Roll No. | | | | | | | | | | | | **Total No. of Pages : 03**

Total No. of Questions : 18

B.Tech (Mechanical Engineering) (Sem.–5)

HEAT TRANSFER

Subject Code : BTME-501-18

M.Code : 78247

Time : 3 Hrs. **Max. Marks : 60**

INSTRUCTION TO CANDIDATES :

1. **SECTION-A is COMPULSORY consisting of TEN questions carrying TWO marks each.**
2. **SECTION-B contains FIVE questions carrying FIVE marks each and students have to attempt any FOUR questions.**
3. **SECTION-C contains THREE questions carrying TEN marks each and students have to attempt any TWO questions.**

SECTION-A

Answer briefly :

1) What will be your response to a person who states that heat cannot be transferred in vacuum?

2) Mention some of the cases where heat is generated internally at uniform rate in the conducting medium itself.

3) Enumerate the various assumptions made in the formation of energy equation for one dimensional heat dissipation from an extended surface.

4) What are Heisler charts?

5) Define Nusselt number. How it is related to temperature gradient in the fluid immediately in contact with the solid surface.

6) What do you understand by hydrodynamic and thermal boundary layers?

7) In the design of condensers, which of the two types of condensation is usually selected and why?

8) What do you understand by fouling of heat exchanger? How does it affect the performance of heat exchanger?

9) Define monochromatic and total emissive power.

10) Define radiosity and irradiation.

SECTION-B

11) Starting from the differential element, establish the following expression for loss of heat from a lagged pipe per m^2 of metal surface per degree temperature difference between the metal and lagging surfaces

$$q = \frac{k}{r \log_e (R/r)}$$

Where k is thermal conductivity of lagging material, R and r are the radii of lagging and metal surfaces respectively. Neglect the thermal resistance of the metal surface.

12) A fin 30 cm long and 10 *mm* diameters throughout is made of steel alloy of thermal conductivity 43 $W/m - °C$. The fin attached to a plane heated wall at 200°C, extends into surroundings at 25°C and unit surface conductance of 120 $W/m^2 -$ °C. Workout the heat flow rate from the fin to the surroundings. Presume that the tip of the fin is insulated and thermal radiation effects are negligible.

13) What is the radiant energy flux from a steel product at 1000 K. The product may be treated as grey body with constant emissivlty $\in = 0.7$. Also workout the wave length corresponding to the maximum spectral intensity of radiation.

14) For a certain forced convection process, the following correlation applies:

$$Nu = 0.031(Re)^{0.75}(Pr)^{0.30}$$

Workout the percentage change in the rate of heat flow per degree temperature difference when the original coolant is replaced by another fluid having viscosity equal to two third that of the original coolant. Assume that other fluid variables and configuration remains the same.

15) Explain the phenomenon of nucleate boiling. List the factors that affect nucleate boiling.

SECTION-C

16) Water enters a counter flow double pipe heat exchanger at 12°C temperature and flow rate of 0.16 kg/s. The water is to cool alcohol (c_p = 2520 $kj/kg - K$) from 75°C to 35°C. The convection coefficient between alcohol and the tube wall is 340 $W/m^2 - K$ and that between the tube wall and water is 225 $W/m^2 - K$. Presuming tube to be thin, make calculations for the capacity ratio, the effectiveness and the heat transfer area required.

17) Explain in detail the mechanism of forced convection. Show by dimensional analysis that for problems in heat transfer involving forced convection only, the Nusselt number can be expressed as a function of Prandtl number and the Reynolds number.

18) Write short notes on the following :

a) Heat transfer from piston crown

b) Radiation shields

c) Nusselt theory of condensation.

NOTE : Disclosure of Identity by writing Mobile No. or Making of passing request on any page of Answer Sheet will lead to UMC against the Student.