

Roll No

ME-6003 (CBGS)**B.E. VI Semester**

Examination, May 2019

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

- Note:** i) Attempt any five questions out of eight.
 ii) All questions carry equal marks.
 iii) The standard HMT data book is permitted in exam.
- State Fourier's law of heat conduction. How this law is similar to ohm's law. Explain.
 - A plastic pipe ($K=0.5\text{W/mk}$) of ID 3cm and OD 4cm carries a fluid of average temperature 100°C and $n=300\text{ W/m}^2\text{k}$ The rate of heat transfer per unit length is 500 W/m . Find.
 - Outside surface temperature of pipe
 - The overall heat transfer coefficient based on out side area.
 - A 3 cm diameter pipe at 100°C is losing heat at the rate of 100 W per m length of pipe to the surrounding air at 20°C . This is to be reduced to a minimum value by providing insulation . The following insulation materials are available:
 Insulation A=Quantity= $3.15\times 10^{-3}\text{m}^3$ per m length of pipe
 Thermal conductivity= 5W/m deg .
 Insulation B Quantity= $4\times 10^{-3}\text{m}^3$ per m length of pipe. Thermal conductivity= 1W/m deg .
 Examine the position of better insulating layer relative to pipe. What percentage saving in heat dissipation results from the arrangement.
 - Define fin effectiveness.

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- A stainless steel fin ($k = 20\text{W/mk}$) having a diameter of 20mm and a length of 0.1 m is attached to a wall at 300°C . The ambient temperature is 50°C and heat transfer coefficient is $10\text{ W/m}^2\text{k}$. The fin tip is insulated. Determine
 - The rate of heat transfer
 - Temperature at the fin tip
 - Heat transfer rate from the same fin geometry of the stainless steel fin is replaced by a fictitious fin with infinite thermal conductivity.
 - Rate of heat transfer from the wall area covered by the fin if the fin was not used.
- State Buckingham π theorem. What are it's merits?
 - Air at 20°C and 1 atm flows over a flat plate at 40m/sec . The plate is 80 cm long and is maintained at 60°C . Assume unit length in Z direction, calculate the heat transfer rate from the plate. Properties of air at 40°C are $Pr = 0.7$, $k = 0.02723\text{ W/mk}$, $C_p = 1.007\text{kJ/kg K}$ and $\mu = 1.906\times 10^{-5}\text{ kg/ms}$.
- What is limitation of LMTD method. How ϵ -NTU method superior to it.
 - Explain Fick's law of diffusion. What is mass diffusivity
- A 4kg/sec of product stream from a distillation column is to be cooled by 3kg/sec water stream in a counterflow heat exchanger. The hot and cold stream inlet temperatures are 400K and 300K respectively and the area of heat exchanger is 30m^2 . If the overall heat transfer coefficient is estimated to be $820\text{W/m}^2\text{K}$. Determine the outlet temperature of both fluid if the specific heat is product stream is 2500J/kg k .
- Define the following: <http://www.rgpvonline.com>
 - Emissivity of surface.
 - Black body.
 - Film wise condensation.
 - Planck's distribution law.
- Explain different regime of boiling.
 - The filament of a 75 W light bulb may be considered a black body radiating into black enclosure at 80°C . The filament dia is 0.10m and length is 60 mm. Considering radiation only, determine filament temperature.