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Week 7
Intention
Goal: What do you want to achieve at the end of Week 7? To get a better understand on heat transfer with a more in-depth explanation on specific scenarios compared to vague concepts
Desired Outcomes—learning outcomes I want to achieve in MECH 3228
Discuss the topics that seemed most interesting to you and where you anticipate you will use them. To see the applications of fluid mechanics in Heat transfer and show how closely related these topics are with all the scenarios and ways to approach questions.
Self-Understanding—strengths that I can build on and development needs I can address to be successful in MECH 3228
Strengths: My strengths are notetaking and concentrating in class, which will both be very helpful when studying later for tests/assignments. Development Needs: Time management outside of class and organizing it so everything is studied as need be.

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LECTURE CONTENT
How can energy be transferred during a steady-flow process? Energy can be transferred by heat, work, and mass.
What are the boundary layer approximation assumptions? The velocity of the x components is much greater than the y direction. Velocity gradients become the change of v components over x is 0, same with the y direction. The change of the u component over y is larger than with x. Temperature gradient with respect to y is larger than x. When effects of gravity and other body forces are negligible y component momentum equation becomes change in pressure over y is zero.
Explain the energy transfer by work. Work needs to be considered only in the presence of significant gravitational, electric, or magnetic effects. The work done by pressure is already accounted for in the analysis above by using enthalpy for the microscopic energy of the fluid instead of internal energy. The shear stresses that result from viscous effects is usually very small hence can be neglected in many cases.
When are viscous effects not negligible? The viscous shear stresses are not negligible when and where the viscous dissipation function is obtained which may play a dominant role in high-speed flows. $\rho c_p \left(u \frac{\partial T}{\partial x} + v \frac{\partial T}{\partial y} \right) = k \left(\frac{\partial^2 T}{\partial x^2} + \frac{\partial^2 T}{\partial y^2} \right) + \mu \Phi \qquad (6-36)$
What is fluid over solid bodies responsible for? Fluids over solid bodies are responsible for drag force like automobiles and powerlines. They are also responsible for Lift force like in airplane wings and lastly are responsible for cooling of metal or plastic sheets.
When is the local heat transfer coefficient infinite? Why? It is infinite at the leading-edge x=0 and decreases by a factor of sqrt(x) in the flow direction. This is because there's nothing there to stop the heat transfer coefficient to increase, so it's the initial impact where the heat transfer is the largest there.
When a flat plate is subjected to uniform heat flux, how different are the relations compared to the isothermal plate case? Transitions depend on geometry, roughness, velocity, temperature, and type of fluid. The equation is a little different. It is different because we must Integrate the laminar from the critical location and integrate the turbulent critical to the end of the flat plate which alters the equation. $Nu = \left(0.037\,\mathrm{Re}_L^{0.8} - 871\right)\mathrm{Pr}^{1/3}$

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Laminar: $Nu_x = 0.453\,\mathrm{Re}_L^{0.5}\,\mathrm{Pr}^{1/3}$ $Re < 5 \times 10^5$ Turbulent $Nu_x = 0.0308\,\mathrm{Re}_x^{0.8}\,\mathrm{Pr}^{1/3}$ $\left\{ \begin{array}{l} 0.6 \le \mathrm{Pr} \le 60 \\ 5\times10^5 \le \mathrm{Re}_x \le 10^7 \end{array} \right.$
What is Nu equivalent to? Nusselt number of 1 for a fluid layer represents heat transfer across the layer by pure conduction. Nusselt number Is equivalent to the heat transfer coefficient multiplied by L divided by the thermal conductivity.