Roll No												

PRESIDENCY UNIVERSITY
BENGALURU

Department of Research & Development

Mid - Term Examinations – AUGUST S2024

Odd Semester: Ph.D. Course Work
Course Code: MEC 821
Course Name: Thermal Systems Design
Department: Mechanical Engineering

Date: 13-08-2024
Time: 09.30am to 11.00am
Max Marks: 50
Weightage: 25%

Instructions:

(i) Read all questions carefully and answer accordingly.
(ii) Make suitable assumptions wherever required with justification.
(iii) ***Books, notes and data handbooks are allowed.***

1. To heat feed water in a closed feed water heater steam at the rate of 0.1 kg/s, at a temperature of T_s, bled from a turbine. Feed water at 70°C flowing at the rate of 2 kg/s enters the heater. The heat transfer coefficient for the feed water heater 1500 W/m^2 K. The area of the exchanger (heater) is 8 m^2.
   Where hg = (2500- 3.5T_s) kJ/kg - The latent heat of vaporization of steam and T_s is the temperature at which steam condenses in °C (which is also the same as the temperature at which steam is bled assuming no heat losses along the way).
   Find out the following things for the above problem
   a. Energy balance equations for the steam side and the water side.
   b. The expression for the heat transfer of the feed water heater.
   c. Find the relationship between (1) and (2)
   d. determine the outlet temperature of the feed water (T_0) and the condensing temperature of steam T_s. Using information from (1) (2) and (3) and the method of successive substitution,
   e. Start with an initial guess of T_o= 120 °C and perform at least 3 iterations **[25 M]**

   (CO:01 BL: Analyze)

2. Two-dimensional steady heat conduction is shown in the figure 1. where thermal conductivity k = 40 W/mK, uniform internal heat generation is 200 kW/m^3. The boundary conditions are shown in the figure.
   Find out
   a. Governing equation
   b. Using Gauss-Seidel method estimate T_1, T_2, T_3, and T_4 , Take Initial guess for all temperature 40 ^{o}C (5 iterations at least)
   c. Calculate center temperature approximate? Rough Center temperature? What is the difference between two? **[25 M]**

   (CO:02 BL: Analyze)

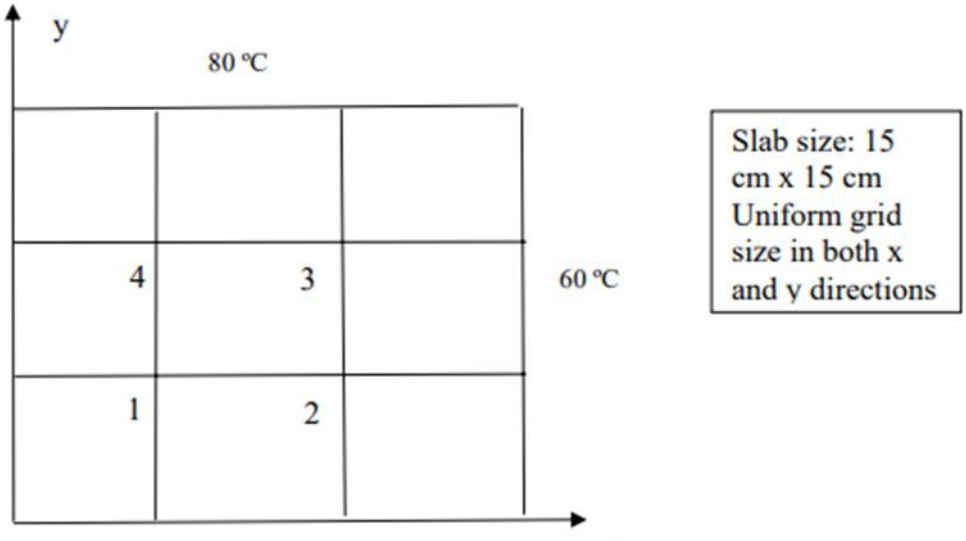
y
80 ℃
60 ℃
4
3
1
2
Slab size: 15 cm x 15 cm
Uniform grid size in both x and y directions

Figure 1.