BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

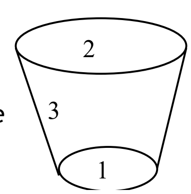
CLASS: M.Tech/Pre_PhD — **SEMESTER : II**
BRANCH: MECH — **SESSION : SP/2023**

SUBJECT: ME592 ADVANCED HEAT TRANSFER

TIME: 3 Hours — **FULL MARKS: 50**

INSTRUCTIONS:
1. The question paper contains 5 questions each of 10 marks and total 50 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
***4*. Before attempting the question paper, be sure that you have got the correct question paper.**
5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.

			CO	BL
Q.1(a)	Consider a two dimensional steady state heat conduction equation with no generation $\frac{\partial^2 T}{\partial x^2} + \frac{\partial^2 T}{\partial y^2} = 0$ The three sides of the rectangular plate are subjected to a constant temperature boundary condition and the forth side has T = $T_m \sin\left(\frac{\pi x}{w}\right) + T_1$. The notations used have its usual meaning. Determine the temperature distribution in the plate.	[5]	1	BTM
Q.1(b)	A steel ball bearing (k = 50 W/mK, α = 1.3 x 10-5 m^2/s) having a diameter of 40 mm is heated to a temperature 650 °C and then quenched in a tank of oil at 55 °C. If the heat transfer coefficient between the ball bearing oil is 300 W/m^2K, Determine duration of time the ball must remain in oil to reach 200 °C.	[5]	1	BTM
Q.2(a)	Derive energy integral equation for a boundary layer flow.	[5]	2	BTM
Q.2(b)	Describe the numerical technique to solve boundary layer equation.	[5]	2	BTH
Q.3(a)	Explain mixing length turbulent model.	[5]	3	BTL
Q.3(b)	Explain analogy solution for boundary flow. What is Reynolds analogy?	[5]	3	BTL
Q.4(a)	Derive Stefan-Boltzmann's law and Wien's displacement law from Plank's law of radiation.	[5]	4	BTM
Q.4(b)	A truncated cone of height 10 cm and has bottom and top diameters of 8 cm and 16 cm respectively. The bottom surface intercepts 15 percent of radiation leaving the top surface. Determine the shape factor between (i) top surface and the side surface (F_{23}) and (ii) the side surface with itself (F_{33}).	[5]	4	BTM
Q.5(a)	What are the factors responsible for attenuation of radiation intensity in a participating medium? Write down the expression for it.	[5]	5	BTH
Q.5(b)	Derive the general expression for radiative transport equation in a participating medium.	[5]	5	BTM



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