U.S.N.										

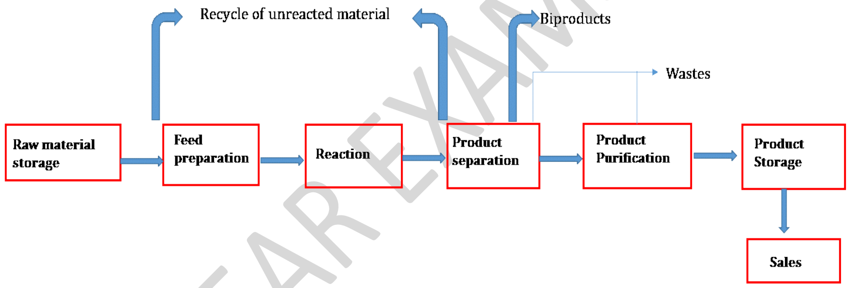
B.M.S. College of Engineering, Bengaluru-560019

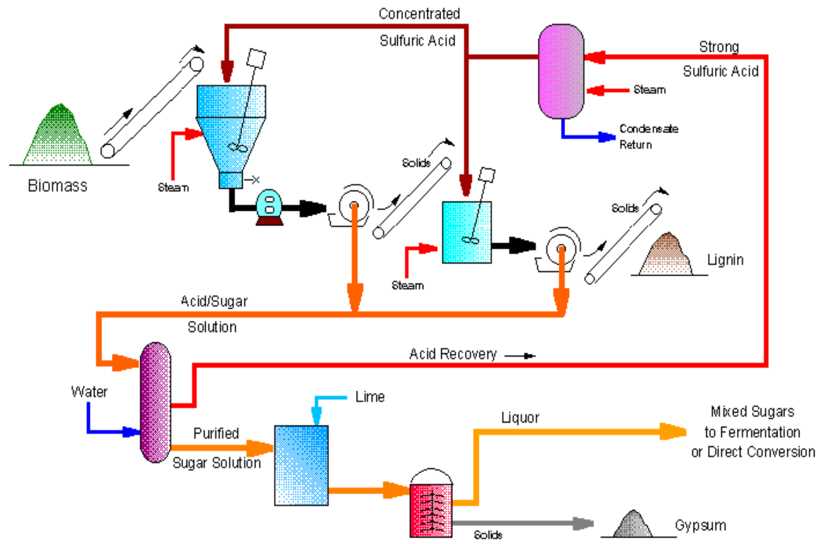
Autonomous Institute Affiliated to VTU

June 2025 Semester End Main Examinations

Programme: B.E. | **Semester: VII**
Branch: Biotechnology | **Duration: 3 hrs.**
Course Code: 22BT7PCEQD | **Max Marks: 100**
Course: Bioprocess Equipment Design & CAED

Instructions: 1. Answer any THREE full questions, choosing one full question from each it.
2. Missing data, if any, may be suitably assumed.
3. Use of Perrys hand book, IS 2825 and IS 4503 is allowed.

		UNIT - I	CO	PO	Marks
1	a)	How to optimize the design of a biochemical process? Illustrate.	CO1	PO 1	**10**
	b)	 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.	CO1	PO1	**10**
		OR			
2	a)	With a schematic representation, describe how the design constraints restricts the possible solutions to a given design problem.	CO1	PO1	**07**
	b)	Deliberate on how the P and I diagram aids in deriving the engineering flow-sheet.	CO1	PO1	**06**
	c)	Analyze the process flow diagram, identify the equipments and demonstrate the conversion of cellulose to mixed sugars.	CO1	PO1	**07**



			UNIT - II			
	3	a)	Draw the assembled sectional view of the Gland and stuffing box joint. Provide the parts list.	*CO2*	*PO2*	**15**
		b)	Draw a neat sketch of edge joint and cross pipe fitting.	*CO2*	*PO2*	**05**
			OR			
	4	a)	Draw the assembled sectional view of the Non-return Valve. Provide the parts list.	*CO2*	*PO2*	**15**
		b)	Draw a neat sketch of lap joint and lateral pipe fitting.	*CO2*	*PO2*	**05**
			UNIT - III			
	5	a)	Design a 1-2 shell and tube heat exchanger for the following duty. 6 kg/s of hot fluid leaves the pressure vessel at 473K and is cooled to 363K by exchange with 19 kg/s of cold fluid coming from storage at 313K. The hot fluid enters the exchanger from shell side at pressure of 500 kPa and the cold fluid enters at tube side at 650 kPa. A pressure drop of 80 kPa is permissible on both streams. Allowance should be made for fouling by including fouling factor of 0.0003 $(W/m^2K)^{-1}$ on cold fluid and 0.0002 $(W/m^2K)^{-1}$ on the hot fluid stream. Consider overall heat transfer coefficient of 400 W/m^2K. Material of construction of shell and tube is carbon steel with thermal Conductivity 55 W/mK. Allowable stress for the material is 11.7 kgf/cm^2. Use 19.05mm od, 14.83 mm id and 5 m long tubes with triangle pitch of 24 mm.	*CO3*	*PO3*	**60**

Physical properties	Hot fluid	Cold Fluid
Specific heat	2.47 kJ/kg K	2.05 kJ/kg K

Density	730 kg/m^3	820 kg/m^3
Viscosity	0.43 cP	3.2 cP
Thermal Conductivity	0.132 W/mK	0.134 W/mK

Draw a neat proportional drawing of shell and tube heat exchanger and name the parts.

OR

6	a)	A distillation column is required to separate 150kgmol/h of feed contains 50 mol% benzene. 96% of benzene is present in overhead product. The feed is liquid at its boiling point and at 1 atm. Reflux ratio is given as 3. Raschig ring with 2-inch diameter is used as packing material. Consider operating velocity as the 60% of flooding velocity. Mass transfer coefficient is 0.035 kmol/m^{3}s. Relative volatility of feed mixture is 2.5. Specific gravity of benzene and toluene are 0.879 and 0.866 respectively. Allowable stress for the material is 11.7 kgf/cm^2. Design packed bed distillation for the given requirement. Calculate the shell and head thickness of the column based on the internal pressure.	*CO3*	*PO3*	**60**

T (c)	111	106	99	92	87	85	83	80
Mol% of benzene in liquid	0	10	30	50	70	80	90	100
Mol% of benzene in vapor	0	20	51	71	85	91	96	100

Draw a neat proportional drawing of packed bed distillation column and name the parts.

******