Name:

Roll No.:

**ME341A: Heat and Mass Transfer**

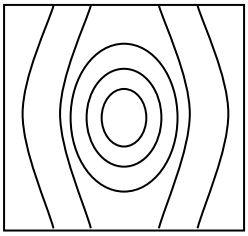
**Instructor: Prof. Sameer Khandekar**

**Time: 30 minutes** **Marks: 20 (Q1-Q7: 2 each, Q8: 6)**

**QUIZ #1**

1. For one dimensional heat conduction through a slab, draw the temperature profile for the configuration when $k = k_0(1+\beta T)$ and $\beta>0$ and $\beta=0$:

2. Draw the constant heat flux lines in the figure on the right, if the isotherms are as shown in it.



3. Mathematically describe the boundary condition at the interface of two different e material having perfect thermal contact (Draw a suitable figuer also).

4. Steel balls at 140°C with a specific heat of 0.5 kJ/kg°C are quenched in an oil bath to an average temperature of 85°C at a rate of 35 balls per minute. If the average mass of steel balls is 1.2 kg, the rate of heat transfer from the steel balls to the oil is:
(a) 33 kJ/s (b) 49 kJ/s (c) 30 kJ/s (d) 19 kJ/s

5. A room is heated by a 1.2 kW electric resistance heater whose wires have a diameter of 4 mm and a total length of 3.4 m. The air in the room is at 23ºC and the interior surfaces of the room are at 17ºC. The convection heat transfer coefficient on the surface of the wires is 8 W/m$^2$K. If the rates of heat transfer from the wires to the room by convection and by radiation are equal, the surface temperature of the wires is:
(a) 3534 °C (b) 1778°C (c) 1772 °C (d) 98 °C

6. The door of a domestic refirigerator has an area of 0.7 m$^2$ and is essentially made up of a thin metal sheet with a 2.5 cm thick layer of insulation ($k_{insulation}$ = 0.25 W/mK) on the inside. The heat transfer coefficients to the surrounding air on each side of the door are both 10 W/m$^2$K. The heat flow rate through the door of the refrigerator will be
(a) about 50 W (b) about 75 W (c) about 25 W (d) None of the above

7. A sphere has internal radius 3 cm, external radius 8 cm and the corresponding temperatures are 95°C and 85°C. The steady-state heat transfer is 10 W. Determine the value of the thermal conductivity and the temperature at a point halfway through the sphere wall.
(a) 2.65 W/mK, 88°C (b) 1.65 W/mK, 88°C (c) 2.65 W/mK, 92 °C (d) 1.65 W/mK, 92°C

8. The top surface of a horizontally kept metallic plate of size 600 mm x 900 mm x 25 mm, thermal conductivity $k$ = 45 W/mK, is being cooled by air flow at 15°C, which provides an effective heat transfers coefficient $h$ = 22 W/m$^2$K on the top surface. The bottom surface of the plate is maintained at 315°C. It is also known that the top surface of the plate is loosing 250 W of theraml energy by radiation heat transfer to the environment.

   (i) Find the surrace temperature of the plate.

   (ii) If the surface temperature of the plate is to be maintained at 300°C due to a process requirement, comment on the possible practical ways of achieving this goal.

   (iii) State at least two assumptions which you have used while solving this problem.