A **Reg. No. :** | | | | | | | | | | |

Question Paper Code: 56703

B.E. / B.Tech. DEGREE EXAMINATION, APRIL 2019

Sixth Semester

Mechanical Engineering

15UME603 - HEAT AND MASS TRANSFER

(Regulation 2015)

(Approved Heat and Mass Transfer Data Book & Steam Tables are allowed)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. The unit of thermal conductivity is CO1- R

   (a) W/mK (b) W/m^2 (c) W/m^2K (d) W/m

2. Heat transfer mode in vacum is known as CO1- R

   (a) Conduction (b) Convection (c) Radiation (d) Both a & b

3. $Nu = C\ Re^m\ Pr^n$ represents heat transfer under CO2- R

   (a) Forced Convection (b) Free convection

   (c) Combined convection (d) Conduction

4. The Reynolds number is the ratio of inertia force to the _____ CO2- R

   (a) Viscous force (b) Gravity force (c) Thrust force (d) Thrust force

5. By keeping constant area the heat transfer in counter flow heat exchanger is _____ than parallel flow heat exchanger. CO3- R

   (a) Higher (b) Lower (c) Same (d) None of these

6. The heat transfer rate of film wise condensation compared to drop wise condensation. CO3- R

   (a) Higher (b) Lower (c) Equal (d) Not able to predicted

7. The emissivity value of black body is equal to _____. CO4- R

(a) 0 (b) 1 (c) Negative (d) None of the above

8. The introduction of shields between the radiate surfaces will_____ the heat exchange rate between them. CO4- R

(a) Increase (b) Decrease (c) Do not alter (d) All the above

9. The mass flux is proportional to _____. CO5- R

(a) Velocity gradient (b) Temperature gradient

(c) Concentration gradient (d) Pressure gradient

10. Which dimensionless number is not used in Mass Transfer CO5- R

(a) Nusselt Number (b) Sherwood Number

(c) Reynolds Number (d) Schimidt Number

PART – B (5 x 2= 10 Marks)

11. Define the term fin efficiency. CO1- R
12. What do you understand about Reynolds number? CO2- R
13. How the heat exchangers are classified? CO3- R
14. Define the term emissivity. CO4- R
15. Give some practical examples of mass transfer. CO5- R

PART – C (5 x 16= 80 Marks)

16. (a) A steel pipe line (k = 50 W/mK) of I.D .100 mm and O.D. 110 mm is to be covered with two layer of insulation each having a thickness of 50 mm . The thermal conductivity of the first insulation material is 0.06 W/mK and that of the second is 0.12 W/mK. Calculate the loss of heat per meter length of pipe, when the temperature of the inside tube surface is 240°C and that of the outside surface of the insulation is 50°C CO1- Ana (16)

Or

(b) A turbine blade 6 cm long having an cross sectional area 4.65 cm^2 and perimeter 12 cm, is made of stainless steel (k= 23.3 W/mK). The temperature of the root is 500˚C. The blade is exposed to a hot gas at a temperature of 870˚C. The convective heat transfer co -efficient of the gas is 442 W/m^2K. Determine the temperature and the rate of heat flow from the root of the blade. Assume the tip of the blade to be insulated. CO1- Ana (16)

17. (a) A Vertical pipe of 20 cm diameter, at a surface temperature of 100˚C is in a large room where the air temperature is 20˚C. The pipe is 3 m in length. What is the heat loss per metre length of a pipe. CO2- App (16)

Or

(b) Water enters at 50˚C in a 1.5 cm diameter and 3 m long tube with a velocity of 1 m/s. The tube wall is maintained at a temperature of 90˚C. Determine the amount of heat transferred and convective heat transfer co-efficient if the exit temperature of water is at 64˚C. CO2- App (16)

18. (a) (i) Discuss the various regimes of pool boiling in detail. CO3- App (12)

(ii) Explain the mechanism involved in drop wise condensation. CO3- App (4)

Or

(b) Hot exhaust gases which enter a cross-flow heat exchanger at 300°C and leaves at 100°C are used to heat water at a flow rate of 1kg/s from 35 to 125°C . The specific heat of the gas is 1000 J/ kgK and the overall heat transfer coefficient based on the gas side surface is 100 W/m².K . Determine the required gas side surface area. CO3- App (16)

19. (a) Two large parallel plates with emissivity values of 0.6 are maintained at a te temperatures of 1000 K and 300 K respectively. Determine the net heat exchange between the plates per square metre area. Determine the percentage reduction in heat exchange if a polished aluminum shield with a surface emissivity 0.05 are introduced between the parallel to the plates. CO4- U (16)

Or

(b) Calculate the following for an Industrial furnace in the form of a black body and emitting radiation at 2500^0C. CO4- U (16)

(i) Monochromatic Emissive power at 1.2 μm length.

(ii) Wavelength at which Emissions maximum.

(iii) Maximum Emissive power.

(iv) Total Emissive power.

(v) Total Emissive power of the furnace if it is assumed as a real surface with emissivity equal to 0.9.

20. (a) Air at 10^0C with a velocity of 3 m/s flows over a flat plate. If the plate is 0.3m long , Determine mass transfer coefficient. CO5- App (16)

Or

(b) Estimate the diffusion rate of water from the bottom of the test tube of 20 mm diameter and 4 cm long in to a dry air at 27^0C. Take diffusion coefficient of water into air is 0.24×10^{-4} m^2/s. CO5- App (16)