

- (c) What do you mean hydraulicity of cement?
- (d) Discuss the setting & hardening of cement while concrete is used for construction jobs.

4 + 2 + 3 + 3 = 12

9. (a) How refractory bricks are manufactured from raw minerals feeds? Give a process block diagram giving details of drying and firing schedule.
- (b) Explain the terms (a) Pyrometric cone equivalent, (b) RUL & (c) Compressive strength for a refractory material to be used in steel making furnace.

6 + 6 = 12

**CHEMICAL PROCESS TECHNOLOGY-I
(CHEN 3101)**

Time Allotted : 3 hrs

Full Marks : 70

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.

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

**Group - A
(Multiple Choice Type Questions)**

1. Choose the correct alternative for the following: **10 × 1 = 10**
- (i) Permanent hardness of water can be completely removed by
 (a) Boiling (b) Soda-lime treatment
 (c) Deionisation (d) Nanofiltration.
- (ii) Ultrafiltration of waste water can remove
 (a) All cations & anions
 (b) Only cations
 (c) Macromolecules or flocs of suspended solids
 (d) Only anions.
- (iii) In modified Solvay Process (Dual Process) for soda ash production NH_3 is recovered as
 (a) Pure NH_3 (b) Co-product NH_4HCO_3
 (c) Co-product NH_4Cl (d) Co-product CaCl_2 .
- (iv) Primary concentration of NaOH obtained from Mercury cell is
 (a) 10 – 14% (b) 45 – 50%
 (c) 30 – 35% (d) 70 – 90%.
- (v) Which of the following manufacturing plant is generally called 'cogeneration' plant?
 (a) NH_3 (b) H_2SO_4
 (c) HNO_3 (d) NH_2CONH_2 .
- (vi) The azeotropic composition by % of mass of HCl acid under a pressure of 0.1 bar (absolute)
 (a) 20.2% HCl (b) 27% (c) 19% (d) 23%.

- (vii) The catalyst used for manufacturing nitric acid by oxidation of ammonia is
 (a) Rh (b) Pt
 (c) Pt/Rh alloy (d) Fe/Cr alloy.
- (viii) Liquid NH₃ can be obtained by -----of NH₃ from the reactor at 200 atm & 550 °C
 (a) water absorption in absorption tower
 (b) bubbling NH₃ mixture in water
 (c) cooling with water to 40 °C in a condenser
 (d) compression above 200 atm.
- (ix) The Bone Phosphate of Lime(BPL) in phosphate fertiliser production gives a measure of
 (a) % 'P' (b) % H₃PO₄
 (c) % P₂O₅ (d) % Ca₃(PO₄)₂.
- (x) Blast furnace for steel making may be lined with -----refractories
 (a) acidic (b) basic
 (c) neutral (d) none of the above.

Group - B

2. (a) Write down water treatment methods for laundry application of water.
 (b) Blow-down operation of boiler water is done to avoid scaling: Explain the statement.
 (c) Mention the boiler feed water specification.
 (d) Mention the Reverse Osmosis principle with the process flow diagram for water purification through reverse osmosis device.
3 + 2 + 2 + 5 = 12
3. (a) How Solvay process of soda ash production has been modified into dual Solvay process?
 (b) With a neat sketch explain every step of dual Solvay process of soda ash production.
 (c) Show the construction of diaphragm cell with proper cell notation and respective cell reactions.
2 + 5 + 5 = 12

Group - C

4. (a) Describe the four-stage DCDA converter process with diagram considering thermodynamics and kinetics issues for manufacturing sulphuric acid from SO₂.
 (b) Narrate and Explain different processes adopted commercially for concentrating dilute HCl acid to 35% or above.
6 + 6 = 12
5. (a) Discuss the engineering problems associated with the manufacturing of phosphoric acid by wet process.
 (b) Describe the reactor configuration and process conditions for manufacturing nitric acid by ammonia oxidation.
 (c) How is syrupy white phosphoric acid manufactured from phosphate rock by dry process?
4 + 4 + 4 = 12

Group - D

6. (a) What are the bindings of quality of feed gases namely H₂ & N₂ and nature of catalyst on the yield of NH₃? Explain elaborately with thermodynamic and kinetic factors.
 (b) Highlight the engineering problems and quality issues in urea manufacturing from carbondioxide and ammonia and suggest remedies thereof.
 (c) Draw a process flow diagram for the manufacture of NH₃ with details of heat utilisation scheme.
4 + 4 + 4 = 12
7. Describe the manufacturing process of triple superphosphate with the help of a neat flow diagram.
12

Group - E

8. (a) What are the advantages and disadvantages of wet process & dry process for manufacturing Portland cement?
 (b) Write down the chemical composition of clinker, a precursor of Portland cement.