

Code No: **R32033****R10****Set No. 1****III B.Tech II Semester Supplementary Examinations, April -2017****HEAT TRANSFER****(Mechanical Engineering)****Time: 3 hours****Max. Marks: 75****Answer any FIVE Questions****All Questions carry equal marks**

- 1 a) Explain the different modes of heat transfer with neat sketches. Write down the basic laws of heat transfer [5M]
b) Derive the one-dimensional, steady state heat conduction equation with internal heat generation by writing the energy balance for a differential equation volume element in cylindrical coordinate system [10M]
- 2 A furnace wall is made up of three layers of thicknesses 250mm, 100mm and 150 mm with thermal conductivities of 1.65, k and $9.2 \text{ W/m}^0\text{C}$ respectively. The inside is exposed to gases at 1250^0C with a convection coefficient of $25 \text{ W/m}^2 \text{ }^0\text{C}$ and the inside surface is at 1100^0C , the outside surface is exposed air at 25^0C with convection coefficient of $12 \text{ W/m}^2 \text{ }^0\text{C}$. Determine [15M]
 - (i) The unknown thermal conductivity k
 - (ii) The overall heat transfer coefficient
 - (iii) All surface temperatures
- 3 a) What are Biot and Fourier's numbers? Explain their significance [5M]
b) An aluminum sphere weighing 7 kg and initially at a temperature of 260^0C is suddenly immersed in a fluid at 10^0C . If $h=50 \text{ W/m}^2\text{k}$, compute the time required to cool the sphere to 90^0C . [10M]
For aluminium: $\rho=2707 \text{ kg/m}^3$, $c=9000 \text{ J/kg}^0\text{C}$, $k=204 \text{ W/m}^0\text{C}$
- 4 a) Distinguish between natural and forced convection heat transfer [5M]
b) The surface temperature of the steel wall ($k=53.6 \text{ W/mK}$) 0.3 thick are maintained at 100^0C and 40^0C . Water at a temperature of $T_\infty=20^0\text{C}$ flows over the surface at 40^0C . Calculate the convection coefficient associated with the water flow. [10M]
- 5 Air flows through a long rectangular (30cm height $\times$ 60 cm width) air conditioning duct maintains the outer duct surface temperature at 15^0C . If the duct is insulated and exposed to air at 25^0C , calculate the heat gained by the duct per meter length, assuming it to be horizontal [15M]
- 6 a) Distinguish between film wise and drop wise condensation. Which of the two does give a higher heat transfer coefficient? Why? [5M]
b) A vertical tube 12.5 mm diameter and 1.7 m long is used for condensing steam at 0.4 bar. The tube surface temperature is maintained at 54^0C . Determine the average heat transfer coefficient in condensation. What would be the value of the heat transfer coefficient if the plate were held in horizontal position? [10M]

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