VIT
Vellore Institute of Technology

Continuous Assessment Test – II

Programme Name & Branch: B.Tech (BEM, BME, BMA)

Course Name & Code: Thermal and Heat Transfer (MEE2038)

Class Number: VL2019201001128 **Slot:** C1/TC1/V2 **Exam Duration:** 90 mins

Maximum Marks: 50

General instruction(s):

Heat and Mass Transfer data book is permitted

Assume suitable data, if necessary

Answer all the questions

S.No.	Question
1.	Saturated air at 21 °C is passed through an adiabatic drier so that its final relative humidity becomes 20 %. The air is then passed through a cooler until its final temperature is 21 °C without a change in specific humidity. Find out **(a)** the temperature of air at the end of the drying process, **(b)** the heat rejected in kJ/kg dry air during the cooling process, **(c)** the relative humidity at the end of cooling process, **(d)** the dew point temperature at the end of cooling process, and **(e)** the moisture removed during the drying process in kg vapour/ kg dry air. **(10 Marks)**
2.	A steam pipe is covered with two layers of insulation; the 1st layer is 3 cm thick whereas the 2nd layer is 5 cm thick. The pipe is made of steel with inner and outer diameters as 160 mm and 170 mm respectively. The inside and outside convection heat loss coefficients are 30 and 5.8 W/m^2-K respectively. Consider the thermal conductivities of the steel, 1st and 2nd insulation layer as 58, 0.17 and 0.093 W/m-K respectively. a) Calculate the heat transfer rate per meter length of the pipe **(5 Marks)** b) Find the inner and outer surface temperatures **(5 Marks)**
3.	a) Find the expression for critical radius of insulation for 1-D sphere **(5 Marks)** b) A steam pipe of 10 cm inner diameter and 11 cm outer diameter is covered with an insulating material (k = 1 W/m-K). The temperature of steam and the ambient are 200 °C and 20 °C respectively. If the convective heat transfer coefficient between the insulating surface and ambient is 8 W/m^2-K, find the critical radius of insulation. For this insulating radius, find the rate of heat transfer per meter length of the pipe and outer surface temperature **(5 Marks)**
4.	One surface of the plane wall is insulated whereas the other surface is maintained at a constant temperature of T_s. The rate of heat generation within the wall is of the form $\dot{q} = q_0 e^{-\gamma x}$ W/m^3, where q_0 and γ are constants and x is measured from the insulated surface. Develop an expression for the temperature distribution in the plane wall. **(10 Marks)**
5.	An Aluminium fin of 3 mm thick and 7.5 cm long protrudes from a wall at 300 °C. The ambient temperature is 50 °C with convective heat transfer coefficient of 10 W/m^2-K. Compute the heat loss from the fin per unit depth of the fin. Also, calculate its efficiency and effectiveness. Consider the thermal conductivity of the fin as 200 W/m-K **(10 Marks)**