 Roll No ....

MMTP - 103

M.E./M.Tech., I Semester

Examination, June 2014

Heat And Mass Transfer

Time : Three Hours

Maximum Marks : 70

Note : 1. Answer any five questions.
2. All questions carry equal marks.

1. The heat generation rate in a cylindrical fuel rod of nuclear reactor is given by

$$\dot{q}_g = \dot{q}_{g0}\left[1-\left(\frac{r}{r_0}\right)^2\right]$$ where $r_0 \rightarrow$ out side radius, $\dot{q}_{g0} \rightarrow$ heat generation rate at centre line $\dot{q}_g$ is the heat generation rate at some radius r. Find the drop in temperature from the centre line to the surface of 3cm diameter rod having k = 22w/m°K (cylinder), $\dot{q}_{g0}$ = |2w|m³. Derive the formula used?

2. Derive the expression for temperature distribution for two dimentional conduction in a semi infinite strip and a long rectangular rod.

3. The temperature of hot gas flowing through a pipe is measured by a mercury in glass thermometer immersed in an oil well made of steel. The thermometer reads the temperature at the end of well which in lower than the gas temperature due to transfer of heat along the well. Calculate the error in percentage in measurement of temperature thermometer reads 150°C the temperature of pipe well is 80°C.
The well is 10cm long and thickness is 2mm, assume k steel = 40w/m°k, h = 100w/m²k, neglect the heat losses through the glass thermometer.

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4. Explain the meaning of displacement thickness, momentum thickness and energy thickness and prove that they are expressed by the following expressions

displacement thickness = $\int_0^\delta \left(1-\frac{4}{4\infty}\right)dy$

Momentum thickness = $\int_0^\delta \left[\left(1-\frac{4}{4\infty}\right)\frac{4}{4\infty}\right]dy$

Energy thickness = $\int_0^\delta \left[\left\{1-\left(\frac{4}{4\infty}\right)^2\right\}\frac{4}{4\infty}\right]dy$

with usual notations.

5. Deduce following dimentionless numbers by their definitions.
a) Froude Number
b) Nusselt Number
c) Stanton Number
d) Peclet Number
e) Grashof Number

6. Derive the Nusselt theory of laminar flow film condensation on a vertical plate.

7. Show that Planck's distribution law will have the form $E_{\lambda b} = \frac{C_1 T}{C_2 \lambda^4}$ where $C_2/\lambda T \leq 1$ and calculate the error, when compared to Planck's law for the condition $\lambda T = 10^5$ µm K.

8. Write short notes on followings:
a) Boundary layer mass transfer.
b) Electrical Analogy for Radiation Heat transfer problems.
c) Equation for convective mass transfer (derivation).

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