Reg. No.										

Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)

I SEMESTER M.TECH (CHEMICAL & IPC)
END SEMESTER EXAMINATIONS, NOV/DEC 2015
SUBJECT: ADVANCED TRANSPORT PHENOMENA(CHE-503)
REVISED CREDIT SYSTEM

Time: 3 Hours MAX. MARKS: 100

Instructions to Candidates:

- Answer **ANY FIVE FULL** the questions.
- Missing data may be suitably assumed.
- Use of Transport Phenomena Tables is permitted.

1.	An incompressible Newtonian fluid is flowing through a narrow slit formed by parallel plates at a distance 2B apart. The right plate moves with velocity V and the left plate is stationary. Derive an expression for the velocity profile. Obtain an expression for the volumetric flow rate.	**20**
2A.	A spherical vessel of 3 m inside diameter is made of steel sheets of 9 mm thickness (k= 14 W/m K). The inside temperature is -80^{o}C. The vessel is layered with a 10cm thick foam (k= 0.02 W / mK) followed by a 15 cm outer layer of cork (k= 0.045 W/m K). If the outside surface temperature is 30^{o}C. Calculate the rate of heat flow to the vessel and the intermediate temperature.	**10**
2B.	Compute the stress on each plate when the lower plate velocity is 3m/min in the positive x direction and the upper plate velocity is 10m/min in the negative x direction. The plates are placed 5cm apart and the fluid viscosity between the plate remains constant at 150 CP . Also calculate the fluid velocity at every 1cm interval.	**10**
3.	Consider a plane wall with internal heat generation. Heat is conducted only in one direction. The other walls are assumed to be insulated. The volumetric rate of heat generation is q_G and the thermal conductivity is K. Derive the equation for temperature distribution for the following two cases. a) the temperature T_w is held constant at x=-b and x=+b and the maximum at the center denoted by T_o. b) the temperature is T_1 at x=-b and T_2 at x=+b with the maximum at some distance away from center. Find the distance where maximum temperature prevails.	**20**
4.	Gas A dissolves in liquid B and diffuses into liquid phase. As it diffuses, A also undergoes an irreversible first order chemical reaction: A + B → AB. Derive an expression for the concentration of A as a function of liquid depth. Obtain also expression for average concentration in the liquid phase and molar flux of A at the gas liquid interface.	**20**

Reg. No.										

प्रज्ञानं ब्रह्म

INSPIRED BY LIFE

Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)

KNOWLEDGE IS POWER

MANIPAL INSTITUTE OF TECHNOLOGY

5.	Two immiscible , incompressible fluids are flowing in a horizontal thin slit of length L and width W under the influence of pressure gradient. The fluid rates are so adjusted that the slit is half filled with fluid I(more dense phase)and half filled with fluid II (less dense phase). Determine the velocity distribution and the average velocity.	
6.	A fluid of constant density and viscosity is in a cylindrical container of radius R. The container is caused to rotate about its own axis at an angular velocity Ω. The cylindrical axis is vertical so that $g_r=g_\theta= 0$ and $g_z= -g$. Find the shape of the free surface when steady state is established.	**20**