Advanced Mathematical techniques in Chemical Engineering

Module XIII : Solution of PDEs by Integral method

Exercises

1. The equation $4y\frac{\partial c}{\partial x} - 3k\frac{\partial c}{\partial y} = 2\frac{\partial^2 c}{\partial^2 y}$ is valid within mass transfer boundary layer. Subject to at x=0, c=1; at y=0, $\frac{\partial c}{\partial y} + c = 0$ and at y=δ, c=1. Using the quadratic profile solve the above equation. The quadratic profile must satisfy the condition, at y=0, c=c_g

2. The equation $\frac{\partial c}{\partial t} - k\frac{\partial c}{\partial y} = 2\frac{\partial^2 c}{\partial^2 y}$ is valid within mass transfer boundary layer. Subject to at t=0, c=1; at y=0, $\frac{\partial c}{\partial y} + c = 0$ and at y=δ, c=1. Using the quadratic profile solve the above equation. The quadratic profile must satisfy the condition, at y=0, c=c_g

3. Solve the equation $\frac{\partial u}{\partial t} = \frac{\partial^2 u}{\partial y^2}$ within momentum boundary layer subject to following conditions. At t=0, u=0; at y=0 u=1 and at y=δ, u=1. Solve this equation, assuming a linear profile of u inside the boundary layer.

4. Solve the equation $\frac{\partial u}{\partial t} = \frac{\partial^2 u}{\partial y^2}$ within momentum boundary layer subject to following conditions. At t=0, u=0; at y=0 u=1 and at y=δ, u=1. Solve this equation, assuming an exponential profile of u inside the boundary layer.

5. The equation $4y\frac{\partial c}{\partial x} - 3k\frac{\partial c}{\partial y} = 2\frac{\partial^2 c}{\partial^2 y}$ is valid within mass transfer boundary layer. Subject to at x=0, c=1; at y=0, $\frac{\partial c}{\partial y} + c = 0$ and at y=δ, c=1. Using a linear profile, solve the above equation. The linear profile must satisfy the condition, at y=0, c=c_g