

B.TECH/CHE/5TH SEM/CHEN 3101/2019
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) The most common example of coagulant is
 (a) Aluminium sulphate (b) Chromium sulphate
 (c) Benzene (d) Naphtha.
- (ii) Phosphoric acid is used in cooling tower water treatment unit to
 (a) inhibit the corrosion (b) promote the catalyst
 (c) inhibit the scale formation (d) prevent the algal growth.
- (iii) Mercury cell process for caustic production compared to diaphragm cell process
 (a) requires low initial investment (b) requires more power
 (c) produces lower concentrated (d) produces higher concentrated.
- (iv) Raw materials of soda ash production for modified Solvay process are
 (a) Ammonia, salt, limestone (b) Salt, limestone, coke or coal
 (c) Ammonia, limestone, coke or coal (d) Ammonia, coke, nitric acid.
- (v) Which one is obtained as a by product during ammonium sulphate production?
 (a) CaCO₃ (b) CO₂
 (c) (NH₄)₂SO₄ (d) NH₃.
- (vi) Formation of clinker nodules takes place in
 (a) Tube mill unit (b) Blending unit
 (c) Kiln section (d) Rotary drier.
- (vii) Dilute HCl acid can be concentrated to 35% HCl by
 (a) normal fractional distillation (b) normal azeotropic distillation
 (c) extractive distillation with MgCl₂ (d) vacuum distillation.

- (viii) Purging is done in ammonia manufacturing loop from synthesis gas for the purpose of greater thermodynamically favourable conversion to ammonia by
 (a) reducing the total pressure (b) removal of combustibles
 (c) reducing the total number of moles (d) adjusting the N₂:H₂ ratio to 1:3.
- (ix) Sulphuric acid plant is operated at atmospheric pressure because
 (a) increased pressure decreases equilibrium conversion
 (b) at atmospheric pressure, the equilibrium conversion is maximum
 (c) increased yield does not compensate the cost of compression
 (d) V₂O₅ catalyst cannot withstand high pressure.
- (x) For manufacturing NH₃, H₂ is resourced economically from
 (a) dehydrogenation of hydrocarbons (b) electrolysis of sea water
 (c) steam reforming of hydrocarbons (d) electrolysis of pure water.

Group – B

2. (a) What does a boiler feed water treatment system typically remove?
 (b) Briefly explain “water demineralization” system.
 (c) Discuss the advantages and limitations of reverse osmosis process for purification of water.
 (d) Which compounds are responsible for water hardness?
- 3 + 4 + 4 + 1 = 12**
3. (a) Discuss the major engineering problems associated with soda ash production through Solvay process.
 (b) Show the construction of diaphragm cell with proper cell notation and compare with membrane cell process.
 (c) How Solvay process of soda ash production has been modified to dual Solvay process?

4 + 5 + 3 = 12

Group – C

4. (a) In the light of the reaction SO₂(g) + 1/2O₂(g) = SO₃(g); ΔH=-23 Kcal at 25°C, explain the statement: In the two stage catalytic converter, it is advisable to run the reaction at higher temperature in the 1st stage and lower temperature in the 2nd stage.
 (b) What is acid mist? What are the major engineering problems associated with the manufacture of Sulphuric acid?

8 + 4 = 12

5. (a) Discuss the commercial production of hydrochloric acid for industrial and laboratory grade.
- (b) Describe the manufacturing process of HNO₃ acid by the catalytic oxidation of NH₃ with a neat sketch of the process layout. Mention the thermodynamic and kinetic considerations for the overall process.

6 + 6 = 12

Group – D

6. (a) Critically examine the kinetics of production of ammonia by Haber's Bosch process.
- (b) What are the major engineering problems associated with the manufacture of Urea? How can we overcome these problems?
- (c) Describe the manufacturing process of nitric acid by the catalytic oxidation of ammonia with special reference to the heat recovery steps and systems involved.

3 + 5 + 4 = 12

7. (a) Briefly explain the manufacturing process of single super phosphate production with a help of flow diagram.
- (b) How the handling and storage problems during ammonium sulphate production are taken care of?
- (c) Write the chemical reactions involved in NPK fertiliser production.

7 + 2 + 3 = 12

Group – E

8. (a) Compare the manufacturing processes of cement by wet and dry method with a help of neat flow sheet.
- (b) Also discuss the major engineering problems associated with cement production.

8 + 4 = 12

9. (a) What is refractoriness? Classify different types of refractory materials used in the industry?
- (b) What are raw materials of glass? What is annealing of glass?

(2 + 4) + (2 + 4) = 12