Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A Constituent Institution of MAHE, Manipal)

V SEMESTER B.TECH. (CHEMICAL ENGINEERING)

MAKEUP EXAMINATIONS, DEC 2018

SUBJECT: TRANSPORT PHENOMENA [CHE 3103]

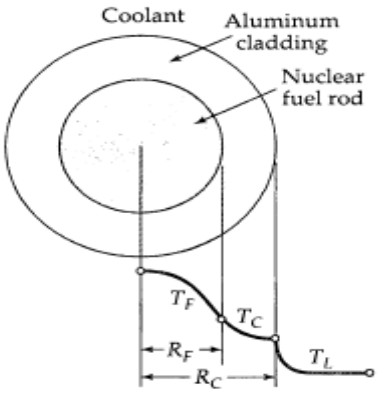
REVISED CREDIT SYSTEM
01/01/2019

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

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

1A.	Consider the flow of steady state laminar incompressible fluid along an inclined flat plate which is at an angle β from the vertical, the film thickness over flat plate is δ and the fluid is moving with a velocity V. Develop an equation for velocity distribution using shell balance and from this find out i) Maximum velocity ii) Average velocity. iii) Volumetric flow rate.	**8**
1B.	An oil has a kinematic viscosity of $2x10^{-4}$ m^2/s and density of $0.8x10^3$ kg/m^3, if we want to have a falling film of thickness 2.5mm vertical wall, what should the mass rate flow of the liquid be?	**2**
2A.	Derive an expression for diffusion through a spherical shell of radius 'r_1' and gas film radius 'r_2' to get concentration profile and molar flux. a) When there is no temperature change between spherical surface and gas film. b) Extend this result to describe the diffusion in Non-isothermal film in which the temperature changes with distance according to the following relation $$\frac{T}{T_1} = \left(\frac{r}{r_1}\right)^n$$ Where T_1 is at temperature r_1. Assume as rough approximation that D_{AB}, varies as 3/2 power of temperature $$\frac{D_{AB}}{D_{AB1}} = \left(\frac{T}{T_1}\right)^{3/2}$$ P.T.O	**10**

3.	Consider a long spherical 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 spherical 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**
4.	Consider a catalytic reactor in which dimerization reaction 2A $\rightarrow A_2$ is carried out, assuming that each catalyst particle is surrounded by stagnant gas film through which 'A' has to diffuse in order to arrive at the catalytic surface, assume the gas film in isothermal condition, derive the concentration profile in the gas film and the molar flux through the film when i) Reaction take place instantaneously ii) The rate at which 'A' disappears at catalyst coated surface as $N_{AZ} = k''C_A = C\ k''\ X_A$	**10**
5.	Two immiscible, incompressible fluids are flowing in a horizontal thin slit of length L and width W, under the influence of a pressure gradient, the fluid rates are so adjusted that the slit is half filled with fluid 1 (more dense phase) and half filled with fluid 2 (less dense phase). Determine the velocity distribution and the average velocity for the system.	**10**