

MAHARASHTRA ANIMAL AND FISHERY SCIENCES UNIVERSITY, NAGPUR
SEMESTER END THEORY EXAMINATION, B.Tech. Dairy Technology 2018-19

Semester : **II (V Dean)**
Course No. : **DE-205**

Academic Year : **2018-2019**
Course Title : **Heat and Mass Transfer**

Credits : **2+1**
Day & Date : **Monday, 24.06.2019**

Total Marks : **50**
Time : **11.00 to 13.00 Hrs.**

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

SECTION - 'A'

Q. 1 A) Choose the most appropriate answer from the options given below. (05)

i) Heat transfer takes place according to law of thermodynamics is

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|-----------|----------|
| a) Zeroth | b) First |
| c) Second | d) Third |

ii) For steady state heat flow and constant value of thermal conductivity, the temperature distribution for a plane wall is a

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|----------------|----------------------|
| a) Linear | b) Parabolic |
| c) Logarithmic | d) Exponential curve |

iii) Fin efficiency is defined as the ratio of the heat transferred across the fin surface to the theoretical heat transfer across an equal area held at

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|-------------------------------|---|
| a) Temperature of fin end | b) Constant temperature equal to that of base |
| c) Average temperature of fin | d) None of these |

iv) The amount of heat radiated by a body is directly proportional to the Power of its absolute temperature.

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|-----------|----------|
| a) Second | b) Third |
| c) Fourth | d) Fifth |

v) The dimensionless parameter $(\beta g \rho^2 l^3 \Delta t) / \mu^3$ is referred to as

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|-------------------|-------------------|
| a) Stanton number | b) Schmidt number |
| c) Grashof number | d) Peclet number |

B) Define the following. (05)

- i) Overall heat transfer coefficient
- ii) Thermal conductivity
- iii) LMTD
- iv) Effectiveness of fins
- v) Thermocouple

Q. 2. A) Do as directed (05)

- i) Why fins are used?
- ii) Why negative sign is written before the Fourier's equation?
- iii) Why counter flow is considered better than parallel flow?
- iv) Why PHE is used in dairy for heating of milk rather than other types of heat exchangers?
- v) Is there any analogy between electrical circuits and thermal circuits? Give one relation.

B) Correct the given statement.

(05)

- i) For free convection, Nusselt number is a function of Prandtl and Reynolds number.
- ii) The additional resistance to heat transfer due to scale formation on the surface of tubes of a heat exchanger is called initial load.
- iii) Grashof number has a significant role in the heat transfer by conduction.
- iv) The heat transfer by conduction takes place by means of electromagnetic waves.
- v) Emissivity and absorptivity of black body is less than unity.

SECTION - 'B'

- Q. 3 A) Derive the equation for heat conduction through composite wall consisting of three layers. (05)
- B) What do you mean by log mean temperature difference and derive expression for parallel flow heat exchanger. (05)
- Q. 4 A) Estimate the heat loss from stainless steel pipe having thermal conductivity of 17 W/m-K carrying 90°C water. The atmospheric temperature is 25°C . The inner and outer diameter of pipe is 38 mm and 41 mm respectively. The inside and outside heat transfer coefficients are $810 \text{ W/m}^2\text{K}$ and $180 \text{ W/m}^2\text{K}$ respectively. (05)
- B) List out the different types of heat exchanger and explain plate type heat exchanger in brief. (05)
- Q. 5 A) Define force and natural convection with some examples. (03)
- B) Discuss the significance of overall heat transfer coefficient in heat transfer process and derive its expression. (03)
- C) A cold liquid ($C_p = 3.15 \text{ kJ/kg-K}$) at 20 kg/min is to be heated from 25°C to 55°C in a heat exchanger. The task is accomplished by extracting heat from hot water ($C_p = 4.186 \text{ kJ/kg-K}$) available at mass flow rate of 5 kg/min and inlet temperature of 80°C . On the co-current and counter current flow, which one would you choose for above application and why? (04)
- Q. 6 A) Discuss the properties of insulating material. (03)
- B) Explain the various modes of heat transfer. (03)
- C) A plane wall having 100 mm thickness and 3.5 m^2 area has a thermal conductivity of $9.15 \text{ W/m}^\circ\text{C}$. If the surface temperatures are 155°C and 55°C , determine the rate of heat flow. (04)
- Q. 7 Discuss the various types of fins with neat sketch and derive expression for heat transfer rate through a rectangular fin. (10)
