ANNA UNIVERSITY, CHENNAI
NON-AUTONOMOUS COLLEGES AFFILIATED COLLEGES

REGULATIONS 2021
CHOICE BASED CREDIT SYSTEM

B.TECH. PETROCHEMICAL TECHNOLOGY

CURRICULUM FOR SEMESTERS I TO VIII AND SYLLABI FOR SEMESTERS III AND IV

SEMESTER I

S. No.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	IP3151	Induction Programme	-	-	-	-	-	0
THEORY								
2.	HS3151	Professional English – I	HSMC	3	0	0	3	3
3.	MA3151	Matrices and Calculus	BSC	3	1	0	4	4
4.	PH3151	Engineering Physics	BSC	3	0	0	3	3
5.	CY3151	Engineering Chemistry	BSC	3	0	0	3	3
6.	GE3151	Problem Solving and Python Programming	ESC	3	0	0	3	3
7.	GE3172	அறிவியல் தமிழ் / **Scientific Thoughts in Tamil**	HSMC	1	0	0	1	1
PRACTICALS								
8.	GE3171	Problem Solving and Python Programming	ESC	0	0	4	4	2
9.	BS3171	Physics and Chemistry Laboratory	BSC	0	0	4	4	2
10.	GE3172	English Laboratory $	EEC	0	0	2	2	1
			TOTAL	**16**	**1**	**10**	**27**	**22**

$ Skill Based Course

SEMESTER II

S. No.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	HS3251	Professional English – II	HSMC	2	0	0	2	2
2.	MA3251	Statistics and Numerical Methods	BSC	3	1	0	4	4
3.	PH3253	Materials Science for Technologists	BSC	3	0	0	3	3
4.	BE3252	Basic Electrical, Electronics and Instrumentation Engineering	BSC	3	0	0	3	3
5.	CY3251	Chemistry for Technologists	BSC	3	0	0	3	3
6.	GE3251	Engineering Graphics	ESC	2	0	4	6	4
7.	GE3252	**தமிழர் மரபு / Heritage of Tamils**	HSMC	1	0	0	1	1
8.		NCC Credit Course Level 1*	-	2	0	0	2	2
PRACTICALS								
7	GE3271	Engineering Practices Laboratory	ESC	0	0	4	4	2
8	BE3272	Basic Electrical, Electronics and Instrumentation Engineering Laboratory	ESC	0	0	4	4	2
9	GE3272	Communication Laboratory / Foreign Language $	EEC	0	0	4	4	2
			TOTAL	**17**	**1**	**16**	**34**	**26**

#*NCC Credit Course level 1 is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA.

$ Skill Based Course

SEMESTER III

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	MA3351	Transforms and Partial Differential Equations	BSC	3	1	0	4	4
2.	PE3351	Process Calculations	PCC	3	0	0	3	3
3.	PC3351	Fluid Mechanics for Petrochemical Technologists	PCC	3	0	0	3	3
4.	PC3353	Petroleum Primary Processing Technology	PCC	3	0	0	3	3
5.	CH3491	Heat Transfer	PCC	3	0	0	3	3
6.	PC3352	Mechanical Operations	PCC	3	0	0	3	3
PRACTICALS								
7.	PE3481	Heat Transfer Laboratory	PCC	0	0	4	4	2
8.	PE3361	Fluid Mechanics and Solid Operations laboratory	PCC	0	0	4	4	2
9.	GE33361	Professional Development$	EEC	0	0	2	2	1
			TOTAL	**18**	**1**	**10**	**29**	**24**

$ Skill Based Course

SEMESTER IV

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	PE3451	Chemical Engineering Thermodynamics	PCC	3	0	0	3	3
2.	PC3451	Petroleum Secondary Processing Technology	PCC	3	0	0	3	3
3.	CH3451	Mass Transfer I	PCC	3	0	0	3	3
4.	PC3401	Industrial Chemical Technology	PCC	3	0	0	3	3
5.	CPE331	Chemical Reaction Engineering	PCC	3	0	0	3	3
6.	GE3451	Environmental Sciences and Sustainability	BSC	2	0	0	2	2
7.		NCC Credit Course Level 2#		3	0	0	3	3
PRACTICALS								
8.	PC3461	Petrochemical and Polymer Analysis Laboratory	PCC	0	0	4	4	2
9.	PC3462	Petroleum Product Testing Laboratory	PCC	0	0	4	4	2
10.	PC3511	Industrial Training/Internship I*	EEC	-	-	-	-	-
			TOTAL	**17**	**0**	**8**	**25**	**21**

NCC Credit Course level 2 is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA.

*Four weeks industrial training/internship carries two credits. Industrial training/internship during IV Semester Summer Vacation will be evaluated in V semester

SEMESTER V

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	CH3551	Mass Transfer II	PCC	2	1	0	3	3
2.	PC3551	Catalytic Reaction Engineering	PCC	3	0	0	3	3
3.		Professional Elective I	PEC	3	0	0	3	3
4.		Professional Elective II	PEC	3	0	0	3	3
5.		Professional Elective III	PEC	3	0	0	3	3
6.		Mandatory Course-I&	MC	3	0	0	3	0
PRACTICALS								
7.	PC3511	Industrial Training/Internship I**	EEC	-	-	-	-	2
8.	CH3561	Mass Transfer Laboratory	PCC	0	0	4	4	2
			TOTAL	**17**	**1**	**4**	**22**	**19**

& Mandatory Course-I is a Non-credit Course (Student shall select one course from the list given under MC-I)

**Four weeks industrial training/internship carries two credits. Industrial training/internship during IV Semester Summer Vacation will be evaluated in V semester

SEMESTER VI

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	PC3652	Process Instrumentation Dynamics and Control	PCC	3	0	0	3	3
2.		Open Elective – I*	OEC	3	0	0	3	3
3.		Professional Elective IV	PEC	3	0	0	3	3
4.		Professional Elective V	PEC	3	0	0	3	3
5.		Professional Elective VI	PEC	3	0	0	3	3
6.		Professional Elective VII	PEC	3	0	0	3	3
7.		Mandatory Course-II[&]	MC	3	0	0	3	0
8.		NCC Credit Course Level 3[#]		3	0	0	3	3
PRACTICALS								
9.	PC3611	Chemical Reaction and Process control Laboratory	PCC	0	0	4	4	2
10.	PC3651	Computational Petrochemical Laboratory	PCC	0	0	4	4	2
11.	PC3711	Industrial Training/Internship II**	EEC	-	-	-	-	-
			TOTAL	**24**	**0**	**8**	**32**	**22**

***Open Elective – I shall be chosen from the emerging technologies.**

**Two weeks industrial training/internship carries one credit. Industrial training/Internship during VI Semester Summer Vacation will be evaluated in VII semester

[&] Mandatory Course-II is a Non-credit Course (Student shall select one course from the list given under MC- II)

[#] NCC Credit Course level 3 is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA.

SEMESTER VII/VIII*

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	PC3752	Process Safety in Petrochemical Industries	PCC	3	0	0	3	3
2.	PC3751	Process Equipment Design	PCC	3	0	0	3	3
3.	GE3791	Human values and Ethics	HSMC	2	0	0	2	2
4.		Elective- Management [#]	HSMC	3	0	0	3	3
5.		Open Elective – II**	OEC	3	0	0	3	3
6.		Open Elective – III***	OEC	3	0	0	3	3
7.		Open Elective – IV***	OEC	3	0	0	3	3
PRACTICALS								
8.	PC3711	Industrial Training/Internship II[##]	EEC	-	-	-	-	2
			TOTAL	**20**	**2**	**0**	**20**	**22**

***If students undergo internship in Semester VII, then the courses offered during semester VII will be offered during semester VIII.**

****Open Elective – II shall be chosen from the emerging technologies.**

*****Open Elective III and IV (Shall be chosen from the list of open electives offered by other Programmes**

[#] Elective- Management shall be chosen from the Elective Management courses

[##]Two weeks industrial training/internship carries one credit. Industrial training/Internship during VI Semester Summer Vacation will be evaluated in VII semester

SEMESTER VIII/VII*

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
PRACTICALS								
1.	PC3811	Internship#/Project Work	EEC	0	0	20	20	10
			TOTAL	**0**	**0**	**20**	**20**	**10**

***If students undergo internship in Semester VII, then the courses offered during semester VII will be offered during semester VIII.**

#15 weeks of continuous Internship in an organization carries 10 credits.

TOTAL CREDITS: 166

ANNA UNIVERSITY
PROGRESS THROUGH KNOWLEDGE

ELECTIVE – MANAGEMENT COURSES

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PERWEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	GE3751	Principles of Management	HSMC	3	0	0	3	3
2.	GE3752	Total Quality Management	HSMC	3	0	0	3	3
3.	GE3753	Engineering Economics and Financial Accounting	HSMC	3	0	0	3	3
4.	GE3754	Human Resource Management	HSMC	3	0	0	3	3
5.	GE3755	Knowledge Management	HSMC	3	0	0	3	3
6.	GE3792	Industrial Management	HSMC	3	0	0	3	3

MANDATORY COURSES I

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	MX3081	Introduction to Women and Gender Studies	MC	3	0	0	3	0
2.	MX3082	Elements of Literature	MC	3	0	0	3	0
3.	MX3083	Film Appreciation	MC	3	0	0	3	0
4.	MX3084	Disaster Management	MC	3	0	0	3	0

MANDATORY COURSES II

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	MX3085	Well Being with traditional practices (Yoga, Ayurveda and Siddha)	MC	3	0	0	3	0
2.	MX3086	History of Science and Technology in India	MC	3	0	0	3	0
3.	MX3087	Political and Economic Thought for a Humane Society	MC	3	0	0	3	0
4.	MX3088	State, Nation Building and Politics in India	MC	3	0	0	3	0
5.	MX3089	Industrial Safety	MC	3	0	0	3	0

PROFESSIONAL ELECTIVE COURSES: VERTICALS

Vertical I Petrochemical Process Technology	Vertical II Hydrocarbon Transportation and Storage	Vertical III Health, Safety and Environment	Vertical IV Process Intensification
Petrochemical Unit processes	Storage Transportation of Crude Oil and Natural Gas	Fire and Explosion Control	Multi component Distillation
Petroleum Exploration and Exploitation Techniques	Petroleum Corrosion Technology	Industrial Hygiene	Process modelling and simulation
Process equipment auxiliaries & Utilities	Piping Engineering	Transportation Safety	Optimization of chemical Processes
Polymer Technology	Unconventional Hydrocarbon sources	Process Hazard Analysis Studies	Modern Separation Techniques
Fertilizer Technology	Design of Pressure Vessels and storage Vessels	Health Safety and Environmental Management	Fluidization Engineering
Petrochemical Derivatives	Natural Gas and LNG Processing	Plant Safety and Risk Management	Process Instrumentation

Registration of Professional Elective Courses from Verticals:
Professional Elective Courses will be registered in Semesters V and VI. These courses are listed in groups called verticals that represent a particular area of specialisation. Students are permitted to choose all Professional Electives from a particular vertical or from different verticals. Further, only one Professional Elective course shall be chosen in a semester horizontally (row-wise). However, two courses are permitted from the same row, provided one course is enrolled in Semester V and another in semester VI.

The registration of courses for B.E./B.Tech (Honours) or Minor degree shall be done from Semester V to VIII. The procedure for registration of courses explained above shall be followed for the courses of B.E/B.Tech (Honours) or Minor degree also. For more details on B.E./B.Tech (Honours) or Minor degree refer to Regulations 2021 Clause 4.10.

PROGRESS THROUGH KNOWLEDGE

PROFESSIONAL ELECTIVE COURSES : VERTICALS

VERTICAL 1: PETROCHEMICAL PROCESS TECHNOLOGY

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	PC3001	Petrochemical Unit processes	PEC	3	0	0	3	3
2.	PC3002	Petroleum Exploration and Exploitation Techniques	PEC	3	0	0	3	3
3.	PC3003	Process equipment auxiliaries & Utilities	PEC	3	0	0	3	3
4.	CPE332	Polymer Technology	PEC	3	0	0	3	3
5.	PC3004	Fertilizer Technology	PEC	3	0	0	3	3
6.	PC3005	Petrochemical Derivatives	PEC	3	0	0	3	3

VERTICAL 2: HYDROCARBON TRANSPORTATION AND STORAGE

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CPE345	Storage Transportation of Crude Oil and Natural Gas	PEC	3	0	0	3	3
2.	CPE341	Petroleum Corrosion Technology	PEC	3	0	0	3	3
3.	CPE343	Piping Engineering	PEC	3	0	0	3	3
4.	CPE347	Unconventional Hydrocarbon sources	PEC	3	0	0	3	3
5.	CPE332	Design of Pressure Vessels and storage Vessels	PEC	3	0	0	3	3
6.	CPE339	Natural Gas and LNG Processing	PEC	3	0	0	3	3

VERTICAL 3: HEALTH, SAFETY AND ENVIRONMENT

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CPC331	Fire and Explosion Control	PEC	3	0	0	3	3
2.	CPE338	Industrial Hygiene	PEC	3	0	0	3	3
3.	CPE346	Transportation Safety	PEC	3	0	0	3	3
4.	CPC333	Process Hazard Analysis Studies	PEC	3	0	0	3	3
5.	CPE336	Health Safety and Environmental Management	PEC	3	0	0	3	3
6.	CPE344	Plant Safety and Risk Management	PEC	3	0	0	3	3

VERTICAL 4: PROCESS INTENSIFICATION

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	PC3006	Multi component Distillation	PEC	3	0	0	3	3
2.	CCH331	Process modelling and simulation	PEC	3	0	0	3	3
3.	PC3007	Optimization of chemical Processes	PEC	3	0	0	3	3
4.	PC3008	Modern Separation Techniques	PEC	3	0	0	3	3
5.	CPE335	Fluidization Engineering	PEC	3	0	0	3	3
6.	CPC334	Process Instrumentation	PEC	3	0	0	3	3

OPEN ELECTIVES

Students shall choose the open elective courses, such that the course contents are not similar to any other course contents/title under other course categories.

OPEN ELECTIVE I AND II (EMERGING TECHNOLOGIES)

To be offered other than Faculty of Information and Communication Engineering

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	OCS351	Artificial Intelligence and Machine Learning Fundamentals	OEC	2	0	2	4	3
2.	OCS352	IoT Concepts and Applications	OEC	2	0	2	4	3
3.	OCS353	Data Science Fundamentals	OEC	2	0	2	4	3
4.	OCS354	Augmented and Virtual Reality	OEC	2	0	2	4	3

OPEN ELECTIVES – III

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	OHS351	English for Competitive Examinations	OEC	3	0	0	3	3
2.	OCE353	Lean Concepts, Tools And Practices	OEC	3	0	0	3	3
3.	OMG352	NGOs and Sustainable Development	OEC	3	0	0	3	3
4.	OMG353	Democracy and Good Governance	OEC	3	0	0	3	3
5.	OME353	Renewable Energy Technologies	OEC	3	0	0	3	3
6.	OME354	Applied Design Thinking	OEC	2	0	2	4	3
7.	OMF351	Reverse Engineering	OEC	3	0	0	3	3
8.	OMF353	Sustainable Manufacturing	OEC	3	0	0	3	3
9.	OAU351	Electric and Hybrid Vehicle	OEC	3	0	0	3	3
10.	OAS352	Space Engineering	OEC	3	0	0	3	3
11.	OIM351	Industrial Management	OEC	3	0	0	3	3
12.	OIE354	Quality Engineering	OEC	3	0	0	3	3
13.	OSF351	Fire Safety Engineering	OEC	3	0	0	3	3
14.	OML351	Introduction to non-destructive testing	OEC	3	0	0	3	3
15.	OMR351	Mechatronics	OEC	3	0	0	3	3
16.	ORA351	Foundation of Robotics	OEC	3	0	0	3	3
17.	OAE352	Fundamentals of Aeronautical engineering	OEC	3	0	0	3	3
18.	OGI351	Remote Sensing Concepts	OEC	3	0	0	3	3
19.	OAI351	Urban Agriculture	OEC	3	0	0	3	3
20.	OEE352	Electric Vehicle technology	OEC	3	0	0	3	3
21.	OEI353	Introduction to PLC Programming	OEC	3	0	0	3	3
22.	OBT352	Biomedical Instrumentation	OEC	3	0	0	3	3
23.	OFD352	Traditional Indian Foods	OEC	3	0	0	3	3
24.	OFD353	Introduction to food processing	OEC	3	0	0	3	3
25.	OPY352	IPR for Pharma Industry	OEC	3	0	0	3	3
26.	OTT351	Basics of Textile Finishing	OEC	3	0	0	3	3
27.	OTT352	Industrial Engineering for Garment Industry	OEC	3	0	0	3	3
28.	OTT353	Basics of Textile Manufacture	OEC	3	0	0	3	3
29.	OCH353	Energy Technology	OEC	3	0	0	3	3
30.	OCH354	Surface Science	OEC	3	0	0	3	3

31.	OPT351	Basics of Plastics Processing	OEC	3	0	0	3	3
32.	OEC351	Signals and Systems	OEC	3	0	0	3	3
33.	OEC352	Fundamentals of Electronic Devices and Circuits	OEC	3	0	0	3	3
34.	OBM351	Foundation Skills in integrated product Development	OEC	3	0	0	3	3
35.	OBM352	Assistive Technology	OEC	3	0	0	3	3
36.	OMA352	Operations Research	OEC	3	0	0	3	3
37.	OMA353	Algebra and Number Theory	OEC	3	0	0	3	3
38.	OMA354	Linear Algebra	OEC	3	0	0	3	3

OPEN ELECTIVES – IV

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	OHS352	Project Report Writing	OEC	3	0	0	3	3
2.	OCE354	Basics of Integrated Water Resources Management	OEC	3	0	0	3	3
3.	OMA355	Advanced Numerical Methods	OEC	3	0	0	3	3
4.	OMA356	Random Processes	OEC	3	0	0	3	3
5.	OMA357	Queuing and Reliability Modelling	OEC	3	0	0	3	3
6.	OMG354	Production and Operations Management for Entrepreneurs	OEC	3	0	0	3	3
7.	OMG355	Multivariate Data Analysis	OEC	3	0	0	3	3
8.	OME352	Additive Manufacturing	OEC	3	0	0	3	3
9.	OME353	New Product Development	OEC	3	0	0	3	3
10.	OME355	Industrial Design & Rapid Prototyping Techniques	OEC	2	0	2	4	3
11.	OMF352	Micro and Precision Engineering	OEC	3	0	0	3	3
12.	OMF354	Cost Management of Engineering Projects	OEC	3	0	0	3	3
13.	OAU352	Batteries and Management system	OEC	3	0	0	3	3
14.	OAU353	Sensors and Actuators	OEC	3	0	0	3	3
15.	OAS353	Space Vehicles	OEC	3	0	0	3	3
16.	OIM352	Management Science	OEC	3	0	0	3	3
17.	OIM353	Production Planning and Control	OEC	3	0	0	3	3
18.	OIE353	Operations	OEC	3	0	0	3	3

		Management						
19.	OSF352	Industrial Hygiene	OEC	3	0	0	3	3
20.	OML352	Electrical, Electronic and Magnetic materials	OEC	3	0	0	3	3
21.	OML353	Nanomaterials and applications	OEC	3	0	0	3	3
22.	OMR353	Sensors	OEC	3	0	0	3	3
23.	ORA352	Foundation of Automation	OEC	3	0	0	3	3
24.	ORA353	Concepts in Mobile Robotics	OEC	3	0	0	3	3
25.	OMV351	Marine Propulsion	OEC	3	0	0	3	3
26.	OMV352	Marine Merchant Vehicles	OEC	3	0	0	3	3
27.	OMV353	Elements of Marine Engineering	OEC	3	0	0	3	3
28.	OAE353	Drone Technologies	OEC	3	0	0	3	3
29.	OGI352	Geographical Information System	OEC	3	0	0	3	3
30.	OAI352	Agriculture Entrepreneurship Development	OEC	3	0	0	3	3
31.	OEN352	Biodiversity Conservation	OEC	3	0	0	3	3
32.	OEE353	Introduction to control systems	OEC	3	0	0	3	3
33.	OEI354	Introduction to Industrial Automation Systems	OEC	3	0	0	3	3
34.	OBT353	Environment and Agriculture	OEC	3	0	0	3	3
35.	OFD354	Fundamentals of Food Engineering	OEC	3	0	0	3	3
36.	OFD355	Food safety and Quality Regulations	OEC	3	0	0	3	3
37.	OPY353	Nutraceuticals	OEC	3	0	0	3	3
38.	OTT354	Basics of Dyeing and Printing	OEC	3	0	0	3	3
39.	OTT355	Fibre Science	OEC	3	0	0	3	3
40.	OTT356	Garment Manufacturing Technology	OEC	3	0	0	3	3
41.	OCH353	Energy Technology	OEC	3	0	0	3	3
42.	OCH354	Surface Science	OEC	3	0	0	3	3
43.	OPT352	Plastic Materials for Engineers	OEC	3	0	0	3	3
44.	OPT353	Properties and Testing of Plastics	OEC	3	0	0	3	3
45.	OEC353	VLSI Design	OEC	3	0	0	3	3
46.	OEC354	Industrial IoT and Industry 4.0	OEC	2	0	2	4	3
47.	OBM353	Wearable devices	OEC	3	0	0	3	3
48.	OBM354	Medical Informatics	OEC	3	0	0	3	3

SUMMARY

B.TECH. PETROCHEMICAL TECHNOLOGY										
S.No	Subject Area	Credits per Semester								Total Credits
		I	II	III	IV	V	VI	VII/VIII	VIII/VII	
1	HSMC	4	3					5		12
2	BSC	12	13	4	2					31
3	ESC	5	8							13
4	PCC			19	19	8	7	6		59
5	PEC					9	12			21
6	OEC						3	9		12
7	EEC	1	2	1		2		2	10	18
8	Non-Credit /(Mandatory)					√	√			
Total		22	26	24	21	19	22	22	10	166

PROGRESS THROUGH KNOWLEDGE

Enrollment for B.E. / B. Tech. (Honours) / Minor degree (Optional)

A student can also optionally register for additional courses (18 credits) and become eligible for the award of B.E./B.Tech. (Honours) Minor degree.

For B.E. / B. Tech. (Honours), a student shall register for the additional courses (18 credits) from semester V onwards. These courses shall be from the same vertical or a combination of different verticals of the same programme of study only.

For minor degree, a student shall register for the additional courses (18 credits) from semester V onwards. All these courses have to be in a particular vertical from any one of the other programmes, Moreover, for minor degree the student can register for courses from any one of the following verticals also.
Complete details are available in clause 4.10 of Regulations 2021.

VERTICALS FOR MINOR DEGREE (In Additions to all The Verticals of Other Programmes)

Vertical I Fintech and Block Chain	Vertical II Entrepreneurship	Vertical III Public Administration	Vertical IV Business Data Analytics	Vertical V Environment and Sustainability
Financial Management	Foundations of Entrepreneurship	Principles of Public Administration	Statistics For Management	Sustainable infrastructure Development
Fundamentals of Investment	Team Building & Leadership Management for Business	Constitution of India	Datamining For Business Intelligence	Sustainable Agriculture and Environmental Management
Banking, Financial Services and Insurance	Creativity & Innovation in Entrepreneurship	Public Personnel Administration	Human Resource Analytics	Sustainable Bio Materials
Introduction to Blockchain and its Applications	Principles of Marketing Management For Business	Administrative Theories	Marketing And Social Media Web Analytics	Materials for Energy Sustainability
Fintech Personal Finance and Payments	Human Resource Management for Entrepreneurs	Indian Administrative System	Operation And Supply Chain Analytics	Green Technology
Introduction to Fintech	Financing New Business Ventures	Public Policy Administration	Financial Analytics	Environmental Quality Monitoring and Analysis
-	-	-	-	Integrated Energy Planning for Sustainable Development
-	-	-	-	Energy Efficiency for Sustainable Development

(Choice of courses for Minor degree is to be made from any one vertical of other programmes or from anyone of the following verticals)

VERTICAL 1: FINTECH AND BLOCK CHAIN

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CMG331	Financial Management	PEC	3	0	0	3	3
2.	CMG332	Fundamentals of Investment	PEC	3	0	0	3	3
3.	CMG333	Banking, Financial Services and Insurance	PEC	3	0	0	3	3
4.	CMG334	Introduction to Blockchain and its Applications	PEC	3	0	0	3	3
5.	CMG335	Fintech Personal Finance and Payments	PEC	3	0	0	3	3
6.	CMG336	Introduction to Fintech	PEC	3	0	0	3	3

VERTICAL 2: ENTREPRENEURSHIP

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CMG337	Foundations of Entrepreneruship	PEC	3	0	0	3	3
2.	CMG338	Team Building & Leadership Management for Business	PEC	3	0	0	3	3
3.	CMG339	Creativity & Innovation in Entrepreneurship	PEC	3	0	0	3	3
4.	CMG340	Principles of Marketing Management For Business	PEC	3	0	0	3	3
5.	CMG341	Human Resource Management for Entrepreneurs	PEC	3	0	0	3	3
6.	CMG342	Financing New Business Ventures	PEC	3	0	0	3	3

VERTICAL 3: PUBLIC ADMINISTRATION

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CMG343	Principles of Public Administration	PEC	3	0	0	3	3
2.	CMG344	Constitution of India	PEC	3	0	0	3	3
3.	CMG345	Public Personnel Administration	PEC	3	0	0	3	3
4.	CMG346	Administrative Theories	PEC	3	0	0	3	3
5.	CMG347	Indian Administrative System	PEC	3	0	0	3	3
6.	CMG348	Public Policy Administration	PEC	3	0	0	3	3

VERTICAL 4: BUSINESS DATA ANALYTICS

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CMG349	Statistics For Management	PEC	3	0	0	3	3
2.	CMG350	Datamining For Business Intelligence	PEC	3	0	0	3	3
3.	CMG351	Human Resource Analytics	PEC	3	0	0	3	3
4.	CMG352	Marketing And Social Media Web Analytics	PEC	3	0	0	3	3
5.	CMG353	Operation And Supply Chain Analytics	PEC	3	0	0	3	3
6.	CMG354	Financial Analytics	PEC	3	0	0	3	3

VERTICAL 5: ENVIRONMENT AND SUSTAINABILITY

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CES331	Sustainable infrastructure Development	PEC	3	0	0	3	3
2.	CES332	Sustainable Agriculture and Environmental Management	PEC	3	0	0	3	3
3.	CES333	Sustainable Bio Materials	PEC	3	0	0	3	3
4.	CES334	Materials for Energy Sustainability	PEC	3	0	0	3	3
5.	CES335	Green Technology	PEC	3	0	0	3	3
6.	CES336	Environmental Quality Monitoring and Analysis	PEC	3	0	0	3	3
7.	CES337	Integrated Energy Planning for Sustainable Development	PEC	3	0	0	3	3
8.	CES338	Energy Efficiency for Sustainable Development	PEC	3	0	0	3	3

MA3351 TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS L T P C
3 1 0 4

OBJECTIVES:

- To introduce the basic concepts of PDE for solving standard partial differential equations.
- To introduce Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems.
- To acquaint the student with Fourier series techniques in solving heat flow problems used in various situations.
- To acquaint the student with Fourier transform techniques used in wide variety of situations.
- To introduce the effective mathematical tools for the solutions of partial differential equations that model several physical processes and to develop Z transform techniques for discrete time systems.

UNIT I PARTIAL DIFFERENTIAL EQUATIONS 9+3

Formation of partial differential equations –Solutions of standard types of first order partial differential equations - First order partial differential equations reducible to standard types- Lagrange's linear equation - Linear partial differential equations of second and higher order with constant coefficients of both homogeneous and non-homogeneous types.

UNIT II FOURIER SERIES 9+3

Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series and cosine series – Root mean square value – Parseval's identity – Harmonic analysis.

UNIT III APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS 9+3

Classification of PDE – Method of separation of variables - Fourier series solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two dimensional equation of heat conduction (Cartesian coordinates only).

UNIT IV FOURIER TRANSFORMS 9+3

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

UNIT V Z - TRANSFORMS AND DIFFERENCE EQUATIONS 9+3

Z-transforms - Elementary properties – Convergence of Z-transforms - – Initial and final value theorems - Inverse Z-transform using partial fraction and convolution theorem - Formation of difference equations – Solution of difference equations using Z - transforms.

TOTAL: 60 PERIODS

OUTCOMES :

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

- Understand how to solve the given standard partial differential equations.
- Solve differential equations using Fourier series analysis which plays a vital role in engineering applications.
- Appreciate the physical significance of Fourier series techniques in solving one and two dimensional heat flow problems and one dimensional wave equations.
- Understand the mathematical principles on transforms and partial differential equations would provide them the ability to formulate and solve some of the physical problems of engineering.
- Use the effective mathematical tools for the solutions of partial differential equations by using Z transform techniques for discrete time systems.

TEXT BOOKS:

1. Grewal B.S., “Higher Engineering Mathematics", 44th Edition, Khanna Publishers, New Delhi, 2018.
2. Kreyszig E, "Advanced Engineering Mathematics ", 10th Edition, John Wiley, New Delhi, India, 2016.

REFERENCES :

1. Andrews. L.C and Shivamoggi. B, "Integral Transforms for Engineers" SPIE Press, 1999.
2. Bali. N.P and Manish Goyal, "A Textbook of Engineering Mathematics", 10th Edition, Laxmi Publications Pvt. Ltd, 2015.
3. James. G., "Advanced Modern Engineering Mathematics", 4th Edition, Pearson Education, New Delhi, 2016.
4. Narayanan. S., Manicavachagom Pillay.T.K and Ramanaiah.G "Advanced Mathematics for Engineering Students", Vol. II & III, S.Viswanathan Publishers Pvt. Ltd, Chennai, 1998.
5. Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2018.
6. Wylie. R.C. and Barrett . L.C., “Advanced Engineering Mathematics “Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012.

PE3351 PROCESS CALCULATIONS L T P C
3 0 0 3

OBJECTIVE:

- To teach concept of degree of freedom and its application to solution of mass and energy balance equations for single and network of units and introduce to process simulators.

UNIT I 9

Base and derived Units - Composition of Mixture and solutions - 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 9

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 9

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

UNITIV 9

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.

UNIT V 9

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 burning compounds - Application of Process simulators in energy and material balance problems.

TOTAL: 45 PERIODS

COURSE OUTCOMES: (COs)

1. Understand the fundamentals of system of units, apply ideal gas law to solve problems in pure components and mixtures.
2. Apply stoichiometric principles to solve problems and write material balance for different process equipments.
3. Understand and apply basics of humidity to solve problems in humidification and other processes.
4. Understand and apply the basics of energy balance concepts to solve to different chemical processes.
5. Understand the basics of fuels and combustion, to solve problems on combustion of various fuels and also to find excess air.
6. Apply the above knowledge in process flow sheeting calculations.

TEXT BOOKS:

1. Himmelblau, D.M., "Basic Principles and Calculations in Chemical Engineering", EEE Sixth Edition, Prentice Hall Inc., 2003
2. Felder, R. M. and Rousseau, R. W., "Elementary Principles of Chemical Processes",3rd Edn., John Wiley & Sons, New York, 2000.
3. Bhatt, B.L., Vora, S.M., "Stoichiometry ", 4th Edition,Tata McGraw-Hill (2004)

REFERENCES:

1. Hougen O A, Watson K M and Ragatz R A, "Chemical process principles" Part I, CBS publishers (1973).
2. Venkatramani. V, Anatharaman. N and Meera Shariffa Begam " Process Calculations" Printice Hall of India, New Delhi,
3. K.V.Narayanan, B.Lakshmipathy,"Stoichiometry and Process Calculation", PHI Learning Ltd.(2013).

PC3351 FLUID MECHANICS FOR PETROCHEMICAL TECHNOLOGISTS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To impart to the student knowledge on fluid properties, fluid statics, dynamic characteristics for through pipes and porous medium.
- To impart flow measurement and fluid machineries.

UNIT I PROPERTIES OF FLUIDS AND CONCEPT OF PRESSURE

Introduction – Physical properties of fluids – Types of fluids – Fluid statics and its applications - Hydrostatic equilibrium – Pressure measurement - Rheological properties of fluids.

UNIT II MOMEMTUM BALANCE AND ITS APPLICATIONS

Basic equation of fluid flow –Mass balance in a flowing fluid; continuity- Differential momentum balance; Equations of motion - macroscopic momentum balances -Bernoulli's equation – Correction for fluid friction – Correction for pump work - Velocity potential - Reynolds experiment and significance.

UNIT III DIMENSIONAL ANALYSIS

The principle of dimensional homogeneity – dimensional analysis, Rayleigh method and the Pi theorem - non-dimensional action of the basic equations - similitude – relationship between dimensional analysis and similitude.

UNIT III FLOW OF INCOMPRESSIBLE FLUIDS THROUGH DUCTS

Flow of incompressible fluids in pipes – Shear stress and skin friction in pipes -laminar flow in pipes and channels –Velocity profile and friction factor for smooth and rough pipes – Loss due to friction in pipes and Fittings – Fluidization – Mechanism – Types – General properties – Applications. Flow past immersed bodies, Drag and Drag coefficient, Flow through beds of solids – Ergun's Equation.

UNIT V TRANSPORTATION AND METERING

Measurement of fluid flow – Orifice meter – Venturimeter – Rotameter – Weirs and notches – Transportation of fluids – Positive displacement pumps – Rotary and Reciprocating pumps – Centrifugal pumps – Performance and characteristics.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Noel de Nevers, “Fluid Mechanics for Chemical Engineers “, Second Edition, McGraw-Hill, (1991).
2. Munson, B. R., Young, D.F., Okiishi, T.H. “Fundamentals of Fluid Mechanics”, 5th Edition“, John Wiley, 2006.
3. McCabe W.L, Smith, J C and Harriot. P “Unit operations in Chemical Engineering”, McGraw Hill, VII Edition, 2005

REFERENCES:

1. White, F.M., “Fluid Mechanics “, IV Edition, McGraw-Hill Inc., 1999.
2. James O Wilkes and Stacy G Bike, “Fluid Mechanics for Chemical Engineers’ Prentice Hall PTR (International series in Chemical Engineering) (1999)

PC3353 PETROLEUM PRIMARY PROCESSING TECHNOLOGY L T P C
3 0 0 3

OBJECTIVE:

- To make the students to learn the primary refining operation of crude oil and testing of petroleum products and its treatment techniques.

UNIT I CRUDE OIL COMPOSITION AND CLASSIFICATION 9

Theories behind the Origin of petroleum – Exploration and production of petroleum – Basics of hydrocarbon chemistry - Composition of crude oil – Impurities present in crude oil - Crude oil classification and its characteristics – Crude oil properties, Crude oil assay – Indigenous and imported crudes – Crude availability Vs demands – Refining capacity of India.

UNIT II TESTING OF PETROLEUM PRODUCTS 9

IS 1448: Standard – Important commercial petroleum products: LPG, Gasoline, Kerosene, ATF, Diesel, and Lube oil - Specifications, Important testing methods and their Significance.

UNIT III CRUDE PROCESSING 9

Pretreatment of crude oil – Dehydration and desalting – Types of fractionating column - Types of trays - Flow pattern in the trays – Products separation using Atmospheric distillation - Vacuum distillation of residue products – Reflux types and its significance.

UNIT IV LUBE DISTILLATE TREATMENT TECHNIQUES 9

Lubricating oil classification and its uses - Production of lubricating oils from vacuum distillates with different treatment techniques: Solvent extraction, Deasphalting, Dewaxing, Catalytic dewaxing and Hydrofining process – Industrial Grease - Manufacture of Calcium Grease.

UNIT V WAX AND BITUMEN PROCESSING TECHNIQUES 9

Paraffinic wax: Classification and its uses, Petroleum jelly manufacture - Bitumen: Types and their properties – Bitumen Testing: Ductility, Penetration Index and Softening point - Asphalt manufacture: Air blowing technology.

TOTAL: 45 PERIODS

OUTCOMES:

CO1. Acquire knowledge on crude composition, types and their characteristics primary refining operations.
CO2. Analyse the suitability of test methods to check the quality of crude oil and its products.
CO3. Understand the concept of separating crude products using fractionating column
CO4. Understand the significance of units present in the lube complex.
CO5. Understand the classification, production and uses of wax and bitumen.
CO6. Identify the role of additives added in the commercial products of petroleum.

TEXT BOOKS:

1. Ram Prasad, "Petroleum Refining Technology", Khanna Publishers.2008
2. Bhaskara Rao, B.K., "Modern Petroleum Refining Processes", 6th edition, Oxford and IBH Publishing Company Pvt. Ltd. 2018.

REFERENCES:

1. James H. Gary and Glenn E. Handwerk., "Petroleum Refining Technology and Economics", 4th Edition, Marcel Dekker Inc., 2001.
2. Nelson, W.L., "Petroleum Refinery Engineering", McGraw Hill Publishing Company Limited, 1985.
3. Hobson, G.D., "Modern Petroleum Refining Technology ", 5th Edition, John Wiley Publishers, 1984

CH3491 HEAT TRANSFER

L	T	P	C
3	0	0	3

OBJECTIVE:

The course is aimed to

- Teach the fundamental concepts of heat transfer viz., conduction, convection, radiation, boiling and condensation and its application to the students

UNIT I 9

Importance of heat transfer in Chemical Engineering operations - Modes of heat transfer ; One dimensional steady state heat conduction through plane and composite walls, hollow cylinder and spheres - Thermal conductivity measurement-effect of temperature on thermal conductivity; Heat transfer in extended surfaces; Transient heat conduction

UNIT II 11

Concepts of heat transfer by convection - Natural and forced convection, Hydrodynamic and thermal Boundary layers; analogies between transfer of momentum and heat - Reynold's analogy, Prandtl and Colburn analogy. Dimensional analysis in heat transfer, heat transfer coefficient for flow through a pipe, flow past flat plate.

UNIT III 9

Heat Exchangers – classification and design, overall and individual film coefficients, mean temperature difference, LMTD correction factor for multiple pass exchanger, NTU and efficiency of Heat exchangers

UNIT IV 8

Heat transfer to fluids with phase change - heat transfer from condensing vapours, drop wise and film wise condensation, Nusselt equation for vertical and horizontal tubes, condensation of superheated vapours, Heat transfer to boiling liquids - mechanism of boiling, nucleate boiling and film boiling

UNIT V **8**

Evaporation- single and multiple effect operation, material and Energy balance in evaporators, boiling point elevation, Duhring's rule. Radiation heat transfer - Black body radiation, Emissivity, Stefan - Boltzman law, Plank's law, radiation between surfaces.

TOTAL: 45 PERIODS

OUTCOMES:

On the completion of the course students are expected to

CO1: To familiarize the students with the fundamental concepts of Heat Transfer. Provide the student with knowledge about heat transfer by conduction in solids for steady state

CO2: Students will understand convective heat transfer and use of heat transfer coefficients for laminar and turbulent flows

CO3: The course gives the student insight about boundary layer flow, laminar and turbulent flows

CO4: Students will be able to calculate and use overall heat transfer coefficients in designing heat exchangers

CO5: The course provides the student with knowledge about heat transfer with phase change(Boiling and condensation) and evaporation

CO6: Students will understand radiative heat transfer including blackbody radiation and Kirchoff'slaw, and will be able to solve radiative problems apply knowledge of heat transfer to solve thermal engineering problems

TEXT BOOKS:

1. Holman, J. P., 'Heat Transfer ', 10th Edn., McGraw Hill,2010.
2. Ozisik, M. N., Heat Transfer: A Basic Approach, McGraw-Hill, 1984
3. Kern, D.Q., "Process Heat Transfer ", McGraw-Hill, 1999.
4. B.K. Dutta, Heat transfer principles and applications, PHI Learning PVT Ltd, 2016

REFERENCES:

1. McCabe, W.L., Smith, J.C., and Harriot, P., "Unit Operations in Chemical Engineering",6th Edn., McGraw-Hill, 2001.
2. Coulson, J.M. and Richardson, J.F., "Chemical Engineering " Vol. I, 4th Edn., Asian Books Pvt. Ltd., India, 1998

PC3352 **MECHANICAL OPERATIONS** **L T P C**
3 0 0 3

OBJECTIVE:

- To impact knowledge in the field of particle size reduction and also deals with the detail construction and working of equipment's used for mechanical operations.

UNIT I PARTICLE CHARACTERIZATION AND MEASUREMENT 9

General characteristics of solids, different techniques of size analysis- Static - Image analysis and Dynamic analysis - Light scattering techniques, shape factor, surface area determination, estimation of particle size. Advanced particle size analysis techniques. Screening methods and equipment, screen efficiency, ideal and actual screens.

UNIT II PARTICLE SIZE REDUCTION AND SIZE ENLARGEMENT 9

Laws of size reduction, energy relationships in size reduction, methods of size reduction, classification of equipments, crushers, grinders, disintegrators for coarse, intermediate and fine grinding, power requirement, work index; Advanced size reduction techniques - Nano particle fabrication - Top down approach - Bottom-up approach. Size enlargement - Importance of size enlargement, principle of granulation, briquetting, palletization, and flocculation. Fundamentals of particle generation.

UNIT III PARTICLE SEPARATION (GAS-SOLID AND LIQUID-SOLID SYSTEM) 9

Gravity settling, sedimentation, thickening, elutriation, double cone classifier, rake classifier, bowl classifier. Centrifugal separation - continuous centrifuges, super centrifuges, design of basket centrifuges; industrial dust removing equipment, cyclones and hydro cyclones, electrostatic and magnetic separators, heavy media separations, floatation, jigging

UNIT IV FILTRATION AND FILTRATION EQUIPMENTS 9

Theory of filtration, Batch and continuous filters, Flow through filter cake and filter media, compressible and incompressible filter cakes, filtration equipments - selection, operation and design of filters and optimum cycle of operation, filter aids.

UNIT V MIXING AND PARTICLE HANDLING 9

Mixing and agitation - Mixing of liquids (with or without solids), mixing of powders, selection of suitable mixers, power requirement for mixing. Storage and Conveying of solids - Bunkers, silos, bins and hoppers, transportation of solids in bulk, Powder hazards, conveyer selection, different types of conveyers and their performance characteristics.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to

1. Determine and Estimate various properties of particulates, particle size using advanced analysis techniques
2. Understand the overview of equipment design used for size reduction, and understand the importance of size enlargement.
3. Examine and identify various separation and purification equipment for solid-solid, solid-liquid and solid-gas system.
4. Categorize various filters and problems associated during the implementation and applications of filtration equipments
5. Analyze and understand the working of various types of impellers, mixers, Handling, Storage and Transportation of Solids.
6. Know the future challenges and obtain knowledge on various unit operations and their applications

TEXT BOOKS:

1. McCabe, W.L., Smith, J.C., and Harriot, P., “Unit Operations in Chemical Engineering”, 7th Edn., McGraw-Hill, 2005.
2. Badger W.L. and Banchero J.T., “Introduction to Chemical Engineering”, Tata McGraw Hill, 1997.
3. Foust, A. S., Wenzel, L.A., Clump, C.W., Naus, L., and Anderson, L.B., “Principles of Unit Operations”, 2nd Edn., John Wiley & Sons, 1994.
4. Hiroaki Masuda , KoHigashitani and Hideto Yoshida, Powder Technology Handbook, 3rd Edition.

REFERENCES:

1. Coulson, J.M. and Richardson, J.F., “Chemical Engineering” Vol. II, 4th Edn., Asian Books Pvt. Ltd., India, 1998.
2. Christie J. Geankoplis, Transport processes and unit operations.
3. Sunggyu Lee, Kimberly H. Henthorn, Particle Technology and Applications.
4. Martin Rhodes, Introduction to Particle Technology, Second Edition.

PE3481 **HEAT TRANSFER LABORATORY** **L T P C**
0 0 4 2

OBJECTIVE:

- To enable the students to develop a sound working knowledge on different types of heat transfer equipments.

LIST OF EXPERIMENTS

1. Heat Transfer in a Double Pipe Heat Exchanger
2. Heat transfer in Shell and Tube Heat Exchanger
3. Heat Transfer in a Bare and Finned Tube Heat Exchanger
4. Heat transfer in composite wall
5. Heat transfer by Forced / Natural Convection
6. Heat Transfer by Radiation - Determination of Stefan Boltzmann constant
7. Heat Transfer by Radiation - Emissivity measurement
8. Heat transfer in Open Pan Evaporator
9. Heat transfer by Single effect evaporation / Multiple effect evaporation
10. Boiling Heat Transfer
11. Heat Transfer through Packed Bed
12. Heat Transfer in a Horizontal Condenser / Vertical Condenser
13. Heat Transfer in Helical Coils
14. Heat Transfer in Agitated Vessels

TOTAL: 60 PERIODS

Minimum 10 experiments to be offered

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

1.	Double Pipe Heat Exchanger	1 No.
2.	Shell and Tube heat exchanger	1 No.
3.	Bare and Finned Tube Heat Exchanger	1 No.
4.	Composite wall set up	1 No.
5.	Natural convection set up or Forced convection set up	1 No.
6.	Stefan Boltzmann Apparatus	1 No.
7.	Emissivity measurement set up	1 No.
8.	Open Pan Evaporator	1 No.
9.	Single effect evaporator or Multiple effect evaporator	1 No.
10.	Boiler	1Compulsory equipment
11.	Packed Bed	1 No.
12.	Vertical Condenser or Horizontal Condenser	1 No.
13.	Helical Coil	1 No.
14.	Agitated Vessel	1 No.
15.	Jacketed vessel	1 No.

Any 10 equipment excluding boiler

OUTCOME:

- Student would be able to calculate heat transfer by conduction, different types of convection using classical models for these phenomena.

PE3361 FLUID MECHANICS AND SOLID OPERATIONS LABORATORY L T P C
0 0 4 2

OBJECTIVES:

- To learn experimentally to calibrate flow meters, find pressure loss for fluid flows and determine pump characteristics.
- Students develop a sound working knowledge on different types of crushing equipments and separation characteristics of different mechanical operation separators.

LIST OF EXPERIMENTS - Phase – I (minimum 5 Experiments to be conducted)

1. Calibration of constant and variable head meters
2. Open drum orifice and draining time
3. Flow through straight pipe
4. Flow through annular pipe
5. Flow through helical coil and spiral coil
6. Characteristic curves of pumps
7. Pressure drop studies in packed column

EQUIPMENT REQUIRED

1. Venturi meter
2. Orifice meter
3. Rotameter
4. Weir
5. Open drum with orifice
6. Pipes and fittings
7. Helical and spiral coils
8. Centrifugal pump
9. Packed column
10. Fluidized bed

LIST OF EXPERIMENTS - Phase- II (minimum 5 Experiments to be conducted)

1. Sieve analysis
2. Batch filtration studies using a Leaf filter
3. Batch filtration studies using a Plate and Frame Filter press
4. Characteristics of batch Sedimentation
5. Reduction ratio in Jaw Crusher
6. Reduction ratio in Ball mill
7. Separation characteristics of Cyclone separator
8. Reduction ratio of Roll Crusher
9. Drop weight crusher
10. Drag on Sphere
11. Effectiveness of screen

EQUIPMENT REQUIRED

1. Sieve shaker
2. Leaf filter
3. Plate and Frame Filter Press
4. Sedimentation Jar
5. Jaw Crusher
6. Ball Mill
7. Cyclone Separator
8. Roll Crusher
9. Elutriator
10. Drop Weight Crusher
11. Sieves.

TOTAL: 60 PERIODS

OUTCOMES:

- Use variable area flow meters and variable head flow meters
- Analyze the flow of fluids through closed conduits, open channels and flow past immersed bodies Select pumps for the transportation of fluids based on process conditions/requirements and fluid properties.
- Determine work index, average particle size through experiments by crushers, ball mill and conducting sieve analysis.
- Design size separation equipments such as cyclone separator, sedimentation, Filters etc.

PE3451 CHEMICAL ENGINEERING THERMODYNAMICS L T P C
3 0 0 3

OBJECTIVE:

- Students will learn PVT behaviour of fluids, laws of thermodynamics, thermodynamic property relations and their application to fluid flow, power generation and refrigeration processes.

UNIT I PVT RELATIONS AND FIRST LAW OF THERMODYNAMICS 9

Scope of thermodynamics, basic concepts and definitions, Equilibrium state and phase rule, Energy, Work, Temperature and Zeroth Law of Thermodynamics, reversible and irreversible process, Ideal gas- Equation of State involving ideal and real gas, Law of corresponding states, Compressibility chart, First Law of Thermodynamics and its consequences.

UNIT II SECOND LAW AND THERMODYNAMIC CORRELATIONS 9

Application of first Law of Thermodynamics for Flow and non-flow processes. Limitations of the first Law, statements of second Law of Thermodynamics, Thermodynamic Temperature scale, Entropy, Third law of thermodynamics. Thermodynamic Potentials, thermodynamic correlation, Maxwell relations. Clapeyron equation.

UNIT III SOLUTION THERMODYNAMICS 9

Partial molar properties, ideal and non-ideal solutions, standard states definition and choice, Gibbs-Duhem equation, activity and property change of mixing, excess properties of mixtures. Activity coefficient-composition models.

UNIT IV PHASE EQUILIBRIA 9

Phase equilibrium in ideal solution, excess Gibbs free energy models, Henry's law, fugacity, Vapor-Liquid Equilibrium at low, moderate and high pressures; bubble and dew point calculation, thermodynamic consistency test of VLE data, Phase diagrams for homogeneous systems and for systems with a miscibility gap, effect of temperature and pressure on azeotrope composition, liquid-liquid equilibrium.

UNIT V REACTION EQUILIBRIA 9

Chemical Reaction Equilibrium of single and multiple reactions, Standard Gibbs free change, equilibrium constant-effect of temperature; homogeneous gas and liquid phase reactions.

TOTAL: 45 PERIODS

OUTCOMES:

1. Understand the fundamentals of system of units, apply ideal gas law to solve problems in pure components and mixtures.
2. Apply stoichiometric principles to solve problems and write material balance for different process equipments.
3. Understand and apply basics of humidity to solve problems in humidification and other processes.
4. Understand and apply the basics of energy balance concepts to solve to different chemical processes.
5. Understand the basics of fuels and combustion, to solve problems on combustion of various fuels and also to find excess air.
6. Apply the above knowledge to process flow sheeting in industries.

TEXT BOOKS:

1. Sonntag, Borgnakke, Van Wylen, Fundamentals of Thermodynamics, 7th Edition, Wiley India, New Delhi, 2009.
2. Narayanan, K.V. A Textbook of Chemical Engineering Thermodynamics Prentice Hall India, 2004
3. Smith, van Ness and Abbott, "Chemical Engineering Thermodynamics", 7th Edition, McGraw Hill, New York, 2005

REFERENCES:

1. S. I. Sandler, Chemical, Biochemical and Engineering Thermodynamics, Wiley New York, 2006
2. Y V C Rao, "Chemical Engineering Thermodynamics", Universities Press, Hyderabad 2005.
3. Pradeep Ahuja," Chemical Engineering Thermodynamics", PHI Learning Ltd (2009).
4. Gopinath Halder," Introduction to Chemical Engineering Thermodynamics", PHI Learning Ltd (2009).

PC3451 PETROLEUM SECONDARY PROCESSING TECHNOLOGY L T P C
3 0 0 3

OBJECTIVE:

- Students will learn the process involving to convert one form of hydrocarbon into another form of hydrocarbon to meet the customer requirement using cracking, reforming, alklylation, isomerization and polymerization unit processes.

UNIT I VISBREAKING, THERMAL CRACKING AND COKING 9

Need and significance of Secondary Processing - Types and functions of Secondary Processing – Visbreaking: Principle - Process flow schemes - Coil type, Soaker drum Processes, operating parameters and advantages – Factors influencing visbreaking process.

Thermal Cracking: Process flow schemes, Reaction chemistry and free radical mechanisms, Factors influencing thermal cracking process.

Coking : Principle – Types – Advantages - Process flow schemes - Delayed Coking, Fluid Coking and Flexi-Coking processes - Factors influencing coking process

UNIT II CATALYTIC CRAKING AND HYDRO CRACKING 9

Catalytic Cracking: Principle - Advantages - Process flow schemes - Batch process and Continuous process - Fixed bed, Moving bed and Fludized bed catalytic cracking process, Reaction chemistry and carbonium ion mechanisms, Factors influencing catalytic cracking process. Commercial Catalyst.

Hydro Cracking: Principle - Advantages - Process flow schemes - Reaction chemistry - Factors influencing hydro cracking process - Commercial Catalyst

UNIT III CATALYTIC REFORMING AND POLYMERIZATION 9

Reforming: Principle - Advantages - Process flow schemes - Batch process and Continuous process - Reaction chemistry – Favourable and unfavourable reactions - Factors influencing reforming process - Commercial Catalyst Other commercial reforming process like Platforming, Houdri Forming, Rhein Forming, Power Forming, Selecto Forming. Ultra Forming and Rex Forming Polymerization: Principle - Advantages - Process flow schemes - Reaction chemistry and mechanisms, Factors influencing polymerization process - Commercial Catalyst.

UNIT IV ALKYLATION AND ISOMERIZATION 9

Alkylation Process: Principle - Advantages - Process flow schemes - Sulphuric Acid Alkylation, Hydrofluoric Acid Alkylation - Reaction chemistry, Factors influencing alkylation process - catalyst selection.

Isomerization Process: Principle - Advantages - Process flow schemes - Platinum Catalyst and Aluminium Chloride Process - Reaction chemistry, Factors influencing alkylation process - catalyst selection.

UNIT V FINAL TREATMENT TECHNIQUES 9

Acid gas and Sulphur Removal Techniques: Hydro Desulphurization Processes, Merox process, Metal Oxide process-Iron sponge process, Zinc Oxide process – Chem sweet process, Sulfa Check process, Amine process / Girbotol process and Molecular sieve process. Sulphur recovery using claus process.

TOTAL : 45 PERIODS

OUTCOME:

CO1. Understand the need of different secondary process and demonstrate appropriate technologies available to meet the specified needs of the petroleum products.

CO2. Select appropriate technologies to meet the specified needs of lighter petroleum products from heavier feed

CO3. Select appropriate technologies and different flow sheet to get aromatic and olefin compounds from paraffinic feed and getting heavier products from lighter feed

CO4. Understand different flow sheets, and appropriate technologies to maximize gasoline yield and quality.

CO5. Select appropriate technologies to get cleaner products and demonstrate knowledge on various application of specialty products obtained from crude oil

CO6. Acquiring knowledge on optimization of product blending for quality and quantity improvement.

TEXT BOOKS:

1. Jones, D.S.J. and Pujadó, P.R., Handbook of petroleum processing, Springer, The Netherlands, 2006
2. Nelson, W. L "Petroleum Refinery Engineering", McGraw Hill Publishing Company Limited,1985.
3. Watkins, R. N "Petroleum Refinery Distillations", 2nd Edition, Gulf Publishing Company, Texas, 1981.

REFERENCES:

1. Parkash, S., Refining processes handbook, Gulf Professional Publishing, 2003
2. Hobson, G. D "Modern Petroleum Refining Technology", 4th Edition, Institute of Petroleum, U. K. 1973.

CH3451 MASS TRANSFER I

L	T	P	C
3	0	0	3

OBJECTIVE:

The course is aimed to

- Learn and determine mass transfer rates under laminar and turbulent conditions and apply these concepts in the design of humidification columns, dryers and crystallisers.

UNIT I MOLECULAR DIFFUSION 9

Introduction to mass transfer operations. Molecular diffusion in gases, liquids and solids. Diffusivity measurement and prediction; multi-component diffusion.

UNIT II CONVECTIVE TRANSFER AND INTERPHASE MASS TRANSFER 9

Eddy diffusion, concept of mass transfer coefficients, theories of mass transfer, different transport analogies, application of correlations for mass transfer coefficients, inter phase mass transfer, relationship between individual and overall mass transfer coefficients. NTU and NTP concepts, Stage-wise and differential contractors.

UNIT III HUMIDIFICATION OPERATIONS 9

Humidification – Equilibrium, humidity chart, adiabatic and wet bulb temperatures; humidification operations; theory and design of cooling towers, dehumidifiers and humidifiers using enthalpy transfer unit concept.

UNIT IV DRYING 9

Drying – Equilibrium. Classification of dryers, batch drying – Mechanism and time of cross through circulation drying, theoretical estimation of drying rate and time. Continuous dryers – material and energy balance. Advance drying techniques such as freeze drying, microwave drying

UNIT V CRYSTALLIZATION 9

Crystal geometry. Equilibrium, yield and purity of products, theory of super saturation, nucleation and crystal growth, classification of crystallizers, design of batch crystallizers and continuous crystallizers.

TOTAL: 45 PERIODS

OUTCOMES:

On the completion of the course students are expected to

CO1: Understand the fundamentals, types and mechanism of mass transfer operations

CO2: Understand the theories of mass transfer and the concept of inter-phase mass transfer

CO3: Understand the basics of humidification process and its application

CO4: Understand the concept and mechanism of drying operations

CO5: Understand the concept of crystallization process and identification of suitable crystallizer

CO6: Formulate and solve material balances for unit operations such as humidification, drying and crystallization operations.

TEXT BOOKS:

1. Treybal, R. E., “Mass Transfer Operations”, 3rd Edition, McGraw-Hill,2017.
2. Geankoplis, C.J., “Transport Processes and Unit Operations”, 4th Edition, Prentice Hall Inc., NewJersey, 2003.
3. Narayanan K.V. and Lakshmikutty, B “Mass Transfer – Theory and Applications”, 1st Edition, CBS Publishers & Distributors Pvt Ltd, New Delhi, 2014.

REFERENCES:

1. McCabe, W.L., Smith, J.C., and Harriot, P., “Unit Operations in Chemical Engineering”, 7th Edition., McGraw-Hill, 2005.
2. Coulson, J.M. and Richardson, J.F., “Chemical Engineering” Vol. I and II, 5th Edition, Asian Books Pvt. Ltd., India, 2002.
3. Seader J.D. and Henley E.J., “Separation Process Principles”, 4th Ed., John Wiley, 2016

PC3401 INDUSTRIAL CHEMICAL TECHNOLOGY L T P C
3 0 0 3

OBJECTIVES

The course is aimed to Impart knowledge about unit process and unit operations in various industries. Develop understanding of manufacturing process flow drawing for the manufacturing chemical processes, its applications and major engineering problems encountered in the process

UNIT I CHLORO- ALKALI INDUSTRIES 9

Introduction to chemical processing; symbolic representation of different unit operations and unit processes to build a flow sheet ; Chlor - alkali Industries: Manufacture of Soda ash, Manufacture of caustic soda and chlorine - common salt.

UNIT II ACIDS 9

Sulphur and Sulphuric acid: Mining of sulphur and manufacture of sulphuric acid, Manufacture of hydrochloric acid. Phosphate rock, phosphoric acid.

UNIT III PULP, PAPER, SUGAR AND STARCH INDUSTRIES 9

Pulp – Methods of production – Comparison of pulping processes. Paper – types of paper products, Raw materials, Methods of production. Sugar – Methods of production – by products of the Sugar industry – Starch – Methods of production, Starch derivations.

UNIT IV CEMENT AND INDUSTRIAL GASES 9

Cement – properties of Cement – Methods of production – Fuel Gases – Producer gas, Water gas, Coke oven gas, Natural gas, Liquefied natural gas – Industrial gases – Carbon dioxide, hydrogen, nitrogen and oxygen.

UNIT V FERTILIZER INDUSTRY 9

Fertilizers: Nitrogen Fertilizers; Synthetic ammonia, nitric acid, Urea, Phosphorous Fertilizers: super phosphate and Triple Super phosphate

TOTAL: 45 PERIODS

OUTCOMES:

On the completion of the course students are expected to

CO1: Understand the various unit operations and processes with their symbols.

CO2: Understand the various chemical reactions involved in the process

CO3: Understand the manufacturing process involved

CO4: Know to draw the process Flow sheet and understand the major engineering problems encountered in the processes

CO5: Learn manufacturing processes of organic and Inorganic Chemicals and its applications.

CO6: Understand the role of chemical Engineering in the production

TEXT BOOKS:

1. M. Gopal Rao, Marshall Sittig Dryden's Outlines of Chemical technology, III Ed., Affiliate East West press, 2018.
2. Austin G.T., “Shreve's Chemical Process Industries”, 5th Edition, McGraw-Hill International Book Company, Singapore, 2012.

REFERENCES:

1. Moulin, J.A., M. Makkee, and Diepen, A.V., Chemical Process Technology, Wiley, 2001.
2. Srikumar Koyikkal,”Chemical Process Technology and Simulation”,PHI Learning Ltd (2013).
3. Mark W.V. and Bhatia S.C., “Chemical Process Industries”, Volume-I and II, 2nd Edition, CBS Publishers and Distributors, New Delhi, 2007.

CPE331 CHEMICAL REACTION ENGINEERING L T P C
3 0 0 3

OBJECTIVE:

- To enable the students to gain knowledge on different types of chemical reactors, the design of chemical reactors under isothermal and non-isothermal conditions

UNIT I KINETICS OF HOMOGENEOUS REACTIONS 9

Rate equation, elementary, non-elementary reactions, theories of reaction rate - Arrhenius theory, interpretation of kinetic data, integral and differential analysis.

UNIT II IDEAL REACTORS 9

Design equation for constant and variable volume batch reactors, Design of continuous reactors - stirred tank and tubular flow reactor, recycle reactors, combination of reactors-Equal sized CSTRs in series and parallel - Equal sized PFRs in series and parallel, size comparison of reactors.

UNIT III MULTIPLE REACTIONS 9

Design of reactors for multiple reactions – Series, parallel Reactions - factors affecting choice, optimum yield and conversion, selectivity, reactivity.

UNIT IV NON-ISOTHERMAL REACTORS 9

Heats of reaction and equilibrium conversion from thermodynamics, Non-isothermal homogeneous reactor systems, adiabatic reactors, Material and energy balances in batch reactors, Material and energy balances in plug flow and mixed flow reactors.

UNIT V NON-IDEAL REACTORS 9

Residence time distribution as a factor of performance; residence time functions and relationship between them in reactors; basic models for non-ideal flow-single parameter model, conversion in non-ideal reactors.

TOTAL: 45 PERIODS

OUTCOMES:

1. Apply the principles of reaction kinetics, formulate rate equations and analyze the batch reactor data.
2. Analyze the experimental kinetic data to select a suitable reactor for a particular application and to workout conversion and space time for different types of reactors.
3. Evaluate selectivity, reactivity and yield for parallel and mixed reactions.
4. Design isothermal and non-isothermal reactors for homogeneous reactions.
5. Examine how far real reactors deviate from the ideal reactors.
6. Solve the complex reaction engineering problems.

TEXT BOOKS:

1. Levenspiel O, “Chemical Reaction Engineering”, Wiley Eastern Ltd., III Edition, 2000.
2. Smith, J.M, “Chemical Engineering Kinetics”, McGraw Hill, III Edition, 1981.
3. Fogler.H.S., “Elements of Chemical Reaction Engineering”, Prentice Hall of India Ltd., III Edition, 2000.

REFERENCE:

1. Froment. G.F. & K.B.Bischoff, “Chemical Reactor Analysis and Design”, John Wiley and Sons, III Edition, 2010.

GE3451 ENVIRONMENTAL SCIENCES AND SUSTAINABILITY

L	T	P	C
2	0	0	2

UNIT I ENVIRONMENT AND BIODIVERSITY 6

Definition, scope and importance of environment – need for public awareness. Eco-system and Energy flow– ecological succession. Types of biodiversity: genetic, species and ecosystem diversity– values of biodiversity, India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ.

UNIT II ENVIRONMENTAL POLLUTION 6

Causes, Effects and Preventive measures of Water, Soil, Air and Noise Pollutions. Solid, Hazardous and E-Waste management. Case studies on Occupational Health and Safety Management system (OHASMS). Environmental protection, Environmental protection acts.

UNIT III RENEWABLE SOURCES OF ENERGY 6

Energy management and conservation, New Energy Sources: Need of new sources. Different types new energy sources. Applications of- Hydrogen energy, Ocean energy resources, Tidal energy conversion. Concept, origin and power plants of geothermal energy.

UNIT IV SUSTAINABILITY AND MANAGEMENT 6

Development , GDP ,Sustainability- concept, needs and challenges-economic, social and aspects of sustainability-from unsustainability to sustainability-millennium development goals, and protocols-Sustainable Development Goals-targets, indicators and intervention areas Climate change- Global, Regional and local environmental issues and possible solutions-case studies. Concept of Carbon Credit, Carbon Footprint. Environmental management in industry-A case study.

UNIT V SUSTAINABILITY PRACTICES 6

Zero waste and R concept, Circular economy, ISO 14000 Series, Material Life cycle assessment, Environmental Impact Assessment. Sustainable habitat: Green buildings, Green materials, Energy efficiency, Sustainable transports. Sustainable energy: Non-conventional Sources, Energy Cycles-carbon cycle, emission and sequestration, Green Engineering: Sustainable urbanization-Socio-economical and technological change.

TOTAL: 30 PERIODS

TEXT BOOKS:

1. Anubha Kaushik and C. P. Kaushik's "Perspectives in Environmental Studies", 6th Edition, New Age International Publishers ,2018.
2. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2016.
3. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004.
4. Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall.
5. Bradley. A.S; Adebayo, A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning.
6. Environment Impact Assessment Guidelines, Notification of Government of India, 2006.
7. Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication, London, 1998.

REFERENCE BOOKS :

1. R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media. 38 .
2. Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publ., House, Mumbai, 2001.
3. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT. LTD, New Delhi, 2007.
4. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, 2005.
5. Erach Bharucha "Textbook of Environmental Studies for Undergraduate Courses" Orient Blackswan Pvt. Ltd. 2013.

PC3461 PETROCHEMICAL AND POLYMER ANALYSIS LABORATORY L T P C
0 0 4 2

OBJECTIVE:

- To learn basic principles involved in analysis of petrochemical products.

LIST OF EXPERIMENTS (Any 12 Experiments)

1) Refractive index of petrochemicals
2) Flash and Fire point determination using Cleveland Open cup method
3) Flash and Fire point determination using Pensky Martien Closed cup method
4) Kinematic viscosity determination using Redwood
5) Kinematic viscosity determination using Saybolt
6) Determination of moisture content – KF titrator
7) Total acidity determination
8) Solvent Recovery from petrochemical feed stock
9) Elemental analysis of petrochemicals using GC / NMR
10) Functional group analysis of petrochemicals using UV / FTIR
11) Flue gas Analysis – Orsat Apparatus/Digital flue gas analyzer.
12) Determination of Density, Apparent Density of Polymer
13) Identification of Polymers : Plastics and Rubber – PE/PP/PS/PVC/PET/ NR/SBR/IR
14) Determination of hardness of Polymers
15) Determination of Glass Transition Temperature (Tg) / Melting Point, (Tm) of Polymers
16) Determination of molecular weight by end group analysis (COOH group) / viscosity method.

TOTAL: 60 PERIODS

OUTCOME:

CO1. Perform the testing of various physical properties of the petroleum products in a safe manner.

CO2. Perform the testing of various chemical properties of the petroleum products in a safe manner.

CO3. Differentiate various petroleum products by performing the specific tests.

CO4. Perform the advanced qualitative and quantitative laboratory tasks, including the operation of advanced analytical instrumentation.

CO5. Ability to communicate and perform in the team

CO6. Ability to understand the theoretical knowledge

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

1. Refractometer
2. Cleveland Open cup Flash and fire point apparatus
3. Pensky Martien Flash and fire point apparatus
4. Redwood Viscometer
5. Saybolt Viscometer
6. KF-Titrator
7. Rotary vacuum evaporator.
8. UV- Visible spectrophotometer/FTIR.
9. Gas Chromatography with MS/NMR with MS
10. Sulphur content determination instrument
11. Orsat apparatus/ Digital flue gas analyzer
12. Durometer
13. Melting point apparatus

PC3462 PETROLEUM PRODUCT TESTING LABORATORY

L	T	P	C
0	0	4	2

OBJECTIVE:

- On completion of the course, the students should be conversant with the theoretical principles and experimental procedures for quantitative estimation of petroleum products.

LIST OF EXPERIMENTS (Any 12 Experiments)

1. Specific gravity determination using API gravity / Specific gravity bottle method
2. Carbon residue determination Canrodson / Rams bottom method
3. Dynamic viscosity measerment / Kinematic viscosity by U-Tube viscometer
4. Moisture content determination using Dean & Stark / Centrifuge method
5. ASTM Distillation to identify petroleum fractions and find out boiling range
6. Aniline point determination
7. Copper strip corrosion testing of petroleum products
8. Cloud and Pour point determination
9. Smoke point determination
10. Reid-Vapor pressure determination of gasoline
11. BS&W separation using Centrifuge method
12. Drop point determination for industrial grease
13. Softening point determination
14. Ductility of bitumen - Determination
15. Penetration index determination
16. Calorific value of petrochemical product

TOTAL: 60 PERIODS

OUTCOME:

CO1. Perform the testing of various physical properties of the petroleum products in a safe manner.

CO2. Perform the testing of various chemical properties of the petroleum products in a safe manner.

CO3. Differentiate various petroleum products by performing the specific tests.

CO4. Perform the advanced qualitative and quantitative laboratory tasks, including the operation of advanced analytical instrumentation.

CO5. Ability to communicate and perform in the team

CO6. Ability to understand the theoretical knowledge

LIST OF EQUIPMENT

1. Hydrometer
2. Conradson Apparatus / Muffle furnace
3. Brook Field viscometer
4. Dean and Stark apparatus
5. ASTM Distillation apparatus
6. Aniline point apparatus
7. Copper corrosion apparatus
8. Cloud and Pour point apparatus
9. Smoke point apparatus
10. Reid -Vapour pressure apparatus
11. Centrifuge apparatus
12. Drop point apparatus
13. Ring and ball softening point apparatus
14. Ductilometer
15. Penetrometer
16. Bomb calorimeter

ANNA UNIVERSITY
PROGRESS THROUGH KNOWLEDGE