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## UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, December 2017

Program: BTech (FSE)

Semester – V

Subject (Course): CHEMICAL ENGINEERING III (PROCESS TECHNOLOGY) Max. Marks : 100

Course Code : CHEG391

Duration : 3 Hrs

No. of page/s:

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### Section A (10 × 2 = 20 marks)

All the questions are compulsory (All questions carry equal marks)

Q1. Method used for extraction of copper:

- a) Electrolysis
- b) Reduction using carbon
- c) Heating
- d) None of the above

Q2. Anaerobic digestion happens in the absence of \_\_\_\_\_ (Choose all the correct options)

- a) Oxygen
- b) Molecular oxygen
- c) Air
- d) Nitrogen

Q3. In a blast furnace used for extraction of Iron, the \_\_\_\_\_ formed combines with silicon dioxide, the main impurity in iron ore, to form a molten \_\_\_\_\_.

Q4. According to mode of heat a furnace is classified into?

Q5. Most forms of metal corrosion in aqueous media can be explained by the theory of \_\_\_\_\_.

Q6. Fertilizers are used to compensate for the absence or shortage of which nutrients?

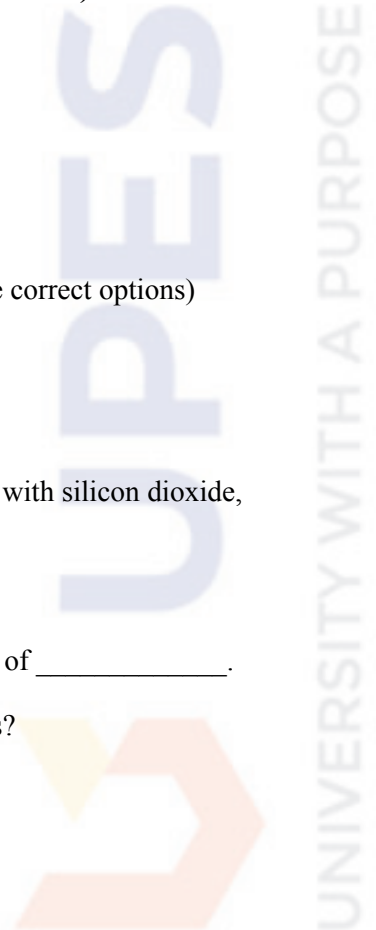
Q7. What is the use of instrumentation in chemical industry?

Q8. Write the full form of:

- a) TSP
- b) SSP

Q9. List two problems associated with use of hydrogen.

Q10. What are the problems associated with harnessing solar energy?



**Section B (5 × 8 = 40 marks)**

**All the questions are compulsory (All questions carry equal marks)**

Q11. What are the various environmental impacts of chlor-alkali industry? What can be done to minimize its impact?

Q12. Explain the urea synthesis process with the help of a diagram.

Q13. Give the complete classification of types of furnaces. What are the characteristics of an efficient furnace?

Q14. What are the steps involved in extraction of Iron using blast furnace? What can be done to improve the purity of Iron?

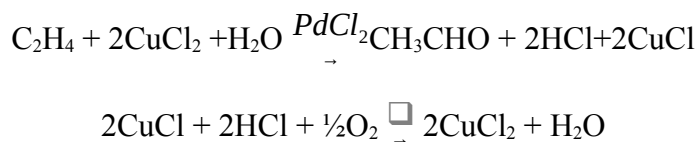
Q15. List the main source of raw material for sugar industry. What are the steps involved in manufacture of sugar?

**Section C (2 × 20 = 40 marks)**

**Answer any two questions (All questions carry equal marks)**

Q16. Name the various process used for manufacture of soda ash. Which process is the most economical and why? Explain Solvay Process with the help of a neat diagram. What are the uses of sodium carbonate?

Q17. One method of preparing acetaldehyde is by the direct oxidation of ethylene. The process employs a catalytic solution of copper chloride containing small quantities of palladium chloride. The reactions may be summarized as follows:



In the reaction, PdCl<sub>2</sub> is reduced to elemental palladium and HCl, and is reoxidized by CuCl<sub>2</sub>. During catalyst regeneration the CuCl is reoxidized with oxygen. The reaction and regeneration steps can be conducted separately or together. In the process, 99.8 percent ethylene, 99.5 percent oxygen, and recycle gas are directed to a vertical reactor and are contacted with the catalyst solution under slight pressure. The water evaporated during the reaction absorbs the exothermic heat evolved, and make-up water is fed as necessary to maintain the catalytic solution concentration. The reacted gases are water-scrubbed and the resulting acetaldehyde solution is fed to a distillation column. The tail gas from the scrubber is recycled to the reactor. Inerts are eliminated from the recycle gas in a bleed stream which flows to an auxiliary reactor for additional ethylene conversion. Prepare, in the form of a flow sheet, the sequence of steps in the

development of a plant to produce acetaldehyde by this process. An analysis of the points to be considered at each step should be included. List the additional information that will be needed to complete the preliminary design evaluation.

Q18. In a number of separate runs different concentrations of substrate and enzyme are introduced into a batch reactor and allowed to react. After a certain time the reaction is quenched and the vessel contents analyzed. From the results found below find a rate equation to represent the action of enzyme on substrate.

<i>Run</i>	$C_{E0}, \text{mol/m}^3$	$C_{A0}, \text{mol/m}^3$	$C_A, \text{mol/m}^3$	<i>t, hr</i>
1	3	400	10	1
2	2	200	5	1
3	1	20	1	1



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### Section A (5 × 4 marks = 20 marks)

All the questions are compulsory (All questions carry equal marks)

Q1. Which of the following is **TRUE** of pilot plant studies? (more than one choice may be true)

- a) They are the same as benchmark experiments
- b) They are used to study the behavior of the system for use in design of larger facilities
- c) They can also be used to train personnel for full-scale plant
- d) They are used to generate data for optimization of the full-scale commercial plant

Q2. Method used for extraction of copper:

- a) Electrolysis
- b) Reduction using carbon
- c) Heating
- d) None of the above

Q3. Which of the following is **TRUE**? A process flow diagram (PDF): (more than one choice may be true)

- a) It contains the detailed specifications of all the equipment required for a chemical process
- b) Is the same as a P&ID
- c) It does not include minor part or component of a system
- d) It shows the relation between major parts of a system

Q4. According to mode of heat a furnace is classified into?

Q5. Most forms of metal corrosion in aqueous media can be explained by the theory of \_\_\_\_\_.

Q6. What are the types of designs, depending on the accuracy and details required, for carrying out a plant design project?

Q7. What is the use of instrumentation in chemical industry?

Q8. Write the full form of:

c) GTSP

d) SSP

Q9. List two problems associated with use of hydrogen.

Q10. What are the problems associated with harnessing solar energy?

**Section B (5 × 8 marks = 40 marks)**

**All the questions are compulsory (All questions carry equal marks)**

Q11. State the difference between aerobic and anaerobic processes?

Q12. What are the various steps involved in the manufacture of pulp and paper? Name the different sections of paper making machine.

Q13. Describe the methods used for extraction of plant oil and animal fat?

Q14. What are the important uses of Sodium hydroxide? Discuss the environmental impact of Chlor-Alkali industry.

Q15. Name the source of raw material for making phosphate fertilizer. What are the processes used for the manufacture of phosphate fertilizer? Name the main phosphate fertilizers.

**Section C (2 × 20 marks = 40 marks)**

**Answer any two questions (All questions carry equal marks)**

Q16. What is corrosion? Why corrosion is harmful? Describe the various methods of prevention of corrosion.

Q17. List and describe the various sources of energy. What are the hurdles to large-scale implementation of renewable sources of energy? Is use of renewable energy source a solution to growing problems of global warming and climate change?

Q18. Name the various process used for manufacture of soda ash. Which process is the most economical and why? Explain Solvay Process with the help of a neat diagram. What are the uses of sodium carbonate?