California State Polytechnic University, Pomona
Aerospace Engineering Department

ARO 3011-01, 03 **Quiz 6**
Open book, open notes. 20 minutes.

BLT = Boundary Layer Theory; **PMT**: Propeller Momentum Theory (also called Actuator Disk Theory).

1. Which type of BL has more energy and momentum? Turbulent
2. During cruise, we prefer to have Laminar BLs on the wings.
3. One of the key findings of BLT is that within the BL, moving normal to the wall, pressure is roughly constant. (or invariant)
4. At a given point, as Reynolds number increases, the boundary layer thickness decreases.
5. For BL on a flat plate, define Cf using the usual symbols: $C_f = \tau_w / (\frac{1}{2} \rho_\infty V_\infty^2)$
6. On a flat plate, is shear stress at the wall larger near the LE or farther downstream? (or $\tau_w/(\frac{1}{2}\rho$
   Near the LE
7. At the point of BL separation, wall shear stress is exactly zero.
8. Fundamentally speaking, there are two types of drag: pressure drag and skin-friction drag.
9. In the "fully rough" region of Fig. 7.6 of White, CD is independent of Reynolds number ~~and non-dimensional roughness~~.
10. In PMT, the induced velocity at the propeller is denoted by w.
11. In PMT, the induced power for a propeller is just (use symbols) Tw.
12. In PMT, does induced velocity vary over the propeller disk? No (or constant)
13. In PMT, can you use actuator-disk theory to do detailed design of a propeller? No.
14. LSA aircraft with two seats, need an engine of about 100 hp or less.
15. Zenith STOL 750 aircraft uses Junker-type flaperons, which are more effective than plain flaps.
16. Are the winglets on the new Boeing 737 MAX the split type? Yes.
17. Do we see examples of winglets in nature, such as bird flight? Yes.
18. Are vortex generators helpful in cruising flight? No.

19. A vortex generator is basically a small wing at an AOA, which generates a vortex (or tip vortex).

20. The strong transverse flow around the wing tip of an aircraft, causes the lift vector on the winglet to lean forward, thus generating a net negative drag.