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

Autonomous Institute Affiliated to VTU

September / October 2023 Supplementary Examinations

Programme: B.E.   Semester: VII
Branch: Biotechnology   Duration: 3 hrs.
Course Code:19BT7DCEQD   Max Marks: 100
Course: Bioprocess Equipment Design & CAED   Date: 14.09.2023
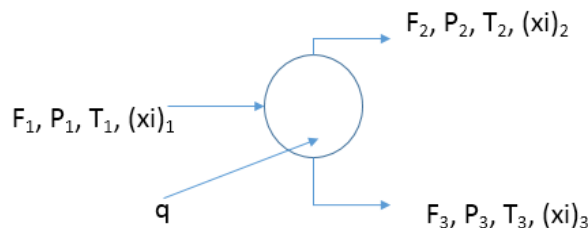
Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

UNIT - I

1. a) Write symbols for the following:
   Magnetic stirrer, heat exchanger, vibrating device, autoclave, centrifuge. **05**

   b) What is the importance of P and I diagram? **05**

   c)

   Analyze the above process streams for flash distillation process, define the design variables and calculate the degrees of freedom. **10**

UNIT - II

2. a) Draw neat sketches of butt joint and edge joint. **05**

   b) Draw a proportionate sketch of gland and stuffing box labelling all the parts. **15**

OR

3. a) Draw neat sketches of welding neck flanges and slip on flanges. **05**

   b) Draw a proportionate sketch of diaphragm valve naming all the parts. **15**

UNIT - III

4. a) A 1-2 shell and tube heat exchanger is required to cool 100000 kg/h of methanol from 95ºC to 40ºC, using brackish water which flows through the tubes with the temperature rise from 25º to 40ºC. 20mm od, 16mm id, **40**

4.88 m long (effective length) cupronickel tubes are to be arranged in triangular pitch. 25% cut baffles are to be spaced. Fouling coefficient for methanol and brackish water are 5000 and 3000W/m² °C respectively. An overall coefficient of 600 W/m² °C can be used for the initial trial. Design the exchanger and check for the pressure drop. (Conductivity of metal; k_w is 50 W/ m² °C).

Properties of Methanol:

Density = 750 kg/m³, Heat capacity = 2.84 kJ/ kg °C, Viscosity = 0.34 mNs/m², Thermal conductivity = 0.19 W/m °C.

Properties of brackish water:

Density = 995 kg/m³, Heat capacity = 4.2 kJ/ kg °C, Viscosity = 0.8 mNs/m², Thermal conductivity = 0.59 W/m °C.

b) Illustrate shell and tube exchanger with neat labelled parts. **20**

OR

5. a) A distillation column is required to separate 150 kmol/h of feed containing benzene toluene mixture. Feed contains 44 mol % benzene. 97 % of benzene is present in overhead product. The feed is liquid at its boiling point. Reflux ratio is 3.5. The pressure in the column is maintained at 1 atm. 2 inch raschig rings are used as packing material inside the column. The column is to be separated at 60 % flooding velocity. **40**

Design the packed bed distillation column.

Data: Mass transfer coefficient- 0.035 kmol/m³s, Viscosity of benzene- 0.33 cP, Viscosity of toluene- 0.29 cP, Specific gravity of benzene- 0.879, Specific gravity of toluene- 0.866

Temperature (°C)	111	106	102	99	95	92	90	87	85	83	80
Mol % of benzene in liquid	0	10	20	30	40	50	60	70	80	90	100
Mol % of benzene in vapor	0	20	38	51	63	71	78	85	91	96	100

b) Draw a neat sketch of Packed bed distillation column with neat label parts. **20**

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