Reg. No. : | | | | | | | | | | |

Question Paper Code: 31762

B.E. / B.Tech. DEGREE EXAMINATION, MAY 2017

Sixth Semester

Mechanical Engineering

01UME602 - HEAT AND MASS TRANSFER

(Regulation 2013)

(HMT data book is permitted)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 2 = 20 Marks)

1. Define Thermal conductivity
2. Distinguish between steady and transient Heat conduction.
3. Define Nusselt number (Nu).
4. Define convection heat transfer co- efficient.
5. What is meant by pool boiling?
6. Classify the Heat exchangers?
7. State Stefan Boltzmann law.
8. What is the purpose of radiation shield?
9. What is molecular diffusion?
10. Compare Heat transfer with mass transfer.

PART - B (5 x 16 = 80 Marks)

11. (a) A furnace wall made up of 75 *mm* of fire plate and 6.5 *mm* of mild steel plate. Inside surface is exposed to hot gas at $650^\circ C$ and outside air temperature is $27^\circ C$. The convective heat transfer co-efficient for inner side is 60 W/m^2K. The convective heat transfer co-efficient for outer side is 8 W/m^2K. Calculate the heat lost per square meter area of the furnace wall and also find outside surface temperature. (16)

Or

(b) From the basic principles derive the three dimensional heat conduction equation in cartesian coordinate system. (16)

12. (a) Air at 1 *atm* and 20^0C is heated as it passes through a tube of 30*mm* inside diameter with a velocity of 12 *m/sec*. the temperature of the tube wall is maintained at 100^0C. (i) calculate the Heat Transfer per unit length of tube. (ii) How much would the Bulk temperature increase over a 3 *m* length of the tube. (16)

Or

(b) In a long annulus (31.25 *mm* ID and 50 *mm* OD) the air is heated by maintaining the temperature of the outer surface of inner tube at $50^\circ C$. The air enters at $16^\circ C$ and leaves at $32^\circ C$. Its flow rate is 30 *m/s*. Estimate the heat transfer coefficient between air and the inner tube. (16)

13. (a) Derive the expressions for LMTD (Logarithmic Mean Temperature Difference) for parallel and counter flow type of Heat exchangers. (16)

Or

(b) A condenser is to designed to condense 600 *kg/h* of dry saturated steam at a pressure of 0.12 bar. A square array of 400 tubes, each of 8 *mm* diameter is to be used. The tube surface is maintained at $30^\circ C$. Calculate the heat transfer coefficient and the length of each tube. (16)

14. (a) Two parallel plates 0.5x1 *m*are spaced 0.5 m apart are located in a very large room, the walls of which are maintained at a temperature of 27^0C. One plate is maintained at a temperature of 900^0C and the other at 400^0C.Their emissivities are 0.2 and 0.5 respectively. If the plates exchange heat between themselves and surroundings, find the net heat transfer to each plate and to the room. Consider only the plate surfaces facing each other. (16)

Or

(b) A gas mixture contains 20% CO_2 and 10% H_2O by volume. The total pressure is 2 atm. The temperature of the gas is $927^\circ C$. The mean beam length is 0.3 *m*. Calculate the emissivity of the mixture. (16)

15. (a) Estimate the diffusion rate of water from the bottom of a test tube 12 *mm* in diameter and 250*mm* long into dry atmospheric air at $30^0 C$ Assume $D=0.20 \times 10^{-4} m^2/sec$. (16)

Or

(b) Air at $10^\circ C$ with a velocity of 3 *m/s* flows over a flat plate. The plate is 0.3 *m* long. Calculate the mass transfer coefficient. (16)