

Roll No

ME-605 (GS)**B.E. VI Semester**

Examination, December 2017

Grading System (GS)**Heat and Mass Transfer***Time : Three Hours**Maximum Marks : 70*

- Note:** i) Attempt five questions.
ii) All questions carry equal marks.

1. A 160mm dia. pipe carrying saturated steam at one atmospheric pressure is covered by a layer of lagging of thickness 40mm ($k=0.8\text{W/m}^\circ\text{C}$). Later, an extra layer of lagging of 10mm thickness ($k=0.12\text{W/m}^\circ\text{C}$) is added. If the surrounding temperature remains constant and heat transfer coefficient for both lagging materials is $10\text{W/m}^2\text{C}$. Determine the percentage change in rate of heat transfer due to extra lagging layer.
2. Derive an expression of general differential equation for heat conduction in Cartesian coordinate.
3. An egg with mean diameter of 40mm and initially at 20°C is placed in a boiling water pan for 4 minutes and found to be boiled to the consumer's 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: $K = 10\text{W/m-K}$, $\rho = 1200\text{kg/m}^3$, $C = 2\text{kJ/kg-K}$ and $h = 100\text{W/m}^2\text{-K}$.
4. A long rod is exposed to air at 28°C . It is heated at one end. At steady state conditions the temperature at two points along the rod separated by 120mm are found to be 130°C and 110°C respectively. The diameter of the rod is 25mm OD and its thermal conductivity is $116\text{W/m}^\circ\text{C}$. Calculate the heat transfer coefficient at the surface of the rod and also the heat transfer rate.

ME-605 (GS)

74

PTO

5. A vertical pipe 15cm OD, 1m long has a surface temperature of 90°C . If the surrounding air is at 30°C , What is the rate of heat loss by free convection per meter length of pipe? If the pipe is inclined to the vertical at an angle of 30° . During installation, how does the heat loss/m change.
6. Development dimensionless groups by using Buckingham's- π theorem for the forced convection heat transfer.
7. In a counter flow heat exchanger, 10,000 kg/h of oil having a specific heat of 2095 J/kg K is cooled from 80°C to 50°C by 8000 kg/hr. of water entering at 25°C . Determine the heat exchanger area for an overall heat transfer coefficient of $300\text{ W/m}^2\text{K}$. Take C_p for water as 4180 J/kg K .
8. Answer any four of the following:
 - a) For the material variation of conductivity with temperature is given by $K = A + BT^2$. Derive expression of mean conductivity.
 - b) What is Fin efficiency? Explain why fins are generally used on gas side in a gas-to-liquid heat exchanger?
 - c) Explain the principle of Dimensional analysis. What are its advantages and limitations?
 - d) What is the Molar Diffusion velocity? Define mass transfer fluxes.
 - e) What is Shape factor?
 - f) What is Nucleate boiling?

75

ME-605 (GS)

HTTP://WWW.RGPVONLINE.COM