Advanced Theory of Helicopter – Final Exam.

6월 11일 (Wednessday) 17:00 – 18:45

1. Under the assumption of pure harmonic motion for pitch and heave motions, unsteady lift acting on an airfoil section is expressed as follows. Explain briefly each constituent in the expression, such as $k, C(k), L_Q, L_{NC}$. (15 Points)

$$L = C(k) L_Q + L_{NC}$$

2. Aeroelastic instabilities of rotary wings in hover indicate some sort of blade design constraints or helicopter operation limits. Describe briefly those limits related with two primary instability phenomena in hover. (Each 10 Points)
   1) Flap-lag flutter
   2) Pitch-flap flutter or pitch divergence

3. Describe briefly the difference between torsional divergence in fixed wing and pitch divergence in rotary wing, especially with respect to the offset between aerodynamic center and elastic axis. (10 Points)

4. In order to analyze the blade motion, there are basically two modeling methods: a rigid blade with a restrained spring and an elastic beam. However, in the first category, the restrained spring used in both rigid flap and rigid lag blade representation has a different purpose from that used in a rigid torsion model. It is a different object to represent. Describe the difference. (15 Points)

5. Plot a typical Coleman diagram of the "Ground Resonance" for an articulated soft in-plane rotor. Explain briefly which points become instability regions, and which of the rotor blade or fuselage modes are involved in them. (10 Points)

6. List and briefly explain the factors by which "unsteady" aerodynamics is more involved in rotary wing analysis than it is in a fixed wing analysis. (10 Points)

7. Explain briefly about the following two phenomena, which appear as important stability and response characteristics occurring in helicopters. (Each 10 Points)
   1) Stall flutter
   2) Aeromechaical instabilities