Assignment 2
The due date for submitting this assignment has passed. As per our records you have not submitted this assignment.

1. For flat plate subjected to uniform heat flux, surface temperature can be non-dimensionalized by

\[ \frac{T}{T_w} = \frac{T}{T_f} = \frac{T_o}{T_f} \]

Accepted Answer: \( \frac{T}{T_w} = \frac{T}{T_f} = \frac{T_o}{T_f} \)

2. Similarity variable for boundary layer in natural convection with constant temperature will be

\[ y^+ = \frac{y}{
u U_w} \]

Accepted Answer: \( y^+ \)

3. In case of natural convection boundary layer with constant heat flux where boundary condition is not valid

\[ \left( \frac{1}{1} \right) \text{(Answer)} \]

Accepted Answer: \( \left( \frac{1}{1} \right) \text{(Answer)} \)

4. No header: 0.644Ry(\text{Pr}^{-1/3}) \text{m}^{-1} \text{s}^{-1} \text{is valid for}

\text{Natural convection over heat flux, Pr} \rightarrow \infty
\text{Natural convection over constant wall temperature, Pr} \rightarrow 0
\text{Natural convection over heat flux, Pr} \rightarrow \infty
\text{Natural convection over constant wall temperature, Pr} \rightarrow 0

Accepted Answer: \( \text{No header: 0.644Ry(\text{Pr}^{-1/3}) \text{m}^{-1} \text{s}^{-1}} \)

5. Air at 300 K and velocity of 2 m/s flows over both surfaces of a 1 m long flat plate maintained at 20 °C. Determine local Nusselt number using \( \text{Nu}_x = 0.0387 \text{Re}^{0.8} \text{Pr}^{0.33} \). Take \( \text{Re}_x = 1.04 \text{m} \text{s}^{-1} \text{Pr} = 4000 \).

Accepted Answer: \( \text{No header: 0.0387 \text{Re}^{0.8} \text{Pr}^{0.33}} \)

6. For the problem mentioned above evaluate local heat flux, \( h \text{Wm}^{-2}\text{K}^{-1} \text{is} \)?

Accepted Answer: \( \text{No header: 0.0387 \text{Re}^{0.8} \text{Pr}^{0.33}} \)

7. Air at 22 °C with a free stream velocity of 10 m/s is used to cool electronic devices mounted on a printed circuit board. Each device, 4 mm by 4 mm, dissipates 50 W which is removed from the top surface. Estimate the Nusselt number at a location of 15 mm from leading edge for the cooling process.

Accepted Answer: \( \text{No header: 0.0387 \text{Re}^{0.8} \text{Pr}^{0.33}} \)

8. For the above problem estimate the surface temperature of the electronic devices at a location of 15 mm from leading edge of the board.

Accepted Answer: \( \text{No header: 0.0387 \text{Re}^{0.8} \text{Pr}^{0.33}} \)

9. Water is heated by a 200 mm x 200 mm vertical flat plate which is maintained at 60 °C. Find the following quantities when the water is at 60 °C. Find the average heat transfer coefficient in Wm\(^{-2}\)K\(^{-1}\), where the water is at 20 °C. Assume the temperature of \( T = 0.65(20 - 60) + 60 \), the reference physical parameters can be taken as \( \text{k} = 0.52 \text{Wm}^{-1}\text{K}^{-1}, \rho = 994.00 \text{kgm}^{-3}, \text{c} = 4.18 \text{Jkg}^{-1}\text{K}^{-1}, \text{h} = 0.65 \times 10^{-3} \text{Wm}^{-2}\text{K}^{-1} \text{S}^{-1/2} \text{K}^{-1/2} \text{. Use Nusselt number for flat plate is valid.} \)

Accepted Answer: \( \text{No header: 0.0387 \text{Re}^{0.8} \text{Pr}^{0.33}} \)

10. Estimate the rate of heat transfer in W for the previous problem.

Accepted Answer: \( \text{No header: 0.0387 \text{Re}^{0.8} \text{Pr}^{0.33}} \)