Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.Tech(CHE-OLD)/SEM-5/CHE-503/2012-13

2012
CHEMICAL PROCESS TECHNOLOGY – I

Time Allotted : 3 Hours *Full Marks* : 70

The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable.

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any *ten* of the following :

$10 \times 1 = 10$

i) Raw materials for Modified Solvay process for manufacturing soda ash are

a) Ammonia, salt, limestone

b) Ammonia, limestone, coke/coal

c) salt, limestone, coke/coal

d) none of these.

ii) Mercury cell process for caustic production compared to diaphragm cell process

a) requires low initial investment

b) requires more power

c) produces lower concentrated NaOH

d) none of these.

iii) Cement contains mainly

a) CaO, SiO_2, Al_2O_3

b) MgO, SiO_2, K_2O

c) Al_2O_3, MgO, Fe_2O_3

d) CaO, MgO, K_2O.

iv) In the production of HNO_3, high space velocity of the reactants is maintained to

a) get high production rate

b) avoid temperature runaway due to highly exothermic reaction

c) avoid decomposition of ammonia

d) facilitate formation of NO_2.

v) In the Triple superphosphate, which of the following is three times that of Single superphophate ?

a) phosphorus content

b) phosphoric acid content

c) phosphorus pentoxide content

d) phosphorus trioxide content.

vi) In pot transfer method of glass melt production the pots are generally made of

a) terra-cotta b) high alumina fireclay

c) china clay d) porcelain.

vii) Silica bricks is a type of ..... refractory.

a) Acidic b) Basic

c) Neutral d) none of these.

viii) Which of the following chemical conversions is catalyzed by vanadium pentoxide for the manufacture of sulfuric acid by contact process ?

a) $S(s) + O_2(g) = SO_2(g)$

b) $SO_2(g) + \frac{1}{2} O_2(g) = SO_3(g)$

c) $SO_3(g) + H_2O(l) = H_2SO_4(l)$

d) none of these.

ix) Feed gas for SO_2 (g) to SO_3 (g) converter in a sulfuric acid manufacturing plant by contact process typically contains about

a) 1-3% SO_2 (g) b) 7-10% SO_2 (g)

c) 25-30% SO_2 (g) d) 50-55% SO_2 (g).

x) Silica gel is used with vanadium pentoxide catalyst in the sulfuric acid manufacturing plant as

a) a porous carrier

b) an active catalytic agent

c) a promoter

d) none of these.

xi) Catalyst used in Haber's process for ammonia is

a) reduced iron oxide b) nickel

c) oxidized iron oxide d) iron sulfate.

xii) lacquers are paint constituents which are used as

a) Pigments b) Volatile vehicles

c) Nonvolatile vehicles d) Accelerators.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. 3 × 5 = 15

2. Show the construction of a diaphragm cell with proper cell notation and respective cell reactions. 5

3. Discuss about the characteristics of cement kilns. What parameters are strictly monitored during kiln feed operation ? 2 + 3

4. What are the major engineering problems associated with the ammonia synthesis in Haber's process ? 5

5. Mention different zones inside the converter with respect to mode of reactions in Ostwald's process of nitric acid manufacturing. Comment on the advantages of using $Mg(NO_3)$ for concentration of HNO_3 by extractive distillation. 3 + 2

6. Why is a refractory characterized by fusion point not by melting point ? What are the options for developing porosity of high temperature insulating bricks ? 2 + 3

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. $3 \times 15 = 45$

7. a) How Solvay process of soda ash production has been modified in Dual process ? With a neat sketch, explain different steps of operation sequentially for Dual process of soda ash manufacturing. 2 + 6

   b) Briefly discuss about the role of 'over-voltage' in the electrolysis of brine solution. Make a comparative study of mercury cell and membrane cell process for NaOH and Cl_2 production with an eye of product purity and cost of production. 3 + 4

8. a) From physicochemical principles for the oxidation of SO_2 to SO_3, justify the optimum operational conditions of DCDA converter. 5

   b) In urea manufacturing process, how is biuret formation prevented ? Explain the chance of ammonium carbonate formation instead of desired ammonium carbamate. Briefly discuss about the engineering problems associated in the urea manufacturing unit. 3 + 2 + 5

9. a) Explain about the consolidated production technology of Phosphoric acid manufacturing (wet process) from rock phosphate with the technology of gypsum recovery and production of mixed fertilizer. 10

   b) What is triple-superphosphate ? Mention the necessary conditions of its manufacturing with related chamical reaction. 1 + 4

10. a) Name different constituents of paints with their principal functions. How is modern paint formulated with the concept of pigment volume concentration (PVC). 5 + 3

    b) Explain briefly about the manufacturing process of TiO_2. 7