6 Miscelleneous - l41 and l42

Lecture 41

1. Derive differential and integral forms of boundary layer equations governing natural convection heat and mass transfer past a vertical surface. Also, describe the boundary conditions.

2. Establish the conditions for existance of similarity solutions to the equations in the previous problem.

3. Making velocity and temperature profile assumptions mentioned in slide 11 , derive appropriate integral momentum and energy equations for laminar natural convection. Hence, obtain solutions for variation of δ and Nu_x.

4. Repeat the above problem for turbulent natural convection (slide 13).

5. Using results from the previous 2 problems and the transition criterion mentioned on slide 12 (lecture 41), derive length-averaged Nusselt number. Compare your evaluations with correlations shown on slide 14.

6. Derive similarity equations for simultaneous heat and mass transfer under natural convection (see slide 15). Write a computer program to solve the equations (see finte-difference equations shown on slide 6). How does the formulation for high and low mass transfer differ ?

Lecture 42

1. Derive similarity equation (slide 5) governing velocity in a laminar jet. Hence, deduce solutions for the velcity profile and the jet-spread angle (slide 7).

2. Making appropriate assumptions, show that the governing equations for a laminar burning jet listed on slide 3 can be converted to a conserved property equation shown on slide 8. Hence, deduce expressions for the length and radius of the laminar diffusion flame (slide 10)

3. List the main assumptions made in modelling turbulent jet. Hence, deduce the velocity profile shown on slide 13.

4. Using solutions shown on slides 18 and 19, construct the flame shape (that is, r_f/D vs x / D) for Methane (A/F = 17.16) burning in air.