GUJARAT TECHNOLOGICAL UNIVERSITY
Master of Engineering, Chemical (Computer Aided Process Design)
Subject Code - 3721617
Semester II
Subject Name: Petroleum Refining & Petrochemical Technology

Type of course: Program Elective –IV

Prerequisite: Basics of Chemical Process Industries and reaction engineering

Rationale:
Petroleum refining as well as petrochemical industries constitute a major part of chemical sector. Every chemical engineer has to invariably handle the enormous consumption of petroleum products, their diversity and increasing applications. Chemical engineer has to apply the relevant concepts for operating petroleum refinery or petrochemical plant in a smooth and safe manner. This course will present an overview of the modern, integrated petroleum refinery, its feedstocks, product slate and the processes employed to convert crude oil and intermediate streams into finished products. Hydrocarbon chemistry, crude oil properties and fuel product quality will be discussed. Each refining process will be presented, covering operating description and conditions, feedstock and catalyst selection, product yields, and the relationship between process parameters, unit performance and product output and properties. This course provides major insights into both primary and secondary processes like Atmospheric Distillation, Vacuum Distillation, Cracking, Hydrocracking, Catalytic Reforming, Processes like Coking, Visbreaking, in a typical refinery.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	0	3	70	30	0	0	100

Syllabus Content:

Sr. No.	Content	Total Hrs
1	Introduction: Indian and Global Petroleum Industries: an overview, emerging crude oil quality and fuel norms, natural gas, shale gas and gas hydrates, changing scenario in crude oil and natural gas availability	4
2	Composition of petroleum, laboratory tests, refinery feedstocks and products. Evaluation of crude oil properties and Design of crude oil distillation column, well testing ,exploration and completion	4
3	Evaluation of crude oil and petroleum products, Composition of crude oil, TBP Assay, ASTM distillation, Product quality analysis and fuel norms.	4
4	Processing of Natural gas and LNG, Enhanced oil recovery	4

5	Thermal Conversion Processes: Thermal Cracking Reactions, Thermal Cracking, Vis breaking, Coking Processes , Delayed and Flexi Coking, Petroleum Coke.	**4**
6	Catalytic Conversion Process: Cracking Feed stocks and reactors, Effect of process variables. Fluid Catalytic Cracking (FCC), Catalyst coking and regeneration, Design concepts, New Designs for Fluidized-Bed Catalytic Cracking Units. Catalytic Reforming. Objective and application of catalytic reforming process, reforming catalysts. Reformer feed, reforming reactor design continuous and semi regenerative process.	**7**
7	Hydro treating and Hydro cracking: Objectives & Hydro cracking Reactions, Hydro cracking feed stocks, Modes of Hydro cracking, Effects of process variables. Hydro treating process and catalysts Resid hydro processing, Effects of process variables, Reactor design concepts.	**4**
8	Isomerization, Alkylation and Polymerization: Isomerization process, Reactions, Effects of process variables. Alkylation process, Feedstocks, reactions, products, catalysts and effect of process variables. L3: Polymerization: Objectives, process, Reactions, catalysts and effect of process variables.	**4**
9	Lube oil processing: propane deasphalting Solvent extraction, dewaxing, Additives production from refinery feed stocks.	**3**
10	Finishing and Sweetening processes : Desulfurization and hydro desulfurisation of petroleum products., Sweetening Processes, Desulphurisation of sour water, sulphur recovery.	**6**
11	Petrochemical Technology : Physical & Chemical Properties, Various Routes of Production, Manufacturing Processes, Flow Sheets, Thermodynamics & Kinetics Consideration of important petrochemicals like Caprolactum, carbon black ,propylene ,ethylene , acetic acid etc;	**7**
12	Future refining trend s: Biofuel, gas to liquid technology, carbon foot prints in petroleum refining, concept of Petrochemical refinery, gas refinery and Biorefinery. Introduction to petroleum software.	**3**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
14	**14**	**28**	**7**	**7**	**--**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1.B. K.Bhaskar Rao, Modern Petroleum Refining Processes, Oxford and IBH 2007 .
2. M Gopal Rao, Dryden's Outlines of chemical technology, 3rd Edition East-West press pvt. Ltd, Delhi
3. B.K.Bhaskar Rao, A Text on Petrochemicals, 2nd Edition, Khanna Publishers, Delhi, 1998
4. George Austin, Shreve's Chemical Process Industries,5th Edition McGraw Hill publication –New Delhi.
5. W.L.Nelson, Petroleum Refinery Engineering, McGraw Hill, Newyork, 1958.
6. James H, Gary & Glenn E. Handwerk, Petroleum Refining, Technology & Economics, 4thEdition, Marcel Dekker, Inc, 2001.
8. Speight, J. G., The Chemistry and technology of Petroleum, 5th Edition, M. Dekker, 1991.
9. Watkins, R. N., Petroleum Refinery Distillation, 2nd Edition Gulf Pub. Co., Houston, Tex, 1979.

Course Outcomes:

Sr. No.	CO statement	Marks % weightage
CO-1	Understand fundamentals of petroleum refinery & various petrochemical plants.	20
CO-2	Characterize & Test various properties of different petroleum fractions.	30
CO-3	Understand scenario of refinery & petrochemical industries.	20
CO-4	Understand manufacturing processes & applications of widely used petrochemicals.	30

Major Equipment :

1. Penskey Martin apparatus:
2. Cleveland Flash and Fire Point apparatus:
3. Ram's bottom apparatus:
4. Conradsonapparatus
5. Cloud and pour point apparatus:
6. ASTM Distillation apparatus:

7. Saybolt Viscometer
8. Engler Viscometer
9. Smoke point apparatus
10. Ring & Ball apparatus
11. Bomb calorimeter
12. Able's apparatus
13. Constant Temperature Bath
14. Aniline Point apparatus

List of Open Source Software/learning website:

1.NPTEL lecture series
2.Literature available for Petroleum Refining
3 MIT Open course lecture on Petroleum Refining