



ANNA UNIVERSITY, CHENNAI
AFFILIATED INSTITUTIONS
REGULATIONS 2021
CHOICE BASED CREDIT SYSTEM (CBCS)

B. TECH. PETROLEUM ENGINEERING

PROGRAM EDUCATIONAL OBJECTIVES:

Bachelor of Petroleum Engineering curriculum is designed to prepare the undergraduates to

1. Have attitude and knowledge for the successful professional and technical career
2. Have strong foundation in basic sciences, engineering, management, mathematics and computational platforms
3. Have knowledge on the theory and practices in the field of Petroleum technology and allied areas
4. Engross in life-long learning to keep themselves abreast of new developments, and practice and inspire high ethical values and technical standards

PROGRAM OUTCOMES:

The Petroleum Engineering Graduates will have the ability to

1. Apply knowledge of mathematics, sciences, engineering and Petroleum technology to get solution for the technological problems in Petroleum industry
2. Identify, formulate, review literature and critically analyze the technological problems in the Petroleum industry to reach substantiated conclusion
3. Design and develop the solutions to the technological and managerial problems in Petroleum industry with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations
4. 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 to the technological problems in Petroleum industry

5. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools for managing Petroleum companies with an understanding of the limitations
6. Apply reasoning gained through the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the profession
7. Understand the impact of the developed solutions in societal and environmental contexts, and demonstrate the knowledge for sustainable development
8. Understand ethical and professional responsibilities
9. Function effectively as an individual, and as a member or leader in diverse teams in the profession
10. Communicate effectively on complex engineering activities with the engineering community and with society at large. Able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. 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
12. 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.

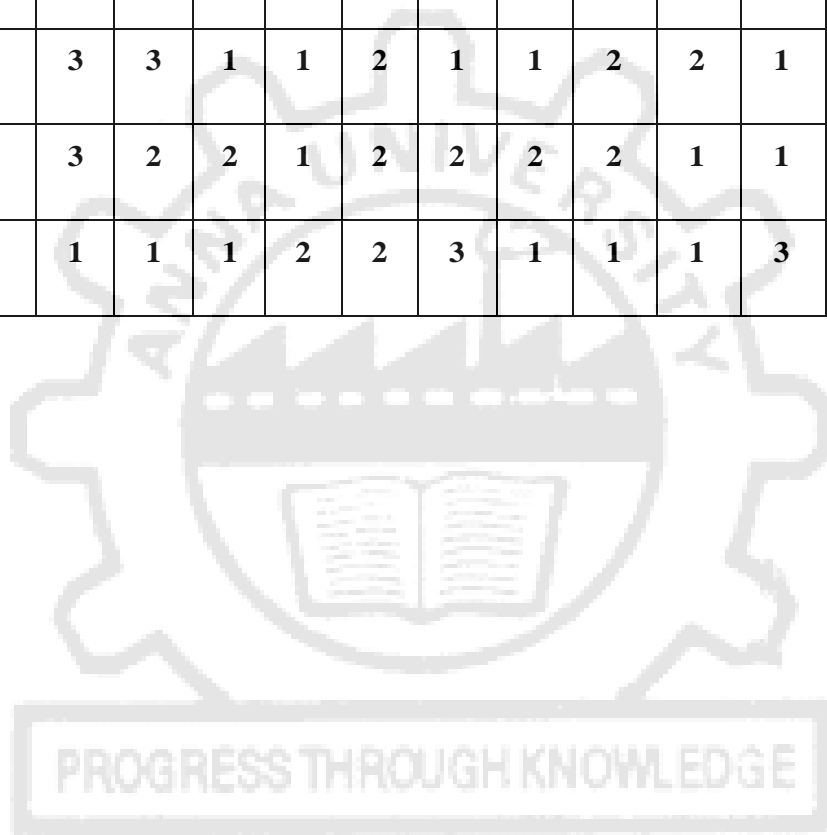
PROGRAM SPECIFIC OUTCOMES:

The Petroleum Engineering Graduates will have the ability to

1. Understand and apply fundamental and the technical knowledge for managing Petroleum industry
2. Be a successful entrepreneur and designer in Petroleum.
3. Design and develop novel products and manufacturing processes in Petroleum fields

PEO's – PO's & PSO's MAPPING

PEO	PO	PSO													
	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
I	3	3	3	1	2	2	2	3	2	3	2	1	3	3	2
II	3	3	3	3	1	1	2	1	1	2	2	1	2	2	1
III	3	3	3	2	2	1	2	2	2	2	1	1	3	3	2
IV	1	2	1	1	1	2	2	3	1	1	1	3	2	2	2



Year	Semester	Course Name	PO												PSO		
			1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
		HUMANITIES AND SOCIAL SCIENCES INCLUDING MANAGEMENT COURSES															
I	I																
I	II																
IV	VII																
IV	VII																
		Basic Science Courses [BSC]	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
I	I																
I	I																
I	I																
I	I																
I	II																
I	II																
I	II																
II	III	Transforms and Partial Differential Equations															
II	IV	Environmental Science and Sustainability															
		ENGINEERING SCIENCE COURSE [ESC]	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
I	I																
I	I																

I	II																
I	II																
I	II																
I	II																
II	III																
		PROFESSIONAL CORE COURSES [PCC]	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
II	III	Geophysics	3	2	2	3	2	-	1	-	-	2	1	2	2	1	-
II	III	Process Calculations	3	1	2	2	1	3	1	2	-	1	2	2	3	3	2
II	III	Fluid Mechanics and Solid Operations	3	2	2	3	2	-	1	-	-	2	1	2	2	1	-
II	III	Reservoir Rocks and Fluid Properties	3	2	2	3	2	-	1	-	-	2	1	2	2	1	-
II	III	Fluid Mechanics and Solid Operations Laboratory	3	1	2	2	1	3	1	2	2	1	2	2	3	3	-
II	III	Geology and Surveying Laboratory	3	1	2	2	1	3	1	2	2	1	2	2	3	3	2
II	IV	Drilling Fluids and Cementing Techniques	3	2	2	2	3	2	-	2	1	2	1	1	2	2	1
II	IV	Chemical Engineering Thermodynamics	3	2	2	1	2	1	1	-	-	2	1	2	3	2	1
II	IV	Heat Transfer	3	1	2	2	1	3	1	2	-	1	2	2	3	3	2
II	IV	Reservoir Engineering	3	3	2	2	2	1	1	-	1	2	2	1	3	1	2
II	IV	Well drilling Equipment and Operations	3	2	2	3	2	-	1	-	-	2	1	2	2	1	-

II	IV	Heat Transfer Laboratory	3	1	2	2	1	3	1	2	2	1	2	2	3	3	-
II	IV	Petroleum Testing Laboratory	3	1	2	2	1	3	1	2	2	1	2	2	3	3	2
III	V	Petroleum Equipment Design	3	1	2	2	1	3	1	2	-	1	2	2	3	3	2
III	V	Drilling Fluids and Cementing Techniques Laboratory	3	1	2	2	1	3	1	2	2	1	2	2	3	3	2
III	V	Computational Petroleum Engineering Laboratory	3	1	2	2	1	3	1	2	-	1	2	2	3	3	2
III	VI	Process Control and Instrumentation	3	1	2	2	1	3	1	2	-	1	2	2	3	3	2
III	VI	Process Control and Instrumentation Laboratory	3	1	2	2	1	3	1	2	-	1	2	2	3	3	2
III	VI	Oil Field Equipment Design and Drawing	3	1	2	2	1	3	1	2	-	1	2	2	3	3	2
IV	VII	Process Safety in Oil and Gas Industries	3	1	2	2	1	3	1	2	-	1	2	2	3	3	1
IV	VII	Well Completion Testing and Work Over	3	2	2	2	2	1	1	1	1	2	2	1	2	2	1

PROGRESS THROUGH KNOWLEDGE

	PROFESSIONAL ELECTIVES [PEC]															
	Well logging	3	2	3	2	2	1	1	-	-	1	1	2	3	2	1
	Numerical reservoir simulation	3	3	3	3	2	1	1	1	-	-	-	2	3	2	2
	Enhanced Oil Recovery Technologies	3	2	2	2	1	1	1	1	1	1	2	1	3	1	2
	Reservoir Characterizations and Modeling	3	2	3	2	1	-	-	-	-	-	-	-	3	1	2
	Flow Assurance in Petroleum Industries	3	3	1	1	1	-	-	-	-	-	-	1	3	1	2
	Petroleum Formation and Evaluation	3	3	3	2	2	-	-	-	-	-	-	1	3	1	2
	Mass Transfer	2	1	1	-	-	2	1	-	-	-	-	-	2	-	-
	Petroleum Refining and Petrochemicals	2	1	1	2	1	2	2	2	1	1	-	1	2	2	3
	Chemical Reaction Engineering	2	2	2	2	-	2	2	2	-	2	2	-	2	2	2
	Fluidsation Engineering	2	2	1	1	1	1	1	1	1	2	2	1	2	3	3
	Petroleum Corrosion Technology	1	2	3	3	2	1	1	2	2	1	2	2	1	1	-
	Process Plant Utilities	2	2	2	-	2	-	-	1	1	1	1	1	2	3	1

	Piping Engineering	-	1	2	2	2	1	1	2	2	1	1	-	2	2	2
	Storage Transportation of Crude oil and Natural gas	1	-	-	-	-	-	-	1	1	1	1	1	3	2	1
	Unconventional Hydrocarbon sources	-	-	2	-	3	-	-	2	2	1	2	1	-	2	-
	Design of Pressure Vessels and storage Vessels	-	-	-	-	1	-	-	-	-	1	1	-	1	2	1
	Natural Gas and LNG Processing	3	2	-	-	1	-	-	-	-	-	2	1	3	2	1
	Petroleum Economics	3	2	2	3	3	-	-	-	-	1	2	1	3	3	2
	Health Safety and Environmental Management	1	1	2	2	2	-	-	-	2	2	2	1	2	2	1
	Plant Safety and Risk Management	3	3	1	2	2	-	-	-	-	2	2	1	3	2	1
	Fire and Explosion Control	2	1	1	2	1	-	-	-	-	1	-	1	2	1	-
	Industrial Hygiene	3	2	3	3	2	-	-	-	-	-	-	1	3	2	3
	Transportation Safety	3	2	3	3	2	1	-	-	-	-	-	2	3	2	3
	Process Hazard Analysis Studies	3	2	2	2	1	-	-	-	-	-	-	1	3	2	3
	Renewable and Non-renewable Energy	3	2	2	2	-	-	-	-	-	-	-	1	3	1	2
	Energy Conservation and Management	3	2	2	2	-	-	-	-	-	-	-	1	3	1	2
	Energy Auditing and Demand Side Management	3	2	2	2	-	-	-	-	-	-	-	1	3	1	3

		Hydrogen and Microbial fuel cells	3	1	2	2	-	-	-	-	-	-	-	1	2	2	2
		Bio Fuels	3	-	-	2	1	-	-	-	-	-	-	1	3	1	1
		Unconventional Hydrocarbon Sources	3	2	2	2	1	-	-	-	-	-	-	2	3	2	3
		EMPLOYABILITY ENHANCEMENT COURSES (EEC)	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
II	IV	Industrial Training/Internship I*	3	3	2	2	2	2	2	2	2	3	2	2	2	2	2
III	V	Life Skills and Soft Skills															
III	V	Industrial Training/Internship I**	3	3	2	2	2	2	2	2	2	3	2	2	2	2	2
III	VI	Industrial Training/Internship II**	3	3	2	2	2	2	2	2	2	3	2	2	2	2	2
IV	VII	Industrial Training/Internship II*	3	3	3	3	1	1	1	2	2	2	2	1	3	2	3
IV	VIII	Industrial Training*/Project Work	3	3	3	3	1	1	1	2	2	2	2	1	3	2	3

PROGRESS THROUGH KNOWLEDGE

ANNA UNIVERSITY, CHENNAI
NON-AUTONOMOUS COLLEGES AFFILIATED COLLEGES
REGULATIONS 2021
B.TECH. PETROLEUM ENGINEERING
CHOICE BASED CREDIT SYSTEM
CURRICULUM FOR SEMESTERS I TO VIII AND SYLLABI FOR SEMESTERS III AND IV

SEMESTER I

S. No.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER			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	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

PROGRESS THROUGH KNOWLEDGE

SEMESTER II

S. No.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER			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	ESC	3	0	0	3	3
5.	PE3201	Introduction to Petroleum	PCC	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	ESC	0	0	4	4	2
9	GE3272	Communication Laboratory / Foreign Language \$	EEC	0	0	4	4	2
TOTAL				17	1	16	34	26

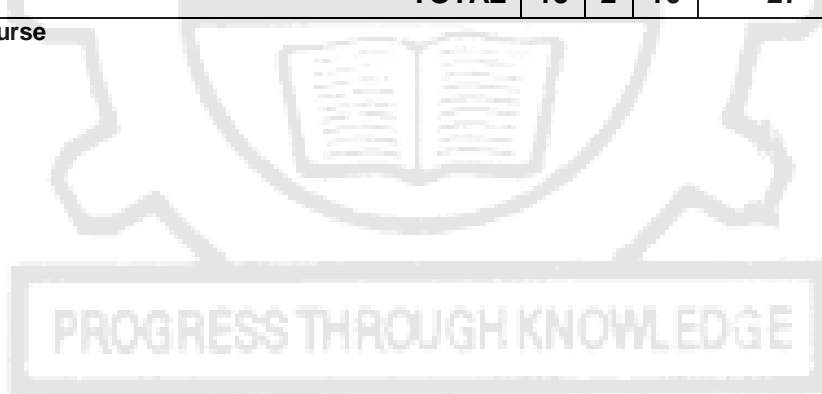
NCC Credit Course level 1 is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA.

\$ Skill Based Course

SEMESTER III

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	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.	PE3301	Geophysics	PCC	3	0	0	3	3
3.	PE3351	Process Calculations	PCC	3	0	0	3	3
4.	PE3302	Fluid Mechanics and Solid Operations	PCC	3	1	0	4	4
5.	PE3303	Reservoir Rocks and Fluid Properties	PCC	3	0	0	3	3
PRACTICALS								
6.	PE3361	Fluid Mechanics and Solid Operations Laboratory	PCC	0	0	4	4	2
7.	PE3311	Geology and Surveying Laboratory	PCC	0	0	4	4	2
8.	GE33361	Professional Development [§]	EEC	0	0	2	2	1
TOTAL				15	2	10	27	22

§ Skill Based Course



SEMESTER IV

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	PE3401	Drilling Fluids and Cementing Techniques	PCC	3	0	0	3	3
2.	PE3451	Chemical Engineering Thermodynamics	PCC	3	1	0	4	4
3.	CH3491	Heat Transfer	PCC	3	0	0	3	3
4.	PE3403	Reservoir Engineering	PCC	3	0	0	3	3
5.	PE3404	Well drilling Equipment and Operations	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.	PE3481	Heat Transfer Laboratory	PCC	0	0	4	4	2
9.	PE3411	Petroleum Testing Laboratory	PCC	0	0	4	4	2
10	PE3513	Industrial Training/Internship I*	EEC	-	-	-	-	-
TOTAL				17	1	8	29	22

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.

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

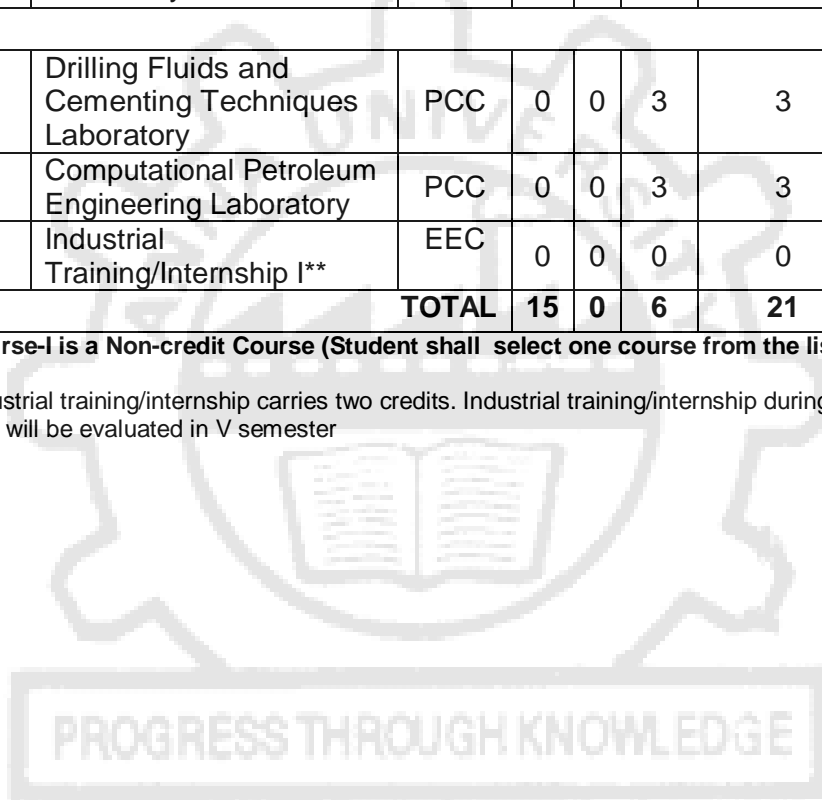
PROGRESS THROUGH KNOWLEDGE

SEMESTER V

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	PE3591	Petroleum Equipment Design	PCC	3	0	0	3	3
2.		Professional Elective I	PEC	3	0	0	3	3
3.	PE3501	Onshore Engineering	PCC	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.	PE3511	Drilling Fluids and Cementing Techniques Laboratory	PCC	0	0	3	3	1.5
8.	PE3512	Computational Petroleum Engineering Laboratory	PCC	0	0	3	3	1.5
9.	PE3513	Industrial Training/Internship I ^{**}	EEC	0	0	0	0	2
TOTAL				15	0	6	21	20

[&] 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.	PE3601	Process Control and Instrumentation	PCC	3	0	0	3	3
2.		Open Elective – I*	OEC	3	0	0	3	3
3.	PE3602	Offshore Engineering	PCC	3	0	0	3	3
4.		Professional Elective IV	PEC	3	0	0	3	3
5.		Professional Elective V	PEC	3	0	0	3	3
6.		Professional Elective VI	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.	PE3611	Process Control and Instrumentation Laboratory	PCC	0	0	4	4	2
10.	PE3612	Oil Field Equipment Design and Drawing	PCC	0	0	4	4	2
11.	PE3711	Industrial Training/Internship II ^{**}	EEC	-	-	-	-	-
TOTAL				21	0	8	29	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.

PROGRESS THROUGH KNOWLEDGE

SEMESTER VII/VIII*

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	PE3701	Process Safety in Oil and Gas Industries	PCC	3	0	0	3	3
2.	PE3702	Well Completion Testing and Work Over	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.	PE3711	Industrial Training/Internship II##	EEC	-	-	-	-	2
TOTAL				20	0	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	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
PRACTICALS								
1.	PE3811	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

ELECTIVE – MANAGEMENT COURSES

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			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	CATEGORY	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	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	MX3086	Well Being with traditional practices (Yoga, Ayurveda and Siddha)	MC	3	0	0	3	0
2.	MX3087	History of Science and Technology in India	MC	3	0	0	3	0
3.	MX3088	Political and Economic Thought for a Humane Society	MC	3	0	0	3	0
4.	MX3089	State, Nation Building and Politics in India	MC	3	0	0	3	0
5.	MX3090	Industrial Safety	MC	3	0	0	3	0

PROFESSIONAL ELECTIVE COURSES : VERTICALS

Vertical I Upstream Processing	Vertical II Petroleum Refining	Vertical III Hydrocarbon Transportation and Storage	Vertical IV Health, Safety and Environment	Vertical V Energy Engineering
Well logging	Mass Transfer	Piping Engineering	Health Safety and Environmental Management	Renewable and Non-renewable Energy
Numerical reservoir simulation	Petroleum Refining and Petrochemicals	Storage Transportation of Crude oil and Natural gas	Plant Safety and Risk Management	Energy Conservation and Management
Enhanced Oil Recovery Technologies	Chemical Reaction Engineering	Product Design and Development for Petrochemical Engineers	Fire and Explosion Control	Energy Auditing and Demand Side Management
Reservoir Characterizations and Modelling	Fluidization Engineering	Design of Pressure Vessels and storage Vessels	Industrial Hygiene	Hydrogen and Microbial fuel cells
Flow Assurance in Petroleum Industries	Petroleum Corrosion Technology	Natural Gas and LNG Processing	Transportation Safety	Bio Fuels
Petroleum Formation and Evaluation	Process Plant Utilities	Petroleum Economics	Process Hazard Analysis Studies	Unconventional Hydrocarbon Sources

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.

PROFESSIONAL ELECTIVE COURSES : VERTICALS

VERTICAL 1: UPSTREAM PROCESSING

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	PE3001	Well logging	PEC	3	0	0	3	3
2.	PE3002	Numerical reservoir simulation	PEC	3	0	0	3	3
3.	PE3003	Enhanced Oil Recovery Technologies	PEC	3	0	0	3	3
4.	PE3004	Reservoir Characterizations and Modelling	PEC	3	0	0	3	3
5.	PE3005	Flow Assurance in Petroleum Industries	PEC	3	0	0	3	3
6.	PE3006	Petroleum Formation and Evaluation	PEC	3	0	0	3	3

VERTICAL 2: PETROLEUM REFINING

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	EL3491	Mass Transfer	PEC	3	0	0	3	3
2.	PE3007	Petroleum Refining and Petrochemicals	PEC	3	0	0	3	3
3.	CPE331	Chemical Reaction Engineering	PEC	3	0	0	3	3
4.	CPE335	Fluidization Engineering	PEC	3	0	0	3	3
5.	CPE341	Petroleum Corrosion Technology	PEC	3	0	0	3	3
6.	PE3008	Process Plant Utilities	PEC	3	0	0	3	3

VERTICAL 3: HYDROCARBON TRANSPORTATION AND STORAGE

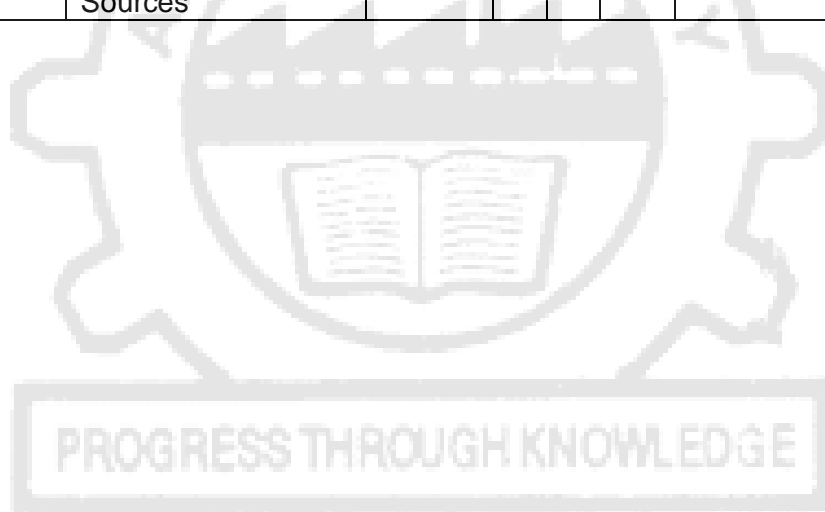
SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CPE343	Piping Engineering	PEC	3	0	0	3	3
2.	CPE345	Storage Transportation of Crude oil and Natural gas	PEC	3	0	0	3	3
3.	CPE340	Product Design and Development for Petrochemical Engineers	PEC	3	0	0	3	3
4.	CPE332	Design of Pressure Vessels and storage Vessels	PEC	3	0	0	3	3
5.	CPE339	Natural Gas and LNG Processing	PEC	3	0	0	3	3
6.	CPE342	Petroleum Economics	PEC	3	0	0	3	3

VERTICAL 4: HEALTH, SAFETY AND ENVIRONMENT

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CPE336	Health Safety and Environmental Management	PEC	3	0	0	3	3
2.	CPE344	Plant Safety and Risk Management	PEC	3	0	0	3	3
3.	PE3009	Fire and Explosion Control	PEC	3	0	0	3	3
4.	CPE338	Industrial Hygiene	PEC	3	0	0	3	3
5.	CPE346	Transportation Safety	PEC	3	0	0	3	3
6.	CPC333	Process Hazard Analysis Studies	PEC	3	0	0	3	3

VERTICAL 5: ENERGY ENGINEERING

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	PE3010	Renewable and Non-renewable Energy	PEC	3	0	0	3	3
2.	CPE334	Energy Conservation and Management	PEC	3	0	0	3	3
3.	CPE333	Energy Auditing and Demand Side Management	PEC	3	0	0	3	3
4.	CPE337	Hydrogen and Microbial fuel cells	PEC	3	0	0	3	3
5.	PE3011	Bio Fuels	PEC	3	0	0	3	3
6.	PE3012	Unconventional Hydrocarbon Sources	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	CATEGORY	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	CATEGORY	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.	OEN351	Drinking Water Supply and Treatment	OEC	3	0	0	3	3
21.	OEE352	Electric Vehicle technology	OEC	3	0	0	3	3
22.	OEI353	Introduction to PLC Programming	OEC	3	0	0	3	3
23.	OBT352	Biomedical Instrumentation	OEC	3	0	0	3	3
24.	OFD352	Traditional Indian Foods	OEC	3	0	0	3	3
25.	OFD353	Introduction to food processing	OEC	3	0	0	3	3
26.	OPY352	IPR for Pharma Industry	OEC	3	0	0	3	3
27.	OTT351	Basics of Textile Finishing	OEC	3	0	0	3	3
28.	OTT352	Industrial Engineering for Garment Industry	OEC	3	0	0	3	3
29.	OTT353	Basics of Textile Manufacture	OEC	3	0	0	3	3
30.	OCH353	Energy Technology	OEC	3	0	0	3	3
31.	OCH354	Surface Science	OEC	3	0	0	3	3
32.	OPT351	Basics of Plastics Processing	OEC	3	0	0	3	3
33.	OEC351	Signals and Systems	OEC	3	0	0	3	3
34.	OEC352	Fundamentals of Electronic Devices and Circuits	OEC	3	0	0	3	3
35.	OBM351	Foundation Skills in integrated product Development	OEC	3	0	0	3	3
36.	OBM352	Assistive Technology	OEC	3	0	0	3	3
37.	OMA352	Operations Research	OEC	3	0	0	3	3

38.	OMA353	Algebra and Number Theory	OEC	3	0	0	3	3
39.	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 Management	OEC	3	0	0	3	3
19.	OSF352	Industrial Hygiene	OEC	3	0	0	3	3
20.	OSF353	Chemical Process Safety	OEC	3	0	0	3	3
21.	OML352	Electrical, Electronic	OEC	3	0	0	3	3

		and Magnetic materials						
22.	OML353	Nanomaterials and applications	OEC	3	0	0	3	3
23.	OMR352	Hydraulics and Pneumatics	OEC	3	0	0	3	3
24.	OMR353	Sensors	OEC	3	0	0	3	3
25.	ORA352	Foundation of Automation	OEC	3	0	0	3	3
26.	ORA353	Concepts in Mobile Robotics	OEC	3	0	0	3	3
27.	OMV351	Marine Propulsion	OEC	3	0	0	3	3
28.	OMV352	Marine Merchant Vehicles	OEC	3	0	0	3	3
29.	OMV353	Elements of Marine Engineering	OEC	3	0	0	3	3
30.	OAE353	Drone Technologies	OEC	3	0	0	3	3
31.	OGI352	Geographical Information System	OEC	3	0	0	3	3
32.	OAI352	Agriculture Entrepreneurship Development	OEC	3	0	0	3	3
33.	OEN352	Biodiversity Conservation	OEC	3	0	0	3	3
34.	OEE353	Introduction to control systems	OEC	3	0	0	3	3
35.	OEI354	Introduction to Industrial Automation Systems	OEC	3	0	0	3	3
36.	OBT353	Environment and Agriculture	OEC	3	0	0	3	3
37.	OFD354	Fundamentals of Food Engineering	OEC	3	0	0	3	3
38.	OFD355	Food safety and Quality Regulations	OEC	3	0	0	3	3
39.	OPY353	Nutraceuticals	OEC	3	0	0	3	3
40.	OTT354	Basics of Dyeing and Printing	OEC	3	0	0	3	3
41.	OTT355	Fibre Science	OEC	3	0	0	3	3
42.	OTT356	Garment Manufacturing Technology	OEC	3	0	0	3	3
43.	OCH353	Energy Technology	OEC	3	0	0	3	3
44.	OCH354	Surface Science	OEC	3	0	0	3	3
45.	OPT352	Plastic Materials for Engineers	OEC	3	0	0	3	3
46.	OPT353	Properties and Testing	OEC	3	0	0	3	3

		of Plastics						
47.	OEC353	VLSI Design	OEC	3	0	0	3	3
48.	OEC354	Industrial IoT and Industry 4.0	OEC	2	0	2	4	3
49.	OBM353	Wearable devices	OEC	3	0	0	3	3
50.	OBM354	Medical Informatics	OEC	3	0	0	3	3

SUMMARY

Name of the Programme										
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	7	4	2					25
3	ESC	5	11							16
4	PCC		3	17	20	9	10	6		65
5	PEC					9	9			18
6	OEC						3	9		12
7	EEC	1	2	1		2		2	10	18
8	Non-Credit (Mandatory)					√	√			
Total		22	26	22	22	20	22	22	10	166

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 · N O.	COURSE CODE	COURSE TITLE	CATE GORY	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	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CMG337	Foundations of Entrepreneurship	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	CATEGORY	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	CATEGORY	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

PROGRESS THROUGH KNOWLEDGE

MA3351	RANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS	SL	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.

PE3301

GEOPHYSICS

L	T	P	C
3	0	0	3

OBJECTIVE:

- To review the basic geophysical concepts as used in the petroleum industry; Applications of seismic data in the reservoir mapping and description.

UNIT I

9

Geophysics as a tool for mapping of subsurface geological features- Introduction. Gravity and magnetism measurement methods. Gravity anomalies and their measurements. Magnetics anomalies and their measurement. Seismic methods.

UNIT II

9

Wave theory, seismic wave reflection and refraction and their use in data acquisition. Seismic attributes- Introduction. Classification of attributes, Reservoir properties, tectonics and fault planes. Lithology, structure and Sedimentology.

UNIT III

9

Land and marine geophysical methods. 2D 3D seismic methods. 3D exploration. Non conventional methods, VSP, shear waves and channel waves, seismic data processing, attribute analysis and migration techniques.

UNIT IV **9**
3D interpretation- fault recognition and mapping. Limitations on 2D fault mapping. Advantage of 3D diagram. 3D structural mapping. Stratigraphic interpretation. Analysis of direct hydrocarbon indicators.

UNIT V **9**
Reservoir evolution – Reservoir management. 4D seismic. Inversion of seismic. 4D reservoir characterization. Work stations- Introduction. Hardware and software. Work station capabilities. Display techniques. 3D visualization.

TOTAL: 45 PERIODS

OUTCOME:

- Student would be able to understand: Main geophysical methods; Wave propagation- P and S waves, Alteration at interfaces (reflection/refraction); Seismic method (data gathering and interpretation); Use and limits of seismic in reservoir description.

TEXT BOOKS:

1. S.BOYER & J.J.MARI “Seismic Surveying and Well logging”- Technip Editions, 2004.
2. J.J.MARI & E.COPPENS “Well Seismic surveying”- Technip Editions, 2003.

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)**

- Understand the fundamentals of system of units, apply ideal gas law to solve problems in pure components and mixtures.
- Apply stoichiometric principles to solve problems and write material balance for different process equipments.
- Understand and apply basics of humidity to solve problems in humidification and other processes.
- Understand and apply the basics of energy balance concepts to solve to different chemical processes.
- Understand the basics of fuels and combustion, to solve problems on combustion of various fuels and also to find excess air.
- 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. Hougén 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 ProcessCalculation", PHI Learning Ltd.(2013).

PE3302	FLUID MECHANICS AND SOLID OPERATIONS	L	T	P	C
		3	1	0	4

OBJECTIVE:

- To impart to the student knowledge on fluid properties, fluid static and dynamic characteristics flow metering and transport, particle mechanics, techniques of solid – fluid separation

UNIT I PROPERTIES OF FLUID**15**

Newtonian fluids Classification of fluid motion Fluid statics – equilibrium of fluid element – pressure variation in a static fluid – Differential analysis of fluid motion – continuity, Euler's and Bernoulli equation

UNIT II FLOW THROUGH PIPES & BOUNDARY LAYER CONCEPTS 15
 Reynolds number regimes, Flow through pipes – pressure drop under laminar and turbulent flow conditions; boundary layer concepts; different types of flowmeters; Valves, pumps, compressors – characteristics and sizing; Agitation and Mixing;

UNIT III SIZE ANALYSIS 15
 General characteristics of solids, techniques of size analysis; Laws of size reduction, equipments for size reduction

UNIT IV FLOW THROUGH FLUIDIZED BEDS 15
 Flow over a sphere – friction and pressure drag - flow through fixed and fluidized beds. Filtration – batch and continuous, filtration equipments - selection, operation

UNIT V CLASSIFIERS 15
 Screening, gravity separation - sedimentation, thickening, elutriation, classifiers - Centrifugal separation - continuous centrifuges, cyclones and hydro cyclones, electrostatic and magnetic separators

TOTAL:75 PERIODS

OUTCOME:

- At the end of this course, the students will be able to understand the principles of fluid mechanics and applications of mechanical operations in process industries.

TEXT BOOKS:

1. Noel de Nevers, "Fluid Mechanics for Chemical Engineers ", Third Edition, McGraw-Hill, (2005).
2. Badger W.L. and Banchero J.T., "Introduction to Chemical Engineering", Fifth Edition, Tata McGraw Hill, 2001.

REFERENCES:

1. Munson, B. R., Young, D.F., Okiishi, T.H. "Fundamentals of Fluid Mechanics", 5th Edition", John Wiley, 2006
2. McCabe W.L, Smith, J C and Harriot. P "Unit operations in Chemical Engineering", McGraw Hill, V Edition, 2001
3. Coulson, J.M. and Richardson, J.F., "Chemical Engineering" Vol. I, 4th Edn., Asian Books Pvt. Ltd., India, 1998.

PE3303 RESERVOIR ROCKS AND FLUID PROPERTIES L T P C
3 0 0 3

OBJECTIVES:

To enable the students to understand

- Petroleum reservoir system and fluid properties
- Basic principles and operations in upstream petroleum industry

UNIT I 9

The earth, crust, plate tectonics and geologic times. Sedimentary geology, Basins and Margins. Origin, accumulation and migration of petroleum. Properties of subsurface fluids. Petroleum Chemistry.

UNIT II**9**

Porosity. Permeability. Porosity – Permeability relationship. Electrical properties of rocks. Measurement of formation resistivity. Correlation of F_R with porosity, permeability and water saturation. F_R of Shaly Reservoir rocks. Effect of stress on porous rocks. Formation evaluation.

UNIT III**9**

Fluid Saturation and Capacity pressure. Determination of capillary pressure. Pore size distribution. Wettability. Evaluation of wettability and its effect on oil recovery. Alteration of wettability. Effect of wettability on electrical properties of rocks.

UNIT IV**9**

Linear flow of incompressible fluids. Linear flow of gas. Darcy's and Poiseuille's laws. Various flow systems. Multiple permeability rocks.

UNIT V**9**

Reservoir fluid properties – Phase behaviour of hydrocarbon system. Fluid rock interactions. Reservoir fluid characteristics. PVT analysis. Flash liberation and differential liberation study.

TOTAL: 45 PERIODS**OUTCOME:**

- Student will learn the use of Darcy's Law to calculate permeability of single phase; definition of interfacial tension; use of capillary pressure to determine saturation changes in reservoir; definition of effective and relative permeability; use of drainage/imbibition curves to characterize reservoir relative permeability.

TEXT BOOKS:

1. Craft, B.C. and Hawkins M.F. revised by Ronald E. Terry and J. Brandon Rogers, "Applied Petroleum Reservoir Engineering" third edition, Prentice-Hall (2014)
2. Djebbar Tiab and Erle C. Donaldson "Theory and practice of measuring Reservoir rock and fluid Transport properties" fourth edition, Gulf Professional Publishing (2015)

REFERENCE:

1. Amyx, J.W., Bass D.M. & Whiting., R.L., "Petroleum Reservoir Engineering" McGraw Hill 1998.

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 - 1 No.
2. Orifice meter - 1 No.
3. Rotameter - 1 No.
4. Weir - 1 No.
5. Open drum with orifice - 1 No.
6. Pipes and fittings - 1 No.
7. Helical and spiral coils - 1 No.
8. Centrifugal pump - 1 No.
9. Packed column - 1 No.
10. Fluidized bed - 1 No.

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 - 1 No.
2. Leaf filter - 1 No.
3. Plate and Frame Filter Press - 1 No.
4. Sedimentation Jar - 1 No.
5. Jaw Crusher - 1 No.

6. Ball Mill - 1 No.
7. Cyclone Separator - 1 No.
8. Roll Crusher - 1 No.
9. Elutriator - 1 No.
10. Drop Weight Crusher - 1 No.
11. Sieves. - 1 No.

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.

PE3311

GEOLOGY AND SURVEYING LABORATORY

L	T	P	C
0	0	4	2

OBJECTIVE:

- To demonstrate various methods involved in the preparation of structural maps and interpretation and calculation the thickness of the beds, studying depositional environment using grain size analysis and find out sediment types using Sand – Silt – Clay ratio.

LIST OF EXPERIMENTS

Geology laboratory

- 1) Calculation of True and Apparent Dip.
- 2) Estimation of Thickness, Distance and Depth of the ore body.
- 3) Estimation of Throw and Nature of the fault.
- 4) Interpretation of surface Geology using contour maps.
- 5) Sand – Silt – Clay ratio estimation.
- 6) Grain – Size analysis.
- 7) Identification of important sedimentary rocks in hand specimen.
- 8) Identification of important sedimentary rocks in microscopic level

Surveying Laboratory

1. Study of linear measuring instruments and chain surveying.
2. Study of theodolite and traversing with theodolite,
3. Study of levels and ordinary leveling with tilting level, Profile leveling,
4. Study of total station and measurement with total station.
5. Study of Global Positioning System (GPS) and measurement with GPS.

TOTAL: 60 PERIODS

OUTCOME:

- Students will be able to understand the preparation of Geological maps and identify the rock specimens by Megascopic and Microscopic, Identify the Depositional environment and Sediment types.

- Students will gain a basic understanding of the principles and operation of the Global Positioning System
- Students will gain the ability to measure differences in elevation, draw and utilize contour plots, and calculate volumes for earthwork
- Students will improve ability to function as a member of a survey party in completing the assigned field work
- Students will Appreciate the need for licensed surveyors to establish positioning information for property and structures.

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

- 1) Sieve Shakers - 1 No.
- 2) Sieves set. - 1 No.
- 3) Petrological Microscopes - 1 No.
- 4) Hot even - 1 No.
- 5) 1000 ml and 50 ml beakers - 1 No.

PE3401	DRILLING FLUIDS AND CEMENTING TECHNIQUES	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To enable the students to understand the types of drilling fluids and cementing techniques

UNIT I **9**

Introduction to the basic functions and properties of drilling fluids and cement slurries. Compositions and related properties of drilling fluids and cement slurries.

UNIT II **9**

Drilling fluids – classification – water base drilling fluids. Testing of drilling fluids. Drilling fluid additives.

UNIT III **9**

Types of equipment and methods used in cementing operations. Drilling fluid and cement slurry hydraulics.

UNIT IV **9**

Determination of torque and drag. Calculation of cutting transport efficiency. Placement technique of cements. Gas migration through cement columns.

UNIT V **9**

Well cementing – chemistry of cements. Cementing principles – primary cementing, secondary cementing, linear cementing, plug cementing, and single stage cementing, multistage casing cementing.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of this course, the students would have

- Learned the concepts and applications of drilling fluids

- Learned the equipments involved in the cementing operations

TEXT BOOKS:

1. Rabia.H. 'Oil Well Drilling Engineering, Principles And Practices' Graham And Trotman Ltd. 1985.
2. Smith.P.K, 'Cementing' SPE Pulications 2nd Edition 1976.
3. Cementing Technology – Powel Schlumberger Publication 1984.

REFERENCES:

1. Mc.Cray. A.W and Cole.F.W. 'Oil Well Drilling Technology' University of Oklahoma Press, Norman 1959.
2. Standard Handbook of petroleum and Natural Gas Engineering. 2nd Edition. William C Lyons, Gary C Plisga. Gulf Profession.

PE3451	CHEMICAL ENGINEERING THERMODYNAMICS	L	T	P	C
		3	1	0	4

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 **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 **9**

Joule's experiment, internal energy, enthalpy, Application of first Law of Thermodynamics for Flow and non flow processes. Limitations of the first Law , statements of second Law of Thermodynamics and its Applications ,Heat Engine, Heat Pump/Refrigerator, Carnot cycle and Carnot theorem, Thermodynamic Temperature scale, Entropy , Clausius inequality, Third law of thermodynamics.

UNIT III **9**

Refrigeration and liquefaction process, Thermodynamic Potentials, thermodynamic correlation, Maxwell relations, criteria for Equilibria and stability. Clapeyron equation

UNIT IV **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.

UNIT V **9**

Activity coefficient-composition models, thermodynamic consistency of phase equilibria, ChemicalReaction equilibria, Extent of reaction, equilibrium constant and standard free energy change

TOTAL: 60 PERIODS

OUTCOME:

- The course will help the students to know about engineering thermodynamics and understand the practical implications of thermodynamic law in engineering design.

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. GopinathHalder," Introduction to Chemical Engineering Thermodynamics", PHI Learning Ltd (2009).

CH3491**HEAT TRANSFER**

L	T	P	C
3	0	0	3

OBJECTIVE:

- To enable the students to learn heat transfer by conduction, convection and radiation and heat transfer equipments like evaporator and heat exchanger

UNIT I**9**

Importance of heat transfer in Chemical Engineering operations - Modes of heat transfer - Fourier's law of heat conduction - one dimensional steady state heat conduction equation for flat plate, hollow cylinder, - Heat conduction through a series of resistances - Thermal conductivity measurement; effect of temperature on thermal conductivity; Heat transfer in extended surfaces.

UNIT II**11**

Concepts of heat transfer by convection - Natural and forced convection, analogies between transfer of momentum and heat - Reynold's analogy, Prandtl and Coulburn analogy. Dimensional analysis in heat transfer, heat transfer coefficient for flow through a pipe, flow past flat plate, flow through packed beds.

UNIT III**9**

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 IV **8**

Theory of evaporation - single effect and multiple effect evaporation - Design calculation for single and multiple effect evaporation. Radiation heat transfer - Black body radiation, Emissivity, Stefan - Boltzmann law, Plank's law, radiation between surfaces.

UNIT V **8**

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

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course,

- The students would have knowledge in various heat transfer methodology in process engineering.
- To design heat transfer equipments such as furnace, boilers, heat exchangers evaporation

TEXT BOOKS:

1. Holman, J. P., 'Heat Transfer', 8th Edn., McGraw Hill, 1997.
2. Ozisik, M. N., Heat Transfer: A Basic Approach, McGraw-Hill, 1984
3. Kern, D.Q., "Process Heat Transfer", McGraw-Hill, 1999.

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.

PE3403	RESERVOIR ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

To enable the students to

- Understand the rock and fluid properties of a hydrocarbon reservoir
- Describe the nature of the fluid flow and pressure distribution in a reservoir
- Understand the effects of production/ injection on recovery of reserves

UNIT I **12**

Introduction to Reservoir Engineering, Basic principles, definitions and data – Reservoir fluids, oil, gas, Gas formation volume factor, oil formation, volume factor, water formation volume factor – oil, gas water, rock compressibility – Resistivity index, wettability and contact angle, effective permeability characteristics, capillary pressure curves – Resistivity factors and saturation exponents. Fluid PVT analysis and oil gas phase behaviour.

UNIT II **12**

Fluid flow in reservoirs, Fluid movement in water flooded Reservoirs – Recovery efficiency – Areal or pattern. Sweep efficiency, - Vertical or invasion sweep efficiency, - Permeability

variation – Cross flow – Estimates of volumetric sweep efficiency – Estimation of water flood recovery by material balance – prediction methods – Monitoring injectivity. Darcy Law and application.

UNIT III **12**

Multi-phase flow: Relative permeability-fractional flow. Well performance – inflow performance, tubing performance.

UNITIV **12**

Recommended methods for assessing residual oil – Existing wells, new wells, Chemical Flooding, Gas injection, Thermal recovery – Well Testing.

UNIT V **12**

Well performance – Reservoir management and simulation – reservoir data acquisition – Reservoir simulation. Mathematical basis of bottom hole analysis; Differential equations for radial flow in a porous medium. Pressure draw down and build up analysis.

TOTAL: 60 PERIODS

OUTCOME:

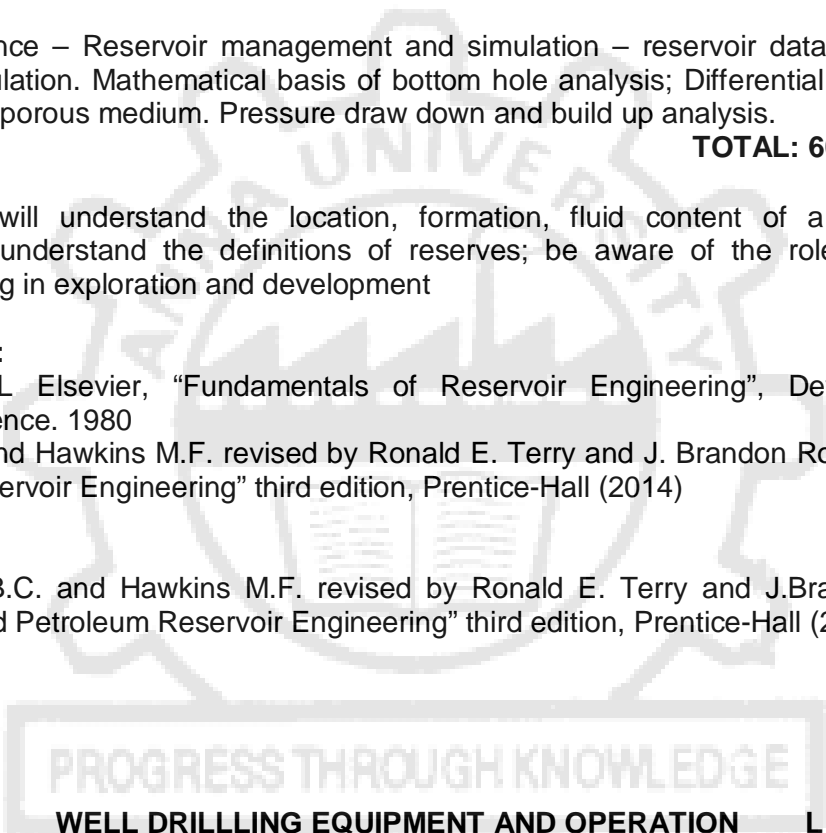
- Students will understand the location, formation, fluid content of a hydrocarbon reservoir; understand the definitions of reserves; be aware of the role of reservoir engineering in exploration and development

TEXT BOOKS:

- 1.L.P. Dake L Elsevier, “Fundamentals of Reservoir Engineering”, Development in Petroleum Science. 1980
- 2.Craft, B.C. and Hawkins M.F. revised by Ronald E. Terry and J. Brandon Rogers “Applied Petroleum Reservoir Engineering” third edition, Prentice-Hall (2014)

REFERENCE:

1. Craft, B.C. and Hawkins M.F. revised by Ronald E. Terry and J.Brandon Rogers “Applied Petroleum Reservoir Engineering” third edition, Prentice-Hall (2014)



PE3404	WELL DRILLING EQUIPMENT AND OPERATION	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To make the students learn about the Drilling Process and Drilling Equipments.

UNIT I **9**

Drilling operations – Location to Rig..Rig Types – Land Types – Marine types- Release Well Bore Diagram, Crews – Operator – Drilling, contractor – Third Party Services.

UNIT II **9**

Components- Overall Drilling Rig, Drilling Sub systems – Mud circulation system – Power – Hoisting Line – speeds and Loads Power – Loading Components – Drill Pipe, Heavy Weight Drill Pipe (HWDP), Drill String Loads - Bottom hole assembly-Drilling Assembly

UNIT III **9**
 Directional Drilling, Well Planning, Two Dimensional, Horizontal, Tools, Techniques, MWD, surveying, Muds, Mud Use, Property measurements, Types, - Pneumatic (Air, Gas, Mist, Foam), Water based, Oil based, solids Control, Definitions, Equipment, Problems, Contaminations Effect.

UNIT IV **9**
 Hydraulics, Classifications of Fluids, Rheological Models – Rotary Drilling Hydraulics – Jet Hydraulic Optimizing and Maximizing – Circulations Rate Selection – Drill Bit – Jet Sizing – Equivalent Circulations Density, Hole Cleaning. Theory – Vertical and Deviated Holes, Annular Velocities – Carrying Capacity – Pills and Slugs.

UNIT V **9**
 Origin of Overpressure, Kick Signs, shut –in Procedures, Kill sheets, Kill Procedures, Driller’s Methods – Engineer’s Method (Wait and Weight)

TOTAL: 45 PERIODS

OUTCOME:

- Students will understand the concepts and techniques used in well drilling. They will learn the design requirements of well planning and construction. Students would be able to optimize the design of a drilling program

TEXT BOOKS:

1. Rabia.H. ‘Oil Well Drilling Engineering, Principles And Practices’ Graham And Trotman Ltd. 1985.
2. D.P Helander ‘Fundamentals Of Formation Evaluation’

REFERENCE:

1. Standard Handbook of Petroluem and Natural Gas Engineering, 2nd Edition, William C Lyons, Gary C Pilisga, Gulf Professional Publishing.

GE3451	ENVIRONMENTAL SCIENCES AND SUSTAINABILITY	L	T	P	C
	<i>PROGRESS THROUGH KNOWLEDGE</i>	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.

OBJECTIVE:

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

LIST OF EXPERIMENTS

- Heat Transfer in a Double Pipe Heat Exchanger
- Heat transfer in Shell and Tube Heat Exchanger
- Heat Transfer in a Bare and Finned Tube Heat Exchanger
- Heat transfer in composite wall
- Heat transfer by Forced / Natural Convection
- Heat Transfer by Radiation - Determination of Stefan Boltzmann constant
- Heat Transfer by Radiation - Emissivity measurement
- Heat transfer in Open Pan Evaporator
- Heat transfer by Single effect evaporation / Multiple effect evaporation
- Boiling Heat Transfer
- Heat Transfer through Packed Bed
- Heat Transfer in a Horizontal Condenser / Vertical Condenser
- Heat Transfer in Helical Coils
- 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 | 1 Compulsory 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.

OBJECTIVE:

- To make the student to be conversant with the theoretical principles and experimental procedures for quantitative estimation of petroleum products.

LIST OF EXPERIMENTS

1. Fluid viscosity determination
2. Carbon residue determination
3. Karl-Fisher Conductometer Apparatus for water estimation
4. Fluid density
5. Aniline point
6. Corrosion testing of petroleum oils and copper
7. Freezing point of Aqueous Engine coolant solution
8. Automatic Distillation
9. Fire point- Flash point
10. Gas Colorific value determination
11. liquid or solid Colorific value determination
12. Smoke point determination
13. Cloud and pour point determination
14. Softening point determination
15. Ductility of bitumen
16. Penetration index determination

TOTAL: 60 PERIODS**OUTCOMES:**

- Perform the various physical and chemical properties of the petroleum products in a safe manner.
- Differentiate various petroleum products by performing the specific tests.
- Perform the advanced qualitative and quantitative laboratory tasks, including the operation of advanced analytical instrumentation.

LIST OF EQUIPMENT

1. Redwood / Saybolt / Engler viscometer - 1 No.
2. Conradson Apparatus - 1 No.
3. Muffle furnace - 1 No.
4. Hydrometer - 1 No.
5. Aniline point apparatus - 1 No.
6. Copper corrosion Apparatus - 1 No.
7. Freezing / Cloud / Pour point apparatus - 1 No.
8. Junkers Gas Calorimeter / Bomb Calorimeter - 1 No.
9. Cleveland / PenskyMartien open and closed cup Flash and fire point Apparatus-1 No.
10. API Distillation Apparatus- 1 No.
11. Abbey Refractometer - 1 No.
12. Dean and Stark apparatus- 1 No.
13. Karl –Fisher Apparatus - 1 No.
14. Softening point apparatus - 1 No.
15. Ductilometer - 1 No.
16. Penetrometer - 1 No.