(42)

Total No of Questions: [12]	***SEAT NO. :***
[Total No. of Pages : *4*]	

T.E. 2008 (HEAT TRANSFER)

(302042)

(Semester - I)

Time: 3 Hours ***Max. Marks : 100***

Instructions to the candidates:

1) ***Answers to the two sections should be written in separate answer books.***
2) ***Answer three questions from section-I and three questions from section-II.***
3) ***Neat diagrams must be drawn wherever necessary.***
4) ***Figures to the right side indicate full marks.***
5) ***Use of Calculator is allowed.***
6) ***Assume Suitable data if necessary.***

SECTION I

Q1)	a)	Derive Three Dimensional Heat Conduction Equation in Cartesian Coordinates for unsteady state. Deduce Poisson's, Fourier's & Laplace Equations from it.	[9]
	b)	A surface having an area of $1.5m^2$ and maintained at 300^0C exchanges heat by radiation with another surface at 40^0C.The value of factor due to the geometric location and emissivity is 0.52. Determine: 1. Heat Loss by radiation 2. The value of Thermal Resistance, & 3. The Value of Equivalent convection Coefficient.	[7]
		OR	
Q2)	a)	Explain in brief the following: 1. Newton's Law of Cooling 2. Isotropic & Anisotropic Materials 3. Comparison between steady state & unsteady state 4. Thermal Diffusivity & its Significance	[8]
	b)	A Plane Wall is 15 cm thick of surface area 4.5 m^2. Thermal conductivity of the wall is 9.5 W/m.K. The inner and outer surfaces of the wall are maintained at 150^0C and 45^0C respectively. Determine: 1. Heat flow rate across the wall. 2. Temperature Gradient in the heat flow direction. 3. Temperature of surfaces at 5 cm and 10 cm away from the inner surface.	[8]
Q3)	a)	Derive an expression for critical radius of insulation for sphere.	[6]
	b)	A plane wall is 1 m thick and it has one surface (x =0) insulated while the other	[10]

		surface (x = L) is maintained at a constant temperature of 350 ^{0}C. The thermal conductivity of the wall is 25 W/m.K and a uniform heat generation per unit volume of 500 W/m^3 is existing throughout the wall. Determine the maximum temperature in the wall and the location of the plane where it occurs.	
		OR	
Q4)	a)	Explain the following: 1. Overall heat transfer coefficient 2. Thermal contact resistance 3. Desirable properties of Thermal insulating material	[6]
	b)	Long Hollow Cylinder has inner and outer radii of 5cm and 15 cm respectively. It generates heat at the rate of 1 kW/m^3, the thermal conductivity of the material is 0.5 W/m.K. If the maximum temperature occurs at radius of 10 cm and the temperature at the outer surface is 50^{0}C, find. 1. Temperature at the inner surface. 2. Maximum Temperature at the cylinder. Derive the formula you may use.	[10]
Q5)	a)	Derive the formula for rate of heat transfer, efficiency & effectiveness for a short fin.	[10]
	b)	An egg with mean diameter of 40 mm and initially at 20^{0}C is placed in a boiling water pan for 4 minutes and found to be boiled to the consumer's taste. For how long should similar egg for same consumer be boiled when taken from a refrigerator at 5^{0}C. Take the following properties for egg: k= *10 W/m.K*, ρ = *1200 kg/m^3*, c = *2 kJ/kg.K* , and h = *100 W/m^2.K*. Use lump theory.	[8]
		OR	
Q6)	a)	Write note on time constant and response of thermocouple.	[6]
	b)	Write note on Biot Number & Fourier Number with their significance	[6]
	c)	Derive the expression for temperature distribution as a function of time in an arbitrary body of volume V and surface area A. The body is initially at a temperature T_i and immersed in surrounding temperature T_s. Take heat transfer coefficient at surface as h.	[6]

		SECTION II	
Q7)	a)	Explain the following: 1. Wien's Displacement law 2. Lambert's law of radiation 3. Planck's law of radiation	[8]
	b)	Three hollow thin walled cylinders having diameter 10 cm, 20 cm, 30cm are arranged concentrically. The temperature of inner most and outer most cylinders are 100 K and 300 K respectively assuming vacuum between the annular space, find the steady state temperature attained the 20 cm diameter cylinder. Take emmisivities of all cylinders as 0.05.	[8]
		OR	
Q8)	a)	Explain how the concept of radiosity and irradiation are used to obtain surface resistance and space resistance.	[4]
	b)	Derive expression for Wien's displacement law.	[4]
	c)	The radiation shape factor of the circular surface of thin hollow cylinder of 10 cm diameter and 10 cm length is 0.1716. What is the shape factor of the curved surface of the cylinder with respect to itself?	[8]
Q9)	a)	Vertical 0.8 m high, 2m wide, double pane window consists of 2 sheets of glass, separated by 2 cm air gap at atmospheric pressure. If the glass surface temp across the air gap is measured to be 12^0C and 2^0C. Determine rate of heat transfer through the window.	[10]
	c)	Explain the following terms: 1. Grashoff Number 2. Reynolds Number	[8]
		OR	
Q10)	a)	Compare natural and forced convection heat transfer.	[4]
	b)	Name and write formulae of 4 dimensional numbers each for natural and forced convection using standard symbols/notations.	[4]
	c)	Liquid metal at the rate of 5 kg/s flows in a tube of 6 cm diameter. It enters at 400^0C into the tube and leaves at 430^0C. A constant heat flux is maintained along the tube. The tube surface temperature is 22^0C higher than the temperature of liquid metal. Calculate the length of tube required for the purpose. Take properties of liquid metal:	[8]

		$\mu = 1.35x\ 10^{-30}$ kg/ms, $Cp = 150$ J/kgK, $Pr = 0.011$, $k = 16$ W/m.K. Use the following correlation: $Nu = 4.82 + 0.0185(Re.Pr)^{0.83}$.	
		OR	
Q12)	a)	Establish expression for LMTD for counter flow heat exchanger with usual notations.	[8]
	b)	Write short notes on: 1. Filmwise and Dropwise condensation 2. Heat Pump	[8]