MODEL QUESTION PAPER

Eighth Semester B.Tech. Degree Examination, May 2017
(2013 Scheme)
13.801: BIOPROCESS PLANT AND EQUIPMENT DESIGN (B)

Time: 4 hours **Max. Marks: 100**

(Answer ONE question from Part A and Part B, each question carries 50 marks. Chemical Engineer's Hand Book by Perry, steam tables, IS CODES and other similar data sources are permitted. Assume suitably if the data is not available from the data sources.)

Part A

1) A cylindrical horizontal vessel has 1.8 m tangent to tangent length. The vessel has to be provided with a suitable type of head based on the minimum design thickness only and no other parameters need to be considered in this respect for the given situation. The operating pressure in the vessel is 2 atm and the operating temperature is 250^0C.The material of construction of the equipment is IS 2002 Gr 2B steel. Design the following types of heads for the above vessel and comment on the thickness obtained. Also sketch the designed vessel and head.
   a) The two types of dished head
   b) A conical head
   c) A flat head
   d) An ellipsoidal head

Or

2) Design a bracket support for the column having the following specifications.

Diameter	= 2 m
Height	= 2.5 m
Clearance from the bottom of the foundation	= 0.9 m
Weight of the vessel and its contents	= 4000 Kg
Wind velocity	= 150 Km/h
Number of Brackets	= 4
Diameter of anchor bolts	= 1.6 m

Permissible stresses for structural steel:

Tension	= 140.1 MN/m^2	
Compression	= 122.5 MN/m^2	
Bending	= 154.8 MN/m^2	**(50 Marks)**

Part B

3) Aqueous solution of sucrose is to be concentrated from 5% solute to 25% solute at the rate of 5000 Kg/h. The feed enters at a temperature of 45 ^oC and the vapor space is maintained at 100 mm Hg. The elevation in boiling point is neglected. Take overall heat transfer coefficient as 740 $Kcal/h.m^2\ ^oC$. Saturated steam used is at 3 Kg/cm^2 gauge.

The enthalpy data are:

Vapour at 100 mm Hg	= 612 Kcal/Kg
5% sucrose solution at 45 ^oC	= 25 Kcal/Kg
25 % sucrose solution at evaporation temperature	= 38 Kcal/Kg

a) Calculate the rate of steam required, heat duty and steam economy for a single effect evaporator.

b) Estimate the heat transfer area and number of tubes required for the calendria using 25 mm OD tubes of 2 mm thickness and 1.5 m height.

c) Estimate the tube sheet diameter, if down take flow area is 50% total tube flow area.

Or

4) Methanol water solution containing 50 % by weight methanol at 26 ^oC is to be continuously rectified at 1 standard atm pressure at a rate of 5000 Kg/h to provide a distillate containing 95 % methanol by weight and a residue containing 1 % methanol by weight. The feed enters at boiling point. The relative volatility is 3.2 and the reflux ratio is 1.5 times the minimum. If the overall efficiency is 75%. Design a suitable sieve tray distillation column by calculating its number of plates, height, diameter and pressure drop. Also sketch the tray with all the design details. **(50 Marks)**