

B. Chemical Engineering (4th Year 2<sup>nd</sup> Semester) Examination, 2024**PETROLEUM REFINERY ENGINEERING & PETROCHEMICALS**

Time: Three Hours

Full Marks: 100

**CO1: Answer Question No.1 or Question No.2**

- 1.(i) What are the physical and chemical processes in a petroleum refinery? [8]
- 1.(ii) Enumerate the treatment of the different products (LPG, Naphtha, ATF, SKO, Diesel) obtained from Crude distillation unit (CDU). [12]
- 2.(i) What are the objectives of Hydrotreating? Stating the effects of the operating conditions, describe the Diesel hydrodesulfurization unit (DHDS) using a flow diagram. [10]
- 2.(ii) Using a flow diagram, briefly describe the desalting, pre-topping, atmospheric and vacuum distillation operations mentioning salient operating conditions. [10]

**CO2 Answer Question No.3 or Question No.4**

- 3.(i) Classify secondary processing unit of petroleum refinery using a flowchart. [10]
- 3.(ii) What are the objectives of fluid catalytic cracking (FCC) operation? Describe the process using a flow diagram mentioning the pertinent major reactions and operating conditions, catalyst employed and product yields. [10]
- 4.(i) What are the objectives of Isomerization operation? Describe the process using a flow diagram mentioning the pertinent major reactions and operating conditions, catalyst employed and product yields. [10]
- 4.(ii) What are the objectives of Hydrocracker Unit(HCU)? Describe the process using a flow diagram mentioning the pertinent major reactions and operating conditions, catalyst employed and product yields. [10]

**CO3 Answer Question No.5 OR Question No.6**

- 5.(i) Consider, the following cases and comment on the separation/purification requirements of the feedstock:
- (a) Separation of methane from hydrogen in toluene hydrodealkylation process.
- (b) Separation of CO from H<sub>2</sub> for phosgene production. [5+5]
- 5.(ii) Mono-ethanolamine can be produced from ethylene oxide and ammonia. Two principal secondary reactions occur to form di-ethanoamine and tri-ethanolamine. Mono-ethanolamine

[ Turn over

is more valuable than both the di and triethanolamines. Explain the effect of presence of excess ammonia in the reactor on the primary and secondary reactions. [10]

6.(i)

(a) In the production of methanol from synthesis gas route, elucidate the purpose of using “cold (or) hot shot” between staged adiabatic packed beds of catalysts.

(b) Why the oxygen concentration is limited below 9% in ethylene oxidation to ethylene oxide.

Elucidate.

[5+5]

6.(ii) Ethylbenzene is primarily produced through two routes: liquid phase with  $AlCl_3$  catalyst or vapour phase in catalytic fixed-bed reactor. Assess the differences as well as advantages and disadvantages of these routes. Enumerate pros and cons in selecting suitable reactors. [10]

#### CO4 Answer Question No.7 OR Question No.8

7.(i) Briefly describe the production of Acrylonitrile by ammoxidation of Propylene mentioning the reactions, catalysts used, operating conditions maintained and byproducts formed using process flow diagram. [10]

(ii) Briefly describe the method of separation of  $C_8$  aromatics into individual components employing the method of fractional crystallization using process flow diagram. [10]

8.(i) A naphtha feed stock for a naphtha thermal cracking unit is to be treated in a hydrotreater for removal of sulfur and nitrogen bearing impurities. It has the following properties:

API gravity = 55°

‘S’ as mercaptans (wt. %) = 0.5

‘S’ as sulfides (wt. %) = 0.3

‘S’ as thiophenes (wt. %) = 0.2

‘N’ as pyrrole (wt. %) = 0.15

‘N’ as pyridine (wt. %) = 0.10

Compute the  $H_2$  requirement in scft/day for complete removal of ‘S’ and ‘N’ from 5000 BPD feed. [8]

8.(ii) Mentioning all the operating conditions maintained, discuss thermal cracking of naphtha using a flow diagram. Elucidate the influence of different operating parameters on the yield of ethylene. [8+4]

**CO5 Answer Question No.9 OR Question No.10**

9. (i) Briefly describe Ziegler Process for polypropylene production mentioning the process conditions using a flow diagram. **[10]**

9. (ii) Briefly describe (using a block flow diagram), the production of polyester fiber employing terephthalic acid as the feedstock. Mention all pertinent reactions, catalysts and process conditions for each conversion step. **[10]**

10. (i) What do you mean by Zeigler Natta catalyst?(b) Why is it better to wash polymer by alcohol instead of water?(c) What is 'melt flow index'? **[5+3+2]**

10.(ii) What is critical micelle concentration pertaining to Emulsion polymerization? Briefly describe the production of Styrene-Butadiene rubber (SBR) from the corresponding monomers mentioning the reaction, reaction medium and catalyst used and operating conditions maintained using a process flow diagram. **[2+8]**