

Seat No.: _____

Enrolment No. _____

GUJARAT TECHNOLOGICAL UNIVERSITY
ME - SEMESTER- 3 (NEW) • EXAMINATION – WINTER - 2023

Subject Code:3733011

Date: 02 Dec 2023

Subject Name:Process plant design and flowsheeting

Time:10:30 AM TO 01:00 PM

Total Marks: 70

Instructions:

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

- Q.1 (a)** A plant design project moves to completion through a series of stages. Discuss all such probable stages with general design consideration of a chemical process plant. **07**
- (b)** Critically discuss various practical considerations in design and engineering ethics. **07**
- Q.2 (a)** Name various methods of capital cost estimates and discuss any one in details. **07**
- (b)** Synthesis gas may be prepared by a continuous, noncatalytic conversion of any hydrocarbon by means of controlled partial combustion in a fire-brick lined reactor. In the basic form of this process, the hydrocarbon and oxidant (oxygen or air) are separately preheated and charged to the reactor. Before entering the reaction zone, the two feed stocks are intimately mixed in a combustion chamber. The heat produced by combustion of part of the hydrocarbon pyrolyzes the remaining hydrocarbons into gas and a small amount of carbon in the reaction zone. The reactor effluent then passes through a waste-heat boiler, a water-wash carbon-removal unit, and a water cooler-scrubber. Carbon is recovered in equipment of simple design in a form which can be used as fuel or in ordinary carbon products. Prepare a simplified equipment flow sheet for the process, with temperatures and pressure conditions at each piece of equipment. **07**

OR

- (b)** A distillation unit has been designed to handle a very hazardous material. The unit utilizes a reflux drum and buffer storage. List several ways in which the inventory of the hazardous material can be reduced or eliminated. Sketch and instrument the system that is recommended. **07**
- Q.3 (a)** Define plant layout. Discuss the general consideration of storage and equipment layout. **07**
- (b)** Chlorine is transferred from a storage tank to a reactor via a vaporizer. The vaporizer may be heated by hot water, by steam, or by closed circuit heating using a heat transfer fluid that is inert to chlorine. The vaporizer may be a coil immersed in a heating bath, a **07**

vertical tube bundle, a concentric tube unit, or an evaporator. Indicate the relative merits of these different systems and select one method. Develop a piping and instrument diagram for the system selected making certain that all temperature, pressure, liquid level and flow control systems, and alarms are included for safe operation.

OR

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| Q.3 | (a) Discuss the success and challenges in process network design and optimization Using P-graph. | 07 |
| | (b) Explain the generation of solution structure (SSAG) algorithm | 07 |
| Q.4 | (a) Discuss with the help of a breakeven chart the significance of production schedule for optimum analysis. | 07 |
| | (b) Discuss various factors for selection of piping lay out and piping support layout. Give examples of various piping supports | 07 |

OR

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| Q.4. | (a) Define Piping insulation and discuss types of insulations. Also list out factor governing for selection of insulation. | 07 |
| | (b) State the selection criteria of valves. Enlist important types of valves and their salient features used in chemical processes. | 07 |
| Q.5 | (a) Write 5 common parameters to characterize wastewater. Enlist primary, secondary and tertiary treatment methods of wastewater. Explain any one in brief | 07 |
| | (b) Discuss the concept of optimum cooling water flow rate and optimum reflux ratio. | 07 |

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| Q.5 | (a) Write a note on 'Break even analysis' | 07 |
| | (b) Discuss Branch-and-bound algorithm for MINLP problems | 07 |
