B. Tech. Semester V

Subject Name: Petroleum Refinery Science & Engineering **Subject Code: BTCH15501**

Type of course: **Open elective I**
Prerequisite: Basic Chemistry
Rationale: Students will be able to understand sources and processes of manufacture of various chemicals such as petroleum and petroleum products, petrochemicals.

Teaching and Examination Scheme:

TEACHING SCHEME				Theory Marks			Practical Marks		Total
L	T	P	C	TEE	CA1	CA2	TEP	CA3	
3	0	2	4	60	25	15	30	20	150

CA1: Continuous Assessment (assignments/projects/open book tests/closed book tests **CA2:** Sincerity in attending classes/class tests/ timely submissions of assignments/self-learning attitude/solving advanced problems **TEE:** Term End Examination **TEP:** Term End Practical Exam (Performance and viva on practical skills learned in course) **CA3:** Regular submission of Lab work/Quality of work submitted/Active participation in lab sessions/viva on practical skills learned in course

Content:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1	Introduction to Crude and Petroleum refining in India	3	7
2	Chemistry of alkanes, alkenes and alkynes: Acyclic and cyclic compounds. General reactions. Functionalization of alkanes – alkanes to alkenes and haloalkanes. Alkanes as fuels – environmental issues, carbon footprint. Oligomerization and polymerization of olefins	4	9
3	Sources of organic compounds: Coal, petroleum, biomass. Petrochemical processes. C1 sources, natural gas hydrates.	6	14
4	Crude oil evaluation: Introduction to Overall Refinery Flow, refinery tests	8	20
5	Products of refining : Low-Boiling Products, Distillate Fuels, Heating Oils, Residual Fuel Oils and their specification and applications	3	6
6	Refinery Feedstocks : Crude Oil Properties, Composition of Petroleum, Crudes Suitable for Asphalt Manufacture, Crude Distillation Curves like ASTM, TBP, EFV Concepts	3	6
7	Crude Distillation : Desalting Crude Oils, Atmospheric Topping Unit, Vacuum Distillation, Auxiliary Equipment	4	9
8	Types, Properties, and Uses of Petroleum Coke, Process Description—Delayed Coking, Flexicoking, Fluid Coking, Yields from Flexicoking and Fluid Coking, Visbreaking	4	9
9	Brief introduction to coking and thermal processes catalytic cracking, catalytic hydrocracking, hydroprocessing, hydrotreating, catalytic reforming and isomerisation, alkylation and polymerization, product blending and supporting processes.	10	20

Suggested Specification table with Marks (Theory/Practical):

% Distribution of Marks					
R Level	U Level	A Level	N Level	E Level	C Level
35	30	30	05	0	0

Legends: R: Remembrance, **U:** Understanding; **A:** Application, **N:** Analyze, **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 Text Books:

Sr. No.	Title of book /article	Author(s)	Publisher and details like ISBN	Year of publication	Publication Edition
1	Modern Petroleum Refining Processes	Rao B.K.B.,	Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi	2002	4th Ed
2	Petroleum Refinery Engineering	W. L. Nelson,	McGraw-Hill Book Company, New York	1958	4th Ed.
3	Handbook of Petroleum Processing	David S. J. Jones, Peter R. Pujado,	Springer Publication	2008	4th Ed.

Course Outcome:

Sr. No.	CO Statement After learning this subject, students will be able to	Marks % weightage
CO-1	Understand crude evaluation and global petroleum refining scenario	25
CO-2	Interpret the significance of tests and ASTM standards	20
CO-3	Analyze simple mechanisms and processing requirements for derivation of petroleum products	15
CO-4	Interpret process flow diagrams/process block diagrams for the manufacture of various chemicals from process description	20
CO-5	Evaluate major engineering problems and simplify the manufacturing process for a trouble free and safe operation.	20

Mapping with POs:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO-1	1	2	1	3	2	3	3	2	1	1	3	3	3	2	2
CO-2	3	3	2	3	2	3	3	2	2	3	3	3	3	3	2
CO-3	3	2	2	3	2	3	3	3	3	2	3	3	3	3	2

CO-4	3	3	3	2	3	3	3	3	2	3	3	3	2	3	3
CO-5	2	3	3	3	3	3	3	3	3	2	3	3	2	3	3
Rationale*	12	13	11	11	12	15	15	13	11	11	15	15	13	14	12

Rationale*: All COs are satisfying the well-defined POs & PSOs

LIST OF PRACTICALS: (Minimum 7 to be performed.)

Sr No.	Description
1	To determine Softening Point for given Petroleum sample.
2	To determine Drop Point for given Petroleum sample.
3	To determine Flash and Fire point of petroleum product by Pensky Marten's apparatus.
4	To determine cloud and pour point for given petroleum sample.
5	To determine Aniline point & Diesel Index for given petroleum sample
6	To determine the carbon residue by Conradson method
7	To determine the Penetration Index using standard Penetrometer device
8	Study ASTM standards: Copper strip Corrosion Test
9	Study ASTM standards: Reid Vapor Pressure
10	Study ASTM standards: Smoke point

Major Equipment: ASTM standard apparatus for experiments 1-7.

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List of Open Source/learning website:

- https://nptel.ac.in/courses/103/102/103102022/
  Refinery introduction, feedstocks, tests, evaluation
- https://nptel.ac.in/courses/114/106/114106017/
  Safety, health Environment engg
- https://nptel.ac.in/courses/114/106/114106042/
  Hazard management
- https://nptel.ac.in/courses/103/103/103103207/
  Biomass conversion and refinery