



# INDIAN INSTITUTE OF TECHNOLOGY, KHARAGPUR

Mid-semester Examination, 2016-2017

Subject : Chemical Process Technology

Subject No.: CH 30014

Date: 21. 2.2017 ( FN)

Time:2 Hrs

Full Marks: 30

**Instructions :** Answer all questions. Do not ask for clarification on any question. State and assume any missing data suitably.

- ~~Q1a.~~ Describe with a neat flow diagram any one process for production of hydrogen to meet the demand of hydrogen in a kerosene hydrodesulfurisation unit in a petroleum refinery. [4marks]
- ~~Q1b.~~ Describe with a block flow diagram how lubricating oil base stock is produced in a petroleum refinery. [4 marks]
- Q1c. Explain what is meant by the term 'utility systems' in a large scale chemical complex. [4 marks]
- Q2. A naphtha based fertilizer plant produces urea  $[\text{CO}(\text{NH}_2)_2]$ . The feed naphtha having 16% w/w  $\text{H}_2$  has a density of  $752 \text{ Kg/M}^3$ . This plant receives naphtha in railway wagons with unloading capacity of  $1000 \text{ M}^3/\text{day}$ . Estimate the maximum daily production of ammonia in the ammonia production section of this plant. (Atomic weights of N, O and H are 14, 16 and 1). [8 marks]
- Q3. A producer gas plant uses a steady mixture of steam and air passed through the coal bed. This coal has 62%w/w carbon. Assume the major reactions to be –
- (i)  $\text{C} + \text{H}_2\text{O} = \text{CO} + \text{H}_2$  [The reaction is endothermic and Heat of reaction is  $\Delta H_1 \text{ kJ/kg C}$ ]
- (ii)  $\text{C} + \text{O}_2 = \text{CO}$  [The reaction is exothermic and Heat of reaction is  $\Delta H_2 \text{ kJ/kg C}$ ]
- (a) Estimate the mole ratio of steam and air.
- (b) List all side reactions that possibly occur in the bed and
- (c) the effect of each of these reaction on the calorific value of the product gas. [4+3+3=10 marks]

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