INTERNAL ASSESSMENT TEST – 1

Dept: ME	Sem / Div: 6th	Sub:Heat Transfer	S Code: 18ME63
Dt:25/05/2021	Time:9.30 -11 am	Max Marks: 50	Elective: N

Note: Answer any 2 full questions.

QN		Questions	Mark	RBT	CO's
		Part A			
1	a	Stating assumptions Derive the general Three Dimensional Heat conduction equation in Cartesian coordinate system and hence obtain Laplace and Poisson equations.	12	L3	CO1
	b	A plane composite wall consists of three different layers in perfect thermal contact. The first layer is 5 cm thick with k = 20 W/(m-K), the second layer is 10 cm thick with k = 50 W/(m-K) and the third layer is 15 cm thick with k = 100 W/(m-K). The outer surface of the first layer is in contact with a fluid at 100°C with a surface heat transfer coefficient of 25 W/(m^2 –K), while the outer surface of the third layer is exposed to an ambient at 30°C with a surface heat transfer coefficient of 15 W/(m^2-K).Draw the equivalent thermal circuit indicating the numerical values of all the thermal resistances and calculate the heat flux through the composite wall. Also calculate the overall heat transfer coefficient for the composite wall.	9	L3	CO1
	c	Explain Stefan Boltzmann Law and Newton's law of cooling.	4	L2	CO1
2	a	Define critical thickness of insulation and Derive the expression for critical thickness of insulation for sphere.	10	L3	CO1
	b	A spherical vessel containing fluid at 160°C is of 0.4 m outer diameter and is made of titanium of 25 mm thickness .The thermal conductivity of titanium is 20 W/mK. The vessel is insulated with two layers of insulation of 5 cm thick each. Thermal conductivity of first layer of insulation is 0.06W/mK and second layer of insulation is 0.12 W/mK. There is a contact Resistance of 0.0006	10	L3	CO1

		and 0.0005 (m^2C)/W between the metal and first insulation and between the insulating layers respectively. The outside is exposed to surrounding at 30 °C with convective heat transfer coefficient of 15 W/m^2K. Determine the rate of heat loss, the interface temperatures and overall heat transfer coefficient based on the outside surface area.			
	c	The roof of an electrically heated home is 6m long,8m wide and 0.25m thick and is made up of flat layer of concrete whose thermal conductivity k is 0.8 Wm/k. Temperature of inner and outer surfaces of the roof in 1 night are measured and equal to 15°C and 4 °C respectively. For a period of 10 hours. find the i) rate of heat loss through the roof in that night .ii)Find the cost of heat loss to the home owner. if the cost of electricity is 8 per kw-hr	5	L3	CO1
		Part B			
3	a	Explain the Boundary conditions of I , II and III kind.	10	L2	CO1
	b	Hot air at a temperature of 65°C is flowing through a steel pipe of 120 mm diameter. The pipe is covered with two layers of different insulating materials of thickness 60 mm and 40 mm and their corresponding thermal conductivities are 0.24 and 0.4 w/m°C. The inside and outside heat transfer coefficients are 60 w/m°C and 12 w/m°C respectively. The atmosphere is at 20°C. Find the rate of heat loss from 60 m length of pipe.	10	L3	CO1
	c	A 5mm diameter spherical ball at 50°C is covered by 1mm thick plastic insulation (K=0.13W/mk).The ball is exposed to a medium at 15°C (h=120W/m^2K).Determine if the plastic insulation on the ball will help or hurt the heat transfer of the ball	5	L3	CO1
		OR			
4	a	Derive the expression for Temperature distribution and heat transfer rate for a Hallow cylinder	10	L3	CO1
	b	An industrial freezer is designed to operate with an internal air temperature of -20°C ,when the external temperature is 25°c, internal and external heat transfer co-efficient are 12 and 8 W/m^2C.	9	L3	CO1

		The wall of freezer is composite construction comprising of inner layer of plastic 3mm thick with thermal conductivity16 W/m°C, sandwiched between these layers of insulation material with thermal conductivity of 0.07W/m°C. Find the width of insulation required to reduce convective heat loss to 15 W/m^2.			
	c	Define the following terms : 1)Thermal contact resistance 2) Thermal conductivity 3) Thermal diffusivity	6	L2	CO1

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