for Chemicals in the Ambient Environment.

UNIT III GREEN CHEMISTRY 9Hrs

Green Chemistry. Green Chemistry Methodologies. Quantitative/Optimization-Based Frameworks for the Design of Green Chemical Synthesis Pathways.Green Chemistry Pollution Prevention in Material Selection for Unit Operations.Pollution Prevention for Chemical Reactors. Pollution Prevention for Separation Devices. Pollution Prevention Applications for Separative Reactors. Pollution Prevention in Storage Tanks and Fugitive Sources.

UNIT IV ESTIMATION OF ENVIROMENTAL EFFECTS 9Hrs

Process Energy Integration. Process Mass Integration. Case Study of a Process Flow sheet- Estimation of Environmental Fates of Emissions and Wastes.

UNIT V ENVIROMENTAL EVALUATIONS 9Hrs

Magnitudes of Environmental Costs. A Framework for Evaluating Environmental Costs. Hidden Environmental Costs. Liability Costs. Internal Intangible Costs.External Intangible Costs. Introduction to Product Life Cycle Concepts. Life-Cycle Assessment. Life-Cycle Impact Assessments. Streamlined Life-Cycle Assessments. Uses of Life-Cycle Studies.

Total No. of Hours: 45Hrs

TEXT BOOKS:

1. Allen, D.T., Shonnard, D.R, Green Engineering: Environmentally Conscious Design of Chemical Processes. Prentice Hall PTR 2002.

2. MukeshDoble and Anil Kumar Kruthiventi, Green Chemistry and Engineering, Elsevier, Burlington, USA, 2007.

Subject Code: EBCT22E05	Subject Name: Modern Separation Processes	T y/ Lb/ ETL/IE	L	T / SLr	P/ R	C
	Prerequisite: Advanced separation	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab/ Internal Evaluation

OBJECTIVE:

- To enable the students to learn the principle and technical concept of advanced separation processes.

COURSE OUTCOMES (COs) : (3- 5)

CO1	The students would fully understand key concepts of separation processes including equilibrium stages, reflux, countercurrent contacting, limiting cases, efficiency and mass transport effects.
CO2	Design various components of equipment used in advanced separation processe
CO3	Compare various options and select an appropriate process for a particular separation
CO4	Describe and discuss principles of various advanced separation processes based on membranes, chromatography, distillation, extractions.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	3	-	-	2	-	-	-	-	1
CO2	2	-	-	-	-	-	3	-	-	-	2	-
CO3	3	-	-	-	2	-	-	-	-	-	-	2
CO4	2	-	-	-	-	1	-	-	-	-	2	-

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	2	-	-
CO2	2	1	-	-
CO3	3	2	-	-
CO4	2	1	-	-

H/M/L indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical /Project			
					√							

Subject Code: EBCT22E05	Subject Name: Modern Separation Processes	T y/ Lb/ ETL/IE	L	T / SLr	P/ R	C
	Prerequisite: Advanced separation	Ty	3	0/0	0/0	3

UNIT I BASICS OF SEPARATION PROCESS 9Hrs

Review of Conventional Processes, Recent advances in Separation Techniques based on size, surface properties, ionic properties and other special characteristics of substances, Process concept, Theory and Equipment used in cross flow Filtration, cross flow Electro Filtration, Surface based solid – liquid separations involving a second liquid.

UNIT II MEMBRANE SEPARATIONS 9Hrs

Types and choice of Membranes, Plate and Frame, tubular, spiral wound and hollow fiber Membrane Reactors and their relative merits, commercial, Pilot Plant and Laboratory Membrane permeators involving Dialysis, Reverse Osmosis, Nanofiltration, Ultra filtration and Micro filtration, Ceramic-Hybrid process and Biological Membranes.

UNIT III SEPARATION BY ADSORPTION 9Hrs

Types and choice of Adsorbents, Adsorption Techniques, Dehumidification Techniques, Affinity Chromatography and Immuno Chromatography, Recent Trends in Adsorption.

UNIT IV INORGANIC SEPARATIONS 9Hrs

Controlling factors, Applications, Types of Equipment employed for Electrophoresis, Dielectrophoresis, Ion Exchange Chromatography and Eletrodialysis, EDR, Bipolar Membranes.

UNIT V OTHER TECHNIQUES 9Hrs

Separation involving Lyophilisation, Pervaporation and Permeation Techniques for solids, liquids and gases, zone melting, Adductive Crystallization, other Separation Processes, Supercritical fluid Extraction, Oil spill Management,Industrial Effluent Treatment by Modern Techniques.

Total No. of Hours: 45Hrs

REFERENCES*:*

1. King, C. J., "Separation Processes", Tata McGraw Hill, 1982.83
2. Roussel, R. W., "Handbook of Separation Process Technology", John Wiley,New York, 1987.
3. Nakagawal, O. V., "Membrane Science and Technology"' Marcel Dekkar,1992.

Subject Code: EBCT22E06	Subject Name: Renewable Energy Engineering	Ty / Lb/ ETL/IE	L	T / SLr	P/ R	C
	Prerequisite: conversion technologies	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab/ Internal evaluation

OBJECTIVE:

- This course helps the students to understand the importance, availability, conversion technologies of renewable energy resources and its applications.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Make interpretation about the energy sources.
CO2	Comprehend the energy and energy types.
CO3	Make interpretation about the solar energy.
CO4	Explain the solar energy power plants.
CO5	Make interpretation about the geothermal energy

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	3	-	-	-	2	-	-	3
CO2	2	3	-	1	-	-	-	-	3	-	1	-
CO3	1	-	-	-	-	1	-	-	-	2	-	-
CO4	3	-	-	-	-	2	-	-	2	-	-	-
CO5	2	-	-	-	-	1	-	1	-	-	-	

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	2	-	-
CO2	2	1	-	-
CO3	1	2	3	-
CO4	3	2	1	-
CO5	1	2	-	-

H/M/L indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical /Project			
					√							

Subject Code: EBCT22E06	Subject Name: Renewable Energy Engineering	Ty / Lb/ ETL/IE	L	T / SLr	P/ R	C
	Prerequisite: conversion technologies	Ty	3	0/0	0/0	3

UNIT I INTRODUCTION **9Hrs**

World energy status, Current energy scenario in India, Environmental aspects of energy utilization, Environment - Economy - Energy and Sustainable development,energy planning.classification of Energy resources, Advantages and disadvantages of Non-Conventional source of energy, Renewable energy resources - potentials -achievements – applications.

UNIT II SOLAR ENERGY **9Hrs**

Basic concepts, Solar thermal systems – Flat plate and concentrating collectors, Solar passive space - Solar heating and cooling techniques – Solar desalination –Solar Pond - Solar cooker - Solar dryers-Solar furnaces - Solar pumping, Solar 139 CHEM-Engg&Tech-SRM-2013 green house- Solar thermal power plant – Solar photo voltaic conversion – Solar cells – PV applications

UNIT III WINDENERGY **9Hrs**

Introduction-Background-Availability- wind power plants , Power from the wind,Wind energy conversion systems, site characteristics, Wind turbines types –Horizontal and vertical axis-design principles of wind turbine, Magnus effect-Performance.Wind energy Applications – New developments - Safety and environmental aspects.

UNIT IV BIOMASS ENERGY **9Hrs**

Biomass – usable forms- composition- fuel properties – applications, Biomass resources, Biomass conversion technologies - direction combustion - pyrolysis –gasification -anaerobic digestion, Bioethanol and Biodiesel Production – Recent developments.Energy farming, Biogas technology - Family biogas plants,Community and institutional biogas plants – design consideration – applications**.**

UNIT V OTHER RENEWABLE ENERGY SOURCES **9Hrs**

Tidal energy – Wave energy – Open and closed OTEC Cycles – Small hydro –Geothermal energy Fuel cell technology - types, principle of operation –applications.Hydrogen energy production - Storage system.

Total No. of Hours: 45Hrs

TEXT BOOK:

1. Rai. G.D. "Non Conventional Energy Sources", Khanna Publishers, New Delhi, 1999.
2. Sukhatme.. S.P. "Solar Energ", Tata McGraw Hill Publishing Company Ltd., New Delhi, 1997.
3. "Renewable energy sources of conversion technology": Bansal..N.K Manfred Kleen Man and Michael Meliss, TMH Publicatio

REFERENCES:

1. Kothari. P, K C, Singal and Rakesh Ranjan, " Renewable EnergySources and Emerging Technologies ", PHI Pvt. Ltd.,New Delhi, 2008
2. Godfrey Boyle, Renewable Energy, Power for a Sustainable Future, OxfordUniversityPress, U.K, 1996.
3. Twidell. J.W. & Weir, A., Renewable Energy Sources, EFN Spon Ltd., UK,1986.
4. Freris, Wind Energy Conversion systems, Prentice Hall, UK, 1990.

PROGRAMME ELECTIVE - III

Subject Code: **EBCT22E07**	**Subject Name: Computational Fluid Dynamics**	**T y/ Lb/ ETL/IE**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite: Basic Mathematics and fluid mechanics	**Ty**	**3**	**0/0**	**0/0**	**3**

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab/ Internal Evaluation

OBJECTIVE:

- To make the students to demonstrate competence in setting up computational fluid dynamics models for some industrially important applications. This technical competence in building and conducting CFD simulations is a skill.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Upon completing the course, the student should have a Hands-on experience with a commercial CFD program.
CO2	Provide the student with a significant level of experience in the use of modern CFD software for the analysis of complex fluid-flow systems.
CO3	Improve the student's research and communication skills using a self-directed, detailed study of a complex fluid-flow problem and to communicate the results in written form.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**2**	**3**	**-**	**-**	**1**	**-**	**-**	**-**	**3**	**-**	**-**	**3**
CO2	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**-**	**-**
CO3	**3**	**2**	**1**	**-**	**-**	**-**	**-**	**2**	**-**	**1**	**-**	**-**

COs / PSOs	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	**2**	**2**	**-**	**-**
CO2	**3**	**1**	**-**	**-**
CO3	**2**	**1**	**-**	**-**
CO4	**3**	**2**	**-**	**-**

H/M/L indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical /Project			
					√							

Subject Code: EBCT22E07	Subject Name: Computational Fluid Dynamics	T y/ Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: Basic Mathematics and fluid mechanics	Ty	3	0/0	0/0	3

UNIT I CONSERVATION LAWS AND TURBULENCE MODELS 9Hrs

Governing equations of fluid flow and heat transfer –mass conservation, momentum and energy equation, differential and integral forms, conservation and non-conservation form. Characteristics of turbulent flows, time averaged Navier Strokes equations, turbulence models-one and two equation, Reynolds Stress, LES and DNS.

UNIT II FINITE DIFFERNCE APPROXIMATION 9Hrs

Mathematical behaviour of PDE, finite difference operators, basic aspects of discretization by FDM, explicit and implicit methods, error and stability analysis.

UNIT III FINITE VOLUME METHOD 9Hrs

Diffusion problems – explicit and implicit time integration Convection-diffusion problems – properties of discretisation schemes, central, upwind, hybrid, QUICK schemes Solution of discretised equations.

UNIT IV FLOW FIELD COMPUTATION 9Hrs

Pressure velocity coupling, staggered grid, SIMPLE algorithm, PISO algorithm for steady and unsteady flows.

UNIT V GRID GENERATION 9Hrs

Physical aspects, simple and multiple connected regions, grid generation by PDE solution, grid generation by algebraic mapping.

Total No. of Hours: 45Hrs

TEXT BOOKS:

1. Anderson, J. D., "Computational Fluid Dynamics: The Basics with Applications", McGraw-Hill, 1995.
2. Fletcher, C. A. J., "Computational Techniques for Fluid Dynamics", Springer Verlag, 1997.
3. Versteeg, H.K. and Malalasekera, W., "An Introduction to Computational Fluid Dynamics: The Finite Volume Method", Pearson Education Ltd., 2007.

REFERENCES*:*

1. Chung T.J Computational Fluid Dynamics Cambridge University Press,2003.
2. Muralidhar, K., and Sundararajan, T., "Computational Fluid Flow and Heat Transfer", arosa Publishing House, New Delhi, 2001.
3. Ghoshdastidar, P.S., "Computer Simulation of flow and heat transfer" Tata McGraw – Hill Publishing Company Ltd. 1998.
4. Subas, V. Patankar "Numerical heat transfer fluid flow", Hemisphere Publishing Corporation, 1980.
5. Taylor, C and Hughes, J.B. "Finite Element Programming of the Navier Stock Equation", Pineridge Press Limited, U.K., 1981.

Subject Code: EBCT22E08	Subject Name : Frontiers of Chemical Engineering	T y/ Lb/ETL/IE	L	T /S.Lr	P/ R	C
	Prerequisite: Chemical product design	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab/ Internal Evaluation

OBJECTIVE:

- To enable the students to understand the chemical product design and available renewable energy resources.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Upon completing the course, the student should have a Hands-on experience with a commercial CFD program.
CO2	To understanding the frontier area in chemical engineering
CO3	To gain knowledge of latest development in chemical science and engineering
CO4	To emphasize emerging to ends in research and development
CO5	To get overview of multi disciplinary fields

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	3	-	-	-	2	-	-	3
CO2	2	3	-	1	-	-	-	-	3	-	1	-
CO3	1	-	-	-	-	1	-	-	-	2	-	-
CO4	3	-	-	-	-	2	-	-	2	-	-	-
CO5	2	-	-	-	-	1	-	1	-	-	-	

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	2	-	-
CO2	2	1	-	-
CO3	1	2	3	-
CO4	3	2	1	-
CO5	1	2	-	-

H/M/L indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical /Project			
					√							

Subject Code: EBCT22E08	Subject Name : Frontiers of Chemical Engineering	T y/ Lb/ETL/IE	L	T /S.Lr	P/ R	C
	Prerequisite: Chemical product design	Ty	3	0/0	0/0	3

UNIT I PROCESS INTENSIFICATION 9Hrs

Novel reactor configurations combination of reaction and separation use of different energy fields, lab on a chip.

UNIT II CHEMICAL PRODUCT DESIGN 9Hrs

Scope and importance identification of needs and specifications sources of ideas and screening ideas selection of product idea process development for product manufacture specialty chemical manufacture economic aspects.

UNIT III RENEWABLE ENERGY 9Hrs

Hydrogen production, Hydrogen economy, Fuel Cell Technology, biofuel cells and bio-hydrogen, solar energy.

UNIT IV MATERIALS ENGINEERING 9Hrs

Polymers and composites, ceramics and glasses, colloidal dispersions and nanoparticles, thin films and electronic materials.

UNIT V BIOENGINEERING 9Hrs

Biomechanics, biotransport and biomaterials, biomolecular and cellular engineering, drug discovery and development.

Total No. of Hours: 45Hrs

TEXT BOOKS:

1. Keil, F. J., Modeling of Process Intensification Wiley-VCH Verlag GmbH & Co. KGaA2007
2. Cussler, E.l. and Moggridge, G.D., "Chemical product design" Cambridge University Press, Cambridge, 2001
3. Hoffmann,P, Tomorrow's energy: hydrogen, fuel cells, and the prospects for a cleaner planet, MIT Press, Sabon, 2002.

REFERENCES*:*

1. Mitchell, B.S., An introduction to materials engineering and science for chemical and materials engineers, John Wiley and Sons Inc., New Jersey,2004

Subject Code: EBCT22E09	Subject Name: Industrial Management	T y/ L/b ETL/IE	L	T / SLr	P/ R	C
	Prerequisite: Basic Management	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab Internal Evaluation

OBJECTIVE:

- To provide an opportunity to learn basic management concepts essential for business.

COURSE OUTCOMES (COs) : (3- 5)

CO1	At the end of this course, the students would have knowledge on the basic management principles to become Management (s) professional.
CO2	Develop attitude for continuous learning.
CO3	Analyses industrial management problem and solve them
CO4	Learn about financial and growth management, analyse problem and solve them

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	2	-	2	-	-	-	1
CO2	2	-	-	-	-	2	-	-	-	3	-	-
CO3	2	-	-	-	2	-	-	2	-	-	-	2
CO4	2	-	2	-	2	-	-	-	2	2	1	1

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	2	-	-
CO2	2	1	-	-
CO3	3	1	-	-
CO4	2	1	-	-

H/M/L indicates Strength of Correlation 3- High, 2- Medium,1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical /Project			
					√							

Subject Code: EBCT22E09	Subject Name: Industrial Management	T y/ L/b ETL/IE	L	T / SLr	P/ R	C
	Prerequisite: Basic Management	Ty	3	0/0	0/0	3

UNIT I INTRODUCTION **9Hrs**

Management - Definition – Functions – Evolution of Modern Management –Scientific Management Development of Management Thought. Approaches to the study of Management, Forms of Organization – Individual Ownership– Partnership – Joint Stock Companies – Co-operative Enterprises – Public Sector Undertakings, Corporate Frame Work – Share Holders – Board of Directors – Committees – Chief Executive –Trade Union.

UNIT II FUNCTIONS OF MANAGEMENT **9Hrs**

Planning – Nature and Purpose – Objectives – Strategies – Policies and Planning Premises – Decision Making – Organizing – Nature and Process – Premises – Departmentalization – Line and staff – Decentralization – Organizational culture, Staffing - selection and training – Placement –Performance appraisal – Career Strategy – Organizational Development. Leading – Managing human factor – Leadership – Communication, Controlling - Process of Controlling – Controlling techniques, productivity and operations management – Preventive control, Industrial Safety.

UNIT III ORGANIZATIONAL BEHAVIOUR **9Hrs**

Definition – Organization – Managerial Role and functions – Organizational approaches, Individual behaviour – causes – Environmental Effect – Behavior and Performance, Perception – Organizational Implications. Personality Contributing factors - Dimension – Need Theories – Process Theories – Job Satisfaction, Learning and BehaviorLearning Curves, Work Design and approaches.

UNIT IV GROUP DYNAMICS **9Hrs**

Group Behavior – Groups – Contributing factors – Group Norms, Communication – Process – Barriers to communication – Effective communication, leadership – formal and informal characteristics – Managerial Grid – Leadership styles – Group Decision Making – Leadership Role in Group. Decision, Group Conflicts – Types – Causes – Conflict Resolution – Inter group relations and conflict, Organization centralization and decentralization – Formal and informal – Organizational Structures – Organizational Change and Development – Change Process – Resistance to Change – Culture andEthics.

UNIT V MODERN CONCEPTS **9Hrs**

Management by Objectives (MBO), Management by Exception (MBE), Strategic. Management - Planningfor Future direction – SWOT Analysis – Information technology in management – Decisions support system – Business Process. Re-engineering (BPR) – Enterprises Resource Planning (ERP) – Supply Chain Management (SCM) – Activity Based Management (ABM).

Total No. of Hours: 45Hrs

TEXT BOOKS:

1. Herald Knottz and Heinz Weihrich, 'Essentials of Management', TataMcGraw Hill Education Pvt. Ltd., 2010.85

2. Stephen P. Robbins, 'Organization Behaviour', Pearson Education Inc., 13 edition, 2010.

REFERENCES*:*

1. Ties, AF, Stoner and R.Edward Freeman, 'Management' Prentice Hall of India Pvt. Ltd. New Delhi 110 011, 1992

2. Joseph J, Massie, 'Essentials of Management' Prentice Hall of India Pvt. Ltd. 1985.

3. P.C. Tripathi & P.N. Reddy, 'Principles of Management', TataMcGraw Hill,2006.

PROGRAMME ELECTIVE – IV & V

Subject Code: EBCT22E10	Subject Name: Drugs And Pharmaceutical Technology	T y/ L/b ETL/IE	L	T / SLr	P/ R	C
	Prerequisite: Engineering Chemistry	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab/ Internal Evaluation

OBJECTIVE:

- To give the students an understanding of the poly technical nature of engineering and drug discovery in the Pharmaceutical industry involving Chemical Engineering.

COURSE OUTCOMES (COs) : (3- 5)

CO1	At the end of this course, the students would have knowledge on the basic management principles to become management(s) professional.
CO2	Emphasis on the mechanism of the action of different inorganic and oraganic compound.
CO3	Knowledge on the method of preparation of different drugs.
CO4	Classification of drug categories with examples under different agents.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	3	-	-	2	-	-	-	-	1
CO2	2	-	-	-	-	-	3	-	-	-	2	-
CO3	3	-	-	-	2	-	-	-	-	-	-	2
CO4	2	-	-	-	-	1	-	-	-	-	2	-

COs / PSOs	PSO1	PSO2	PSO3	PSO4				
CO1	3	2	-	-				
CO2	2	1	-	-				
CO3	3	2	-	-				
CO4	2	1	-	-				

H/M/L indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical /Project			
					√							

Subject Code: EBCT22E10	Subject Name: Drugs And Pharmaceutical Technology	T y/ L/b ETL/IE	L	T / SLr	P/ R	C
	Prerequisite: Engineering Chemistry	Ty	3	0/0	0/0	3

UNIT I INTRODUCTION 9Hrs

Development of drugs and pharamaceutical industry; organic the rapeuticagents uses and economics.

UNIT II DRUG METABOLISM AND PHARMACO KINETICS &MICROBIOLOGICAL AND ANIMAL PRODUCTS 9Hrs

Drug metabolism; physico chemical principles; pharma kinetics-action of drugson human bodies. Antibioticsgram positive, gram negative and broad spectrumantibiotics; hormones

UNIT III IMPORTANT UNIT PROCESSES AND THEIR APPLICATION 9Hrs

Chemical conversion processes; alkylation; carboxylation; condensation andcyclisation; dehydration, esterification, halogenation, oxidation, sulfonation;complex chemical conversions fermentation.

UNIT IV MANUFACTURING PRINCIPLES & PACKING AND QUALITYCONTROL 9Hrs

Compressed tablets; wet granulation; dry granulation or slugging; advancementin granulation; direct compression, tablet presses formulation; coating pills;capsules sustained action dosage forms; parential solutions, oral liquids;injections; ointments; standard of hygiene and manufacturing practice. Packing; packing techniques; quality control.

UNIT V PHARMACEUTICAL PRODUCTS & PHARMACEUTICALANALYSIS 9Hrs

Vitamins; cold remedies; laxatives; analgesics; nonsteroidal contraceptives;external antiseptics; antacids and others. Analytical methods and tests forvarious drugs and pharmaceuticals – spectroscopy, chromatography, fluorimetry, polarimetry, refractometry, pHmetry.

Total No. of Hrs: 45Hrs

TEXT BOOK:

1. Rawlines, E.A.; " Bentleys Text book of Pharmaceutics ", III Edition, BaillereTindall, London, 1977.

REFERENCES:

1. Yalkonsky, S.H.; Swarbick. J.; " Drug and Pharamaceutical Sciences ", Vol.I, II, III, IV, V, VI and VII, Marcel Dekkar Inc., New York, 1975.

2. *"Remingtons Pharmaceutical Sciences ", Mack Publishing Co., 197*5.

Subject Code: EBCT22E11	Subject Name: Professional Ethics in Engineering	Ty / Lb/ ETL/IE	L	T / SLr	P/ R	C
	Prerequisite: Moral science and general English	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab/ Internal evaluation

OBJECTIVE:

- To enable the students to create awareness on Engineering Ethics and Human Values, to instill Moral and Social Values and Loyalty and to appreciate the rights of others.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Distinguish between ethical and non ethical situations
CO2	Practice moral judgment in condition of dilemma
CO3	Relate the code of ethics in social experimentation
CO4	Develop concepts based on moral issues and enquring

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	3	-	-	2	-	-	1	-	1
CO2	2	-	-	-	-	-	3	-	-	-	2	-
CO3	3	-	-	-	2	-	-	-	2	-	-	2
CO4	2	-	1	-	-	1	-	-	-	-	2	-

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	2	-	-
CO2	2	1	2	3
CO3	3	2	-	-
CO4	2	1	-	-

H/M/L indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Science	Engineering Science	Humanities and social Science	Program Core	Program elective	Open Elective	Inter Disciplinary	Skill Component	Practical /Project			
					√							

EBCT22E11	PROFESSIONAL ETHICS IN ENGINEERING	3	0/0	0/0	3

UNIT I HUMAN VALUES 9Hrs

Morals, values and Ethics – Integrity – Work ethic – Service learning – Civicvirtue – Respect for others – Living peacefully – Caring – Sharing – Honesty –Courage – Valuing time – Cooperation – Commitment – Empathy – Self confidence – Character – Spirituality – Introduction to Yoga and meditation for professional excellence and stress management.

UNIT II ENGINEERING ETHICS 9Hrs

Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry –Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory –Consensus and Controversy – Models of professional roles – Theories about right action – Self interest – Customs and Religion – Uses of Ethical Theories

UNIT III ENGINEERING AS SOCIAL EXPERIMENTATION 9Hrs

Engineering as Experimentation – Engineers as responsible Experimenters –Codes of Ethics – A Balanced Outlook on Law.

UNIT IV SAFETY, RESPONSIBILITIES AND RIGHTS 9Hrs

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis andReducing Risk Respect for Authority – Collective Bargaining – Confidentiality– Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination.

UNIT V GLOBAL ISSUES 9Hrs

Multinational Corporations – Environmental Ethics – Computer Ethics –Weapons Development – Engineers as Managers – Consulting Engineers –Engineers as Expert Witnesses and Advisors – Moral Leadership –Code of Conduct – Corporate Social Responsibility

Total No. of Hours: 45Hrs

TEXT BOOKS:

1. Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", Tata McGraw Hill, New Delhi, 2003.

2. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi, 2004.

REFERENCES*:*

1. Charles B. Fleddermann, "Engineering Ethics", Pearson Prentice Hall, NewJersey, 2004.

2. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, "Engineering Ethics – Concepts and Cases", Cengage Learning, 2009

3. John R Boatright, "Ethics and the Conduct of Business", Pearson Education,New Delhi, 2003

4. Edmund G Seebauer and Robert L Barry, "Fundametals of Ethics for Scientists and Engineers", Oxford University Press, Oxford, 2001

Subject Code: EBCT22E12	Subject Name: Industrial Instrumentation	Ty / Lb/ ETL/IE	L	T / SLr	P/ R	C
	Prerequisite: Moral science and general English	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE:

- To enable the students to create an awareness on Engineering Ethics and Human Values, to instill Moral and Social Values and Loyalty and to appreciate the rights of others.

COURSE OUTCOMES (COs) : (3- 5)

CO1	To know basic of Instrumentation
CO2	To know about sensors
CO3	Identify and analyze an ethical issue in the subject matter under investigation or in a relevant field.
CO4	Identify ethical concerns in research and intellectual contexts, including academic integrity, use and citation of sources, the objective presentation of data, and the treatment of human subjects.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	1	-	-	-	1	-	3	-	-
CO2	2	-	-	1	-	-	2	-	-	-	-	1
CO3	3	-	-	-	-	3	-	-	2	-	1	-
CO4	2	3	1	-	-	2	-	-	-	-	2	-

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	2	-	-
CO2	2	1	-	-
CO3	3	1	2	-
CO4	2	3	1	-

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical /Project			
					√							

Subject Code: EBCT22E12	Subject Name: Industrial Instrumentation	Ty / Lb/ ETL/IE	L	T / SLr	P/ R	C
	Prerequisite: Moral science and general English	Ty	3	0/0	0/0	3

UNIT I **5Hrs**

Introduction – Variables, UNITs & standards of measurement, Measurementterms – characteristic. Data Analysis.

UNIT II **12Hrs**

Process Variables Measurement–Temperature systems– Thermocouples,Thermo resistive system, Filled-system thermometers, Radiation thermometry,Location of temperature measuring devices in equipments, Pressure system –Mechanical pressure elements Pressure Transducers and Transmitters,Vacuum measurement, Resonant wire pressure Transducer, Flow system –Differential producers, Variable area flow meters, Velocity, vortex, mass,ultrasonic & other flow meters, positive displacement flow meters, Open –channel flow measurements, Force systems, Strain gauges Humidity Moisturesystem, Humidity Measurement, Moisture measurement system, Rheological system, Viscosity measurement, Radiation system, Nuclear radiationinstrumentation.

UNIT III **10Hrs**

Analytical instrumentation – Analysis instruments, Sample conditioning forprocess analyzers, X-ray Analytical methods, Quadrupole mass spectrometry,Ultra violet Absorption Analysis, Infra red process analyzers, Photometricreaction product analysers Oxygen analyzers, Oxidation – reduction potential lmeasurements, pH measuring systems, Electrical conductivity and Resistivitymeasurements, Thermal conductivity, gas analysis, Combustible, Total hydrocarbon, and CO analyzer, Chromatography.

UNIT IV **9Hrs**

Fundamentals of Automatic process control – Control algorithms-Automaticcontrollers – Electronic controllers - Electric controllers (Traditional) – Hydrauliccontrollers – Fluidics - Programmable controllers.

UNIT V **9Hrs**

Sensors, Transmitters and control valves - Pressure, Flow, Level, Temperatureand Composition sensors, Transmitters, Pneumatic and electronic controlvalves, Types, Actuator, accessories, Instrumentation symbols and Labels.

TOTAL No. of Hrs: 45Hrs

TEXTBOOKS:

1. Fribance, "Industrial Instrumentation Fundamentals" ,Mc Graw Hill Co. Inc.New York 1985

2. Eckman D.P. "Industrial Instrumentation", Wiley Eastern Ltd., 1989.

3. Considine D M and Considine G D "Process Instruments Controls"Handbook 3rd Edition, McGraw – Hill Book Co., NY, 1990.

4. Scborg D E,.Edgar T.F and Mellichamp D.A, "Process Dynamics andControl" John Wiley 1989.

REFERENCES:

1. Ernest Doebelin, Measurement systems, McGraw – Hill Book, Co., NY,1975.

2. Astrom K.J., Bjonwittenmark, Computer controlled systems, Prentice- Hallof India, New Delhi 1994.

3. Cartis Johnson, Process Control Instrumentation Technology, Prentice-Hallof India, New Delhi 1993.

Subject Code: EBCT22E13	Subject Name : Process Optimization Prerequisite: PCE	T y/ Lb/ ETL/IE Ty	L 3	T / S.Lr 0/0	P/ R 0/0	C 3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab/ Internal evaluation

OBJECTIVE:

- To expose the students with various mathematical methods for numerical analysis and use of software tools

COURSE OUTCOMES (COs) : (3- 5)

CO1	Through this course, the students would have learnt about the systems of equations, probability statistics, error analysis and programming concepts using various software tools.
CO2	Define the structure of optimization problems, define the essential properties of optimization problems.
CO3	Explain general solution methods of optimization problems, Define optimization models, explain building up of optimization models.
CO4	Define objective function; define solution tecniques of objective function.
CO5	Define linear programming, explain solution tecniques of linear programming

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	2	-	2	-	-	-	1
CO2	2	-	-	-	-	2	-	-	-	3	-	-
CO3	2	-	-	-	2	-	-	2	-	-	-	2
CO4	2	-	2	-	2	-	-	-	2	2	1	1
CO5	3	-	-	-	-	2	-	2	-	-	-	1

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	2	2	2	-
CO2	3	1	3	-
CO3	2	1	2	-
CO4	3	2	1	-
CO5	1	2	3	-

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical /Project		
					√						

Subject Code: EBCT22E13	Subject Name : Process Optimization	T y/ Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: PCE	Ty	3	0/0	0/0	3

UNIT I OPTIMISATION **15Hrs**

Introduction; formulation of objective functions; fitting models to data classification of functions; necessary and sufficient conditions for optimum unimodal, multimodal functions; analytical methods lagrange multiplier methods.

UNIT II NUMERICAL METHODS **15Hrs**

Unimodel functions; newton's quasi newton, secant methods; region elimination methods, polynomial approximation; quadratic and cubic interpolation techniques for optimum. Multimodal functions; direct methods; random, grid. Hooke's nelder and mead methods; Powell's technique; indirect methods gradient and conjugate gradient methods; secant methods.

UNIT III LINEAR AND NON-LINEAR PROGRAMMING APPLICATIONS **15Hrs**

Review on basic concepts of LP formulations; Simplex methods; Integer,quadratic, geometric and dynamic programming. Heat transfer and energy conservation; separation processes; fluid flow systems; reactor design and operation; large scale systems.

Total No. of Hours: 45Hrs

TEXT BOOKS:

1. Edgar, T.F., Himmelblau, D.M., "Optimisation of Chemical Processes", McGraw-Hill II Edition 2001.
2. Reklaitis, G.V., Ravindran, A., Ragsdell, K.M. "Engineering Optimisation", John Wiley, II Edition 2006

REFERENCES*:*

1. Biles, W.E., Swain, J.J.; "Optimisation and Industrial Experimentation", Inter Science, New York, 1980.
2. Seinfeld, J.H.; Lapidus, L; "Process Modelling, Estimation and Identification"Prentice Hall, Englewood Cliffs, New Jersey, 1974.
3. Beveridge, C.S.; Schechter, R.S.; "Optimisation: Theory and Practice", McGraw-Hill Book Co., New York, 1970.

OPEN ELETIVE OFFERED TO OTHER DEPARTMENT STUDENTS

Subject Code: EBCT22OE1	**Subject Name : Fundamentals of Nanoscience**	**T y/ Lb/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite: Nanomaterial	**Ty**	**3**	**0/0**	**0/0**	**3**

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C:
Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE:

- To enable the students to learn about basis of nanomaterial science, preparation method, types and application.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Will familiarize about the science of nanomaterials
CO2	Will develop knowledge in characteristic nanomaterial
CO3	Will demonstrate the preparation of nanomaterials
CO4	will be able to characterize major top-down and bottom-up strategies
CO5	will know what forces act between atoms and/or molecules when nanoparticles are generated

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**1**	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**-**	**-**	**-**	**2**
CO2	**1**	**1**	**2**	**2**	**2**	**2**	**2**	**1**	**1**	**1**	**1**	**1**
CO3	**2**	**2**	**3**	**1**	**3**	**1**	**-**	**-**	**-**	**-**	**1**	**2**
CO4	**3**	**2**	**2**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**2**	**3**
CO5	**2**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**2**	**2**

COs / PSOs	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	**1**	**2**	**2**	**2**
CO2	**2**	**2**	**3**	**2**
CO3	**3**	**3**	**3**	**2**
CO4	**1**	**1**	**1**	**1**
CO5	**2**	**1**	**1**	**2**

Category	Basic Science	Engineering Science	Humanities and social Science	Program Core	Program elective	Open Elective	Inter Disciplinary	Skill Component	Practical /Project	Basic Science		
						√						

Subject Code: EBCT22OE1	Subject Name : Fundamentals of Nanoscience	T y/ Lb/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Nanomaterial	Ty	3	0/0	0/0	3

UNIT I INTRODUCTION 9Hrs

Nanoscale Science and Technology- Implications for Physics, Chemistry,Biology and Engineering-Classifications of nanostructured materials- nanoparticles- quantum dots, nanowires-ultra-thinfilms-multilayered materials.Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties. Introduction to properties and motivation for study (qualitative only).

UNIT II GENERAL METHODS OF PREPARATION 9Hrs

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.

UNIT III NANOMATERIALS 9Hrs

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.

UNIT IV CHARACTERIZATION TECHNIQUES 9Hrs

X- ray diffraction technique, Scanning Electron Microscopy – environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques-AFM, SPM, STM, SNOM, ESCA, SIMSNanoindentation.

UNIT V APPLICATIONS 9Hrs

NanoInfoTech: Information storage- nanocomputer, molecular switch, super chip, nanocrystal, Nanobiotechlogy: nanoprobes in medical diagnostics and biotechnology, Nano medicines, Targetted drug delivery, Bioimaging – Microelectro 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.

Total No. of Hours: 45Hrs

TEXT BOOKS:

2. A.S. Edelstein and R.C. Cammearata, eds., "Nanomaterials: Synthesis, Properties and Applications",Institute of Physics Publishing, Bristol and Philadelphia, 1996.

3. N John Dinardo, "Nanoscale charecterisation of surfaces & Interfaces",2nd edition, Weinheim Cambridge, Wiley-VCH, 2000

REFERENCES:

1.G Timp (Editor), "Nanotechnology", AIP press/Springer, 1999.

2.Akhlesh Lakhtakia (Editor),"The Hand Book of NanoTechnology,NanometerStructure,

3.Theory, Modeling and Simulations".Prentice-Hall of India (P) Ltd, New Delhi, 2007.

Subject Code: EBCT22OE2	Subject Name: Electrochemical Engineering	Ty / Lb/ ETL/IE	L	T / SLr	P/ R	C
	Prerequisite: Moral science and general English	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab/

OBJECTIVE:

- To solve problems related to the production, storage, distribution and utilization of electrochemical energy and the associated environmental issues

COURSE OUTCOMES (COs) : (3- 5)

CO1	To understand the impact of energy potential and to understand the concept of current distributtion
CO2	To understand the electrochemical process in industries
CO3	To understand the application of electrodes in electrochemical industries
CO4	Student able to understand the social factors in electrochemical engineering

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	1	-	2	-	-	-	-	-	1
CO2	2	-	-	2	-	-	-	-	-	3	-	-
CO3	1	2	-	-	-	-	2	-	-	-	3	-
CO4	3	-	-	-	-	-	-	-	2	-	-	1

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	2	-	-
CO2	2	1	-	-
CO3	2	1	-	-
CO4	3	2	-	-

H/M/L indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical /Project			
						√						

Subject Code: EBCT22OE2	Subject Name: Electrochemical Engineering	Ty / Lb/ ETL/IE	L	T / SLr	P/ R	C
	Prerequisite: Moral science and general English	Ty	3	0/0	0/0	3

UNIT I **9Hrs**

Review basics of electrochemistry: Faraday's law -Nernst potential –Galvanic cells – Polarography, The electrical double layer: It's role in electrochemical processes –Electro capillary curve –Helmoltz layer – Guoy –Steven's layer
–fields at the interface.

UNIT II **9Hrs**

Mass transfer in electrochemical systems: diffusion controlled electrochemical reaction –the importance of convention and the concept of limiting current. Over potential, primary-secondary current distribution –rotating disc electrode.

UNIT III **9Hrs**

Introduction to corrosion, series, corrosion theories derivation of potentialcurrent relations of activities controlled and diffusion controlled corrosion process. Potential-pH diagram, Forms of corrosion-definition, factors and control methods of various forms of corrosion-corrosion control measures industrial boiler water corrosion control –protective coatings –Vapor phase inhibitors –cathodic protection, sacrificial anodes
–Paint removers.

UNIT IV **9Hrs**

Electro deposition –electro refining –electroforming –electro polishing –anodizing –Selective solar coatings, Primary and secondary batteries –types of batteries, Fuel cells.

UNIT V **9Hrs**

Electrodes used in different electrochemical industries: Metals-Graphite –Lead dioxide –Titanium substrate insoluble electrodes –Iron oxide –semi conducting type etc. Metal finishing-cell design. types of electrochemical reactors, batch cell, fluidized bed electrochemical reactor, filter press cell, Swiss roll cell, plug flow cell, design equation, figures of merits of different type of electrochemical
reactors.

Total No.of Hours:45Hrs

TEXTBOOKS*:*

1. Eckenfelder, W. W, Jr. "Industrial Water Pollution Control" McGraw-Hill: New York, 1966.
2. P. L. Ballaney, "Thermal Engineering", Khanna Publisher New Delhi, 1986.
3. Perry R. H. Green D. W. "Perry's chemical Engineer's Handbook", McGraw Hill, New York, 2007.

REFERENCES*:*

1. P. N. Ananthanarayan, "Basic Refrigeration & Air conditioning", Tata McGraw Hill, New Delhi, 2007.

Subject Code: EBCT22OE3	Subject Name: Alternative Fuels And Energy Systems	Ty / Lb/ ETL	L	T / SLr	P/ R	C
	Prerequisite: Moral science and general English	**Ty**	**3**	**0/0**	**0/0**	**3**

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE:

- To know about the types of alternative fuels and energy sources for IC engines.

COURSE OUTCOMES (COs) : (3- 5)

CO1	On completion of the course, the student will understand the various alternative fuels available, its properties, performance characteristics, combustion characteristics, emission characteristics, engine modifications required etc.,
CO2	To know making color as fuel
CO3	To know making vegetable oil as fuel
CO4	Different methods of using hydrogen is SI and CI engines
CO5	Emission and Combustion of biogas

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	3	2	2	2	2	2	-	-	-	2
CO2	1	1	2	2	2	2	2	1	1	1	1	1
CO3	2	2	3	1	3	1	-	-	-	-	1	2
CO4	3	2	2	2	1	1	1	1	1	1	2	3
CO5	2	2	1	1	1	1	1	1	1	1	2	2

COs / PSOs	PSO1	PSO2	PSO3	PSO4				
CO1	1	2	2	2				
CO2	2	2	3	2				
CO3	3	3	3	2				
CO4	1	1	1	1				
CO5	2	1	1	2				

H/M/L indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical /Project			
						√						

Subject Code: EBCT22OE3	Subject Name: Alternative Fuels And EnergySystems	Ty / Lb/ ETL	L	T / SLr	P/ R	C
	Prerequisite: Moral science and general English	Ty	3	0/0	0/0	3

UNIT I : ALCOHOLS AS FUELS **9Hrs**

Introduction to alternative fuels. – Need for alternative fuels – Availability of different alternative fuels for SI and CI engines. Alcohols as fuels. Production methods of alcohols. Properties of alcohols as fuels. Methods of using alcohols in CI and SI engines. Blending, dual fuel operation, surface ignition and oxygenated additives. Performance emission and combustion characteristics in CI and SI engines.

UNIT II : VEGETABLE OILS AS FUELS **9Hrs**

Various vegetable oils and their important properties. Different methods of using vegetable oils engines – Blending, preheating Transesterification and emulsification of Vegetable oils – Performance in engines – Performance, Emission and Combustion Characteristics in diesel engines.

UNIT III : HYDROGEN AS ENGINE FUEL **9Hrs**

Production methods of hydrogen. Combustive properties of hydrogen. Problems associated with hydrogen as fuel and solutions. Different methods of using hydrogen in SI and CI engines. Performance, emission and combustion analysis in engines. Hydrogen storage – safety aspects of hydrogen.

UNIT IV : BIOGAS, NATURAL GAS AND LPG AS FUELS **9Hrs**

Production methods of Biogas, Natural gas and LPG. Properties studies. CO2 and H2S scrubbing in Biogas., Modification required to use in SI and CI Engines- Performance and emission characteristics of Biogas, NG and LPG in SI and CI engines.

UNIT V : ELECTRIC, HYBRID AND FUEL CELL VEHICLES **9Hrs**

Layout of Electric vehicle and Hybrid vehicles – Advantages and drawbacks of electric and hybrid vehicles. System components, Electronic control system – Different configurations of Hybrid vehicles. Power split device. High energy and power density batteries – Basics of Fuel cell vehicles.

Total No. of Hours:45Hrs

TEXT BOOK:

1. *Ayhan Demirbas, 'Biodiesel A Realistic Fuel Alternative for Diesel Engines', Springer-Verlag London Limited 2008.*

REFERENCES:

1. *Gerhard Knothe, Jon Van Gerpen, Jargon Krahl, The Biodiesel Handbook, AOCS Press Champaign, Illinois 2005.*
2. *Richard L Bechtold P.E., Alternative Fuels Guide book, Society of Automotive Engineers, 1997 ISBN 0-76- 80-0052-1.*
3. *Transactions of SAE on Biofuels (Alcohols, vegetable oils, CNG, LPG, Hydrogen, Biogas etc.).*
4. *Science direct Journals (Biomass & Bio energy, Fuels, Energy, Energy conversion Management, Hydrogen Energy, etc.) on biofuels.*
5. *Devaradjane. Dr. G., Kumaresan. Dr. M., "Automobile Engineering", AMK Publishers, 2013.*

Subject Code:	Subject Name: Petrochemical Unit Processes	Ty / Lb/ ETL/IE	L	T / SLr	P/ R	C
EBCT22OE4	Prerequisite: Moral science and general English	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab/ Internal Evaluation

OBJECTIVE:

- To design and conduct experiments and analyze and interpret data related to petrochemical Unit processes.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Students would be able to understand the principles of various unit processes in the petrochemical industry.
CO2	To know sources of petro chemical
CO3	To know sign metric gas production
CO4	To know Oxidation ,Nitration and Hydrolysis
CO5	To know Halogenation and Esterification different

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	3	2	2	2	2	2	-	-	-	2
CO2	1	1	2	2	2	2	2	1	1	1	1	1
CO3	2	2	3	1	3	1	-	-	-	-	1	2
CO4	3	2	2	2	1	1	1	1	1	1	2	3
CO5	2	2	1	1	1	1	1	1	1	1	2	2

COs / PSOs	PSO1	PSO2	PSO3	PSO4				
CO1	1	2	2	2				
CO2	2	2	3	2				
CO3	3	3	3	2				
CO4	1	1	1	1				
CO5	2	1	1	2				

H/M/L indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical /Project			
						√						

Subject Code: EBCT22OE4	Subject Name: Petrochemical Unit Processes	Ty / Lb/ ETL/IE	L	T / SLr	P/ R	C
	Prerequisite: Moral science and general English	Ty	3	0/0	0/0	3

UNIT I FEED STOCK AND SOURCE OF PETROCHEMICALS 9Hrs

Overview of Petrochemical Industry – The key growth area of India, Economics – Feed stock selections for Petrochemicals – Steam cracking of Gas and Naphtha to produce Olefins, Dioletis and Production of Acetylene – Cracker product separation and BTX separation.

UNIT II SYNTHESIS GAS PRODUCTION 9Hrs

Steam reforming of Natural gas – Naphtha and Heavy distillate to produce Hydrogen and Synthesis gas – Production of Methanol – Oxo process.

UNIT III UNIT PROCESSES I 9Hrs

Fundamental and Technological principled involved in Alkylation – Oxidation – Nitration and Hydrolysis.

UNIT IV UNIT PROCESSES II 9Hrs

Fundamental and Technological principled involved in Sulphonation, Sulfation and Isomerisation.

UNIT V UNIT PROCESSES III 9Hrs

Fundamental and Technological principles involved in Halogenation and Esterification

Total No. of Hours:45Hrs

TEXT BOOKS:

1. Bhaskara Rao, B.K., "A Text on Petrochemicals", Khanna Publishers, 2000.
2. Sukumar Maiti, "Indroduction to Petrochemicals", 2nd Edition, Oxford and IBH Publishers,2002.

REFERENCES:

1. Margaret Wells, "Handbook of Petrochemicals and Processes", 2nd Edition, Ash GatePublishing Limited, 2002.
2. Sami Matar, and Lewis F. Hatch., "Chemistry of Petrochemical Processes", 2nd Edition,Gulf Publishing Company, 2000.
3. Dryden, C.E., "Outlines of Chemical Technology", 2nd Edition, Affiliated East-West Press,1993

Subject Code:	Subject Name: Principles of Desalination Technologies	Ty / Lb/ ETL/IE	L	T / SLr	P/ R	C
EBCT22OE5	Prerequisite: Moral science and general English	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/EmbeddedTheory and Lab/ Internal Evaluation

OBJECTIVE: Understand the techniques and technologies of desalination, Correlate the core curriculum to practical
applications, Learn to select the right type of desalination system for a given location and purpose.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Understand the relevance and need for desalination
CO2	Learn the science behind desalination
CO3	To learn the thermal system behind the desalination
CO4	To understand the challenges in desalination system
CO5	To understand the sxial , commercial and environmental aspects of desclination

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	1	1	-	2	-	-	-	-	-
CO2	1	-	-	-	1	2	1	-	-	-	-	-
CO3	2	-	-	-	-	1	1	-	-	1	-	-
CO4	-	-	2	-	-	-	-	-	1	-	-	-
CO5	-	-	-	-	1	-	-	-	1	-	-	-

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	1	2	2	2
CO2	2	2	3	2
CO3	3	3	3	2
CO4	1	1	1	1
CO5	2	1	1	2

H/M/L indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical /Project			
						√						

Subject Code:	Subject Name: Principles of Desalination Technologies	Ty / Lb/ ETL/IE	L	T / SLr	P/ R	C
EBCT22OE5	Prerequisite: Moral science and general English	Ty	3	0/0	0/0	3

UNIT I: INTRODUCTION **9Hrs**

Water Scenario around the world and India – need and relevance of desalination - water sources for desalination – typical seawater composition – brackish water compositional changes- contaminants: anthropogenic and geogenic- drinking water standards – WHO and Indian Standards – Mineral Water standards (indian). Desalination –meaning and description – relation to natural components of desalination - general descriptionminimum energy requirement – review of fundamentals of physical chemistry aspects relevant to desalination, solution properties – estimating the minimum energy requirement - based concept of de-mixing – exergy - estimation from colligative properties – Performance assessment parameters for desalination for thermal and membrane. Different types of Desalination techniques basic resources required for desalination – energy options – relative characteristics of different types of energy options.

UNIT II: MEMBRANE DESALINATION **9Hrs**

General features of Pressure Driven Membrane Processes – classification –Micro-filtration(MF) Ultrafiltration (UF), Nano-Filtration (NF) – pore-size – performance relationship. Pretreatment System – Need and relevance – different unit operations including membrane pretreatment (UF) – scaling calculations – dosing systems – treated water quality monitoring – SDI concept. Reverse Osmosis – basic principle – characteristics of membranes used – Nano-filtration – basic principle – comparative features of NF and RO – concentration polarization - transport mechanism and equations (no derivation required)- energy recovery. Performance characteristics of Reverse Osmosis and Nano-filtration – solute rejection - recovery- water flux – relationship amongst them –effect of temperature – performance of lab experiments – interpretation of lab data.- application of RO and NF for desalination.

UNIT III: THERMAL DESALINATION **9Hrs**

Basic Components of thermal Desalination – Heat Source – Sensible heat vs latent heat for use in desalination – features of isothermal and adiabatic processes. Thermodynamic properties – pressure vs temperature for steam, change of latent, Cp and BPE with temperature. – corrosion of materials and normal material of construction.Description of Flashing and Boiling: single effect evaporation and flashing – Need for multiple effects / stages – accessories for thermal desalination – ejectors – demisters - vacuum systems – pretreatment systems –Pumps. Principles of MSF/ MED : MED with TVC and MVC : Basic design considerations for thermal systems –operational features.

UNIT IV:NON CONVENTIONAL DESALINATION SYSTEMS **9Hrs**

Membrane based Systems :Electrodialysis, Membrane. Distillation, Forward Osmosis.- Basic Principles – performance characteristics – Energy requirements – Challenges. Low temperature thermal desalination including ocean thermal energy and waste heat – Solar desalination including solar stills, solar thermal and solar photovoltaic– limitations and advantages. Hybrid Desalination systems, combined power and water dual purpose plants – examples of working desalination plants.

UNIT V: SOCIETAL, COMMERCIAL, ECONOMICS AND ENVIRONMENTAL ASPECTS **9Hrs**

Selection of Desalination System – considerations based on capacity – local resources (including power, water etc.)– ultimate use– scale up – brackish water systems – considerations for societal cause / industrial water recycle. Economic Aspects of esalination – water cost calculation– capital cost/operating costs – feasibility analysis- Environmental issues –challenges – spent membrane, disposal- discharge concentrated stream – use of concentrate stream – recovery of values.

Total No. of Hours:45Hrs

REFERENCE BOOKS:

1 *Fundamentals of Salt Water Desalination: Hisham T. El-Dessouky and Hisham M. Ettouney, ISBN:978-0-444- 50810-2 Elsevier (2009)2.A Desalination Primer: Introductory Book for Students and Newcomers to Desalination:K.S.Spiegler and Y.M. El-Sayed, ISBN 086689 034 3,*

Subject Code: EBCT22OE6	Subject Name : Piping Design Engineering	T y/ Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: Nil	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab/ Internal Evaluation

OBJECTIVE:

- To secure position of the Chief Piping Engineer in a reputed engineering firm where the sound technical experience and prowess in installation of piping can help in executing projects at a faster pace through reduced costs.

COURSE OUTCOMES (COs) : (3- 5)

CO1	To understanding basic of piping engineering
CO2	The purpose of piping engineering
CO3	Responsibility of piping requirement and methodology
CO4	Learn the calculation in used in piping
CO5	Learn requirement of piping modeling and analysis

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	2	1	-	-	3	-	2	3	-	1
CO2	2	-	-	2	-	-	2	-	-	3	2	1
CO3	2	-	-	-	1	-	2	-	-	-	-	-
CO4	3	-	-	-	-	-	-	2	-	-	-	1
CO5	2	-	-	2	-	-	2	-	-	3	2	1

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	2	2	2	-
CO2	3	1	3	-
CO3	1	2	2	-
CO4	3	2	1	1
CO5	-	-	-	2

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical /Project			
						√						

Subject Code: EBCT22OE6	Subject Name : Piping Design Engineering	T y/ Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: Nil	Ty	3	0/0	0/0	3

UNIT I INTRODUCTION TO PIPING ENGINEERING 9Hrs

Fluid flow, types of fluids and examples, different pipe fittings. Friction factor, pressure drop for flow Newtonian and non-Newtonian fluids, pipe sizing, economic velocity. Pipe line networks and their analysis for flow in branches, restriction orifice sizing. Pressure drop calculations for non-Newtonian fluids. two phase flow, types of two phase flow, two phase flow as encountered in piping for steam, distillation column, pressure drop, vibrations in two phase flow.

UNIT II MATERIALS FOR PIPING 9Hrs

Selection of material for piping, desirable properties of piping materials, materials for various temperature and pressure conditions, materials for corrosion resistance. Common ASTM and IS specifications for: Seamless / ERW pipes, pipe fittings, flanges, and fasteners, materials for valves. Gaskets: Functions and properties, types of gaskets and their selection.

UNIT III CONTROL & SAFETY IN PIPING 9Hrs

Types of valves, control valves, safety valves, constructional features, criteria for selection. Piping components, pressure relieving devices, constructional features, selection criteria and application, safety features. Calculations for line sizing, steam traps, P.R.V. & condensive systems.

UNIT IV PIPING SYSTEM DESIGN 9Hrs

Design principles, calculation of pipe diameter, thickness, important system characteristics and design principles related to steam flow at high and low pressures. Design principles and line sizing for vacuum pipelines, slurry pipelines, surge drums and flare stacks, vacuum devices including ejector system. Considerations governing pump selection, analysis of system and pump characteristics in connection with series, parallel flow, and minimum flow and equalizing lines, NPSH, allowable nozzle loads in various codes. Design principles and line sizing of pneumatic conveying of solids, components of conveying systems, dust and fume extraction systems principles.

UNIT V INSULATION AND COSTING OF PIPING 9Hrs

Purposes of thermal insulation, principles of conductive and convective heat transfer to the extent of application to heat loss / gain through bare pipe surfaces. Critical thickness of insulation, estimating thickness of insulation, optimum thickness of insulation. Insulation for hot and cold materials and their important properties, insulation material selection criteria, typical insulation specification – hot and cold materials. Introduction to P & I Diagrams, Process flow diagrams, standard symbols and notations. Introduction to various facilities required guidelines for Plot Plan / Plant Layout. Introduction to equipment layout, piping layout, piping isometrics and bill of material. Typical piping system layout considerations for following systems: (i) Distillation columns and heat exchangers, (ii) Reactors, (iii) Pipe racks, (iv) Storage tanks, (v) Pumps

Total No. of Hours: 45Hrs

REFERENCE BOOKS:

1. *Piping Design Handbook by John J. Mcketta, by Marcel Dekker, Inc, New York.*
2. *Process plant layout and piping design by Ed Bausbacher & Roger Hunt (PTK Prentice Hall Publication)*
3. *Piping Handbook, Edited by Mohinder Nayyar, McGraw-Hill Education*
4. *Pipe Drafting and Design by Roy A Parisher & Robert A. Rhea. ASME Codes 31*

Subject Code: EBCT22OE7	Subject Name : E-Waste Management	T y/ Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: Nil	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab/ Internal Evaluation

OBJECTIVE:

- To secure position of the Chief Piping Engineer in a reputed engineering firm where the sound technical experience and prowess in installation of piping can help in executing projects at a faster pace through reduced costs.

COURSE OUTCOMES (COs) : (3- 5)

CO1	To learn global environment content and concarn
CO2	To merge hazardous waste
CO3	To merge and waste by volume reduction and reuse
CO4	To know industries and public responsibility

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	-	1	-	-	3	-	-	3	2	-
CO2	2	3	-	2	-	-	2	-	-	3	3	1
CO3	2	3	1	-	-	-	-	-	2	-	-	2
CO4	3	-	--	-	-	-	-	-	2	-	2	-
CO5	2	-	2	-	2	-	1	-	-	-	1	-

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	2	2	2	-
CO2	3	1	3	-
CO3	2	2	1	-
CO4	3	2	1	-
CO5	2	3	1	-

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical /Project
						√			

Subject Code: EBCT22OE7	Subject Name : E-Waste Management	T y/ Lb/ ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: Nil	Ty	3	0/0	0/0	3

UNITI INTRODUCTION **6Hrs**

Composition – e-waste generation in global context – growth of electrical and electronic industry- Environmental concerns.- Effects on Environment and Human Health.

UNIT II THE BASEL CONVENTION **12Hrs**

Compliance and implementation- Scheme to control the movement of hazardous waste - Technical assistance offered by the Convention -Other important highlights of the Basel Convention - Waste Electrical and Electronic Equipment (WEEE)- Obligations of the producer under the WEEE.

UNIT III MANAGEMENT E-WASTE **9Hrs**

Hazardous waste isolation- Guidelines for environmentally sound management- compliance and implementation – inventory management- reduction- process modification- volume reduction- recovery and reuse- Concerns/ Challenges for e-waste management

UNIT IV RECYCLING E-WASTE **12Hrs**

Global trade in hazardous waste - Rising illegal e-waste exports - Main factors in global waste trade economy Waste trading as a quintessential part of electronic recycling - Free trade agreements as a means of waste trading Import of hazardous e-waste - Porous ports and lack of checking facilities - Illegal waste imports seized in ports

UNIT V RECOMMENDED OPTIONS **6Hrs**

Creating awareness-Training for the management and minimization of hazardous wastes – sustainable product design –role of government – Responsibility of Industries and public.

Total No. of Hours: 45Hrs

REFERENCES:

1. K. Satyamurty, 'Managing e-waste without harming environment', The Hindu, 03 April, 2006.
2. Marwaan Macan- Markar, 'Free Trade Cannot Include Toxic Waste', Toxic Trade News, Basel Action Network
(BAN), February, 2007.
3. Freeman M. H. 1989. Standard Handbook of Hazardous Waste Treatment and Disposal, McGraw-Hill Company.

OPEN LABS OFFERED TO OTHER DEPARTMENT STUDENTS

Subject Code:	Subject Name : Chemical Separation Lab	Ty/Lb/ETL/IE	L	T / S.Lr	P/ R	C
EBCT22OL1	Prerequisite: Nil	Lb	0	0/0	3/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab/ Internal Evaluation

OBJECTIVE:

COURSE OUTCOMES (COs) : (3- 5)

CO1	Knowledge of various chemical engineering separation processes
CO2	Ability to select appropriate separation technique and to analyse the separation for multi-component systems
CO3	Ability to understand the reparation techniques.
CO4	To learn the knowledge about extraction process

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	-	1	-	-	3	-	-	3	2	-
CO2	2	3	-	2	-	-	2	-	-	3	3	1
CO3	2	3	1	-	-	-	-	-	2	-	-	2
CO4	3	-	--	-	-	-	-	-	2	-	2	-

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	2	2	2	-
CO2	3	1	3	-
CO3	2	2	1	-
CO4	3	2	1	-

H/M/L indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical /Project			
									√			

Subject Code:	Subject Name : Chemical Separation Lab	Ty/Lb/ETL/IE	I	T / S.Lr	P/ R	C
EBCT22OL1	Prerequisite: Nil	Lb	(	0/0	3/0	1

LIST OF EXPERIMENTS

1. Crystallization
2. Filtration
3. Decantation
4. Sublimation
5. Evaporation
6. Simple distillation
7. Fractional distillation
8. Chromatography
9. Centrifugation
10. Separating funnel
11. Magnetic separation
12. Precipitation
13. Solvent extraction
14. Electro deposition
15. Oxidation and reduction processes

Subject Code: EBCT22OL2	Subject Name : Chemical Composition Analysis Lab	Ty/Lb/ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: Nil	**Lb**	**0**	**0/0**	**3/0**	**1**

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab/ Internal Evaluation

OBJECTIVE:

COURSE OUTCOMES (COs) : (3- 5)

CO1	To analyse various chemical components present in the sample
CO2	To understand the test in cosmetics
CO3	To understand the characterization of in organic substance
CO4	To understand the chemical components in pharma sectors

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	-	1	-	-	3	-	-	3	2	-
CO2	2	3	-	2	-	-	2	-	-	3	3	1
CO3	2	3	1	-	-	-	-	-	2	-	-	2
CO4	3	-	--	-	-	-	-	-	2	-	2	-

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	2	2	2	-
CO2	3	1	3	-
CO3	2	2	1	-
CO4	3	2	1	-

H/**M/L indicates Strength of Correlation 3- High, 2- Medium, 1-Low**

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical /Project			
							√					

Subject Code: EBCT22OL2	Subject Name : Chemical Composition Analysis Lab	Ty/Lb/ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: Nil	Lb	0	0/0	3/0	1

LIST OF EXPERIMENT

1. Elemental Analysis
2. Chemical composition analysis
3. Chemical trace analysis
4. Inorganic substance analysis
5. Contamination detection analysis
6. Material testing analysis
7. Petrochemical testing
8. Polymer and Plastic testing
9. Cosmetics testing
10. Pharmaceutical testing

Subject Code: EBCT22OL3	Subject Name : Alternate Fuel Lab	Ty/Lb/ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: Nil	Lb	0	0/0	3/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab/ Internal Evaluation

OBJECTIVE: Environmental assessment and economic consideration of alternate fuels

COURSE OUTCOMES (COs) : (3- 5)

CO1	Broad comprehension of alternate fuel and their production techniques
CO2	To find API
CO3	To find Density
CO4	To find Cloud point and Pour point

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	-	1	-	-	3	-	-	3	2	-
CO2	2	3	-	2	-	-	2	-	-	3	3	1
CO3	2	3	1	-	-	-	-	-	2	-	-	2
CO4	3	-	--	-	-	-	-	-	2	-	2	-

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	2	3	-	1
CO2	2	3	-	2
CO3	2	3	1	-
CO4	3	-	--	-

H H/**M/L indicates Strength of Correlation 3- High, 2- Medium, 1-Low**

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical /Project			
									√			

Subject Code: EBCT22OL3	Subject Name : Alternate Fuel Lab	Ty/Lb/ETL/IE	L	T / S.Lr	P/ R	C
	Prerequisite: Nil	Lb	0	0/0	3/0	1

LIST OF EXPERIMENT

Determination of

1. MFI
2. Fire pint
3. Flash point
4. Cloud point
5. Pour point
6. Smoke point
7. Viscosity
8. Rheology
9. Stability
10. Density
11. Specific gravity
12. Weathering

Subject Code:	Subject Name : Food Testing Laboratory	Ty/Lb/ETL	L	T / S.Lr	P/ R	C
EBCT22OL4	Prerequisite: Nil	Lb	0	0/0	3/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE: Understand factors that affect viability and potential of new food product

COURSE OUTCOMES (COs) : (3- 5)

CO1	Apply a techniques analysis the food materials
CO2	Analysis the physical and biological properties of food.
CO3	Analyzing food components form specific particular food sample.
CO4	Apply principles methodology and applications and technology of food analysis
CO5	Apply the sampling techniques to food materials having widely divence properties and volumes

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	3	-	-	-	-	-	-
CO2	1	-	-	3	-	1	-	-	-	1	-	-
CO3	-	-	1	-	-	2	-	-	-	1	-	-
CO4	-	-	1	1	1	1	-	-	-	-	-	-
CO5	-	1	-		-	1	1	-	-	-	-	

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	2	3	3	-
CO2	3	3	3	2
CO3	2	2	1	-
CO4	3	2	1	-
CO5	2	3	1	-

H/M/L indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical /Project			
									√			

Subject Code:	Subject Name : Food Testing Laboratory	Ty/Lb/ETL	L	T / S.Lr	P/ R	C
EBCT22OL4	Prerequisite: Nil	Lb	0	0/0	3/0	1

1. Benedict's test for reducing sugars
2. Iodine test for starch
3. Sudan III test for lipids
4. Biuret test for proteins
5. Heavy Metals Analysis
6. Nutritional Analysis
7. Organic Toxins Analysis
8. Pesticide and Residue Analysis
9. Plate Test Method
10. Microbial and Antimicrobial Analysi