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MANIPAL INSTITUTE OF TECHNOLOGY

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V SEMESTER B.TECH. (CHEMICAL ENGINEERING)

END SEMESTER EXAMINATIONS, NOV/DEC 2016

SUBJECT: TRANSPORT PHENOMENA [CHE 3103]

REVISED CREDIT SYSTEM

Time: 3 Hours MAX. MARKS: 100

Instructions to Candidates:

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

1A.	Explain the different types of fluids; describe the behavior of different types of Non-Newtonian fluids with specific examples.	**6M**
1B.	State and describe Newton's law of viscosity	**5M**
1C.	A Newtonian fluid with viscosity 10cp is placed between two large parallel plates, the distance between the plate is 4mm, the lower plate is pulled in the +ve x-direction with a force of 0.5N and the upper plate is pulled in the –ve x-direction with a force of 2N, each plate has an area of $2.5m^2$. if the velocity of the lower plate is 0.1 m/s Calculate i) Steady state momentum flux ii) velocity of the upper plate iii) repeat part i) and ii) for a Newtonian fluid with viscosity 1 cp.	**9M**
2A.	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.	**15M**
2B.	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 ?.	**5M**
3A.	Derive the expression for temperature profile in the rectangular fin with its ends insulated. State assumptions for it.	**15M**
3B.	Thermocouple in a cylindrical well inserted into a gas stream, estimate the true temperature of gas stream if thermocouple junction (wall) temperature 260°C, pipe wall temperature is 176.7°C, h= 681.36 w/m^2 °C, K = 103.8 w/m °C, B= $2.032x10^{-3}$ m L= 0.06096m.	**5M**

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4.	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 $$\frac{D_{AB}}{D_{AB1}} = \left(\frac{T}{T_1}\right)^{3/2}$$	**20M**
5A.	Derive the equation of continuity from the concept of mass conservation.	**6M**
5B.	Establish Navier-Stokes equation from the fundamental momentum balance.	**14M**