

**PETROLEUM REFINERY ENGINEERING
(CHEN 4132)**

Time Allotted : 2½ hrs

Full Marks : 60

Figures out of the right margin indicate full marks.

*Candidates are required to answer Group A and
any 4 (four) from Group B to E, taking one from each group.*

Candidates are required to give answer in their own words as far as practicable.

Group – A

1. Answer any twelve:

12 × 1 = 12

Choose the correct alternative for the following

- (i) The Copper strip corrosion test indicates mainly corrosion by
(a) Nitrogen (b) Acids
(c) Sulfur (d) Oxygen.
- (ii) Cetane number of diesel is determined by comparing against a mixture of n-hexadecane and
(a) n-heptane (b) Cyclohexane
(c) n- Octane (d) hepta methyl nonane.
- (iii) The pressure in a VDU is around
(a) 500 mm Hg (b) 300 mm Hg
(c) 760 mm Hg (d) 40-80 mm Hg.
- (iv) INDMAX is a technology for
(a) Delayed coking (b) Visbreaking
(c) Hydrocracking (d) FCC.
- (v) 2,2,4 tri methyl pentane is also known as
(a) iso pentane (b) iso heptane
(c) iso octane (d) iso hexane.
- (vi) Hydrotreating is used for
(a) Removal of water from crude oil
(b) Improving Octane number of gasoline
(c) Improving cold flow property of ATF
(d) Removal of Sulfur and Nitrogen from petroleum fractions.
- (vii) Which catalyst is used for catalytic reforming?
(a) Ni (b) Pt-Rh (c) Co-Mo (d) Ni-Mo.

- (viii) API gravity of heavy crude is
 (a) >25 but < 31.1 (b) >5 but <10
 (c) > 31.1 (d) <22.3.
- (ix) The solvent used for deasphalting in LOBS production is
 (a) MEK (b) Furfural (c) Hexane (d) Propane.
- (x) The vapour locking characteristics of a fuel is determined by its
 (a) Pour point (b) Smoke point
 (c) Cloud point (d) RVP.

Fill in the blanks with the correct word

- (xi) ASTM distillation gives an idea about the _____ in an oil sample.
- (xii) API Gr. II LOBS has a VI of around _____.
- (xiii) Zeolite is an _____ catalyst.
- (xiv) The catalyst-vapor mixture in an FCC unit is separated in a _____.
- (xv) Sweetening mainly involves removal of _____.

Group - B

2. (a) The molal average boiling point of a crude oil sample is 601.5°F and its Watson characterization factor is 12. Determine whether the crude oil is a heavy, light or medium crude oil. [[CO1](Apply/IOCQ)]
- (b) The T₅₀ of two gasoline samples are 65°C and 105°C. According to ASTM standards, the 50% recovery temperature for gasoline should be around 88°C - 90°C. What problems may be faced by the cars using these two samples as fuel? [[CO1](Evaluate/HOCQ)]
6 + 6 = 12
3. (a) A design engineer for a newly set up atmospheric distillation unit has designed the pump around reflux circuits using side draw liquids from the LPG and light naphtha trays. As his/her superior, what would your reaction be? Justify. [[CO1,2,3](Evaluate/HOCQ)]
- (b) What is the utility of pre-fractionation? [[CO1,2,3](Understand/LOCQ)]
- (c) Why the VDU column has a larger diameter than the ADU column? [[CO1,2](Analyse/IOCQ)]
4 + 4 + 4 = 12

Group - C

4. (a) The feed to a catalytic reforming unit is passed through a hydrotreater at first. What is the reason for this? [[CO2,3](Analyse/IOCQ)]
- (b) Why is a portion of the product hydrogen gas recycled to the catalytic reforming unit? [[CO2,3](Analyse/IOCQ)]
- (c) What is the fate of the off-gases produced in the distillation columns of the secondary processing units in a refinery? [[CO2,3](Understand/LOCQ)]
4 + 4 + 4 = 12

5. (a) What is the function of the expander in the regeneration section of a FCC unit? *[[CO2,3](Analyze/IOCQ)]*
 (b) What modification is done in the catalyst for FCC so as to produce more olefins and increase the octane number of the gasoline formed? *[[CO2,3](Understand/LOCQ)]*
 (c) What are the main feedstocks of an FCC unit? *[[CO2](Remember/LOCQ)]*
- 4 + 4 + 4 = 12**

Group - D

6. (a) What is the function of make-up hydrogen in a hydrocracker? *[[CO3,4](Analyze/IOCQ)]*
 (b) What would be the effect on the condenser duty of the condenser in the fractionating section of the hydrocracker if the pressure let-down valve between the HP and LP separators does not function properly? *[[CO3,4](Evaluate/HOCQ)]*
 (c) What are the main products from the hydrocracker unit? Why is the hydrocracker important with respect to environmental considerations? *[[CO3,4](Analyze/IOCQ)]*
- 3 + 4 + (3 + 2) = 12**
7. (a) Recycling improves the R.O.N. of the isomerate. Justify. *[[CO3,4](Evaluate/HOCQ)]*
 (b) What is the principal engineering problem associated with isomerisation operation? *[[CO3,4](Understand/LOCQ)]*
 (c) How is temperature control in the polymerisation process achieved? *[[CO4](Analyze/IOCQ)]*
- 4 + 4 + 4 = 12**

Group - E

8. (a) If the aromatic removal step during LOBS manufacturing is not carried out, what will be the effect on the VI of the LOBS? *[[CO4](Analyze/IOCQ)]*
 (b) Propane deasphalting is necessary to improve the viscosity and volatility of LOBS. Justify. *[[CO4](Evaluate/HOCQ)]*
 (c) What is the difference between catalytic dewaxing and catalytic iso-dewaxing? *[[CO4](Understand/LOCQ)]*
- 4 + 4 + 4 = 12**
9. (a) There is a recent shift of the refining companies towards integration with petrochemical complexes. Justify. *[[CO4](Evaluate/HOCQ)]*
 (b) What are the problems associated with the storage and transportation of Hydrogen and what are some proposed solutions? *[[CO4](Analyze/IOCQ)]*
- 6 + 6 = 12**

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	25	46	29

Course Outcome (CO):

After the completion of the course students will be able to

1. Understand the oil refining process.
2. Categorize associated downstream processing technologies, operations and economics.
3. Grasp the principles for improving refinery economics.
4. Develop the essential knowledge and skills required to work as an engineer in the oil, gas and petrochemical sectors.

**LOCQ: Lower Order Cognitive Question; IOCQ: Intermediate Order Cognitive Question; HOCQ: Higher Order Cognitive Question.*