Minor II – CHL 727 Heterogeneous catalysis and Catalytic Reactors

Time: 2:30-3:30 pm **Date: 23, March, 2014**

M.M 20 Venue: V-315

1. (i) Why aluminosilicate surfaces are classified as strong brønsted acids, whereas silica gel is a weak acid. How the concentration and strength of acid sites can be controlled in zeolites. Give an explanation for the increased acidity when Al^{3+} is present in the silicon dioxide lattice. 3

   (ii) What information on catalyst can be obtained from X-ray photoelectron spectroscopy (XPS) and Auger electron spectroscopy (AES). 2

2. (a) For a multilayer adsorption, write down the equilibrium rate equations for the adsorption /desorption on the bare surface, first, second and third layers. 3

   (b) What is the principle of N_2 desorption isotherm used for determination of pore size of mesoporous catalysts. Also explain why adsorption- desorption hysteresis is observed in nitrogen desorption. 3

3. How BJH method is used for determination of pore size distribution of a catalyst. The surface area found by the BET method is 220 m^2/g. The pellet density as measured by Pyknometry yielded a value of 1.10 g/cm^3 and a solid density of 2.30 g/cm^3 was obtained by gas sharing experiments. What is the catalyst average pore radius and porosity? 4

4. How metal surface area and crystal size is determined from H_2 chemisorption data. In a Hydrogen adsorption isotherm at 353 K for a 2% Pt/SiO_2 catalyst (based on initial loading of Pt metal) the hydrogen uptake on the catalyst was 0.15 cm^3 H_2/ g catalyst at STP. Assume that no reversible adsorption occurs on silica and adsorption of hydrogen is dissociative on Pt metal (i.e. each H_2 molecule covers two Pt atoms). Calculate metal dispersion and metal surface area. The average site density for Pt metal (Atomic mass 195) may be taken as 1.3 x10^{15} Pt_s /cm^2. 5