Roll No.	(Following Roll No. to be filled by candidate)									
	1	2	0	4	3	5	1	9	0	2

B. TECH.
FIFTH SEMESTER EXAMINATION 2013-14
ECH 502
CHEMICAL REACTION ENGINEERING-II

Time: 3 Hours **Max. Marks: 100**

Note:
- Attempt all questions.
- Marks and number of questions to be attempted from the section is mentioned before each section.
- Assume missing data suitably. Illustrate the answers with suitable sketches

1. Attempt any ***Four*** parts of the following: [4×5]
   a. Derive the design equation for plug flow reactor.
   b. Classify non catalytic heterogeneous reaction illustrating industrial examples.
   c. What do you understand by selectivity and yield?
   d. Derive the rate equations for heterogeneous reaction.
   e. Differentiate conversion and yield with suitable example.
   f. What do you understand by space time and space velocity of plug flow reactor?

2. Attempt any ***Four*** parts of the following: [4×5]
   a. Differentiate homogeneous catalysis and heterogeneous catalysis with suitable examples.
   b. What are the adsorption isotherms? Explain the important assumptions for adsorption isotherms.
   c. Derive the equation for langmour isotherm.
   d. What do you understand by void volume and solid density of a catalyst particle?
   e. What are the physical properties of solid catalyst? And explain catalyst poisoning.
   f. Explain the preparation, testing and characterization of catalysts.

3. Attempt any ***Two*** parts of the following: [2×10]
   a. Define the term effectiveness factor as used in solid gas catalytic reaction. Develop an expression for effectiveness factor for a straight cylindrical pore of length 2L. Both ends of pore are open to reactant gas. A first order reversible reaction occurs in the pore wall A → B.

   b. A hydrogenation catalyst is prepared by soaking alumina particles (100 to 150 mesh size) in aqueous $NiNO_3$ solution. After drying and reduction, the particles contain about 7 wt % NiO. This catalyst is then made in to large cylindrical pellets for rate studies. The gross measurements for one pellet are –Mass = 3.15 g, Diameter = 1.00 cm, Thickness = 0.25 cm, Volume = 3.22 cm^3
   The Al_2O_3 particles contain micropores, and the pelleting process introduces macropores surroundings the particles. From the experimental methods already describes, the macropore volume of the pellet is 0.645 cm^3 and the micropore volume is 0.40 cm^3 / g. of particles. Calculate
      i. The macropore volume in cm^3/ g
      ii. The solid fraction
      iii. The macropore void fraction in the pellet
      iv. The micropore void fraction in the pellet
      v. The void fraction of the particles
   c. Discuss the non-isothermal design of plug flow reactor. Explain the hot spot of the tubular reactor also.

4. Attempt any ***Two*** parts of the following: [2×10]
   a. A solid feed consisting of :- 20 wt% of 1 mm particles and smaller, 30 wt% of 2 mm particles, 50 wt% of 4 mm particles passes through a rotary tubular reactor somewhat like a cement kiln where it reacts with gas to give a hard non friable solid product (SCM/reaction control, t = 4 hr. for 4 mm particles). Find the residence time needed for 80 % conversion of solid. Find the mean conversion of the solids for a residence time of 10 min.
   b. Explain the fixed bed reactor and fluidized bed reactor with suitable diagram and differentiate between them also.
   c. What is progressive conversion model and un-reacted core model? Explain the rate of reaction for shrinking spherical particles with, chemical reaction control. Gas film diffusion controls.

5. Attempt any ***Two*** parts of the following: [2×10]
   a. Discuss the enzymatic and microbial fermentation with neat sketch.
   b. What do you understand by inhibitors? Explain the kinetics of competitive and non-competitive inhibition with neat sketch.
   c. Explain the following:
      i. Batch and Plug flow fermentor with kinetic expression
      ii. Mixed flow fermentor with kinetic expression