PETROCHEMICAL TECHNOLOGY
(CHEN 3131)

Time Allotted : 2½ hrs   **Full Marks : 60**

Figures out of the right margin indicate full marks.

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

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

Group – A
(Multiple Choice Type Questions)

1. Answer any twelve: **12 × 1 = 12**

Choose the correct alternative for the following

(i) Which of the following is a hydrogen purification unit?
(a) Caustic wash tower   (b) Pressure swing adsorption
(c) Hydro treating   (d) Methanator.

(ii) Fischer Tropsch synthesis is normally used to convert
(a) Syngas into liquid fuel   (b) Syngas into petroleum
(c) Syngas to coke   (d) Syngas to gasoline.

(iii) Steam reforming process requires a temperature range of
(a) $700 – 750 \,^{o}C$ (b) $320 – 450 \,^{o}C$
(c) $600 – 650 \,^{o}C$ (d) $800 – 850 \,^{o}C$

(iv) Match the following petrochemical production with their catalyst

P	Vinyl Chloride	I	Bismuth phosphomolybdate
Q	Acrylonitrile	II	Pumic/charcoal
R	Glycerine	III	Copper oxide

(a) P-I, Q-II, R-III   (b) P-III, Q-I, R-II
(c) P-II, Q-III, R-II   (d) P-II, Q-I, R-III

(v) Vacuum pressure is applied during ethanol amine production to
(a) Reduce the operating temperature of distillation column
(b) Reduce the operating pressure of distillation column
(c) Enhance the operating temperature of distillation column
(d) Enhance the operating pressure of distillation column

(vi) In the catalytic cracking unit gasoline obtained has
(a) High calorific value   (b) Low calorific value
(c) Low octane number   (d) High octane number

(vii) Liquid hourly space velocity is expressed as?

(a) $\text{LHSV} = \dfrac{\text{Hourly volume charge rate of naptha}}{\text{volume of catalyst in the reactor}}$

(b) $\text{LHSV} = \dfrac{\text{Hourly volume charge rate of catalyst}}{\text{volume of naptha in the reactor}}$

(c) $\text{LHSV} = \dfrac{\text{Weight charge rate of naptha}}{\text{Weight of the catalyst in the reactor}}$

(d) $\text{LHSV} = \dfrac{\text{Weight charge rate of catalyst}}{\text{Weight of the naptha in the reactor}}$

(viii) What is the pressure range for the polymerization process of low density polyethylene?

(a) 1500-3000 atm   (b) 100-1000 atm

(c) 50-100 atm   (d) 25-50 atm.

(ix) Which of the following oxide works as a catalyst for the formation of high-density polyethylene by Philips process?

(a) Molybdenum oxide   (b) Chromium oxide

(c) Titanium oxide   (d) Calcium oxide.

(x) What range of temperature is generally employed for low density polyethylene formation on kinetic considerations?

(a) 25-50°C   (b) 170-250°C

(c) 200-400 °C   (d) 50-150 °C.

Fill in the blanks with the correct word

(xi) The example of a Filler agent is _____.

(xii) Nitrogen compounds are responsible for the _____ lube oil.

(xiii) The molecular weight of the polymer product_____ with the high pressure.

(xiv) The approximate density of the polymer produced by the Ziegler process of polymerization is_____.

(xv) Permeability to liquid and gas decreases with the density of LDPE is _____.

Group - B

2. (a) Give an overview of petrochemical feedstock.   *[(CO1)(Analyse/HOCQ)]*
   (b) What are the natural impurities present in natural gas?   *[(CO1)(Remember/LOCQ)]*
   (c) Briefly discuss the ultraclean liquid fuel production from natural gas with the help of block diagram.   *[(CO1)(Understand/IOCQ)]*

   5 + 2 + 5 = 12

3. (a) Briefly discuss the manufacturing process of ammonia production from naptha with the help of a neat flow sheet.   *[(CO1)(Analyse/HOCQ)]*
   (b) What are the sulphur removal processes exercised in petroleum refinery industry?   *[(CO1)(Understand/IOCQ)]*
   (c) Name the petroleum coke production unit.   *[(CO1)(Remember/LOCQ)]*

   8 + 3 + 1 = 12

Group - C

4. (a) Discuss the manufacturing process of isopropanol production with the help of a neat flow sheet. *[(CO2)(Analyse/HOCQ)]*
   (b) Write the important reactions involved in isopropanol production? *[(CO2)(Remember/LOCQ)]*
   (c) Which catalyst is used during ethylene dichloride production? *[(CO2)(Apply/IOCQ)]*

   8 + 3 + 1 = 12

5. (a) Write the reactions involved in propylene oxide production. *[(CO2)(Remember/LOCQ)]*
   (b) Discuss the major engineering problem associated with vinyl chloride production? *[(CO2)(Understand/HOCQ)]*
   (c) Why fluidised bed is advantageous compared to packed bed reactor? *[(CO2)(Analyse/IOCQ)]*

   4 + 5 + 3 = 12

Group - D

6. (a) Discuss the manufacturing process of phenol production from cumene with the help of a neat flow sheet. *[(CO3)(Analyse/HOCQ)]*
   (b) What are the important reactions responsible for catalytic reforming of naptha? *[(CO3)(Remember/LOCQ)]*

   8 + 4 = 12

7. (a) Discuss the manufacturing process of linear alkyl benzene sulfonate production with the help of a neat flow sheet. *[(CO3)(Analyse/HOCQ)]*
   (b) Write the reactions involved in styrene production. *[(CO3)(Remember/LOCQ)]*

   10 + 2 = 12

Group - E

8. (a) Describe the difference between NPFR and RPFR. *[(CO4)(Apply/HOCQ)]*
   (b) Describe the synthesis process of phenol formaldehyde resin with neat schematic diagram. *[(CO4)(Analyse/IOCQ)]*

   4 + 8 = 12

9. (a) Describe the mechanical, thermal, chemical, electrical and optical properties of polyethylene. *[(CO4)(Analyse/LOCQ)]*
   (b) Describe the application of polyamide and polyester. *[(CO4)(Remember/IOCQ)]*

   9 + 3 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	26	24	50

Course Outcome (CO):

After the completion of the course students will be able to
1. Classify the variety of petrochemical feedstocks, petroleum refinery products and categorize the synthesis gas productions feedstocks.
2. Interpret the steam cracking operation of naptha and discuss the production mechanism of petrochemical complexes like EDC, VCM, VAM, EO, EA, ACN, PO, Isopropanol etc.
3. Classify the catalytic reforming operation of naptha and interpret the production mechanism of synthetic detergent.
4. Compare and contrast major polymerization processes in industry and describe various process technologies for Fibers, Elastomers and resins etc.

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