Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A Constituent Institution of MAHE, Manipal)

V SEMESTER B.TECH. (CHEMICAL ENGINEERING)

END SEMESTER EXAMINATIONS, Jan/Feb 2021

SUBJECT: TRANSPORT PHENOMENA [CHE 3154]

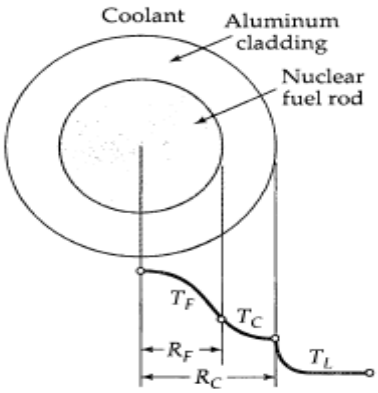
REVISED CREDIT SYSTEM

Time: 3 Hours **04/02/2021** MAX. MARKS: 50

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitably assumed.

1A.	Derive the equation of continuity from the concept of mass conservation with neat diagram.	**4**
1B.	Obtain expression for momentum flux, velocity profile, average velocity, maximum velocity and volumetric flow rate and force for flow through a cylindrical annulus.	**6**
2A.	Explain the general procedure to solve mass transfer problems and its boundary conditions	**4**
2B.	Define overall heat transfer co-efficient and thus obtain U for heat conduction through composite spherical wall.	**6**
3A.	Gas A dissolves in liquid B in beaker and diffuses isothermally into liquid phase. as it diffuses, A also undergoes an irreversible first order homogeneous chemical reaction **A+B →AB** (Treat this as a binary solution of A and B, ignoring the small amount of AB that is present (the pseudo binary assumption)). Derive an expression for concentration of A as a function of liquid depth, also obtain an expression for average concentration in liquid phase and molar flux of A at gas-liquid interface. **Rate = k"'C_A**	**8**
3B.	Explain Fick's law of binary diffusion	**2**
4.	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 $\mathbf{S_{no}}$ and **b** are known constants, and **r** is the radial coordinate measured from the axis of the cylindrical fuel rod. Find the temperature profile for the system and the equation for maximum temperature at the axis of the fuel rod, if the outer surface of the cladding is in contact with a liquid coolant at temperature $\mathbf{T_L}$. The heat transfer coefficient at the cladding –coolant interface is $\mathbf{h_L}$, and the thermal conductivities of the fuel rod and cladding are $\mathbf{k_F}$ and $\mathbf{k_C}$ 	**10**
5A.	A fluid that is very nearly described by the Bingham model, is flowing through a vertical tube as a result of a pressure gradient and gravitational acceleration. The radius and length of the tube are R and L respectively. Find velocity profile equation of the system.	**4**
5B.	Establish Navier-Stokes equation from the fundamental momentum balance with neat diagram.	**6**