B. Tech. Semester VI

Subject Name: Petroleum Engineering and Petrochemicals **Subject Code: BTCH14601**

Type of course: Professional Elective Course IV
Prerequisite: Basic Chemistry, Unit processes, Chemical Process Industries.
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	150
3	0	2	4	60	25	15	30	20	

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 Overall Refinery Flow	2	5
2	PRODUCTS: Low-Boiling Products, Distillate Fuels, Heating Oils, Residual Fuel Oils and their specification and applications.	3	7
3	REFINERY FEEDSTOCKS :Crude Oil Properties, Composition of Petroleum, Crudes Suitable for Asphalt Manufacture, Crude Distillation Curves like ASTM, TBP, EFV.	3	7
4	CRUDE DISTILLATION Desalting Crude Oils, Atmospheric Topping Unit, Vacuum Distillation, Auxiliary Equipment	3	7
5	COKING AND THERMAL PROCESSES Types, Properties, and Uses of Petroleum Coke, Process Description—Delayed Coking, Flexicoking, Fluid Coking, Yields from Flexicoking and Fluid Coking, Visbreaking	3	7
6	CATALYTIC CRACKING: Fluidized-Bed Catalytic Cracking, Cracking Reactions, Cracking Catalysts, FCC Feed Pretreating, Process Variables, Heat Recovery.	4	9
7	CATALYTIC HYDROCRACKING Hydrocracking Reactions, Feed Preparation, Hydrocracking Process, Hydrocracking Catalyst, Process Variables, Hydrocracking Yields	4	9

8	HYDROPROCESSING AND RESIDUE PROCESSING Composition of Vacuum Tower Bottoms, Processing Options, Hydroprocessing, Expanded-Bed Hydrocracking Processes, Moving-Bed Hydroprocessors, Solvent Extraction	4	7
9	HYDROTREATING Hydrotreating Catalysts, Aromatics Reduction, Reactions, Process Variables, Construction and Operating Costs	2	4
10	CATALYTIC REFORMING AND ISOMERIZATION Reactions, Feed Preparation, Catalytic Reforming Processes, Reforming Catalyst, Reactor Design, Yields and Costs, Isomerization	4	9
11	ALKYLATION AND POLYMERIZATION Alkylation Reactions, Process Variables, Alkylation Feedstocks, Alkylation Products, Catalysts, Hydrofluoric Acid Processes, Sulfuric Acid Alkylation Processes, Comparison of Processes, Alkylation Yields and Costs, Polymerization	3	7
12	PRODUCT BLENDING Reid Vapor Pressure, Octane Blending, Blending for Other Properties	3	6
13	SUPPORTING PROCESSES Hydrogen Production and Purification, Gas Processing Unit, Acid Gas Removal, Sulfur Recovery Processes	3	7
14	CRUDE TO CHEMICALS Physical & Chemical Properties, Various Routes of Production, Manufacturing Processes, Flow Sheets, Thermodynamics & Kinetics Consideration & Major Engineering Problems for following Petrochemicals C1, C2, C3 & Aromatic Petrochemicals, polymers.	4	9

Suggested Specification table with Marks (Theory/Practical):

% Distribution of Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
40	**25**	**25**	**05**	**05**	**00**

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	Shreve's Chemical Process Industries"	Austin G. T.	McGraw-Hill Pub.	1994	5th Ed.
4	Dryden's Outlines of Chemical Tech.	Gopalarao M. & Sitting M.	East-West Pub., New Delhi	1997	2nd Ed.

Course Outcome:

Sr. No.	CO Statement After learning this subject, students will be able to	Marks % weightage
CO-1	Understand the evaluation of crude	30
CO-2	Interpret the significance of tests and ASTM standards	25
CO-3	Interpret process flow diagrams/ process block diagrams for the separation of various petroleum products from process description	15
CO-4	Evaluate problems and design alternative routes for carrying out a particular process and provide recommendations for the best choice.	20
CO-5	Apply standard maintenance and operation procedures for safe and trouble free plant operation.	10

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	3	2	2	1	1	2	2	2	1	1	3	3	3	2	2
CO-2	2	3	2	3	2	2	3	3	3	2	3	3	3	3	2
CO-3	3	3	2	3	2	2	3	3	3	3	3	3	3	2	3
CO-4	3	3	2	3	2	3	3	3	3	3	3	3	3	2	3
CO-5	3	3	3	2	3	3	3	3	3	3	3	3	2	3	2
Rationale *	14	14	11	12	10	12	14	14	13	12	15	15	14	12	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 all 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/103/103/103103207/
  Biomass conversion and refinery
- https://nptel.ac.in/courses/114/106/114106042/
  Hazard management