

MAHARASHTRA ANIMAL AND FISHERY SCIENCES UNIVERSITY, NAGPUR
SEMESTER END THEORY EXAMINATION, B.TECH. (D.T.) Degree Course 2017-18

Semester	: II (New Syllabus)	Academic Year	: 2017-2018
Course No.	: DE-204	Course Title	: Heat and Mass Transfer
Credits	: 2+1=3	Total Marks	: 50
Day & Date	: Tuesday, 12.06.2018	Time	: 11.00 to 13.00 Hrs.

- Note :** 1) All questions from **Section 'A'** are compulsory.
2) Solve **Any Five** questions from **Section 'B'**.
3) Draw neat and well labelled diagram wherever necessary.

SECTION - 'A'

- Q. 1 A) Choose the most appropriate answer from the options given below. (05)
- Evidence of heat flow is found in change of
 - Temperature of a body
 - State of a body
 - Both a) and b)
 - None of these
 - Quantum theory of radiation is given by
 - Planck
 - Stefan Boltzmann
 - Kirchoff
 - Newton
 - The unit for thermal resistances is
 - $\text{kcal/m}^2\text{-hr-}^\circ\text{C}$
 - $^\circ\text{C/kcal/m}^2\text{-hr}$
 - kcal/m^2
 - None of the above
 - The Prandtl number will be lowest for
 - Water
 - Liquid metal
 - Glycerine
 - Lubricating oil
 - Thermal conductivity of the material of a wall 40 mm thick, maintaining $\Delta t = 20^\circ\text{C}$, with heat flow 145 W/m^2 is
 - $0.3 \text{ W/m}^\circ\text{C}$
 - $0.29 \text{ W/m}^\circ\text{C}$
 - $3 \text{ W/m}^\circ\text{C}$
 - $1.5 \text{ W/m}^\circ\text{C}$
- B) State these laws/ equation with respect to heat and mass transfer (05)
- Reynold's number
 - Nusselt number
 - Fouriers law
 - Stefan Boltzmann law
 - Newton's law of cooling
- Q. 2 A) Give the formulae for the following. (05)
- Heat transfer coefficient for a three layered hollow cylinder
 - Formula to convert $^\circ\text{C}$ to $^\circ\text{F}$
 - Heat flow through a composite slab with three layers
 - Prandtl number
 - Thermal diffusivity

(P.T.O.)

- B) State "True or False", If False, rewrite the statement after making necessary corrections. (05)
- Extended surfaces/Fins helps in increasing the rate of heat transfer
 - During Pasteurization, in Plate Heat Exchanger all the three modes of heat transfer can be observed
 - Heat Transfer occurs only when temperature difference exists between two systems.
 - Steam boiler is a regenerative type heat exchanger
 - Heat transfer in gases occur by diffusion of free electrons

SECTION - 'B'

- Q.3 Is it better to arrange for the flow in a heat exchanger to be parallel or counter flow? In a counter flow heat exchanger, oil ($c_p = 3 \text{ kJ/kg K}$) at the rate of 1400 kg/hr is cooled from 100°C to 30°C by water that enters the exchanger at 20°C at the rate of 1300 kg/hr. Determine the heat exchanger area for overall heat transfer coefficient of $3975 \text{ kJ/m}^2\text{-hr-K}$. (06)
- Q.4 Derive an equation for Fourier's law in Cartesian co-ordinates. (06)
- Q.5 Derive an equation for heat transfer through a cylinder. (06)
- Q.6 a) Explain Radiation heat transfer. (02)
- b) Calculate the hourly loss of heat through a brick wall 4 m long, 2 m high and 250 mm thick, having surface temperatures 20°C and -30°C , $k = 0.6 \text{ kcal/m-hr-}^\circ\text{C}$. (02)
- c) Define a white body, black body and grey body. (02)
- Q.7 a) An oil cooler in high performance engine has an outside surface area of 0.12 m^2 at temperature of 65°C . The air rushes over surface of cooler at a temperature of 30°C and gives rise to surface co-efficient of heat transfer of $45.4 \text{ W/m}^2\text{K}$. Calculate the heat transfer rate from the cooler. (03)
- b) Write the importance of Reynolds number and Nusselt number in heat transfer. (03)
- Q.8 a) A spherical vessel of 0.5m outside diameter is insulated with 0.2m thickness of insulation of thermal conductivity $0.04 \text{ W/m } ^\circ\text{C}$. The surface of the vessel is -195°C and outside air is at 10°C . Determine the heat flow rate. (02)
- b) Describe fouling and its effect on heat transfer. (02)
- c) Define convection heat transfer. Give the examples of convection heat transfer. (02)
- Q.9 a) Explain Fick's law of diffusion. (02)
- b) A hot fluid is being conveyed through a long pipe of 5 cm outer diameter and covered with 2 cm thick insulation. It is proposed to reduce the conduction heat loss to the surrounding to one-third of the present rate by further covering with same insulation. Calculate additional thickness of insulation. (04)
