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DEPARTMENT OF CHEMICAL ENGINEERING
CH762 -MAJOR TEST

DATE: 4-5-07
Duration : 3:30 -5:30

1. A gas mixture containing 50% steam and 50% carbon dioxide at a high pressure and constant flow rate is entering a coiled tube immersed in a stirred tank containing water boiling at atmospheric pressure. The feed gas is saturated with water vapor at the point of entry into the coiled tube. The coil is completely immersed in boiling water. The flow of gas and condensate in the coil may be assumed to be cocurrent and plug flow. Write down the steady state mass and energy balances for the coil fluid and the tank fluid. Neglect heat losses and solubility of carbon dioxide in water. Assume that water is fed to the tank at the rate at which it boils.Use appropriate notation for the various variables.

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2. Carbon dioxide and water vapor present in a gas are diffusing through a gas film into a liquid bulk containing sodium hydroxide solution. The gas phase consists of insoluble components , namely methane, carbon monoxide, hydrogen, nitrogen and argon. Write the Stefan- Maxwell equations for multi-component diffusion of the above gases from the bulk of the gas phase to the interface. Specify the boundary conditions. Assume all gases are insoluble except carbon dioxide and water vapor and bulk gas composition is given and the composition of carbon dioxide and water vapor at the interface on the gas side are given. Assume ideal thermodynamic behavior for the gas and liquid phases.

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3. Develop a steady state heat transfer model of a 1-2 shell and tube heat exchanger Assuming plug flow in both sides. The specific heat of the tube and shell side fluids is a strong function of temperature. 20

4. What is the effect of micro-mixing on rate of reaction and hence conversion if the order of a single reaction taking place in a single phase fluid is a) half b) zero.

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5. Extend the boiler problem you solved in the class to the situation where the mechanism of heat input is by oil firing in a tube. Assume that oil is being fired with a known flow rate and known air rate which is in excess of the stoichimoetric quantity of air. Assume that heat is released instantly after the fuel and air are injected into the burner and hence heat is exchanged between hot flue gases and the water in the boiler by radiation and convection from inside the tubes to water outside the tubes. 20