Code No: 56020 **R09**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B. Tech III Year II Semester Examinations, December - 2017
HEAT TRANSFER
(Common to AME, ME)

Time: 3 hours **Max. Marks: 75**

Answer any five questions
All questions carry equal marks
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1.a) Explain the mechanism of convection.
b) Water at a mean temperature of 20^0C flows over a flat plate at 80^0C. If the heat transfer coefficient is 200 W/(m^2 .^{0}C), determine the heat transfer per square meter area of the plate over 5 hours. [7+8]

2.a) What is meant by critical thickness of insulation?
b) A steel tube with ID 5.0cm, OD 7.6cm and k= 15 W/(m^0C), is covered with an insulative covering of thickness 2cm of k= 0.2 W/(m^0C). A hot gas at T_a= 330^0C, h_a =400 W/(m^2 .^{0}C), flows inside the tube. The outer surface of the insulation is exposed to cooler air at T_b= 30^0C with h_b =60 W/(m^2 .^{0}C). Calculate the heat loss from the tube to the air from a length of 10m of the tube. [7+8]

3.a) Explain the concept of unsteady state with an example.
b) An iron sphere of thermal conductivity 60 W/(m^0C), density 7850 kg/m^3, specific heat of 460 J/(kg. ^{0}C) and thermal diffusivity $\alpha = 1.6 \times 10^{-5}$ m^2/s of diameter 5 cm is initially at a uniform temperature of 225^0C. Suddenly the surface of the sphere is exposed to an ambient at 25^0C with a heat transfer coefficient of 500 W/(m^2 .^{0}C). Calculate the center temperature 2 mins after the start of cooling. [7+8]

4.a) What is meant by dimensional analysis? Explain in brief.
b) Determine the hydrodynamic entry length for flow at a bulk temperature of 60^0C at a rate of 0.015 kg/s of water through a circular tube of inside diameter 2.5cm. [7+8]

5.a) What are the various non dimensional terms involved in a free convection process?
b) A large vertical plate at a uniform temperature of 100^0C is exposed to atmospheric air at 20^0C. Determine the location from the lower edge of the plate where the transition from laminar to turbulent flow takes place. [7+8]

6.a) Give equations applicable for nucleate and film boiling process.
b) What are the assumptions made by Nusselt in the analysis of laminar film condensation from a vertical plate? [7+8]

7. A counter flow heat exchanger of area A=12.5 m^2 is to cool oil having a specific heat C_p= 2000 J/(kg. ^{0}C) with water of C_p= 4170 J/(kg. ^{0}C). The oil enters at 100^0C at a mass flow of 2 kg/s, while the water enters at 20^0C at 0.48 kg/s. The overall heat transfer coefficient of the heat exchanger is 400 W/(m^2 .^{0}C). Calculate the exit temperature of water and the total heat transfer rate, Q. [15]

8.a) Give the equation for radiation exchange between two black bodies.
b) Explain Wien's law.
c) What is meant by radiation shield? [5+5+5]

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