Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A Constituent Institution of MAHE, Manipal)

V SEMESTER B.TECH. (CHEMICAL ENGINEERING)

END SEMESTER EXAMINATIONS, MARCH 2021

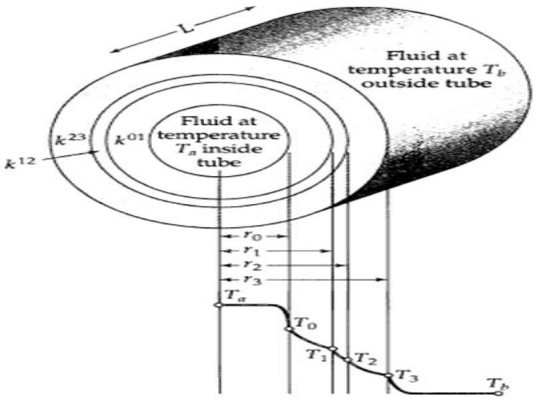
SUBJECT: TRANSPORT PHENOMENA [CHE 3154]

REVISED CREDIT SYSTEM

Time: 3 Hours **26/03/2021** **MAX. MARKS: 50**

Instructions to Candidates:

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

1.	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**
2A.	Consider steady state laminar flow of the fluid at constant density in a very long circular tube of length L and radius R. Derive the velocity profile by performing a shell balance on thin cylindrical shell and find i) Maximum velocity ii) Average velocity iii) Volume flow rate.	**8**
2B.	Glycerin ($CH_2OH.CHOH.CH_2OH$) at 26.5°C flowing through horizontal tube of 0.3048m long and 0.00254 m inside diameter, for a pressure drop of 2.57×10^5 N/m^2 , the flow rate is 1.87×10^{-6} m^3/sec, the density of glycerin at 26.5°C is 1260 kg/m^3 from the flow data, find the viscosity of glycerin in centipoise.	**2**
3A.	Develop a formula for the overall heat transfer co-efficient for the composite cylindrical pipe wall as shown in figure.  	**7**

3B.	A cast iron pipe of 0.1016m inside diameter and 0.1143m outside diameter is insulated with 0.01905m of layer of glass wool, the inside surface of the pipe is at 204.5^{o}C and the glass wool surface temperature is 32^{o}C. Determine the steady state heat transfer per meter of the pipe, the thermal conductivity of the material of the pipe is 51.9 w/m.^{o}C and that of the glass wool is 0.0554 w/m.^{o}C.	**3**
4A.	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 'A' has to diffuse in order to arrive at the catalytic surface, the above reaction takes place instantaneously and the product A_2 diffuse back out through the gas film into the main gas stream, assume the gas film is isothermal. Derive the concentration profile in the gas film and the molar flux through the film.	**7**
4B.	State and describe a) Newton's law of viscosity, b) Fourier's Law of heat conduction c) Fick's law of diffusion.	**3**
5.	A nuclear reaction is taking place in a spherical fuel assembly of radius R_f generating heat at a rate of Sn per unit volume. $S_n = S_{no}\left[1 + b\left(\frac{r}{R_f}\right)^2\right]$ where b = constant The fuel assembly has a concentric cladding of radius Rc, the thermal conductivity of the fuel and cladding are k_f and k_c respectively, the surrounding fluid is at temperature To,. Determine a) The temperature profile in fuel and cladding b) Interface temperature and maximum temperature.	**10**