## Major Test – CHL604

**Answer all questions**

1. For the reduction of $Fe_3O_4$ to metallic iron by $H_2$ gas, determine the time required for 50% penetration of the reaction front assuming shrinking core model. Data is

   $\rho_s$ = 4.6 gm/cc, M.W of Fe = 56

   E = 24000 cal/mol, A = $1.93 \times 10^5$ cm/s

   P = 1atm T = 600°C

2. A solid feed consisting of the distribution of particles as

   | | | | | |
   |---|---|---|---|---|
   | $d_p$ | → | 1mm | 2mm | 4mm |
   | Wt% | → | 20 | 30 | 50 |

   is passed through a tubular reactor where it reacts with a gas to form solid product. Assume the reaction to be chemical reaction control according to shrinking core model. The time for complete conversion of 4 mm particles is 4 hrs. Find the residence time required for 75% conversion of the solid feed.

3. For a catalytic gas-reaction $A \rightleftharpoons B$, derive the overall rate equation for adsorption of A as rate controlling. (Neglect gas-film, diffusional resistances).

4. What is independent deactivation of a catalyst? Derive an equation for the activity of the catalyst for the above case.

   The following data is obtained for an irreversible reaction with a decaying catalyst in a batch reactor with batch catalyst and gas. Determine the Kinetics.

   | | | | | | | |
   |---|---|---|---|---|---|---|
   | $C_A$ | = | 1.0 | 0.802 | 0.675 | 0.532 | 0.422 | 0.368 |
   | t(hr) | = | 0 | 0.25 | 0.5 | 1.0 | 2.0 | ∞ |

5. The reaction A ⟶ 4R is carried out in a tubular packed catalyst bed reactor. Determine the wt of the catalyst required for 35% conversion of A. Pure A enters the reactor at 117°C, 3.2 atm pressure and 1000 moles/hr. The rate constant is $9.6 \times 10^{-3}$ $m^3$/hr. Kg cat. Show the derivation of the required equation separately.

6. For a packed bed catalytic reactor, derive the governing equation with B.C. conditions and transform into dimensionless form also. Assume isothermal condition and no radial mass transfer.