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

CLASS: B.TECH **SEMESTER : IV**
BRANCH: BIOTECHNOLOGY **SESSION : SP/2023**

SUBJECT: BE209 FLUID MECHANICS AND 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)	An incompressible fluid (kinematic viscosity, 7.4x 10^{-7} m^2 /s, specific gravity, 0.88) is held between two parallel plates. If the top plate is moved with a velocity of 0.5 m/s while the bottom one is held stationary, the fluid attains a linear velocity profile in the gap of 0.5 mm between these plates; Calculate the shear stress in Pascals on the surfaces of top plate?	[5]	1	Analyze
Q.1(b)	Water is pumped at a rate of 36 m^3/h from a tank 2 m below the pump to an overhead pressurized vessel 10m above the pump. The pressure values at the point of suction from the bottom tank and at the discharge point to an overhead vessel are 120 kPa and 240 kPa. All pipes in the system have same diameter. Neglecting frictional losses, What is the power required (Kw) to deliver the fluid?	[5]	1	Applying
Q.2(a)	A Venturimeter of 10 mm throat diameter is used to measure the velocity of water in a horizontal pipe of 20 mm diameter. If the pressure difference between the pipe and throat sections is found to be 30 kPa then, neglecting frictional losses, the flow velocity is?	[5]	2	Evaluate
Q.2(b)	A pipe carrying water experiences a sudden reduction in area. The area at point (1) is 0.002 m^2 and at point (2) it is 0.001 m^2. The pressure at point (2) is 500 kPa and the velocity is 8 m/s. The loss coefficient K is 0.4. The density of water is 1000 kg/m^3. Calculate the following. i. The mass flow rate. ii. The pressure at point (1)	[5]	2	Evaluate
Q.3(a)	A plane brick wall, 25 cm thick, is faced with 5 cm thick concrete layer. If the temperature of the exposed brick face is 70°C and that of the concrete is 25°C, find out the heat lost per hour through a wall of 15 m x10 m. Also, determine the interface temperature. Thermal conductivity of the brick and concrete are 0.7 W/m.K and 0.95 W/m.K respectively	[5]	3	Create
Q.3(b)	A spherical vessel of 0.5 m outside diameter is insulated with 0.2 m thickness of insulation of thermal conductivity 0.04 W/m degree. The surface temperature of the vessel is -195 degree Celsius and outside air is at 10 degree Celsius. Determine heat flow?	[5]	3	Analyze
Q.4(a)	A thin 100 cm long and 10 cm wide horizontal plate is maintained at a uniform temperature of 150°C in a large tank full of water at 75°C. Estimate the rate of heat to be supplied to the plate to maintain constant plate temperature as heat is dissipated from either side of plate.	[5]	4	Remembering

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Q.4(b)	A thick walled tube of stainless steel (K = 19 W/m˚C) with 2 cm inner dia and 4 cm outer dia is covered with a 3 cm layer of asbestos insulation (K= 0.2 W/m˚C). Air at 600 ˚C flows through the pipe and the convective heat transfer coefficient from the air to the inside of the pipe has the value of h_i = 35 W/m^2 K . The outside surface of the pipe is surrounded by air which is at 100 ˚C and the convective coefficient for the outside is h_o= 10 W/ m^2 K. Calculate the heat loss through 50 m of this pipe?	[5]	4	Analyze
Q.5(a)	Two parallel black plates 0.5 by 1.0 m are spaced 0.5 m apart. One plate is maintained at 1000 ˚C and the other is at 500 ˚C. What is the net radiant heat exchange between the two plates? The shape factor F_{12} = 0.285.	[5]	5	Analyze
Q.5(b)	A polished metal pipe 5 cm outside diameter and 370 K at the outer surface is exposed to ambient conditions at 295 K. The emissivity of the surface is 0.2 and the heat transfer coefficient is 11.33 W/m^2K. Calculate the heat transfer by radiation and natural convection per meter length of the pipe?	[5]	5	Evaluate

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