NATIONAL INSTITUTE OF TECHNOLOGY DURGAPUR

Even Semester End-term Examination, 2021-22

Course Code: CHO441
Course Name: Process Heat Transfer
Question Paper No.: NITDGP/CHO441/1

Full Marks: 30
Time: 90 Minutes
Date of Exam: 26/04/2022

Instructions: All question are compulsory.

Q. No.	Body of the Question	Marks	Mapped CO
1.	Select the correct answer	1 × 10	1, 2, 4,5

(i) Why fins are provided on a heat transfer surface?

(a) Pressure drop of the fluid should be minimized

(b) Increase turbulence in flow for enhancing heat transfer

(c) Surface area is maximum to promote the rate of heat transfer

(d) Increase temperature gradient so as to enhance heat transfer

(ii) Heat transfer coefficients for natural convection across the surface of a vertical pipe and a vertical flat plate at the same height. What could be the cause(s) of this?

(i) Same height (ii) Both vertical (iii) Same fluid (iv) Same fluid flow pattern

Select the correct answer

(a) iii and iv (b) iv (c) i and ii (d) i

(iii) Mark the system where heat transfer is given by forced convection

(a) Heat flow from hot pavement to the surrounding atmosphere

(b) Heat exchange on the outside of cold and warm pipes

(c) Chilling effect of cold wind on a warm body

(d) Fluid passing through the tubes of a condenser and other heat exchange equipment

(iv) The conductance is

(a) Directly proportional to the resistance to heat flow

(b) The reciprocal of the resistance to heat flow

(c) Directly proportional to the thermal potential difference

(d) The reciprocal of the thermal potential difference

(v) Heat transfer by convection is described by

(a) Fick's law (b) Fourier's law (c) Newton's cooling law (iv) Stefan-Boltzmann law

(vi) The Biot number is important in the problems involving

(a) Heat transfer by natural convection (b) Heat transfer by steady state conduction

(c) Heat transfer by forced convection (d) Heat transfer by unsteady state conduction

(vii) Unit of thermal conduction is

(a) W/m.K (b) $W/m^2.K$ (c) J/m.K (d) $J/m^2.K$

(viii) Logmean heat transfer area for the two heat transfer areas A_1 and A_2 is given by

(a) $(A_1-A_2)/\ln(A_1/A_2)$ (b) $\ln(A_1/A_2)/(A_1-A_2)$ (c) $(A_1-A_2)\ln(A_1/A_2)$ (d) $(A_1-A_2)/\ln(A_2/A_1)$

(ix) Which one of the four factors would cause heat transfer rate by conduction to decrease, if the value of that factor were increased?

(a) Temperature difference (b) thermal conductivity (c) Area (d) Thickness

Course Outcomes
CO1: Learn fundamentals of heat transfer
CO2: Identify principles of different modes of heat transfer
CO3: Design and analyze heat transfer equipment
CO4: Compare performances and select type of heat transfer equipment
CO5: Learn industrial applications of heat exchangers
CO6: Solve heat transfer problems of different difficulty levels through tutorials
CO7: Complete design of a heat exchanger through assignments/ group task

(x) In forces convection, fluid moves under the influence of (a) Changes in fluid pressure produced by external work (b) Buoyant forces arising from changes in density (c) Elastic forces (d) Surface tension forces			
2.	What is the physical significance of dimensionless parameters?	1	1,3
3.	Write the significance of Nusselt and Prandtl Number.	2	1,2
4.	How you differentiate between free and forced convection heat transfer? Which one will give you higher heat transfer rate and Why?	2	1,2
5.	Write Dittus-Boelter Equation and explain all term.	2	2,3
6.	Define thermal conductivity and thermal diffusivity. How they are differ?	2	1,2
7.	Write the differences for three modes of heat transfer.	2	1,2,
8.	Define and discuss velocity boundary layer and thermal boundary layer over a flat plate. Show the thickness of these layers for different Prandtl numbers.	3	1,
9.	A wire of radius 3 mm and 1.25 m length is to be maintained at 60 °C by insulating it by a material of thermal conductivity 0.175 W/m K. The temperature of surrounding is 20 °C with heat transfer coefficient 8.5 W/ m^2K. Find percentage increase in heat loss due to insulation?	3	1,2
10.	A thick walled tube of stainless steel (A) having a k = 21.63 W/m.K with dimensions of 2.54 cm ID and 5.08 cm OD is covered with a 0.025 m layer of asbestos (B) insulation, k = 0.25 W/m.K. the inside wall temperature of the pipe is 140 °C and outside surface of the insulation layer is at 555 °C. For a 0.5 m length of pipe, calculate the heat loss and also the temperature at the interface between the metal and insulation.	3	1,2