Name: Enrolment No:	

UPES

End Semester Examination, December 2023

Course: Chemical Engineering III **Semester: VII**

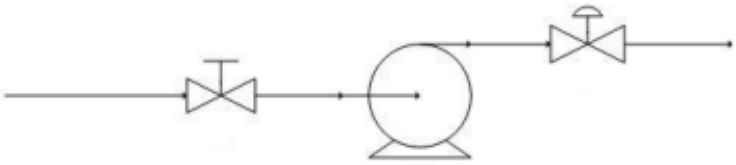
Program: B.Tech in Fire Safety Engineering **Time : 03 hrs**

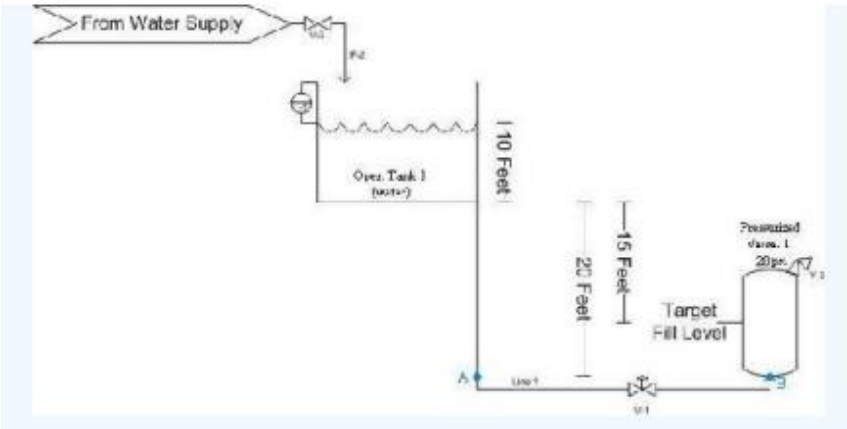
Course Code: HSFS 4019 **Max. Marks: 100**

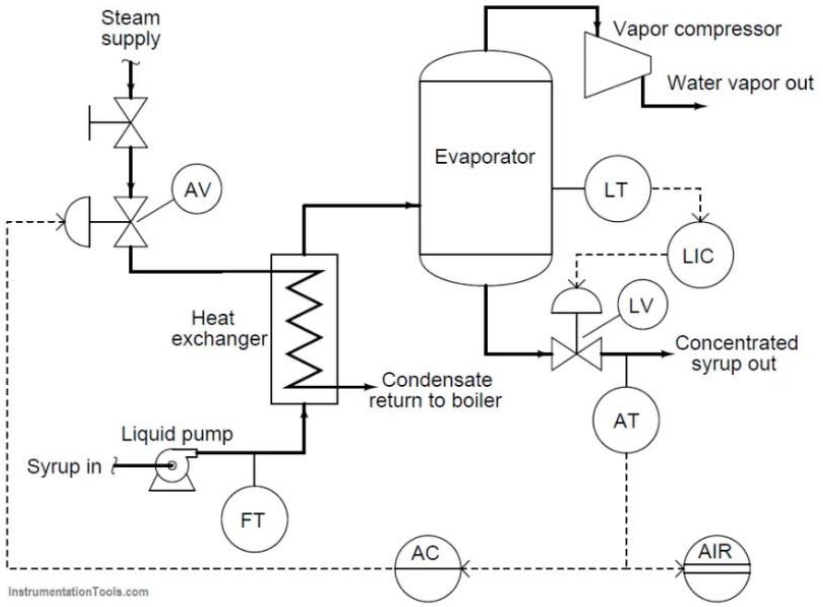
Instructions: 1. Use pencil and scale to draw neat sketches wherever required.
2. Do step-by-step detailed calculations while solving the numerical.

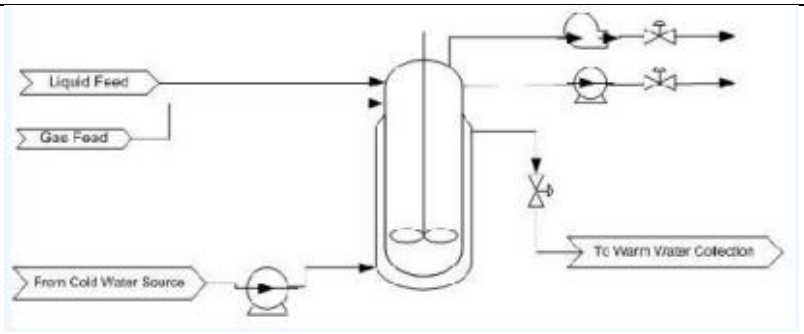
SECTION A

(5Qx4M=20Marks)

S. No.	Short answer type questions:	Marks	CO
Q 1	Role of fermentation in bioprocess operation? Explain what happens in making milk into curd.	2+2	CO1
Q 2	Pl suggest which side of valve is to be removed to make a proper valve placement arrangement for pump. Justify your answer too. 	2+2	CO1
Q 3	Write down the criterion used for the design of bioreactor to achieve consistent and quality products.	4	CO1
Q 4	Applications of biotechnology for environment-friendly solutions.	4	CO1
Q 5	Draw a PI diagram for heat exchanger.	4	CO5

SECTION B **(4Qx10M= 40 Marks)**			
Q 6	Bioprocess engineering is the backbone of the biotechnology industry. It is divided into three parts as follows: • Upstream processing • Bioreactor and bioreactions • Downstream processing Explain clearly, the biotransformation of raw material into a range of product that happens during above three parts. Consider any example to support your answer.	10	CO 2
Q 7	A pipe connects a water tank (open to the atmosphere) and a vessel pressurized to 28psi. The open tank has 10 feet of water in it. A level control system ensures that the 10 foot level is maintained in the open tank. The bottom of the pressurized vessel is 20 feet below the bottom of the open tank and starts with no water in it. The goal is to fill the pressurized vessel up to 5 feet. Due to a poor design by the project engineer, the water is fed into the bottom of the pressurized vessel. Given that the density of water is 62.4 lbm/ft^3 and the gravitational constant is 32.2 ft/s^2, is a pump needed? If so, where should it be placed? Assume that there is no pressure drop due to friction against the pipe and that the air pressure of the pressurized tank remains at a constant 15psi. The figure below may be helpful in visualizing the process. 	10	CO 3
Q 8	List out various considerations involved in designing a food process plant from concept to commissioning.	10	CO 1
Q 9	a) What is the physical significance of the symbols used in a chemical plant for making a piping and instrumentation diagram. b) Sketch out any four symbols used in P&ID.	6+4	CO 5
SECTION-C **(2Qx20M=40 Marks)**			
Q 10	With reference to the process diagram as shown below, in this process maple syrup is heated as it passes through a steam heat exchanger, then enters an evaporator where the water boils off. The purpose of this is to raise the sugar concentration of the syrup, making it suitable for use as a food topping. A level control system (LT, LIC, and LV) maintains constant syrup level inside the evaporator, while an analytical control system (AT, AIR, AC, and AV) monitors the	4+4+4+4+4	CO4

	sugar concentration of the syrup and adjusts steam flow to the heat exchanger accordingly.  Answer the following: i. Suppose the steam tubes inside the heat exchanger become coated with residue from the raw maple syrup, making it more difficult for heat to transfer from the steam to the syrup. This makes the heat exchanger less efficient, which will undoubtedly affect the process. Describe in detail the effect this heat exchanger problem will have on the performance of the analytical control system. ii. Suppose the heat exchanger fouling really is this bad, but we cannot fix the heat exchanger with the tools we have available. What would you recommend the operator do to make this system produce on-spec syrup? iii. Suppose a process operator accidentally leaves the manual block valve locked and tagged shut following an overhaul of the process, so that no steam can enter the heat exchanger. Describe how both control systems will respond over time to this process condition. iv. Why do you think it is important to monitor and control the level of syrup inside the evaporator? v. Suppose the operations personnel of this maple syrup processing facility wished to have an automatic method for detecting heat exchanger fouling. What variable(s) could be measured in this process to indicate a fouled heat exchanger?		
Q 11 (i)	A P&ID appears below to produce a solution containing a pharmaceutically active compound. The reaction taking place in the CSTR is highly exothermic. After examining the P&ID for this part of the process, describe a possible alarm system.	10	CO4

(ii)	 Briefly explain. • Energy resources and their classification • Energy efficiency and energy security	5+5	CO3