UNIVERSITY OF EMBU

2017/2018 ACADEMIC YEAR

SECOND SEMESTER EXAMINATIONS

FIRST YEAR EXAMINATION FOR THE DEGREE OF MASTER IN SCIENCE (CHEMISTRY)
SCH 507: INDUSTRIAL CHEMISTRY

DATE: APRIL 5, 2018 **TIME: 2:00-5:00PM**

INSTRUCTIONS:

Answer Question ONE and any other THREE

QUESTION ONE (30 MARKS)

a) i) Discuss why Leblanc process was replaced by Solvay process in the production of sodium carbonate. (3 marks)

ii) Calculate the Reynolds Numbers for water at 20 °C flowing at 2 m s^{-1}, and for air flowing at 20 m s^{-1}, along a 1 inch pipe. State if the flow would be turbulent or laminar in each case?

Water — Density = 1000 kg m^3, Viscosity - 0.001 Pa s

Air — Density = 1.207 kg m^3, Viscosity - 1.81×10^{-5} Pa s (4 marks)

iii) Discuss why flow of fluid is important to chemical engineers. (4 marks)

b) i) Discuss the benefits of a well designed process control (5 marks)

ii) Differentiate between wet process and dry process in cement manufacturing (3 marks)

iii) Describe three fluid flow regimes (3 marks)

iv) Write the chemical reactions involved in the manufacture of Diammonium phosphate fertilizer (2 marks)

c) Discuss the following engineering aspects in Phthalic acid manufacture process:

i) Advantage of using O-xylene over naphthalene (2 marks)

ii) Effects of temperature and space velocity (2 marks)

iii) Design of reactor (2 marks)

QUESTION TWO (20 MARKS)

a) Illustrate with chemical equations the three main steps in contact process. (6 marks)

b) Discuss some of industrial job hazards and explain how they can be controlled (6 marks)

c) i) The reaction equilibrium of the conversion of sulphur dioxide to sulphur trioxide is affected by temperature, and pressure. Explain how this conditions affects the direction of the reaction. (6 marks)

ii) How does fluid differ from other state of matter? (2 marks)

QUESTION THREE (20 MARKS)

a) State and derive Bernoulli's equation that describe energy balance in fluid flow. (10 marks)

b) Using a real life example describe Bernoulli's equation application. (5 marks)

c) Discuss methods for estimating capital investment. (5 marks)

QUESTION FOUR (20 MARKS)

a) Explain why Hou's process is the most common current process of manufacturing sodium carbonate (5 marks)

b) Describe the theoretical conditions that should be used to maximize the rate of the reaction of nitrogen and hydrogen to produce ammonia. Are these the conditions actually used? If not, why not? (5 marks)

c) i) Discuss the health provisions in part IV of factories act (5 marks)

ii) Discuss the three main components in a control loop. (5 marks)

QUESTION FIVE (20 MARKS)

a) Using a simple chemical process, demonstrate why hydrodynamics is important (6 marks)

b) i) Describe three types of control systems (6 marks)

c) ii) Discuss common sysmptoms of poor process control (3 marks)

d) Derive continuity equation and indicate how constant mass flow rate is maintained (5 marks)

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