

Model Question Paper-1 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. Use of Data Hand book Is permitted
 03. Assume the missing Data suitably

Module -1			CO	*Bloom's Taxonomy Level	Mar ks
Q.01	a	What are Three basic modes of heat transfer? What are the governing laws of these modes? Explain.	CO1	L1	10
	b	A horizontal steel pipe of 50mm diameter maintained at 60°C is kept in a large room at 22°C. Assuming surface emissivity of steel rod as 0.8 and coefficient of air as 6.5 W/m ² C. Calculate the total heat lost by the pipe per unit length.	CO2	L3	10
OR					
Q.02	a	Derive 3D heat conduction equation in Cartesian Co ordinates	CO2	L2	10
	b	A wire of 0.5mm in diameter is stretched along the axis of the cylinder 50mm in diameter and 250mm long. The temperature of the wire is 750K while the cylinder is at 250K and gas it has k=0.0251w/mk. Find the rate of heat transfer through the gas by conduction and by radiation if the wire is black.	CO1	L4	10
Module-2					
Q. 03	a	Explain the following(i)Thermal Diffusivity (ii)Efficiency of the fin (iii)Effectiveness of the fin	CO1	L2	05
	b	Derive the one dimensional fin equation for fins of uniform cross section. Reduce it to long fin.	CO2	L1	10
	c	Calculate the heat loss rate from the surface of rectangular fin of length 2cm on a plane wall. Thickness of the fin is 2mm and its breadth b is 20cm. Take $\theta_0=200^\circ\text{C}$, $h=15\text{W/m}^2\text{K}$ and $k=45\text{WmK}$ and assume heat loss from the tip is negligible	CO2	L3	05
OR					
Q.04	a	What are Hessler's Chart ? Explain their significance in solving transient conduction problems.	CO1	L2	10
	b	A steel ball of 50mm diameter and 900°C temperature is placed in still temperature of 30°C atmospheric conditions. Calculate the initial rate of cooling of the ball in °C/min. Take $\rho=7800\text{kg/m}^3$; $c_p=2\text{kJ/kg}$; $h=30\text{W/m}^2\text{K}$. Neglect internal thermal resistance.	CO2	L3	10
Module-3					
Q. 05	a	Obtain Fundamental relationship between Nusselt,, Prandtle and Grasheff's numbers using Buckingham π theorem	CO2	L1	10
	b	A circular hot plate 15cm in diameter is maintained at 160°C atmospheric air at 20°C. Calculate the convection heat loss from both the surface of	CO2	L3	10

		plate, when the upper surface is heated and lower surface is cooled and the plate is kept in horizontal position.			
OR					
Q. 06	a	What are the significance of following numbers in forced convection (a) Reynold's number (b) Prandtl number (c) Nusselt number (d) Grashoff's number	CO2	L3	10
	b	Air at 25°C and atmospheric pressure flows across a heated cylinder of diameter 7.5cm. If the velocity of air flow is 1.2 m/sec and the cylinder surface is maintained at 95°C, compute the rate of heat transfer	CO1	L3	10
Module-4					
Q. 07	a	Derive an expression for the effectiveness of a heat exchanger for parallel flow arrangements	CO4	L1	10
	b	Water enters a counterflow double pipe heat exchanger at 15°C flowing at a rate of 1300 kg/hr. It is heated by oil ($c_p = 2000 \text{ J/kgK}$) flowing at the rate of 550 kg/hr from an inlet temperature of 94°C for an area 1 cm^2 and overall heat transfer co-efficient of $1075 \text{ W/m}^2\text{K}$. Determine the total heat transfer and outlet temperature of water and oil. Take C_p of water = 4186 J/kgK	CO4	L4	10
OR					
Q. 08	a	Write a note on filmwise and dropwise condensation	CO4	L1	10
	b	A horizontal condenser is to be designed to condense 225 kg of steam per hour at a pressure of 0.15 bar. A square array of 400 tubes, each of 6 mm in diameter is available, if the surface temperature is to be maintained at 26°C. Find the length of each tube	CO4	L3	10
Module-5					
Q. 09	a	Explain (i) Stefan Boltzmann Law (ii) Kirchoff's Law (iii) Wein's displacement Law (iv) Planck's Law	CO5	L1	10
	b	The temperature of a black surface 0.2 m^2 in area is 540°C. Calculate a) The total rate of energy emission b) Intensity of normal radiation c) The wavelength of maximum monochromatic emissive power	CO5	L4	10
OR					
Q. 10	a	Derive an expression for the radiation heat exchange between two large parallel gray planes	CO5	L1	10
	b	Two large parallel planes are at 1000K and 600K. Determine the heat exchange per unit area: (i) If the surfaces are black (ii) If the hot one has the emissivity of 0.8 and the cooler one 0.5 (iii) If a large plate is inserted between these two having emissivity of 0.2. What is the temperature of this large plate and also find the percentage reduction in heat transfer with this large plate		L4	10

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

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Sixth Semester B.E. Degree Examination Heat Transfer

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Module -1			CO	*Bloom's Taxonomy Level	Mar ks
Q.01	a	Explain briefly the mechanism of conduction , convection and radiation heat transfer	CO1	L1	10
	b	A 240mm steam main, 210 m long is covered with 50mm of high temperature insulation (K =0.092W/m°C) and 40mm of low temperature insulation (K = 0.062 W/m°C) the inner and outer surface temperature's as measured are 390°C and 40°C respectively. Determine i) The total heat loss per hour ii) The total heat loss per m of outer surface iii) Temperature between two layre's of insulation. Neglecting condition through pipe material.	CO2	L3	10
OR					
Q.02	a	Derive 3D heat conduction equation in Cartesian Co ordinates	CO2	L2	10
	b	An exterior wall of house may be approximated by a 0.1m layer of common brick (K=0.7W/m °C) followed by a 0.04m layer of gypsum plaster (K = 0.48 Whm°C). What thickness of loosely packed rock wool insulation (K = 0.065 W/m C) should be added to reduce the heat loss (or) gain through the wall by 80%?	CO1	L4	10
Module-2					
Q. 03	a	Derive an expression for the temperature distribution for a short fin of uniform cross section without insulated tip starting from fundamental energy balance equation.	CO1	L2	10
	c	Calculate the heat loss rate from the surface of rectangular fin of length 2cm on a plane wall. Thickness of the fin is 2mm and its breadth b is 20cm. Take $\theta_0=200^\circ\text{C}$, $h=15\text{W/m}^2\text{K}$ and $k=45\text{WmK}$ and assume heat loss from the tip is negligible	CO2	L3	10
OR					
Q.04	a	Write short notes on : i) Biot numbers ii) Fourier's number	CO1	L2	10
	b	A steel ball of 50mm diameter and 900°C temperature is placed in still temperature of 30°C atmospheric conditions. Calculate the initial rate of cooling of the ball in °C/min. Take $\rho=7800\text{kg/m}^3$; $c_p=2\text{kJ/kg}$; $h=30\text{W/m}^2\text{K}$. Neglect internal thermal resistance.	CO2	L3	10
Module-3					
Q. 05	a	Obtain Fundamental relationship between Nusselt,, Prandtle and Grasheff's numbers using Buckingham π theorem	CO2	L1	10
	b	A vertical cylinder 1.5m high and 180 mm in diameter is maintained at 100C in an atmosphere environment of 20C. Calculate heat loss by free convection from the surface of the cylinder. Assume properties of air at mean temperature as $\rho = 1.06 \text{ kg/m}^3$, $\nu=18.97 \times 10^{-6} \text{ m}^2/\text{s}$, $C_p = 1.004 \text{ kJ/kg }^\circ\text{C}$ and $K = 0.1042 \text{ kJ/mh }^\circ\text{C}$	CO2	L3	10

OR					
Q. 06	a	Explain the significance of i) Reynolds number ii) Prandtl number iii) Nusselt number iv) Stanton number.	CO2	L3	10
	b	Air at 25°C and atmospheric pressure flows across a heated cylinder of diameter 7.5cm. If the velocity of air flow is 1.2 m/sec and the cylinder surface is maintained at 95°C, compute the rate of heat transfer	CO1	L3	10
Module-4					
Q. 07	a	Derive an expression for LMTD for counter flow heat exchanger	CO4	L1	10
	b	Water enters a counterflow double pipe heat exchanger at 15°C flowing at a rate of 1300 kg/hr. It is heated by oil ($c_p=2000\text{J/kgK}$) flowing at the rate of 550kg/hr from an inlet temperature of 94°C for an area 1 cm^2 and overall heat transfer co-efficient of $1075\text{W/m}^2\text{K}$. Determine the total heat transfer and outlet temperature of water and oil. Take C_p of water = 4186J/kgK	CO4	L4	10
OR					
Q. 08	a	With a neat diagram, explain the typical boiling curve for water at 1 atm pressure	CO4	L1	10
	b	A horizontal condenser is to be designed to condense 225kg of steam per hour at a pressure of 0.15bar. A square array of 400 tubes, each of 6mm in diameter is available, if the surface temperature is to be maintained at 26°C. Find the length of each tube	CO4	L3	10
Module-5					
Q. 09	a	Explain (i) Stefan Boltzmann Law (ii) Kirchoff's Law (iii) Wein's displacement Law (iv) Planck's Law	CO5	L1	10
	b	The temperature of a black surface 0.2m^2 in area is 540°C. Calculate a) The total rate of energy emission b) Intensity of normal radiation c) The wavelength of maximum monochromatic emissive power	CO5	L4	10
OR					
Q. 10	a	Derive an expression for the radiation heat exchange between two large parallel gray planes	CO5	L1	10
	b	Two large parallel plates with $E = 0.5$ each are maintained at different temperatures and are exchanging heat only by radiation. Two equally large radiation shields with surface emissivity 0.05 are introduced in parallel plates. Find the percentage reduction in net radiative heat transfer	CO5	L4	10