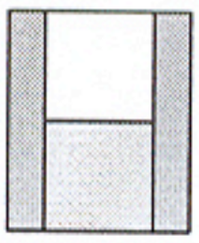
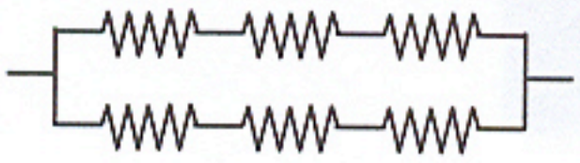
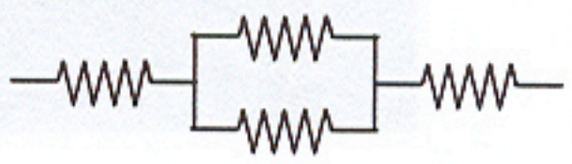
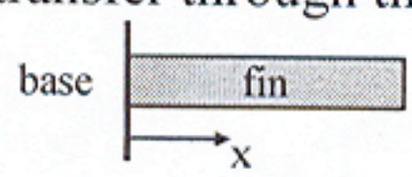
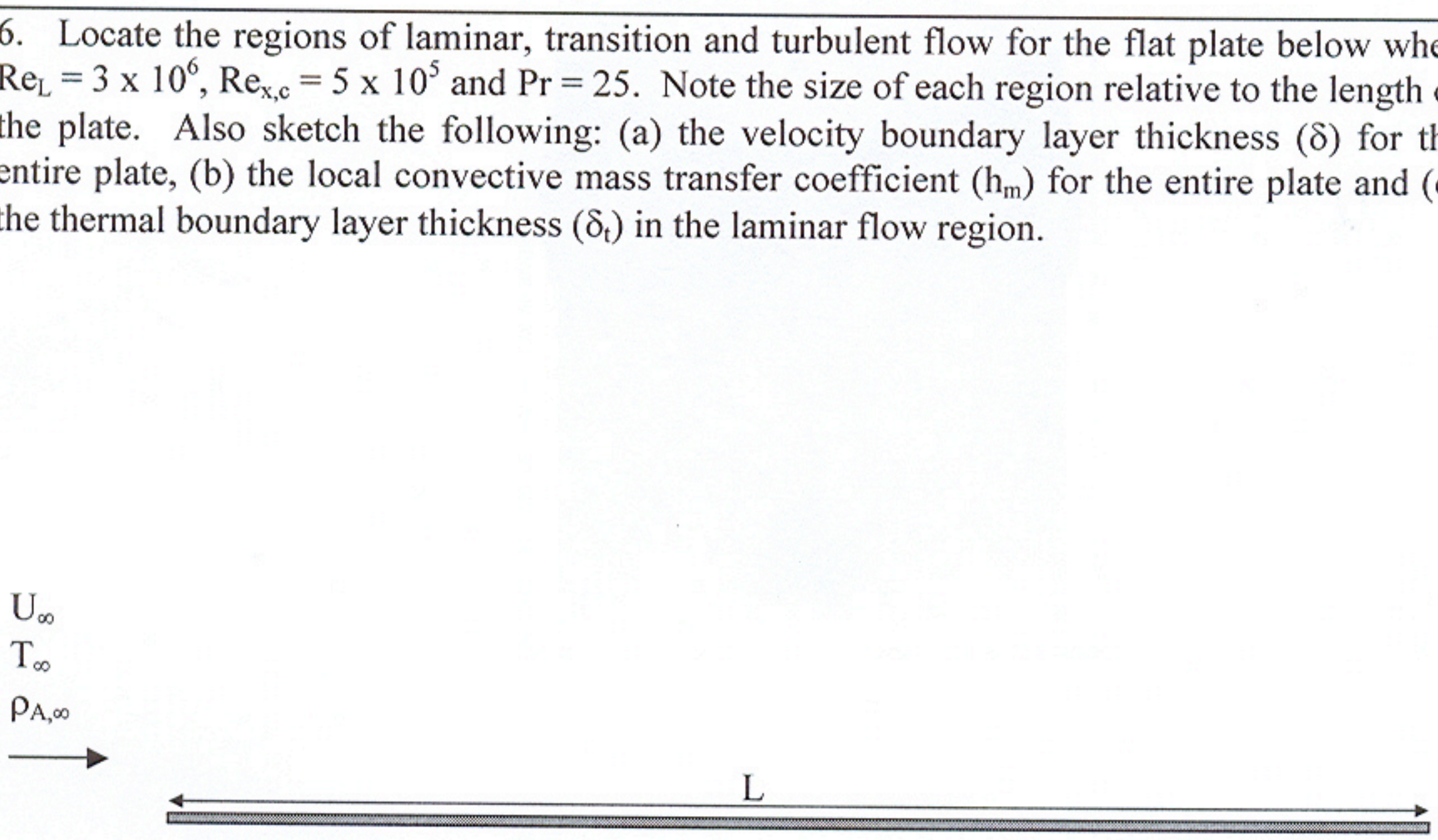
ME 327 Midterm Exam

October 27, 2004 (Time: 1.5 hours)

This is an **open book** exam (text, notes, assignments, etc. are allowed).
Answer **all questions (6 in part I and 3 in part II)**.
State all **assumptions** and justify, where possible. **Reference** all data used.

Part I Short Answer (Answer on the exam paper)

	Marks
1. Which method of approximating the thermal resistance circuit for the composite wall below typically overestimates the resistance of the wall?   parallel  series-parallel	(1)
2. When using fins to increase the heat transfer between a gas and a liquid (e.g., in a heat exchanger), are fins typically placed in the gas or liquid? Why?	(1)
3. The governing equation for heat transfer through a 1-D fin with constant surface area is given below. What conservation equation does this equation represent? What does each term represent? $\frac{d^2T}{dx^2} - \frac{hP}{kA_c}(T - T_\infty) = 0$	(2)
4. Knowing the temperature distribution (T(x)) throughout an entire fin, how can the heat transfer through the fin be calculated? 	(1)
5. In general transient heat transfer, we obtained a non-linear, 1st order, non-homogeneous, ordinary differential equation as given below. Is there an exact solution available to this equation? If yes, what method is used to achieve the solution? If no, how would you solve this equation? $q''_s A_{s,h} + \dot{E}_g - \left[h(T - T_\infty) + \varepsilon\sigma(T^4 - T_{sur}^4)\right]A_{s(c,r)} = \rho V c \frac{dT}{dt}$	(1)
6. Locate the regions of laminar, transition and turbulent flow for the flat plate below when $Re_L = 3 \times 10^6$, $Re_{x,c} = 5 \times 10^5$ and $Pr = 25$. Note the size of each region relative to the length of the plate. Also sketch the following: (a) the velocity boundary layer thickness (δ) for the entire plate, (b) the local convective mass transfer coefficient (h_m) for the entire plate and (c) the thermal boundary layer thickness (δ_t) in the laminar flow region. 	(4)
TOTAL	**10**