

Name:	
Enrolment No:	

UPES

End Semester Examination, December 2024

Programme Name : B.Tech (Fire and Safety Engineering)

Semester : VII

Course Name : Chemical Engineering III

Time : 03 hrs

Course Code : HSFS 4019

Max. Marks: 100

Nos. of page(s) : Two

Instructions: Assume suitable data wherever necessary. Your answer should be precise and to the point.

SECTION A (6 Marks * 5 = 30 Marks)

S. No.		Marks	CO
Q 1	Choose the best answer: i. Which of the following machines do not require a chemical separation technique? a) The washing machine b) Refrigerator c) Coffee machine d) Water cooler ii. In what way is a chemical or biochemical plant not operated? a) Continuous b) Batch-wise c) Semi-continuous d) Discontinuous iii. In what situation a separation process not required in a manufacturing process? a) When there is a decomposition reaction b) When there is a complete conversion c) When the byproducts are in form of gases d) When the reaction is reversible iv. Chemical reactions often use feedstock derived from non-renewable resources like coal, petroleum. What is used in place of non-renewable sources? a) Sunlight b) Biomass c) Biodiesel d) Microorganisms	1.5 x 4	CO1
Q 2	i. What is bioprocess engineering? ii. Why do breads and cakes rise when yeast is added?	3+3	CO1
Q 3	Describe the unit operations involved in bioprocess.	6	CO1
Q 4	What are the key features of carbon and low alloy steels that make them suitable for chemical plant construction?	6	CO1
Q 5	How does scale-up from laboratory to industrial scale affect bioprocess operations?	6	CO1

SECTION B (15 Marks * 3 = 45 Marks)

Q 6	<p>a. A fire-rated door has a thermal conductivity of 0.55 W/m·K and a thickness of 12 cm. If one side is exposed to a temperature of 750°C and the other side is at 50°C, calculate the rate of heat transfer through the door if the area is 5 m².</p> <p>b. A tragic fire occurred on the night of November 15, 2024, at the Neonatal Intensive Care Unit (NICU) of Maharani Laxmi Bai Medical College in Jhansi, Uttar Pradesh, resulting in the deaths of at least 10 newborns and injuries to 16 others. Based on the knowledge and your understanding of this incidence, highlight your thoughts on the following:</p> <p>i. What were the main causes of the fire at the Jhansi Hospital?</p> <p>ii. In the context of Fire Safety Engineering, how can hospitals better implement a fire safety risk assessment process?</p>	5	CO2
		5+5	
Q 7	<p>i. List examples of conventional and unconventional energy sources. Evaluate the trade-offs between safety and operational efficiency in renewable versus non-renewable energy systems.</p> <p>ii. Compare the economic costs of producing electricity from coal versus solar energy.</p> <p>iii. Why is solar energy considered safer than fossil fuels in terms of fire and explosion hazards?</p>	5+5+5	CO3
Q8	<p>Questions based on the Iron-Carbon phase diagram:</p> <p>i. Why is understanding the critical temperature important for fire-resistant steel design for chemical plants?</p> <p>ii. In the event of a fire, how might the heat affect the microstructure and mechanical properties of low-carbon steel versus high-carbon steel?</p>	7	CO1
		8	
SECTION C (25 Marks)			
Q 9	<p>Key components included in the Piping and Instrumentation Diagrams (P&IDs) of a simple continuous distillation unit are as follows:</p> <p>i. Feed Tank</p> <p>ii. Pump</p> <p>iii. Distillation Column</p> <p>iv. Reboiler</p> <p>v. Condenser</p> <p>vi. Product Tanks</p> <p>a) Please explain the function of each component.</p> <p>b) Draw the standard P&ID symbols for any four components.</p> <p>c) Create a P&ID for a fire suppression system.</p>	15	CO5
Q 10	<p>a. Write the extraction process for the following daily life examples:</p> <p>i. Silica Sand (SiO₂) to Glass</p> <p>ii. Iron from Ore</p> <p>b. “Nothing happens suddenly” This statement encourages mindfulness and deeper analysis of the processes leading to any event, reminding us to stay attentive to the journey rather than just the outcome. What is your opinion?</p>	2+2	CO4
		6	