Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- SEMESTER–IV (NEW) EXAMINATION – WINTER 2020

Subject Code:3142507 Date:11/02/2021

Subject Name:Fluid Mechanics and Heat Transfer

Time:02:30 PM TO 04:30 PM Total Marks:56

Instructions:

1. **Attempt any FOUR questions out of EIGHT questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

			Marks
Q.1	**(a)**	What do you understand by hydrostatic paradox?	**03**
	(b)	State and prove Pascal's law.	**04**
	(c)	Derive Euler's equation of motion. State assumptions made. How will you obtain Bernoulli's equation from Euler's equation?	**07**
Q.2	**(a)**	Define centre of pressure. Obtain expression for centre of pressure for vertical plane surface submerged in liquid.	**03**
	(b)	With neat sketch explain the stability conditions of submerged body.	**04**
	(c)	Enunciate Newton's law of viscosity. Explain importance of viscosity in fluid motion. What is the effect of temperature on viscosity of water and air?	**07**
Q.3	**(a)**	Define the terms: Unsteady flow, Three dimensional flow, Uniform flow	**03**
	(b)	How repeating variables selected for dimensionless analysis?	**04**
	(c)	The water is flowing through a taper pipe of length 100 m having diameters 600 mm at the upper end and 300 mm at the lower end, at the rate of 50 lps. The pipe has slope of 1 in 30. Find the pressure at the lower end if pressure at the higher level is 19.62 N/cm^2.	**07**
Q.4	**(a)**	Explain electrical analogy of the heat transfer with the help of thermal network.	**03**
	(b)	Define the terms: heat capacity and thermal diffusivity with their physical significance.	**04**
	(c)	Derive general heat conduction equation in Cartesian coordinate system. Reduce the equation to Laplace equation.	**07**
Q.5	**(a)**	Explain the mechanism of convection heat transfer. Also explain natural and forced convection.	**03**
	(b)	What are dimensionless numbers? Explain physical significance of Nusselt Number and Prandtl Number	**04**
	(c)	A furnace wall consists of 200 mm layer of refractory bricks, 6 mm layer of steel plate and a 100 mm layer of insulation bricks. The maximum temperature of the wall is 1150°C on the furnace side and the minimum temperature is 40°C on the outermost side of the wall. An accurate energy balance over the furnace shows that the heat loss from the wall is 400 W/m^2. It is known that there is a thin layer of air between the layers of refractory bricks and steel plate. Thermal conductivities for the three layers are 1.52, 45 and 0.138 W/m°C respectively. Find : i. To how many millimetres of insulation brick is the air layer equivalent? ii. What is the temperature of the outer surface of the steel plate ?	**07**

Q.6	**(a)**	Explain the concept of thermal boundary layer.	**03**
	(b)	Explain the following: i. Fin efficiency ii. Fin effectiveness	**04**
	(c)	By dimensionless analysis show that for forced convection $Nu = f(Re, Pr)$	**07**
Q.7	**(a)**	Define the tems: Absorptivity, Reflectivity, Transmittivity.	**03**
	(b)	State and prove Kirchoff's law of radiation.	**04**
	(c)	Derive the equation of heat exchange between two infinite parallel planes of non-black body.	**07**
Q.8	**(a)**	State limitations of LMTD method.	**03**
	(b)	State and explain Wein's displacement law.	**04**
	(c)	The flow rates of hot and cold water streams running through a parallel-flow heat exchanger are 0.2 kg/s and 0.5 kg/s respectively. The inlet temperatures on the hot and cold sides are 75°C and 20°C respectively. The exit temperature of hot water is 45°C. If the individual heat transfer coefficients on both sides are 650 W/m^2°C, calculate the area of the heat exchanger.	**07**

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