Roll No _____

# Examination May-2014

Total no of page-1

HEAT TRANSFER
(ME – 303)
Paper ID-A0815

**Time Allowed: 3 Hours** **Max. Marks: 60**

## Section A (Compulsory) [Marks: 02 each]

Q1. a) Define apparent thermal conductivity.
b) What is meant by critical thickness of insulation?
c) Define Fourier's law.
d) Write general heat conduction equation in cylindrical coordinates.
e) Define thermal diffusivity. What is its physical significance?
f) What is the value of shape factor in case of concentric cylinders?
g) Define Prandtl Nuber, Stanton number and Nusset number.
h) Define fin effectiveness. What parameters should be considered for fin to be effective?
i) Draw velocity profile and temperature profile in case of flow over flat plate.
j) What is a heat exchanger? How they are classified?

## Section B (Attempt any four) [Marks: 05 each]

Q2. Derive relation for heat dissipation from an infinitely long fin. Also write design considerations for fins.
Q3. Derive three dimensional heat conduction equation in cylindrical coordinates.
Q4. Derive the relation for radiation heat exchange in case of non black bodies assuming no medium between them.
Q5. What is meant by lumped capacity? What physical dimensions are required to apply lumped unsteady state analysis?
Q6. Derive Effectiveness-NTU relation in case of counter flow heat exchanger.

## Section C (Attempt any two) [Marks: 10 each]

Q7. The rate of heat generation in a slab of thickness 160 mm (k= 180 $W/m^0C$) is 1.2 x $10^6$ $W/m^3$. If the temperature of each of the surface is $120^0C$, determine:
(i) The temperature at the mid and quarter plane.
(ii) The heat flow rate and temperature gradients at the mid and quarter planes.

Q8. The furnace of a steam boiler is composed of two layers, inner refractory wall and outer insulating wall. Temperature of gases in the furnace is $1300^0C$ and the temperature of air in the boiler room is $30^0$ C. The thickness of refractory material is 250 mm. The heat transfer coefficient from gases to refractory wall is 30 $W/m^2\ ^0C$ and heat transfer coefficient from outer layer to surrounding air is 10 $W/m^2\ ^0C$. Estimate the thickness of the outer insulating layer so that the loss of heat to the surroundings should not exceed 750 $W/m^2$ if:
$k_{refractory} = 0.28\ (1+ 0.000833\ t)\ W/m^0C$
$k_{outer} = 0.113\ (1+ 0.000206\ t)\ W/m^0C$

Q9. Write short notes on:
a) Types of condensation.
b) Plank's law of monochromatic radiation.
c) Newtonian heating and cooling of solids.

End