Total No. of Questions – [06] Total No. of Printed Pages: 2

G.R. No.	

DECEMBER 2021-ENDSEM EXAM

T. Y. B. TECH. (Mechanical Engineering) (SEMESTER - I)

COURSE NAME: Heat Transfer

COURSE CODE: (MEUA31182)

(PATTERN 2018)

Time: [1Hr] [Max. Marks: 30]

(*) Instructions to candidates:

1) **Answer Q.1 OR Q.2, Q.3 OR Q.4, Q.5 OR Q.6.**
2) **Figures to the right indicate full marks.**
3) **Use of scientific calculator is allowed**
4) **Use suitable data where ever required**

Q. 1) a) Draw a neat sketch of velocity boundary layer formed over a surface of airplane wings and elaborate. [4 marks]

b) The engine of an automobile can be considered as a box of length of 0.7 m, width 0.23 m and height 0.1 m. Its surface temperature is maintained at 60°C. When the automobile moves at a velocity of 30 m/s, the air at 20°C passes over the crankcase at relative speed. Assuming the flow to be turbulent with $Nu = 0.036\ Re^{0.8}\ Pr^{0.33}$, find the rate of heat transfer from all sides of the crankcase. [6 marks]

Take : Density = 1.09 kg/m³, $\mu = 20.1 \times 10^{-6}$ kg/ms, k = 0.027 W/m K, Pr=0.7

OR

Q.2) a) Interpret the significance of Nusselt number and Reynolds number in designing of heat transfer equipments. [4 marks]

b) A horizontal cylindrical rod of 4 cm diameter and 60 cm length is initially at a temperature of 124°C. Calculate the rate of heat lost from it, if it is exposed to still water at 30°C. [6 marks]

$Nu = 0.53\ (Gr^* Pr)^{1/4}$ for $10^4 < Gr^* Pr < 10^9$

$= 0.13\ (Gr^* Pr)^{1/3}$ for $10^9 < Gr^* Pr < 10^{12}$.

Properties of water :

Cp = 4191 J/kg K, k = 0.668 W/mK, $\mu = 3.72 \times 10^{-4}$ kg/ms, Pr=2.33

Density = 937.7 kg/m³, Coeff. of thermal expansion (β)= 6.286×10^{-4}/K

Q.3) a) State and illustrate with application the Wien's displacement law and Stefan Boltzmann law. [4 marks]

b) Determine the heat loss rate by radiation from a steel tube of outside diameter 70 mm and 3 m long at a temperature of 227°C.This tube is located within a square brick conduit of 0.3 m side and at 27°C. Assume, emissivity of steel $\epsilon 1$= 0.79; emissivity of brick, $\epsilon 2$ = 0.93. [6 marks]

OR

Q. 4) a) A body at 1400 K of area 10 m^2 is kept in black surroundings at 800 K of area 6 m^2. It has an emissivity of 0.4 at 1400 K and emissivity of 0.6 at 800 K. Calculate the rate of heat loss by body at 1400 K. [4 marks]

b) Two very large parallel planes with emissivities 0.3 and 0.8 exchange heat. Find the percentage reduction in heat transfer when a polished-aluminum radiation shield (emissivity =0.04 on both side) is placed between them. [6 marks]

Q.5) a) Elaborate the suitability of heat exchanger for automotive car radiator? Justify your answer with sketch. [4 marks]

b) A counter flow double pipe heat exchanger is used to heat water from 20°C to 40°C by cooling an oil from 90°C to 55°C. The exchanger is designed for a total heat transfer rate of 59 kW with overall heat transfer coefficient of 340 W/m^2K. Calculate the surface area required? [6 marks]

OR

Q.6) a) Illustrate the heat exchanger effectiveness for the shell and tube heat exchanger [4 marks]

b) Hot water is cooled from 90°C to 60°C in a tube type heat exchanger by circulating cold water which enters at 25°C and leaves at 55°C. Find the effectiveness of H.E. when it operates in parallel flow arrangements and counter flow arrangements. In case the mass flow rate of hot water and cold water are increased by 2.5 times what is change in effectiveness? [6 marks]

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