

R09

Code No: C7614

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M.Tech I - Semester Examinations, March/April-2011

ROTORCRAFT AERODYNAMICS

(AEROSPACE ENGINEERING)

Time: 3hours

Max. Marks: 60

Answer any five questions
All questions carry equal marks

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- 1.a) Based on momentum theory, derive the expression for wake contraction ratio in hovering flight of a helicopter.
- b) Derive an expression for pressure above and below the rotor disk in hover and the difference of the two. [12]
- 2.a) Derive an expression for the coning angle of a blade with flapping hinge at the rotation axis, under the influence of aerodynamics and centrifugal force.
- b) Derive the expression for the coning angle if the flapping hinge is not at the axis. [12]
3. Derive the expression for the power coefficient for a helicopter in climb

$$C_P = \left(\frac{1}{FM}\right) \frac{C_W^{3/2}}{\sqrt{2}}.$$
 [12]
4. Discuss the limitations on the rotor diameter, tip speed, rotor solidity, and number of blades in the design of a rotor. [12]
5. Identify the important aerodynamic coefficients of rotor blades, describe their characteristics (variations of aerodynamic coefficients of the blade with pertinent parameters), and explain how they can be improved. [12]
6. In the context of lift and pitching moment over a rotor blade, explain the apparent mass effect, circulatory effect and 'Theodorsen' function. Derive the expressions for the lift and pitching moment coefficients of an oscillating airfoil. [12]
7. Describe the phenomenon of dynamic stall of a rotor blade, the methods available to model the dynamic stall. [12]
8. Explain the characteristics of the rotor wake in forward flight. [12]

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