Model Question Paper with effect from 2022(CBCS Scheme)

USN | | | | | | | | | |

6th 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. Use of Heat Transfer Data hand Book and Steam Tables are permitted.

		Module -1	*Bloom's Taxonomy Level	COs	Marks
Q.01	**a**	State and explain the laws governing the three basic modes of Heat Transfer.	**L2**	**CO1**	**06**
	b	Explain the experimental method of determining the thermal conductivity of a metal rod.	**L2**	**CO1**	**08**
	c	Explain the Boundary Conditions of 1st, 2nd and 3rd kind.	**L2**	**CO1**	**06**
		OR			
Q.02	**a**	Derive an expression for temperature distribution and rate of heat transfer for a plane wall.	**L3**	**CO1**	**10**
	b	A furnace wall is made of inside silica brick (k=1.6W/mK) and outside magnesite brick (k=5W/mK). The thickness of silica brick is 12cm and magnesite brick is 20cm. The temperature on inside surface of the wall of silica brick is 800°c and outside magnesite brick surface temperature is 130°c. Find the heat flow through this composite wall per meter square per hour. Assume the contact resistance between the two walls as $0.003 m^2K/W$. Also find the temperature of the surfaces at the interface.	**L3**	**CO1**	**10**
		Module-2			
Q. 03	**a**	Derive an expression for the temperature distribution for a pin fin when the tip of the fin is insulated.	**L3**	**CO2**	**08**
	b	Define: (i) Effectiveness of a fin (ii) Efficiency of a fin	**L1**	**CO2**	**04**
	c	A 1 m long, 5 cm diameter cylinder placed in an atmosphere of 40^0C 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 $23.3 W/m^2K$. Calculate the rate of heat transfer if the surface temperature of the cylinder is 150^0C.	**L3**	**CO2**	**08**
		OR			
Q.04	**a**	Obtain an expression for instantaneous heat transfer and total heat transfer for lumped heat analysis treatment of heat conduction problems.	**L3**	**CO2**	**08**
	b	Define Biot number and Fourier number. Explain their significance.	**L2**	**CO2**	**04**
	c	A 50mm thick iron plate is initially at 225°c. It's both surfaces are suddenly exposed to an environment at 25°c with convection coefficient of $500W/m^2K$. (i) Calculate the central temperature 2min after the start of exposure. (ii) Calculate the temperature at a depth of 10mm from the surface after 2min of exposure. (iii) Calculate the energy removed from the plate per square meter	**L2**	**CO2**	**08**

		during this period. Take thermo physical properties of iron plate as k=60W/mK, ρ=7850kg/m^3, C_P=460j/kgK, α=1.6X10^{-5}m^2/s.			
Module-3					
Q. 05	**a**	Explain briefly the concept of a black body with an example.	**L2**	**CO3**	**04**
	b	State and Explain: (i) Steafan Boltzmann Law (ii) Kirchoff's law (iii) Planck's law (iv) Wein's displacement law	**L2**	**CO3**	**08**
	c	Two very large parallel planes with emissivities 0.3 and 0.8 exchange radiative energy. Determine the percentage reduction in radiative energy transfer where a polished aluminium radiation shield having emissivity of 0.04 is placed between them.	**L3**	**CO3**	**08**
OR					
Q. 06	**a**	Discuss the different implicit and explicit finite difference schemes used to solve the transient heat conduction problems.	**L2**	**CO3**	**10**
	b	An iron rod 6cm long of diameter 2cm with thermal conductivity 50W/m^{0}C protrudes from a wall and is exposed to an ambient temperature of T_∞ = 20^{0}C and h = 100 W/m^2 ^{0}C. The base of the rod is at 320^{0}C and its tip is insulated. Assuming one dimensional steady state heat flow, calculate the temperature distribution along the rod using finite difference method. Divide the rod into three parts. The governing differential equation is given by $\frac{\partial^2\theta(x)}{\partial x^2} - N^2\theta(x) = 0$ where $N^2 = \frac{4h}{KD}$ and $\theta(x) = T(x) - T_\infty$ with usual notations.	**L3**	**CO3**	**10**
Module-4					
Q. 07	**a**	With respect to the fluid flow over a flat plate, explain the formulation of a Velocity Boundry layer.	**L2**	**CO4**	**08**
	b	Define: (i) Hydrodynamic Boundry layer thickness (ii) Thermal Boundry layer thickness.	**L1**	**CO4**	**04**
	c	Air at 25^{o}c flows over a flat plate at 2.5m/s. The plate measures 60cm x 30cm and is maintained at uniform temperature of 35^{o}c. Calculate the heat loss from the plate if the air flows parallel to 60cm side. How would this heat loss be affected if the flow of air is parallel to 30cm side?	**L3**	**CO4**	**08**
OR					
Q. 08	**a**	Explain the experimental method of determining heat transfer and heat transfer coefficient when the air flows over a (i) horizontal cylinder (ii) Vertical cylinder.	**L2**	**CO4**	**06**
	b	Define the following non dimensional numbers: (i) Reynolds number (ii) Prandtl number (iii) Nusselt number	**L1**	**CO4**	**06**
	c	Consider the body of a man as a vertical cylinder of 300mm diameter and 160cm height. If the temperature of body is to be maintained at 36^{o}c. Find the heat generated in 24hrs. The ambient temperature is 14^{o}c.	**L3**	**CO4**	**08**
Module-5					
Q. 09	**a**	Derive an expression for LMTD for a Counter flow heat exchanger and state the assumptions made.	**L3**	**CO5**	**10**
	b	A cross flow heat exchanger (both fluids un mixed) and having a heat transfer area 8.4m^2 is to heat air (C_P=1.005kJ/kgK) with water (C_P=4.187kJ/kgK). Air enters the exchanger at 18^{o}c with a mass flow rate of 2kg/s while water enters at 90^{o}c with a mass flow rate of 0.25kg/s. The overall heat transfer coefficient is 250W/m^{2}K. Calculate the exit temperature of two fluids and heat transfer rate.	**L3**	**CO5**	**10**
OR					

Q. 10	**a**	Sketch a pool boiling curve for water and explain briefly the various regimes in boiling heat transfer.	**L2**	**CO5**	**10**
	b	A steam condenser consists of a square array of 400tubes 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 25^{o}c. Calculate the condensation rate per unit length of the tube.	**L3**	**CO5**	**10**