



GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering

Subject Code: 3160510

Semester – VI

Subject Name: Petroleum Refining and Petrochemicals

Type of course: Professional Elective Course

Prerequisite: Basics of Chemical Technologies

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 safe manner. Beside this, a chemical engineer must be aware about the various properties of petroleum fractions as well as petrochemicals. Hence, this course has been designed to develop such expertise and skills.

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
			ESE (E)	PA (M)	ESE (V)	PA (I)		
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
PETROLEUM REFINING		
1	Basics of Petroleum: Role of Crude Oil in Global Economy, Present Scenario of Crude Oil Refinery, Origin(Formation), Composition, Classification and Evaluation of Crude Oil, Crude Assay Analysis, Distillation Characteristics such as TBP,ASTM & EFV etc.	04
2	Properties of Petroleum Products: Types of Gases and their Composition, Types of Gasoline & it's Important Properties and Tests such as ASTM Distillation , RVP, Octane number , Oxidation stability , Sulphur Content etc., Various types of Naphtha and their Important Properties and Application, Important tests and Properties of Kerosene such as Flash & Fire Point , Smoke Point , Aniline Point etc., Types of Diesel & its Important Properties and Tests such as Pour Point, Diesel Index , Cetane Number etc. , Heavy Fractions Like Lube Oil, Bitumen ,Asphalt etc. and their Important Properties Such as Viscosity Index, Carbon Residue, Penetration Index, Softening Point etc.	06
3	Processing of Petroleum: Pretreatment of Crude (Dehydration & Desalting), Pumping of Waxy Crude , Heating of Crude , Distillation of Petroleum & Types of Reflux , ADU & VDU etc	05



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4	Treatment Techniques: Physical Impurities Found in Crude & their Removal, Sweetening Techniques, Production and Treatment of LPG, Gasoline Treatment Such as Lead Doctoring, Merox Sweetening, Catalytic Desulphurization etc. Various Methods of Treatment of Lubes Such as Phenol Extraction , Furfural Extraction, etc.	06
5	Thermal & Catalytic Cracking : Necessity and types of cracking Thermal cracking: Mechanism of Thermal Cracking, Properties of Cracked Materials, Visbreaking, Dubb's Two Coil Process, Delayed Coking, Naphtha Cracking etc. Catalytic cracking: Advantages & Theory of Catalytic Cracking, Fixed Bed, Moving Bed & Fluidized Bed Technology, FCC, Hydrocracking, Catalytic Reforming, Platforming, Continuous Catalyst Regeneration Reforming, Catalytic Polymerization, Catalytic Alkylation, Catalytic Isomerization etc.	09
PETROCHEMICALS		
Properties, Uses, Manufacturing Processes, Flow-Sheets etc. of following Petrochemicals		
6	C1 and C2 Petrochemicals: Methanol, Formaldehyde, Chlorome thane etc. Ethylene, Ethylene Dichloride, Vinyl Chloride, Ethylene Oxide, Ethylene Glycol, Ethanol amines etc.	05
7	C3, C4, Aromatics and Polymers: Propylene, Butadiene, etc. BTX Separation, p-xylene, Styrene, p-terephthalic acid, etc. PVC, LDPE, LLDPE, HDPE, Polypropylene , Polypropylene Co-polymers , Polystyrene , SBR ,PBR, Polyesters etc.	10

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R level	U Level	A Level	N Level	E Level	C Level
14	28	14	14	0	0

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



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- George Austin, Shreve's Chemical Process Industries, 5th edition McGraw Hill publication –New Delhi.
- W.L.Nelson, Petroleum Refinery Engineering, McGraw Hill, New York, 1958.
- James H, Gary & Glenn E. Handwerk, ' Petroleum Refining, Technology & Economics', 4th Edition, Marcel Dekker, Inc, 2001.
- Speight, J. G., The Chemistry and technology of Petroleum, 5th Edition, M. Dekker, 1991.
- Watkins, R. N., Petroleum Refinery Distillation, 2nd Edition Gulf Pub. Co., Houston, Tex, 1979.

Course Outcomes:

Students should be able to

Sr. No.	CO statement	Marks % weightage
CO-1	Define various test properties of crude oil and petroleum products and also explain their physical significance.	20
CO-2	Explain crude oil processing, treatment techniques and cracking reactions taking place in a petroleum refinery.	40
CO-3	Apply acquired knowledge of refinery processing and manufacturing technologies of producing petrochemicals for problem solving.	20
CO-4	Compare various routes of production of widely used petrochemicals.	20

List of Experiments:

1.	To determine the carbon residue of given sample by Ramsbottom apparatus.
2.	To determine the carbon residue of given sample by Conradson apparatus.
3.	To determine the calorific value of given sample by bomb calorimeter.
4.	To determine the viscosity of given sample using Engler viscometer at different temperatures.
5.	To determine the viscosity of given sample using Saybolt viscometer at different temperatures.
6.	To determine the flash & Fire point of given oil sample using Cleveland open cup apparatus.
7.	To determine the smoke point of given kerosene (with and without acid treatment) sample using smoke point apparatus.
8.	To determine the percentage of corrosive sulfur in a given petroleum product using constant temperature bath.
9.	To characterize the given petroleum product (Diesel, petrol etc.) by A.S.T.M distillation (To plot ASTM curve)
10.	To find out the flash point of given oil sample using Abel's apparatus
11.	To determine the flash and fire point of given sample of oil using Pensky-Martin apparatus.
12.	To determine the softening point and penetration index of Bitumen
13.	To determine the cloud and pour point of a given oil sample
14.	To determine the aniline point of a given sample.

Major Equipments:

- Pensky Martin apparatus
- Cleveland Flash and Fire Point Apparatus:



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3. Softening point Apparatus
4. Ram's bottom Apparatus
5. Conradson carbon residue Apparatus
6. Cloud and pour point Apparatus
7. ASTM Distillation Apparatus
8. Red wood viscometer:
9. Saybolt Viscometer
10. Engler Viscometer
11. Constant Temperature bath
12. Bomb calorimeter
13. Able's apparatus

Open Source Software/learning website:

- Video lectures available on the websites including NPTEL lecture series
- Open access Literature available for Petroleum Refining
- MIT Open course lecture on Petroleum Refining