**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**

\- - -

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]

* * * * * *