Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER– IV (New) EXAMINATION – WINTER 2019

Subject Code: 2142105 Date: 12/12/2019

Subject Name: Heat and Mass Transfer in Metallurgy

Time: 10:30 AM TO 01:00 PM Total Marks: 70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1	**(a)**	Define and classify fluids.	**03**
	(b)	Explain Fick's first law of diffusion and derive unit for diffusivity.	**04**
	(c)	Derive differential equation of momentum balance (Equation of motion) in rectangular coordinate system.	**07**
Q.2	**(a)**	Explain mass concentration, molar concentration, mass fraction & molar fraction.	**03**
	(b)	Derive differential mass balance (Continuity Equation).	**04**
	(c)	Derive differential equation for heat conduction in rectangular coordinate system.	**07**
		OR	
	(c)	What are different type of fluid flows? Explain them.	**07**
Q.3	**(a)**	If max. velocity of fluid flowing through pipe of diameter 20cm is 5m/sec & shear stress required to create flow is 20 N/m^2. Calculate dynamic viscosity of fluid. Consider velocity of fluid at wall is zero.	**03**
	(b)	State Fourier law of heat conduction and derive units of thermal conductivity (k).	**04**
	(c)	Derive Hagen-Poiseulle Equation for fluid flowing through pipe.	**07**
		OR	
Q.3	**(a)**	Calculate discharge of fluid flowing through pipe of 20 cm radius and 5 m/sec velocity.	**03**
	(b)	For temperature difference of 200 ^0C for refractory thickness of 400 mm having thermal conductivity of 0.2 W/mK. Calculate heat flux.	**04**
	(c)	What is convective heat transfer? Discuss different modes of convective heat transfer.	**07**
Q.4	**(a)**	Determine temperature inside of furnace refractory wall of thickness 2000 mm having k= 0.15W/mK if outside temperature is 75 ^0C for heat flux of 100 W/m^2.	**03**
	(b)	Explain lambert's law for radiative heat transfer.	**04**
	(c)	From Euler's equation, derive Bernoulli's equation by integration.	**07**
		OR	
Q.4	**(a)**	What is mass transfer? Briefly explain different modes of mass transfer.	**03**
	(b)	State Newton's law of cooling and derive unit for coefficient of convective heat transfer (h).	**04**
	(c)	Write note on Kirkindall effect.	**07**
Q.5	**(a)**	For convective heat transfer condition if heat flux of 1500 W/m^2 and temperature difference of 30 ^0C. Calculate co-efficient of convective heat transfer (h).	**03**
	(b)	A sphere of diameter 10 mm and emissivity 0.9 is maintained at 80 ^0C inside oven with wall temperature of 400 ^0C. Calculate net heat transfer rate from oven wall to object.	**04**
	(c)	What is emissive power, emissivity, black body, white body and gray body?	**07**
		OR	
Q.5	**(a)**	Briefly explain pseudo steady diffusion.	**03**
	(b)	What is radiative heat transfer? How it is different than conductive & convective heat transfer?	**04**
	(c)	State and explain plank's law, wein's law,	**07**

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