Advanced Theory of Helicotpers – Mid-Term Exam

April 30, 2014 (Wed) 17:00 – 18:30

1. Describe the reason why "Blade Element Theory" is required for analyzing the rotor aerodynamics accurately, in addition to "Momentum Theory." (15 Points)

2. Show that the rigid flapping uniform blade without any hinge offset has fundamental frequency which is exactly the same as the rotor rotational speed. (You may need to derive the equation, if necessary.) Describe its trend of change when the hinge offset is included in the blade. (15 Points)

3. List up and describe each component which will contribute to the power required in helicopter forward flight. (You don't have to derive equations for each component. Just comment about the final form of the equation for each component.) (20 Points)

4. Describe the reason why Lock number is needed in order to obtain the similarity between small-scaled wind-tunnel experimental model and the full-scale helicopter blade. (10 Points)

5. Descrbe briefly which components among the harmonics in the hub loads are transmitted from the rotating blades to the fuselage and how the rotor acts as a filter for a few harmonics, without the detailed derivation of equations. (20 Points)

6. Describe the reason why three hinges (flapping, lead-lag, and feathering) are required in the fully-articulated rotor system. In the cases of hingeless and bearingless rotor, respectively, which mechanisms are used instead of those hinges? (20 Points)