QPC: RN18001180 AR - 18 Reg. No. | | | | | | | | | | |

GIET MAIN CAMPUS AUTONOMOUS GUNUPUR – 765022

B. Tech Degree Examinations, November – 2021

(Seventh Semester)

BCHPC 7010 – TRANSPORT PHENOMENA

(Chemical Engineering)

Time: 3 hrs Maximum: 100 Marks

Answer ALL Questions

The figures in the right hand margin indicate marks.

PART – A: (Multiple Choice Questions) (2 x 10 =20 Marks)

Q.1. Answer ***ALL*** questions [CO#] [PO#]

a. Control volume analysis is carried out in ____ study. CO1 PO1
   (i) Macro level (ii) Micro level
   (iii) Molecular level (iv) All of these

b. Momentum flux has the unit of as CO1 PO1
   (i) Force (ii) Stress
   (iii) Heat flux (iv) None of these

c. 1cP is CO1 PO1
   (i) 0.1 Pa-s (ii) 0.01 Pa-s
   (iii) 0.001 Pa-s (iv) 0.0001 Pa-s

d. For laminar flow In a pipe the ratio of centre line velocity to average velocity is CO1 PO2
   (i) 0 (ii) 0.5
   (iii) 1 (iv) 2

e. The heat transfer by the fin is based on CO2 PO1
   (i) conduction (ii) convection
   (i) Both (i) & (ii) (ii) None of these

f. Schimdt number is used in CO3 PO1
   (i) Momentum transfer (ii) Energy transfer
   (iii) Mass transfer (iv) All of these

g. In falling film the velocity distribution is _____ in nature for steady laminar flow of Newtonian fluid. CO1 PO2
   (i) Linear (ii) Parabolic
   (iii) Logarithmic (iv) None of these

h. The velocity distribution is _____ in nature for steady laminar flow of Newtonian fluid in a pipe. CO1 PO2
   (v) Linear (vi) Parabolic
   (vii) Logarithmic (viii) None of these

i. According to Blassius formula for friction factor, Reynold is related with the power CO4 PO1
   (i) 0.25 (ii) 0.5
   (iii) 0.33 (iv) None of these

j. Peclet number is CO4 PO1
   (i) Re×Pr (ii) Re/Pr
   (iii) Re+Pr (iv) Re-Pr

PART – B: (Short Answer Questions) (2 x 10 = 20 Marks)

Q.2. Answer ***ALL*** questions [CO#] [PO#]

a. Write mathematical expression for time dependant and time independent fluids. CO1 PO1

b. What is combined momentum flux? CO1 PO1

c. Write the Ergun equation for Packed bed Pressure drop. CO2 PO1

d. Write Fourier's Law of heat conduction with linear temp. gradient. CO2 PO1

e. How thermal conductivity depends on temperature in case of low density gases and liquid? CO2 PO2

f. Write the formula for overall heat transfer coefficient for a composite cylinder consisting of four different layers with different thermal conductivities with different thicknesses. CO2 PO1

g. Write Fick's Law of diffusion CO3 PO1

h.	What is friction factor?	CO4	PO1
i.	Write the Prandtle formula for friction factor	CO4	PO1
j.	Define the Prandtl, Schmidt and Lewis numbers.	CO4	PO1

PART – C: (Long Answer Questions) **(15 x 4 = 60 Marks)**

Answer ***ALL*** questions

		Marks	[CO#]	[PO#]
3.a.	Derive an expression for average velocity profile of power law fluid flow between two vertical walls, separated by a distance 2B, taking origin at mid-point of 2B distance.	15	CO1	PO2
	(OR)			
b.	Derives an expression for average velocity in a circular pipe of radius R and length L when a Bingham fluid is flowing inside the pipe vertically downward	15	CO1	PO2
4.a.	The heat generate per unit volume in a parallel plate is given by $S_V = \mu\left(\frac{v}{b}\right)^2, \frac{w}{m^3}$, where v is the upper plate velocity; b is the distance between two plates. Taking origin at the lower plate with boundary condition x = 0, T =T_0, and x = b, T=T_b, Derive an expression for dimensionless temperature difference profile in terms of Brinkman number (Br), where $Br = \frac{\mu\, v^2}{k(Tb - To)}$	15	CO2	PO2
	(OR)			
b.	Consider a long cylindrical nuclear fuel rod, surrounded by an annular layer of aluminium cladding. Within the fuel rod heat is produced by fission; this heat source depends on position approximately as, $S_n = S_{n0}\left[1 + b\left(\frac{r}{R_F}\right)^2\right]$. Here S_{n0} and *b* are known constants, and *r* is the radial coordinate measured from the axis of the cylindrical fuel rod. R_F and R_C are the radius of fission and cladding materials. Derive an expression for temperature profile in the fission and cladding material if the temperature at the outer surface of cladding is T_0 .	15	CO2	PO2
5. a.	In studying the rate of leaching of a substance A from solid particles by a solvent B, the rate controlling step is diffusion of A from the particle surface through a stagnant liquid film thickness δ out into the main stream. The molar solubility of A in B is C_{A0} and the main stream is $C_{A\delta}$. Show that, i) rate of leaching is $N_{AZ} = D_{AB}(C_{AO} - C_{A\delta})/\delta$ ii) Concentration profile is linear with respect to direction of mass flow	10	CO3	PO2
b.	Write the combined mass flux and boundary conditions used to obtain concentration profile in solids and in laminar flow.	5	CO3	PO2
	(OR)			
c.	Derive an expression for molar flux in steady state fluid at rest and in laminar flow in terms of partial pressure for non-diffusing case.	10	CO3	PO2
d.	Convert the differential equation into dimensionless form with Reynolds number. $K\frac{d^2v}{dx^2} = \rho\frac{dv}{dt}$	5	CO4	PO2
6. a.	Discuss the friction factor in case of pipe flow	10	CO4	PO2
b.	Explain the combined momentum flux.	5	CO1	PO2
	(OR)			
c.	Convert the differential equation into dimensionless form with Reynolds number and Prandtle number. $K\frac{d^2T}{dx^2} = \rho Cp\frac{dT}{dt}$	10	CO4	PO2
d.	Derive the formula for drag coefficient in case of solid sphere dropping in a fluid.	5	CO4	PO2

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