Model Question Paper-2 with effect from 2022-23 (CBCS Scheme)

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Sixth Semester B.E. Degree Examination

HEAT TRANSFER

TIME: 03 Hours **Max. Marks: 100**

Note: 01. Answer any **FIVE** full questions, choosing at least **ONE** question from each **MODULE**.
02. M: Marks, L: Blooms Level, C: Course outcomes
03. Use of Heat Transfer Data Hand Book, Thermodynamics Data Hand Book and Steam Tables are permitted.
04. Assume missing data suitably

		Module-1	**M**	**L**	**C**
Q.01	**a**	Derive the general three dimensional Heat Conduction Equation in Cartesian coordinates and state the assumptions made.	**10**	**L3**	**CO1**
	b	A composite wall is made up of external thickness of brick work 110 mm thick and inside layer of fibre glass of 75mm thick. The fibre glass is covered internally by an insulating board 25mm thick. The coefficient of thermal conductivity for three materials are as follows: Brick work=1.15W/mK, fibre glass=0.04W/mK, insulating board=0.06W/mK. Surface heat transfer coefficient of inside wall is 2.5W/m^{2}K while that of outside wall is 3.1W/m^{2}K. Determine the overall heat transfer coefficient for the wall and using the same determine the heat loss per hour through such a wall. The wall is 4m high & 10m long. Take inside wall temperature as 27ºC & external ambient temperature 10ºC.	**10**	**L3**	**CO1**
		OR			
Q.02	**a**	Explain the Boundary Conditions of 1st, 2nd and 3rd kind.	**6**	**L2**	**CO1**
	b	Derive an expression for temperature distribution and rate of heat transfer for a hollow cylinder.	**6**	**L3**	**CO1**
	c	A 100mm diameter steam pipe is covered by layers of lagging. The inside layer is 40mm thick and has thermal conductivity of 0.07W/m-K. The outside layer is 25mm thick and has K_2=0.1W/m-K. The pipe conveys steam at a temperature of 130ºC. The outside temperature of lagging is 24ºC. If the steam pipe is 20m long, determine the heat lost per hour, interface temperature of lagging neglecting the resistance of steam pipe.	**8**	**L3**	**CO1**
		Module-2			
Q.03	**a**	Derive the one dimensional fin equation for a fin of uniform cross section. By integrating the fin equation, obtain the expression for the temperature variation in a long fin.	**10**	**L3**	**CO2**
	b	A 1 m long, 5 cm diameter cylinder placed in an atmosphere of 40^{0}C is provided with 12 longitudinal straight fins (k= 75 W/mK), 0.75 mm thick. The fin protrudes 2.5 cm from the cylinder surface. The heat transfer coefficient is 23.3 W/m^{2}K. Calculate the rate of heat transfer if the surface temperature of	**10**	**L3**	**CO2**

		the cylinder is 150^0C.			
		OR			
Q.04	**a**	Obtain an expression for instantaneous heat transfer and total heat transfer for lumped heat analysis treatment of heat conduction problems.	**10**	**L3**	**CO2**
	b	An iron sphere of diameter 5cm is initially at uniform temperature of 225^0C. It is suddenly exposed to an ambient at 25^0C with convection coefficient of $500W/m^2K$ 1. Calculate the centre temperature 2 min after the start of exposure 2. Calculate the temperature at a depth of 1cm from the surface after 2min of exposure 3. Calculate the energy removed from sphere during this period. Take thermo physical properties of iron plate as k=60W/m-K, ρ=7850 kg/m^3, C_P=460J/kg-K, $\alpha=1.6X10^{-5}m^2/s$.	**10**	**L3**	**CO2**
		Module-3			
Q.05	**a**	Differentiate between the experimental, analytical and numerical methods of determining the solution of a heat transfer problem.	**10**	**L2**	**CO3**
	b	Explain how the numerical solution is obtained for an one dimensional transient heat transfer problem using finite difference method.	**10**	**L2**	**CO3**
		OR			
Q.06	**a**	State and Explain the following laws of radiation: (i) Steafan Boltzmann Law (ii) Kirchoff's law (iii) Planck's law (iv) Wein's displacement law (v) Lambert's Cosine law.	**10**	**L2**	**CO3**
	b	Two large parallel plates with emissivities 0.5 and 0.8 are maintained at 800 K and 600 K respectively. A radiation shield having an emissivity of 0.1 on one side and 0.05 on the other side is placed in between. Calculate the heat transfer per unit area with and without the radiation shield.	**10**	**L3**	**CO3**
		Module - 4			
Q. 07	**a**	Differentiate between Free and Forced Convection.	**4**	**L2**	**CO4**
	b	With respect to fluid flow over a flat plate, explain the following: (i) Velocity Boundry layer (ii) Thermal Boundry layer.	**6**	**L2**	**CO4**
	c	Air at 20ºC and at atmospheric pressure flows at a velocity of 4.5m/s over a flat plate with sharp leading edge. The Entire plate surface is maintained at a temperature of 60ºC. Assuming that the transition rate occurs at a critical Reynolds number of $5x10^5$, find the distance from the leading edge at which the flow in the boundary layer changes from laminar to turbulent. At this location, calculate the following: (i) Thickness of hydrodynamics boundary layer (ii) Thickness of thermal boundary layer (iii) Local & average heat transfer coefficient (iv) Heat transfer rate from both sides for unit width of the Plate (v) Skin friction coefficient.	**10**	**L3**	**CO4**
		OR			

Q.08	a	Explain the experimental method of determining the heat transfer coefficient using Natural convection method when the air follows over a (i) horizontal cylinder and (ii) Vertical cylinder.	10	L2	CO4
	b	Calculate the heat transfer from a 60W incandescent bulb at 125ºC to ambient air at 25ºC. Assume the bulb as a sphere of 50mm diameter. Also find the percentage of power lost by free convection; $Nu=0.6(GrPr)^{1/4}$.	10	L3	CO4
Module-5					
Q.09	a	Differentiate between the mechanism of filmwise and dropwise condensation. Explain why dropwise condensation is preferred over filmwise condensation.	6	L2	CO5
	b	List the assumptions made in the Nusselts Condensation theory.	6	L2	CO5
	c	A steam condenser consists of a square array of 400 tubes each 6mm in diameter. The tubes are exposed to saturated steam at a pressure of 0.15bar. The tube surface is maintained at a temperature of 25ºC. Calculate the condensation rate per unit length of the tube.	8	L3	CO5
OR					
Q.10	a	Derive an expression for effectiveness in terms of NTU for a parallel flow heat exchanger.	10	L3	CO5
	b	A cross flow heat exchanger with both fluids unmixed is used to heat water flowing at the rate of 20kg/s from 25ºC to 75ºC using gases available at 300ºC to be cooled to 180ºC the overall heat transfer coefficient is 95 W/m^2K. Using LMTD method only, determine the area of heat exchanger required for heat transfer. Take C_P for gases=1005J/kg-K.	10	L3	CO5