USN ☐☐☐☐☐☐☐☐☐☐   **18CH63**

Sixth Semester B.E. Degree Examination, June/July 2023
Process Equipment Design and Drawing

Time: 4 hrs.   Max. Marks: 100

Note: 1. Answer any ONE full question.
2. Chemical engineering Perry Hand book. IS code 2825 (1965), STHE is code 4503 is permitted.

1   Design 1-1 pass shell and tube heat exchanger to cool ethanol from 120 to 30°C. Using water. Cooling water enters at 25°C in tubes and flows counter currently to ethanol and leaves at 55°C. Flow rate of ethanol is 2330kg/hr. Operating pressure can be taken as 2atm. Dirt factor on ethanol and water side are 1661 and 1400 °cm²/w respectively. Assume overall heat transfer coefficient as 250W/m²°C.

The outside diameter of the tube is 2.54cm and are of 14BWG thick and are placed in triangular pitch and length of tube is 6m.

  a. Calculate the number of tubes required and detail design of heat exchanger.   **(50 Marks)**
  b. Calculate pressure drop on both side of the steam.   **(15 Marks)**
  c. Draw the sectional elevation of heat exchanger showing all details.   **(25 Marks)**
  d. Show the details of tube sheet layout.   **(10 Marks)**

2   Single effect evaporator is required to concentrate 36000kg/hr of solution from 10-50% solids. Steam is available at 250kN/m². Evaporation takes place at 13.5kN/m². The condensate leaves at condensate temperature. The feed to evaporator is 294K. The overall heat transfer coefficient is 3.2kW/m²°C. The specific heat of 10% and 50% solutions are 3.76 and 3.14kJ/kgK respectively. The height of evaporator body above the heating element may be atleast 3m to minimize entrainment. The calendria has vertical tubes of 5cm ID and 2m long placed on triangular pitch of 6.25cm. Cross sectional area of down comer should be atleast 75% CSA of all the tubes.

  a. Determine the number of tubes, diameter of down comer, diameter and thickness of shell.
                                                    (70 Marks)
  b. Draw the sectional elevation of evaporator showing all the details.   **(20 Marks)**
  c. Draw the layout of tubes.   **(10 Marks)**

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