FINAL EXAMINATION

ENG 310 – MASS TRANSFER FOR BIOLOGICAL SYSTEMS

INSTRUCTION: ATTEMPT ALL QUESTIONS

TIME: THREE HOURS

Question 1. (20 Marks)

a. Define Convective mass transfer and list the two different cases of convective mass transfer
b. Discuss the significant parameters in connective mass transfer for the molecular diffusivities of the three transport processes (momentum, heat, and mass)

Question 2. (20 Marks)

a. Define the following five terms
   - Mass
   - Velocity
   - Molecular weight

- Diffusion flux
- Drying

b. Discuss Fick's diffusional molar flux law and demonstrate Fick's rate equation in detail

Question 3. (20 Marks)

a. Show the difference between diffusivity in liquid and diffusivity n solids giving examples for each case
b. A vertical glass tube 3 mm in diameter is filled with liquid toluene to a depth of 20 mm from the top open end. After 275 hrs at 39.4^{O}C and a total pressure of 760 mm Hg the level has dropped to 80 mm from the top. Calculate the value of diffusivity.

Question 4. (20 Marks)

a. Oxygen is diffusing in a mixture of oxygen-nitrogen at 1 std atm, 25^{O}C. The concentration of oxygen at planes 2 mm apart are 10 and 20 volume % respectively. Nitrogen is non-diffusing

i. Derive the appropriate expression to calculate the flux oxygen. Define the units of each term clearly.

ii. Calculate the flux of oxygen. Diffusivity of oxygen in nitrogen = 1.89 * 10^{-5} m^2 /sec

b. List four methods of operation of evaporators and draw a simplified well labeled diagram of one of the four choices you come up with

Question 5. (20 Marks)

a. List and explain five types of dryers

b. In a gas mixture of hydrogen and oxygen, steady equimolar counter diffusion is occurring at a total pressure of 100 kPa and temperature of $20^{O}C$. If the partial pressures of oxygen at two planes 0.01 m apart and perpendicular to the direction of diffusion are 15 kPa and kPa, respectively and the mass diffusion flux of oxygen in the mixture is 1.6 * 10^{-5} Kmol/ m^{-2} .sec, calculate the molecular diffusivity for the system.