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10AE762

Seventh Semester B.E. Degree Examination, Dec.2016/Jan.2017
Helicopter Dynamics

Time: 3 hrs. Max. Marks:100

Note: ***Answer FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. Draw some helicopter configurations. Explain the major components and their functions. **(10 Marks)**

b. With a neat sketch, explain the genealogical tree of aircraft. **(10 Marks)**

2 a. Write short notes on the following:
(i) Disk loading and power loading.
(ii) Figure of merit. **(10 Marks)**

b. Derive an expression for axial climb and descent and deduce,

$$\frac{V_i}{V_h} = -\left(\frac{V_c}{2V_h}\right) + \sqrt{\left(\frac{V_c}{2V_h}\right)^2 + 1} \quad \text{and} \quad \frac{V_i}{V_h} = -\left(\frac{V_c}{2V_h}\right) - \sqrt{\left(\frac{V_c}{2V_h}\right)^2 - 1}$$ **(10 Marks)**

3 a. Derive an expression for momentum analysis in forward flight. **(10 Marks)**

b. With a neat sketch, explain cyclic pitch control of a helicopter. **(06 Marks)**

c. Explain forces acting on helicopter during forward flight with neat sketch. **(04 Marks)**

4 Explain the following with relevant expressions and neat sketches:
a. Factors affecting maximum attainable forward speed.
b. Performance of coaxials and Tandems.
c. Autoration revisited.
d. Height-velocity (HV) curve. **(20 Marks)**

PART – B

5 a. Explain the following with relevant expressions and neat sketches,
(i) Concept of boundary layer.
(ii) Rotor airfoil requirements. **(10 Marks)**

b. Write short notes on the following:
(i) Engineering models of dynamic stall.
(ii) Effects of sweep angle on dynamic stall. **(10 Marks)**

6 Write short notes on the following:
a. Static stability.
b. Dynamic stability.
c. Control characteristics.
d. Auto stabilization. **(20 Marks)**

7 a. With the help of flow chart explain Cooper-Harper handling qualities rating scale. **(12 Marks)**

b. Explain the methods for assessing pilot-vehicle system quality. **(08 Marks)**

8 a. Discuss in detail the reasons why the modern helicopter is still essentially a low speed aircraft. Discuss how a main rotor system might be designed so that a helicopter can achieve higher overall forward flight speed and a possible expansion of the maneuvering envelope. Identify any potential trade-offs with any design option. **(12 Marks)**

b. Discuss the design of tail rotor. **(08 Marks)**

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