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B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

January 2024 Semester End Main Examinations

Programme: B.E. **Semester: VII**
Branch: Biotechnology **Duration: 3 hrs.**
Course Code: 19BT7DCEQD **Max Marks: 100**
Course: Bioprocess Equipment design and CAED

Instructions: 1. Unit 1 is compulsory.
2. Unit 2 and Unit 3 are provided with internal choices.
2. Missing data if any may be suitably assumed.
4. Use of Perry's hand book/code book is permitted.

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

			UNIT - I	*CO*	*PO*	Marks
1	a)		How the codes and standards are useful in designing specific equipment? Explain with suitable example.	*CO1*	*PO 6*	5
	b)		Draw symbol used in P & ID for the following equipment: a. Autoclave b. Rotary drier c. Double pipe heat exchanger	*CO2*	*PO1*	5
	c)		Draw a neat block diagram representing the anatomy of biochemical process of your choice. Describe each stage of biochemical process with respect to design perspective.	*CO2*	*PO2*	10
			UNIT - II			
2	a)		Draw neat sketches of Tee joint and Lap joint.	*CO3*	*PO1*	5
	b)		Draw a proportionate sketch of gate valve labelling all the parts.	*CO3*	*PO2*	15
			OR			
3	a)		Explain the working of diaphragm valve in detail.	*CO3*	*PO1*	5
	b)		Draw a proportionate sketch of centrifugal pump naming all the parts.	*CO3*	*PO2*	15
			UNIT - III			
4	a)		Design one shell side pass and two tube side pass, shell and tube heat exchanger to cool kerosene from 200°C to 90°C by exchanging the heat with crude oil entering the STHE at 40°C. The kerosene enters the exchanger at a pressure of 5 bar and crude oil enters at 6.5 bar. The flow rate of crude oil is 70000 kg/h. A pressure drop of 0.8 bar is permissible on both streams. Allowance should be made for the fouling by including	*CO4*	*PO2, 3*	40+20

			the fouling factors of 0.0003 (W/ m^2 ºC)$^{-1}$ and 0.0002 (W/ m^2 ºC)$^{-1}$ on the crude stream and kerosene stream respectively. Consider the overall heat transfer coefficient as 300 W/ m^2 ºC for the calculation of area of heat transfer. 20 mm od, 16 mm id, 4.88 m long carbon steel tubes are to be arranged in triangular pitch Conductivity of carbon steel is K_w is 45 W/ m ºC and allowable stress of the material is 12 kgf/cm^2. Draw a neat front sectional view of STHE. Name atleast 10 parts.			

Properties at mean temperatures	**Kerosene**	**Crude oil**
Specific heat (kJ/kg ºC)	2.47	2.05
Thermal conductivity (W/ m ºC)	0.132	0.134
Density (kg/m^3)	730	820
Viscosity (cP)	0.43	3.2

		OR			
5		It is desired to use fermenter to produce citric acid. The dimensions and process requirements are given below: The height and volume of fermenter vessel is 3.3 m and volume 6 m^3. Two flat blade open turbine agitators are provided for agitation. Diameter of the agitator is 60 cm. The first blade is present at the height of 60 cm from the bottom of the tank and other is from 180 cm from the bottom of tank. Agitator speed is 75 rpm. Air is introduced below the lower impeller at 0.011 m/s superficial velocity based on tank cross sectional area. Top and bottom head is torispherical type. Specific gravity of the fluid is 1.038.Viscosity of fluid is 1.4cP. Jacket spacing is 100 mm. Steam pressure is 1.5 kgf/cm^2. Internal pressure in the vessel is 2.5 kgf/cm^2. Material of construction is stainless steel. Allowable stress is 55 N/mm^2. Yield stress is 2000 kgf/cm^2. Draw to suitable scale indicating sectional details and name the parts.	***CO4***	***PO2, 3***	40+20

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