

Intermediate Heat Transfer (MCL347)

Minor 2 Examination, Semester 2, 2018-19

LH 310, 1 PM (March 28, 2019)

Duration: 1 hr.

Full Marks: 20

Instructions

- Symbols have usual meanings as introduced in class.
- Sketches should be adequately labelled and drawn neatly.

Questions

Q. 1. Comment on the relative importance of the convective transport terms of the energy equation: $u \frac{\partial T}{\partial x}$ and $v \frac{\partial T}{\partial y}$ for heat transfer in laminar boundary layer flow in the two limits: (a) $Pr \ll 1$, and (b) $Pr \gg 1$. Give appropriate reasons to support your response. (4)

Q. 2. Using integral method, find the thermal boundary layer thickness and the Nusselt number for the limiting case of $Pr \ll 1$. Assume linear velocity and temperature profiles within the boundary layers. The Von Kármán momentum integral equation and energy integral equation are given

below: $\frac{d}{dx} \int_0^{\delta} u(u_{\infty} - u) dy = \frac{\partial u}{\partial y} \Big|_{y=0}$, $\frac{d}{dx} \int_0^{\delta_T} u(T_{\infty} - T) dy = \alpha \frac{\partial T}{\partial y} \Big|_{y=0}$. (8)

Q. 3. What will be the nature of the axial temperature variation for heat transfer in a tube for the two cases (a) constant surface heat flux and (b) constant surface temperature? Derive the appropriate conditions and then illustrate the temperature variations. (8)