VTOL Aircraft Theory, Design, and Practice II Final Exam.

2023/06/19 9:30 – 11:30

1. Descrbe briefly the difference among the following flight conditions: turbulent wake state, vortex-ring state, windmill brake state, autorotation state. (15 Points)

2. Explain briefly about the following two phenomena, which appear as important stability and response characteristics taking place in helicopters. (10pts)
   a) Pylon whirl flutter
   b) Air/ground resonance

3. Describe the reason why "blade element theory" is further required to analyze the rotor aerodynamics more accurately, in addition to "momentum theory." (15 Points)

4. Describe briefly about the figure of merit (F.M.) (Provide a physical meaning instead of the detailed derivation of equations) and why it is smaller than 1.0 in practice. (15 Points)

5. 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.) (15 Points)

6. Describe the reason why three hinges (flapping, lead-lag, and feathering) are required in the fully-articulated rotor in a general rotorcraft. In the case of hingeless and bearingless rotor, respectively, which mechanisms are used to replace those hinges? (15 Points)

7. Describe briefly about the "Equivalence of Flapping and Feathering" and particularly the case in which such "Equivalence" is not precisely maintained between them any more. (You don't have to derive the equations. Just comment about the final form of the equation, if necessary.) (15 Points)