U.S.N.										

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

Autonomous Institute Affiliated to VTU

April 2025 Semester End Make-Up Examinations

Programme: B.E. **Semester: VII**

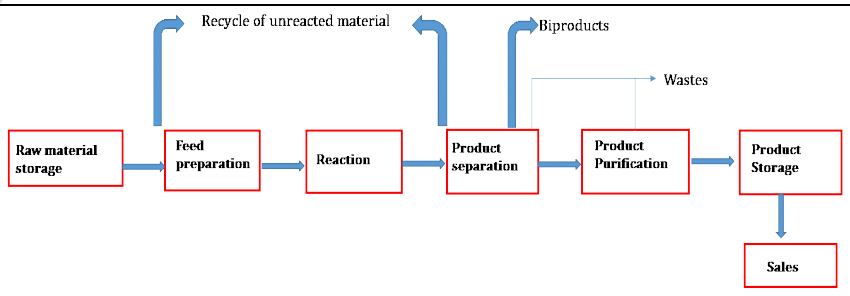
Branch: Biotechnology **Duration: 3 hrs.**

Course Code: 22BT7PCEQD **Max Marks: 100**

Course: Bioprocess Equipment Design and CAED

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.
3. Use of Perrys hand book, IS2825, IS4503 is allowed.

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)	Draw a neat flow chart of citric acid production. Identify the external and internal constraints in each step of this process. Based on the constraints, elucidate any three major challenges existing in the large-scale production of citric acid.	*CO4*	*PO 5*	**10**
	b)	Draw symbol used in P & ID for the following equipment: a. Centrifugal pump b. Agitated vessel c. Distillation column	*CO1*	*PO1*	**6**
	c)	Illustrate the significance of degree of freedom.	*CO1*	*PO1*	**4**
		OR			
2	a)	How the codes and standards are useful in designing specific equipment? Explain with suitable example.	*CO1*	*PO1*	**4**
	b)	Draw symbol used in P & ID for the following equipment: d. Drier e. Cyclone separator f. Double pipe heat exchanger	*CO1*	*PO1*	**6**
	c)	 The general anatomy of biochemical manufacture process is given in the above flowchart. By choosing suitable unit operations, develop a flowchart of any biochemical process of your choice. Explain each step of the process.	*CO4*	*PO5*	**10**

			UNIT - II			
	3	a)	Draw neat sketches of Butt joint and Cross joint.	*CO1*	*PO1*	**5**
		b)	Draw a proportionate sketch of centrifugal pump labelling all the parts.	*CO2*	*PO2*	**15**
			OR			
	4	a)	Explain the working of non-return valve in detail.	*CO1*	*PO1*	**5**
		b)	Draw a proportionate sketch of gland and stuffing box expansion joint naming all the parts.	*CO2*	*PO2*	**15**
			UNIT - III			
	5		Design a shell and tube exchanger for a cellulose production process. The hot fluid is entering the shell side at 70^{o}C and get cooled to 30^{o}C with a mass flow rate of 1 kg/s. Cold fluid entering the tubes at 55^{o}C and get heated upto 75^{o}C. The heat exchanger is assumed to have counter current flow with following data. Shell side (Hot water): Specific heat is 4178 J/kg^{o}C, Density is 996 kg/m^{3}, viscosity is 0.798 cP, thermal conductivity is 0.53 W/m^{o}C Tube side (Brackish water): Specific heat is 4193 J/kg^{o}C, Density is 1000 kg/m^{3}, viscosity is 0.378 cP, thermal conductivity is 0.67 W/m^{o}C Tube OD is 0.024 m, Tube ID is 0.018 m, Tube length is 4.245 m, Triangular pitch arrangement. Material of construction is carbon steel with fouling factor on shell side and tube side of 0.0002 (W/m^{2o}C)$^{-1}$ and 0.0003 (W/m^{2o}C)$^{-1}$ respectively. Thermal conductivity of the carbon steel is 45 W/m^{o}C. Operating pressure is 1atm. Allowable stress is 11.7 kgf/cm^{2}. Design split ring floating head type, 1-2 shell and tube heat exchanger (STHE) by considering overall heat transfer coefficient as 800 W/m^{2o}C. Draw a neat sectional front view of STHE by naming at least 15 parts.	*CO3*	*PO3*	**60**
			OR			
	6		It is required to design an industrial scale fermenter for vaccine production. Diameter of the fermenter is 501 mm and volume are 200 L. Two flat blade disc turbines are provided for agitation with diameter of 168 mm. The heights of the impellers are distributed	*CO3*	*PO3*	**60**

			evenly from the bottom of vessel. Speed of agitation is 500 rpm. Air is introduced below the lower impeller at a gas flow rate of 150 L/min. Data: Specific gravity of fermenter broth is 1.013 Viscosity of fermenter broth is 1.2 cP Material of construction is high grade stainless steel Design pressure is 0.3 MPa Yield stress is 205 MPa Allowable stress is 51 M Pa Design the agitated and jacketed fermenter for the above requirements. Draw a neat sectional front view of fermenter by naming all the parts.			

******