U.S.N.										

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

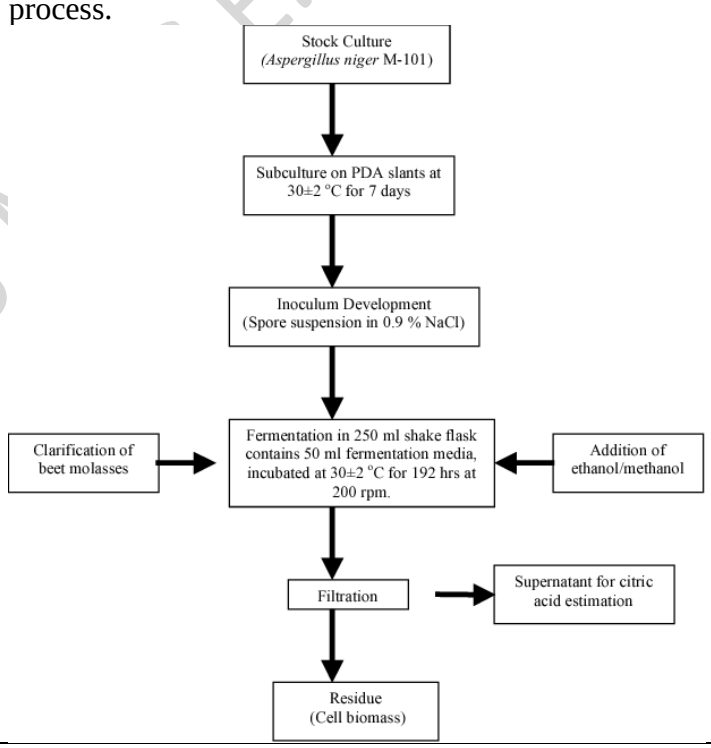
Autonomous Institute Affiliated to VTU

January / February 2025 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)	Sketch the symbols for (i) Centrifugal pump (ii) Evaporator (iii) Heat exchanger (iv) Rotary Drum Filter (v) Plate and filter press (vi) Roller Crusher	*CO2*	*PO 1*	**12**
	b)	Explain the various factors satisfying the performance and reliability of the process equipment.	*CO1*	*PO1*	**08**
		OR			
2	a)	Analyse the process flow diagram, suggest the 5 major equipments required to the production of citric acid and explain the entire process. 	*CO2*	*PO2*	**12**

		b)	Differentiate between internal and external constraints of bioprocess.	*CO1*	*PO1*	**08**
			UNIT - II			
	3	a)	Draw a neat proportional sketch of gate valve and list its parts.	*CO3*	*PO2*	**15**
		b)	Draw a schematic diagram for normal flow and tangential flow filtration systems.	*CO3*	*PO1*	**05**
			OR			
	4	a)	Draw a neat sketch of gland and stuffing box expansion joint.	*CO3*	*PO2*	**15**
		b)	Draw a neat proportional sketch of corner joint and tee joint.	*CO3*	*PO1*	**05**
			UNIT - III			
	5	a)	A 1-2 Shell & tube heat exchanger required to cool 18.528 kg/s of ethylene glycol from 120°C to 103°C using Toluene as the coolant. The Toluene is heated from 27°C to 63°C. Use steel tubes of 14 BWG thicknesses having an outer diameter of 19.05mm and inner diameter of 16.56 mm. The tubes have a length of 8 ft and are to be laid on a triangular pitch of 1 inch. The shell contains 25 % cut segmented baffles spaced 152 mm apart. Let the ethylene glycol flow in tubes because it is more corrosive liquid. Design the heat exchanger for U_D= 343 W/m^2 °C and R_D=0.0003 (W/m^2 °C)$^{-1}$. Heat exchanger is operated at 1 atm. Material of construction is carbon steel with allowable stress 12 kgf/cm^2. a) Design the shell and tube heat exchanger b) Draw a neat sectional front view of the heat exchanger and label its parts. Data: Components | NBP | Density | Viscosity | Specific Heat (Cp) | Thermal Conductivity (*k*) Units | °C | kg/m^3 | kg/m sec | kJ/kgK | W/mK Toluene | 110.8 | 867 | 5.90 x10^{-4} | 1.675 | 0.134 Ethylene Glycol | 197.3 | 1070 | 3.00 x10^{-3} | 2.685 | 0.259	*CO4*	*PO2, 3*	**40+20**
			OR			
	6	a)	A continuous fractionating packed bed column is to be designed for separating 5,000 kg/h of a liquid mixture containing 30 mole % of acetone and 70 mole % of water into overhead product containing 90 mole % of acetone. The residue containing 5 mole % of acetone. A reflux ratio of 1.0 is used. The distillation column is operated at 1 atmosphere pressure and at 70% flooding velocity. Relative volatility of feed mixture is 1.5. Consider allowable stress of material 12 kgf/cm^2. Density of acetone 792 kg/m^3. Mass transfer coefficient is 0.035 kmol/m^{3}s. Design the packed bed distillation column.	*CO4*	*PO2, 3*	**40+20**

(i) Calculate the overall material balance & estimate total number of plates in the column
(ii) Estimate the height & diameter of fractionating column
(iii) Draw the sectional front view details of the fractionating column
Data: Acetone Water

Temperature (°C)	x	y
74.80	0.05	0.6381
68.53	0.10	0.7301
65.26	0.15	0.7716
63.59	0.20	0.7916
61.87	0.30	0.8124
60.75	0.40	0.8269
59.95	0.50	0.8387
59.12	0.60	0.8532
58.29	0.70	0.8712
57.49	0.80	0.8950
56.68	0.90	0.9335
56.30	0.95	0.9627

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