Reg. No. | | | | | | | | | | | | | | |

B.E / B.TECH. DEGREE EXAMINATION, MAY 2023

Seventh Semester

CH18701 – TRANSPORT PHENOMENA

(Regulation 2018)

TIME: 3 HOURS **MAX. MARKS: 100**

CO 1 Impart knowledge on the fundamental connections between the conservation laws in heat, mass and momentum in terms of vector and tensor fluxes.
CO 2 Apply the shell balance approach to derive differential mass and heat balance equations for laminar flow system.
CO 3 Develop the ability to model and analyze fluid flow, heat and mass transfer processes.
CO 4 Augment the capability to design and to solve open ended transport problems
CO 5 Apply different analogies to study the similarities in different transport phenomena.

PART- A (10 x 2 = 20 Marks)

(Answer all Questions)

		CO	RBT LEVEL
1.	State the limitations of analysis in transport phenomena.	1	2
2.	Relate the phenomenological laws involved in transport phenomena in a single definition.	1	2
3.	Write the boundary conditions involved in 2D Couette flow.	2	2
4.	Calculate the hydraulic diameter for an annulus space created by coaxial cylinders where inner cylinder is 50mm diameter and outer cylinder is 85mm diameter.	2	3
5.	Sketch the temperature profile of a copper wire which is a electrical heat source.	3	2
6.	Mention the significance of dimensionless number characterize the free and forced convection.	3	2
7.	Convert in all possible ways the pressure gradient term in Navier stokes equation into dimensionless form.	4	2
8.	Prove the continuity equation takes the form $\nabla . v = 0$	4	2
9.	Justify on why we have to use averaging technique in order to model turbulent fluid flow.	5	2
10.	Relate the importance of dimensionless number in defining the acceptance of analogous nature of transport process.	5	3

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PART- B (5 x 14 = 70 Marks)

			Marks	CO	RBT LEVEL
11. (a)	**(i)**	Compute the thermal conductivities of NO and CH4 at 300K and atmospheric pressure from the following data for these conditions,	**(7)**	1	3

Gas	μ x 10^7 (g/cm.s)	C_p (cal/g.mole K)
NO	1929	7.15
CH_4	1116	8.55

			Marks	CO	RBT LEVEL
	(ii)	Compute the diffusivity of Hg^{203} in normal liquid Hg using Erying theory using the following the data and compare with experimental values.	**(7)**	1	3

Temperature (K)	Experimental, D_{AA}, (cm/s)	μ (cp)	V (cm^3/g)
275.7	1.52 x 10^{-5}	1.68	0.0736
289.6	1.68 x 10^{-5}	1.56	0.0737
364.2	2.57 x 10^{-5}	1.27	0.0748

(OR)

		Marks	CO	RBT LEVEL
(b)	Compare and contrast the molecular and convective mechanisms for momentum transport; And verify that momentum per unit area per unit time has the same dimensions as force per unit area.	**(14)**	1	3
12. (a)	Devise a meaningful sketch showing the flow pattern in arbitrary shape, which explains the components of τ and ρvv for the Newtonian fluid.	**(14)**	2	3
	(OR)			
(b)	With the assumption of steady-state axial flow of an incompressible fluid in a circular pipe. Devise the model to capture the velocity distribution, and average velocity at outlet and list the assumptions clearly.	**(14)**	2	3
13. (a)	Take a copper wire which carrying a current of 5 A, voltage 240V as the heat source and devise the model to estimate the temperature distribution and perform heat transfer analysis and identify the thickness of plastic lagging required to have minimum temperature over the surface. Assume the missing parameters and list them clearly.	**(14)**	3	4
	(OR)			
(b)	Assume a solid wall diffusing through flowing fluid in the circular pipe and devise the model to estimate the mass fraction distribution by considering the no chemical reaction that occurs on the solid surface and diffuses back to the bulk fluid, and list the assumptions clearly.	**(14)**	3	4
14. (a)	Devise a general model equation to solve for mass transport in a binary system, where a chemical reaction conducted on mole basis?	**(14)**	4	3

(OR)

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		Marks	CO	RBT
(b)	Contrast the development of Euler equation and Stoke equation, starting from Equation of motion and Comment on general boundary conditions used for fluid – solid interfaces	**(14)**	**4**	**3**
15. (a)	Exemplify the time smoothed form of velocity by following Reynolds definition and explain how Navier Stokes equation has closure problem.	**(14)**	**5**	**4**
	(OR)			
(b)	Compare and Contrast the different analogies used in solving the fluid pressure drop calculation and film coefficient calculation for hot fluid flowing in cold pipe.	**(14)**	**5**	**4**

PART- C (1 x 10 = 10 Marks)

(Q.No.16 is compulsory)

		Marks	CO	RBT LEVEL
16.	Construct the rate of change of temperature of the water referred in the below picture as measured by Mr. Euler and Mr. Lagrange and list the assumptions used.	**(10)**	**1**	**5**