CRAWFORD UNIVERSITY
COLLEGE OF NATURAL AND APPLIED SCIENCES
DEPARTMENT OF PHYSICAL AND EARTH SCIENCES
(INDUSTRIAL CHEMISTRY UNIT)
HARMATTAN SEMESTER EXAMINATIONS 2013/2014 SESSION

COURSE CODE: ICH 347
COURSE TITLE: INTRODUCTION TO CATALYSIS **UNITS: 2**
TIME ALLOWED: 2 HOURS
DATE: FEBRUARY, 2014

INSTRUCTION: ATTEMPT ONLY THREE QUESTIONS

1. (a) Define the following terms with ONE example each:
   (i) Homogeneous catalysis
   (ii) Heterogeneous catalysis.
   (b) (i) Differentiate between the terms "Catalytic Turnover Number (TON) and Catalytic Turnover Frequency (TOF)".
   (ii) State the basis for the classification of catalysts.
   (c) (i) Describe the range of the types of catalysts using diagram only.
   (ii) Briefly explain the term "Autocatalysis". Support your explanation with one suitable example.
   (d) Mention factors that must be considered in choosing a catalyst for a commercial purpose.

2. (a) Explain the following terms:
   (i) Inhibitor.
   (ii) Selectivity
   (iii) Active agent
   (b) (i) State the attributes of a good catalyst.
   (ii) Mention three possible types of homogeneous catalysis.
   (c) Consider the catalyzed reactions:

$$S + H^+ \longrightarrow P + H^+ \quad \text{.....(1)}$$
$$S + OH^- \longrightarrow P + OH^- \quad \text{..... (2)}$$

Show that $K' = K_o + K_H[H^+] + \frac{K_{OH}K_w}{[H^+]}$

3. (a) Derive the Michaelis-Menten equation: $V_o = \frac{V_{max}[S]}{K_m + [S]}$

   (b) (i) Mention four applications of enzyme catalyzed reactions.

   (ii) What is the full meaning of ECIUB as related to the classifications of enzymes?

   (c) What is the Lineweaver-Burk plot?

4. (a) Write short notes on any three of the following:

   (i) Hydroformylation

   (ii) Wilkinson's catalyst

   (iii) Monsanto acetic and synthesis

   (iv) Wacker oxidation alkenes

   (b) Mention five industrial applications of catalysis, stating the processes and the catalyst system involved.

   (c) Draw the structures of the following catalysts:

   (i) C_6H_{11}= cyclohexyl (Grubbs catalyst 2)

   (ii) Schrock catalys

   (iii) Tricyclohexyl phosphate (Grubbs catalyst 3)

   (iv) Metallocene catalyst

   (d) Distinguish between the terms "Chemosorption and Physisorption".

5. (a) Using the catalytic cycle, show the mechanism of reaction below:

$$2H_2 + O_2 \xrightarrow{NO_2} 2H_2O$$

   (b) Outline the types of elementary steps that are possible with organometallic catalysts.

   (c) Differentiate between integral selectivity and differential selectivity.