

**PETROLEUM REFINERY ENGINEERING  
(CHE3131)**

**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) Desalting of crude oil is done in an electric desalter at pH  
(a) 1 – 3                      (b) 6.5 – 8.5                      (c) 7                      (d) above 10
- (ii) 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
- (iii) During catalytic reforming, the only reaction where hydrogen is consumed is  
(a) Hydrocracking                      (b) Dehydrogenation  
(c) Isomerization                      (d) Dehydrocyclisation
- (iv) Which of the following is a feedstock for hydrocracking?  
(a) LCN                      (b) LSR Naptha                      (c) HVG0                      (d) Kerosene
- (v) 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
- (vi) The latest catalysts used in the Isomerization unit are  
(a) Zeolites                      (b) Pt                      (c) Metal Sulfates                      (d) Mo-Oxides
- (vii) Which undesirable reaction occurs during the Isomerization process?  
(a) Cyclisation                      (b) Hydrocracking  
(c) Hydrogenation                      (d) Dehydrogenation
- (viii) RON of alkylate is around  
(a) 80                      (b) 64                      (c) 93                      (d) 87
- (ix) The solvent used for deasphalting is  
(a) Butane                      (b) Propane                      (c) Hexane                      (d) Heptane

- (x) Hydrofinishing is used for  
 (a) Decreasing pour point (b) Increasing VI  
 (c) Improving colour (d) Increasing Viscosity

*Fill in the blanks with the correct word*

- (xi) Pour point indicates relative amount of \_\_\_\_\_ present in crude oil.  
 (xii) The starting characteristics of a gasoline engine is determined by \_\_\_\_\_ of the gasoline.  
 (xiii) The endothermic heat of cracking in the FCC is supplied by the \_\_\_\_\_.  
 (xiv) API Gr IV LOBS mainly consists of \_\_\_\_\_.  
 (xv) \_\_\_\_\_ is an example of a petrochemical feedstock.

### 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 the large number of tubes are put in a pipe still furnace? [[CO2](Understand/LOCQ)]  
 (b) Why cetane number is important parameter for fuel? [[CO2,3](Analyse/IOCQ)]  
 (c) List the products and their boiling point range, obtained from atmospheric distillation unit. [[CO2](Remember/LOCQ)]  
**3 + 4 + 5 = 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) The hot stream coming out of a visbreaker is at a temperature of 450°C. Water at 30°C is available for quenching this steam to 200°C. The water outlet temperature should not be more than 70°C. If the overall heat transfer coefficient is 250 W/m<sup>2</sup>K, find the heat exchanger area required. Assume a water flow rate of 10000 kg/hr and specific of water as 4190 J/kgK. [[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) For a DHDS system, which type of catalyst will you choose for a normal feed and for a feed with high Nitrogen content?

[[CO4](Analyse/IOCQ)]

(b) What is the function of the pressure reduction step in a DHDS process?

[[CO4](Understand/LOCQ)]

(c) What are the reactions taking place in a DHDS process?

[[CO4](Remember/LOCQ)]

**5 + 4 + 3 = 12**

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

[[CO4](Analyse/IOCQ)]

(b) For an isomerization feed containing a lot of water, which type of catalyst will be the most suitable?

[[CO4](Remember/LOCQ)]

(c) What is the principal engineering problem that occurs in isomerization process?

[[CO4](Understand/LOCQ)]

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

8. (a) Mention the significance of viscosity index in connection to LOBS.

[[CO5](Analyse/IOCQ)]

(b) Why are very heavy crude oils not suitable for LOBS manufacturing?

[[CO2,3,4](Understand/LOCQ)]

(c) What is the objective of propane deasphalting?

[[CO2,3,6](Understand/LOCQ)]

**4 + 4 + 4 = 12**

9. (a) Differentiate between grey, blue and green hydrogen.

[[CO3](Analyse/IOCQ)]

(b) What are the challenges of using hydrogen as a fuel and what are the potential solutions?

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

**5 + (3 + 4) = 12**

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	42.71	48.96	8.33

