

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL (A constituent unit of MAHE, Manipal)

I SEMESTER M.TECH (CHEMICAL) END SEMESTER EXAMINATIONS - NOV, 2018

SUBJECT: ADVANCED TRANSPORT PHENOMENA [CHE 5102]

REVISED CREDIT SYSTEM (22/11/2018, AN)

Time: 3 Hours

MAX. MARKS: 50

Instructions to Candidates:

- ✤ Answer ALL the questions.
- Missing data may be suitably assumed.
- ✤ Use of Transport Phenomena tables is allowed.

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1.	A steady state tangential laminar fluid with constant density and viscosity flows between two vertical concentric cylinders. If the outer cylinder is rotating with angular velocity, Ω . Find a) velocity and shear stress distribution. (b) torque required to turn the outer cylinder. Assume the inner cylinder is stationary.	10
2.	An incompressible Newtonian fluid is flowing through a narrow slit formed by parallel plates at a distance 2B apart. Derive an expression for the velocity profile. What is the ratio of average to maximum velocity in the slit? Obtain an expression for the volumetric flow rate.	10
3.	Two large porous horizontal plates are separated by relatively small distance, L. The upper plate at $y = L$ is at $T = T_L$ and lower one at $y=0$, is to be maintained at a lower temperature T=To. To reduce the amount of heat that must be removed from lower plate, a coolant gas is blown upward through both the plates at steady rate. Develop an expression for temperature distribution and conductive heat flux, q, to the cold plate as a function of properties and flow rate of gas.	10
4.	A solid body occupying the space from $y=0$ to $y=\infty$ is initially at temperature T_0 . At time t= 0, the surface at y= 0 is suddenly raised to a temperature T_1 and is maintained at that temperature for t > 0. Find the time dependent temperature profile $T(y, t)$ and heat flux at the wall.	10
5.	A dimerization reaction $2A \rightarrow A_2$ is carried out in a catalytic reactor. Assume that each catalyst particle is surrounded by a gas film through which A has to diffuse in order to arrive at the catalytic surface. At the catalyst surface the above reaction takes place instantaneously and that the product A_2 diffuses back out through gas film into main gas stream. Find the concentration profile in the gas film and molar flux through the film.	10