

**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) Sour crude contains a high amount of
(a) Nitrogen (b) Sulfur (c) Oxygen (d) Acids.
- (ii) RON measurement is carried out in an engine running at
(a) 600 rpm (b) 900 rpm (c) 800 rpm (d) 400 rpm.
- (iii) Vacuum distillation of crude oil is carried out at
(a) 20-30 mm Hg (b) 50 - 80 mm Hg
(c) 200 - 300 mm Hg (d) 760 mm Hg.
- (iv) During catalytic reforming, the only reaction where hydrogen is consumed is
(a) Hydrocracking (b) Dehydrogenation
(c) Isomerization (d) Dehydrocyclisation.
- (v) The equipment which separates the catalyst dust from the oil vapour in an FCC is called
(a) Bag filter (b) Reactor
(c) Electrostatic precipitator (d) Cyclone separator.
- (vi) BS VI specification for S content in diesel is
(a) upto 30 ppm (b) between 20 and 30 ppm
(c) 15-20 ppm (d) ≤ 10 ppm.
- (vii) Along with olefins, what is the other feed for Alkylation unit?
(a) Isobutane (b) n-Butane
(c) Isooctane (d) n-Heptane.
- (viii) Which undesirable reaction occurs during the Isomerization process?
(a) Cyclisation (b) Hydrocracking
(c) Hydrogenation (d) Dehydrogenation.

- (ix) The V.I. of API Group III LOBS is
 (a) 75 (b) 80 (c) 80-120 (d) >120.
- (x) Which catalyst is used for catalytic iso-dewaxing?
 (a) Molecular sieves (b) Zeolite with noble metals
 (c) Alumina (d) Phosphoric acid.

Fill in the blanks with the correct word

- (xi) The starting characteristics of a gasoline engine is determined by _____ of the gasoline.
- (xii) For the maximisation of the propylene yield from FCC, _____ catalyst is added along with zeolite Y.
- (xiii) Decoking is done by _____.
- (xiv) Besides HF, _____ is used as an alkylation catalyst.
- (xv) At present, refineries are looking to set up _____ plants within refineries.

Group - B

2. (a) Explain the phenomenon of “vapour-locking”. [[CO1](Analyse/IOCQ)]
 (b) Why is Pour point reported at a slightly higher temperature than the actual temperature where the oil ceases to flow? [[CO1](Understand/LOCQ)]
 (c) For a particular fuel sample, which has a flash point of 70°C, which apparatus will you use for measuring the flash point? Justify your choice. [[CO1,4](Evaluate/HOCQ)]
4 + 4 + 4 = 12
3. (a) Why is pump-back reflux stream withdrawn from the intermediate and bottom trays of the ADU? [[CO3](Analyse/IOCQ)]
 (b) If there is a problem of line plugging in the pump-around reflux circuits, what would be the potential problems that would occur in crude oil distillation? [[CO2,3](Evaluate/HOCQ)]
 (c) Why the pressure in the ADU is slightly more than atmospheric pressure? [[CO3](Analyse/IOCQ)]
3 + 5 + 4 = 12

Group - C

4. (a) What is the utility of the fluidized bed in FCC? [[CO2,3,4](Analyse/IOCQ)]
 (b) For a coil visbreaker, what is the function of the gas oil stripper? [[CO2,4](Analyse/IOCQ)]
 (c) What type of heat exchanger is used for quenching the hot product stream coming out of the coil visbreaker? Justify. [[CO4](Evaluate/HOCQ)]
4 + 4 + 4 = 12
5. (a) Find the resultant Blending value (indicative of RVP) of the gasoline blend from the following data in Table 1:

Table 1

| Component | Blending value | Volume % in blend |
|----------------------|----------------|-------------------|
| Alkylated gasoline | 5 | 15 |
| FCC stream | 27.3 | 20 |
| Straight Run Naphtha | 30 | 55 |
| n-Butane | 100 | 10 |

[[CO4](Apply/IOCQ)]

(b) Name some common additives used as anti-knock compounds.

[[CO4](Remember/LOCQ)]

(c) What is the purpose of hydrotreatment in a refinery?

[[CO4](Understand/LOCQ)]

6 + 2 + 4 = 12**Group - D**

6. (a) Explain the types of catalysts used in hydrocracking and their specific functions.

[[CO2,4](Understand/IOCQ)]

(b) What are the feedstocks for hydrocracking?

[[CO2,4](Remember/LOCQ)]

(c) If the pressure let-down valve before the low pressure separator in a 2-stage hydrocracker malfunctions, what will be the potential problems?

[[CO4](Evaluate/HOCQ)]

4 + 4 + 4 = 12

7. (a) What problems will occur if the acid concentration decreases in an alkylation process?

[[CO4](Analyse/IOCQ)]

(b) An engineer selects the Isobutane/Olefin ratio for an alkylation unit to be 1.8. Is her/his selection practical? Justify.

[[CO4](Evaluate/HOCQ)]

(c) Why is recycling of the normal paraffins in the product from the isomerization unit extremely important?

[[CO4](Analyse/IOCQ)]

4 + 4 + 4 = 12**Group - E**

8. (a) Catalytic conversion leads to the production of higher grades of LOBS. What are the catalytic processes that are involved?

[[CO2,4](Analyse/IOCQ)]

(b) What is the principal difference between catalytic dewaxing and catalytic isodewaxing?

[[CO2,4](Understand/LOCQ)]

(c) What is the importance of the hydrofinishing step in LOBS production?

[[CO2,4](Analyse/IOCQ)]

3 + 4 + 5 = 12

9. (a) How is biodiesel produced by transesterification?

[[CO3](Understand/LOCQ)]

(b) Differentiate between 1st, 2nd and third generation biofuels.

[[CO3,4](Analyse/IOCQ)]

6 + 6 = 12

| Cognition Level | LOCQ | IOCQ | HOCQ |
|-------------------------|------|------|------|
| Percentage distribution | 25 | 53 | 22 |

