

**MAHARASHTRA ANIMAL AND FISHERY SCIENCES UNIVERSITY, NAGPUR**  
**SEMESTER END THEORY EXAMINATION, B.Tech. (D. T.)**

Semester	: II (V Dean)	Academic Year	: 2024-2025
Course No.	: DE-205	Course Title	: Heat and mass transfer
Credits	: 1+1=2	Total Marks	: 50
Day & Date	: Tuesday; 12/08/2025	Time	: 2.00 hrs.

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

**SECTION –‘A’**

Q. 1 A) Define the following. (05)

- i) Fouling factor in a heat exchanger
- ii) Radiation
- iii) Specific heat
- iv) Thermal conductivity
- v) Thermal diffusivity

B) Answer in one line. (05)

- i) What is the Fourier number?
- ii) What is Biot number?
- iii) Conduction heat transfer is guided by which law?
- iv) What is unit of thermal conductivity?
- v) What is See back effect?

Q. 2 A) State whether True or False. If false, rewrite the statement after making necessary corrections in the underlined word. (05)

- i) SSHE is used for manufacturing viscous dairy and food products.
- ii) Thermal diffusivity is the ratio of  $k/\rho c_p$ .
- iii) Fins are used in air cooled engines.
- iv) Reynolds number is used for forced convection.
- v) Critical thickness is the thickness up to which heat flow decreases and after which heat flow increases.

B) Choose the most appropriate answer from the options given below. (05)

- i) Heat transfer coefficient is high for .....
  - a) Natural convection
  - b) Forced convection
  - c) Stationary film of air
  - d) None of these
- ii) The governing equation for heat transfer by radiation is .....
  - a) Stefan Boltzmann's law
  - b) Newton's law of cooling
  - c) Fourier's equations
  - d) None of these
- iii) Quantity of heat transfer per unit area is known as .....
  - a) Heat Capacity
  - b) Heat Flux
  - c) Thermal efficiency
  - d) Heat Transfer coefficient

(P.T.O.)

- iv) Compared to counter flow heat exchanger, LMTD in case of parallel flow heat exchanger is .....
- a) Higher
  - b) Lower
  - c) Equivalent
  - d) Depends upon condition
- v) In steady state heat transfer .....
- a) Temperature gradient remains constant with time
  - b) Temperature decreases with time
  - c) Temperature gradient changes with time
  - d) Constant entropy cycle

### SECTION - 'B'

- Q. 3 A) Derive an expression for heat conduction through a composite cylindrical conductor consisting of three layers. (05)
- B) Explain the different properties related to heat transfer. (05)
- Q. 4 A) A steam pipe is covered with two layers of insulation. The inner layer is 30 mm thick and the outer one is 50 mm thick. The thermal conductivity of inner and outer insulating materials is 0.17 and 0.093 W/m.K respectively. The pipe is made of steel ( $K = 58$  W/m.K) and has inner and outer diameter of 160 and 170 mm respectively. The temperature of steam is  $300^{\circ}\text{C}$  and the ambient air is at  $50^{\circ}\text{C}$ . If the inside and outside film coefficients are 30 and  $5.8$  W/m<sup>2</sup>K, respectively, calculate the heat lost per unit length of pipe. (05)
- B) Derive the expression for steady state unidirectional heat flow through sphere of uniform conductivity without heat generation. (05)
- Q. 5 A) Explain how fins enhances the heat transfer rate. (03)
- B) Explain different types of fins used in different application. (03)
- C) Derive the expression for Log mean temperature difference (LMTD) for counter current heat exchanger. (04)
- Q. 6 A) Explain construction and working principal of thermocouple. (03)
- B) Explain Fourier's law of heat conduction and Newton's law of cooling. (03)
- C) What is critical thickness of insulation, derive expression for it. (04)
- Q. 7 Classify the heat exchangers commonly used in food and dairy industry and explain PHE with neat sketch. (10)

\*\*\*\*\*