VIT
Vellore Institute of Technology

SCHOOL OF MECHANICAL ENGINEERING

Continuous Assessment Test – I - Fall Semester 2019-2020

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

Course Name & Code: Heat Transfer, MEE2005

Class Number: 1210 Slot: A1/TA1/V1 Exam Duration: 90 mins Maximum Marks: 50

General instruction(s):

Use of Heat and Mass Transfer Data book is permitted

Assume Suitable data if required

Answer all questions (5 x 10 = 50 Marks)

S.No.	Question	Course Outcome (CO)
1.	The inside of a furnace wall is at 1000°C and with the existing wall of material with thermal conductivity of 1.7 W/mK, looses 2.5 kW/m^2 when the outside is exposed to convection to air at 30°C with h = 27 W/m^{2}K. Determine the wall thickness. Additionally 75 mm thickness of insulation with k = 0.15 W/mK is added inside. The furnace wall temperature and the surrounding temperature and convection coefficient remain unchanged. Determine the reduction in heat flow and reduction in the outside surface temperature.	CO1
2.	Derive the expression of critical radius of insulation. Heat is generated at the constant rate of 2 x 10^8 W/m^3 in a copper sphere (k = 386 W/mK) of 1 cm radius. The sphere is cooled by convection from its outer surface into an ambient at 10°C with a convection coefficient of 2000 W/m^{2}K. What would be the maximum rate of heat transfer can be achieved by the insulation with the plastic material (k = 5 W/mK)	CO1
3.	Derive a study state temperature profile (T=f (x)) for a semi-infinite slab (width 2L) with constant heat generation (g), cooling in the environment (T_∞). Assume the other parameters as constant.	CO2
4.	Consider a homogeneous spherical piece of radioactive material of radius r_o = 0.04 m that is generating heat at a constant rate of q_{gen} = 4 x 10^7 W/m^3. The heat generated is dissipated to the environment steadily. The outer surface of the sphere is maintained at a uniform temperature of 80°C and the thermal conductivity of the sphere is k= 15 W/m°C. Assuming steady one dimensional heat transfer, (a) Express the differential equation and the boundary conditions for heat conduction through the sphere, (b) Determine the temperature at the centre of the sphere.	CO2
5.	An egg with mean diameter of 40 mm and initially at 20°C is placed in a boiling water pan for 4 minutes and found to be boiled to the consumers taste. For how long should a similar egg for same consumer be boiled when taken from a refrigerator at 5°C? Take the following properties for egg: Thermal conductivity = 50 W/m°C, density = 1200 kg/m^3, Specific heat = 2 kJ/kg°C and heat transfer coefficient = 100 W/m^2°C.	CO3