Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

ME - SEMESTER IV (NEW) – EXAMINATION – SUMMER - 2017

Subject Code: 2741601 **Date:03/05/2017**

Subject Name: Advance Transport Phenomena (ATP)

Time:02:30PM-05:00 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)**	Derive Equation of continuity which describes the time rate of change of the fluid density at a fixed point in space.	**07**
	(b)	Derive the mathematical model of friction for flow around sphere for various flow conditions.	**07**
Q.2	**(a)**	A spherical tank of radius R and its drainage of length L and diameter D are completely filled with heavy oil. At time t = 0 the valve at the bottom of the drainpipe is opened. How long will it take to drain the tank? There is an air vent at the very top of spherical tank. Ignore the amount of oil that clings to the inner surface of the tank, and assume that the flow in drainpipe is laminar.	**07**
	(b)	An incompressible fluid flows from a small circular tube into a large tube in turbulent flow. The cross-sectional areas of the tubes are *S1* and S2. Obtain an expression for the pressure change between planes 1 and 2 and for the friction loss associated with the sudden enlargement in cross section. Let $\beta = S1/S2$, which is less than unity.	**07**
		OR	
	(b)	Write in brief about heat transfer coefficient for forced convection through packed bed.	**07**
Q.3	**(a)**	Determine the temperature distribution in an incompressible liquid confined between two coaxial cylinders, the outer one of which is rotating at a steady angular velocity Ω_0. Consider the radius ratio k to be fairly small so that the curvature of the fluid streamlines must be taken in to account. The temperature of the inner and outer surface of the annular region is maintained at T_k and T_1 respectively with $T_k \neq T_1$. Assume steady laminar flow and neglect the temperature dependence of the physical properties.	**07**
	(b)	Define Transpiration Cooling. Consider system with two concentric porous spherical shells of radii *KR* and *R*. The inner surface of the outer shell is at temperature *Tu* and the outer surface of the inner shell is at a lower temperature *TK*. Dry air at *TK* is blown outward radially from the inner shell into the intervening space and then through the outer shell. Develop an expression for the required rate of heat removal from the inner sphere as a function of the mass rate of flow of the gas. Assume steady laminar flow and low gas velocity.	**07**
		OR	
Q.3	**(a)**	Derive a mathematical model describing diffusion with a homogeneous chemical reaction	**07**
	(b)	Derive an equation for time smoothen temperature profile near a wall.	**07**
Q.4	**(a)**	Discuss in detail about heat transfer coefficient for forced convection in tubes.	**07**

(b) Develop expressions for the mole fraction profile *xA(y)* and the temperature profile *T{y)* for the system , given the mole fractions and temperatures at both film boundaries (y = 0 and $y = \delta$). Here a hot condensable vapor, *A*, is diffusing at steady state through a stagnant film of noncondensable gas, B, to a cold surface at $y = 0$, where *A* condenses. Assume ideal gas behavior and uniform pressure. Furthermore assume the physical properties to be constant, evaluated at some mean temperature and composition. Neglect radiative heat transfer. **07**

OR

Q.4 **(a)** Explain basic laws of scalar and vector algebra. Also discuss tensor operation in brief. **07**

(b) A liquid of constant density and viscosity is in a cylindrical container of radius R. The container is caused to rotate about its own axis at an angular velocity Ω. The cylinder axis is vertical, so that $g_r = 0$, $g_\theta = 0$ and $g_z = -g$, in which g is magnitude of the gravitational acceleration. Find the shape of the free surface of the liquid when steady state has been established. **07**

Q.5 **(a)** Derive correlation of binary transfer coefficient in one phase. **07**

(b) Discuss in detail about Reynolds anology and Prandtl mixing length. **07**

OR

Q.5 **(a)** Discuss about mass transfer coefficient in falling film on plane surface. **07**

(b) Discuss advantages, limitations, application for Computational fluid dynamics. **07**

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