

**B.E. CHEMICAL ENGINEERING FOURTH YEAR SECOND SEMESTER SUPPLEMENTARY EXAM 2024**  
**PETROLEUM REFINERY ENGINEERING & PETROCHEMICALS**

Time: Three Hours

Full Marks: 100

<p><b>CO1: Answer Question No.1 or Question No.2</b></p> <p>1.(i) What are the objectives of Vacuum Distillation of Reduced Crude oil? Elucidate the significance of the Vacuum Distillation unit (VDU) mentioning salient operating conditions. (ii) What are the critical/key quality parameters of LPG, motor spirit(MS), ATF and SKO. <span style="float: right;">[10+10]</span></p> <p>2.(i)What are the objectives of hydrotreatment of petroleum feedstocks bearing sulfur, nitrogen and oxygen impurities? (ii)Mention the pertinent major reactions and operating conditions and catalyst employed and their effects on the hydrotreatment process. <span style="float: right;">[5+15]</span></p>
<p><b>CO2 Answer Question No.3 or Question No.4</b></p> <p>3. (i) What are the major types of hydrocarbon molecules present in crude oil? What are the major types of chemical impurities present in crude oil? <span style="float: right;">[4+2]</span></p> <p>3.(ii) What are the objectives of catalytic reforming operation? Describe the process using a flow diagram mentioning the pertinent major reactions and operating conditions, catalyst employed and product yields. <span style="float: right;">[14]</span></p> <p>4. 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. <span style="float: right;">[5+15]</span></p>
<p><b>CO3 Answer Question No.5 or Question No.6</b></p> <p>5.(i) What are the pertinent reactions involved in removal of H<sub>2</sub>S and CO<sub>2</sub> using ethanolamine solvent from sour hydrocarbon gases? Describe the Girbotol Process for gas sweetening using a flow diagram mentioning representative operating parameters/conditions. <span style="float: right;">[5+5]</span></p> <p>5.(ii) What are the objectives of Alkylation Process? Explain the influence of critical operating variables on Alkylation process in a petroleum refinery. <span style="float: right;">[10]</span></p>

[ Turn over

6.(i)(a) Why is Kinetic Severity Function' (KSF) in thermal cracking of naphtha evaluated on the basis of "n-pentane"? (b) Explain why is steam used during dehydrogenation of ethylbenzene for production of styrene? (c) Explain the roles of HCl and AlCl<sub>3</sub> during alkylation of benzene with ethylene.

[4+3+3]

6.(ii) (a) Enumerate the acetylene-ethylene combined scheme for production of Vinyl chloride monomer (VCM) using a block flow diagram. (b) Explain the role of oxychlorinator in the production of VCM when ethylene is used as feed stock. [5+5]

**CO4 Answer Question No.7 or Question No.8**

7.(i) Mention typical operating conditions in hydration of ethylene for production of ethanol using phosphoric acid as catalyst. Why do low temperature and high pressure favor the yield of ethanol?

[10]

(ii) Write the reactions, catalysts used, operating conditions pertaining to production of 2-ethylhexanol using propylene and synthesis gas as feed stocks.

[10]

8.(i) What are the process conditions and catalyst employed in direct oxidation of methanol to formaldehyde? Use a flow diagram to describe the production.

[10]

8.(ii) Describe the production of vinyl acetate monomer using a flow diagram mentioning the reactions, heterogeneous catalysts used and operating conditions maintained. Mention the drawbacks of homogeneous catalytic process in this context.

[10]

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

9. (i) (a) Elucidate "Auto-acceleration" (Gel Effect) behaviour in free radical polymerization systems.

(b) Briefly describe Polyethylene Production through Ziegler Process mentioning the process conditions using a process flow diagram.

[2+8]

9. (ii) What is critical micelle concentration pertaining to Emulsion polymerization for PVC production? Discuss PVC production by emulsion polymerization using a flow diagram mentioning pertinent process features.

[10]

10. (i) Describe the production of Nylon 6,6 starting with Cyclohexane mentioning the reactions, catalysts used and operating conditions maintained with the help of a flow diagram.

[10]

10.(ii) With the help of a flow diagram; describe the production of acrylonitrile-butadiene-styrene plastic.

[10]