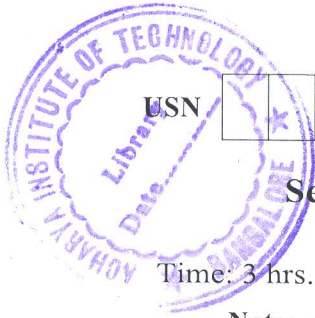


# CBCS SCHEME



17AE743

## Seventh Semester B.E. Degree Examination, Jan./Feb.2021 Helicopter Dynamics

Time: 3 hrs.

Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

### Module-1

- 1 a. Explain the major parts of a helicopter and their functions. (08 Marks)
- b. Using momentum theory analysis in Hover. Obtain expression for Rotor Thrust. Induced velocity and power required in Hover. (12 Marks)

OR

- 2 a. With the help of a schematic, briefly explain the flapping, lead-lag and feathering motion of a Rotor Blade. (08 Marks)
- b. Using Blade element analysis. Derive expression for one increment in Thrust coefficient and Rotor Torque coefficient. (12 Marks)

### Module-2

- 3 a. With neat diagram, show the equilibrium of forces on a helicopter in forward flight. Obtain expression for the total power coefficient for the Helicopter in Forward Flight. (12 Marks)
- b. Briefly explain the factors affecting the maximum attainable forward speed. (08 Marks)

OR

- 4 a. Obtain expressions for the speed for minimum power and maximum range. (12 Marks)
- b. With respect to the performance analysis of a helicopter, show the effect of Gross weight and effect of density altitude. (08 Marks)

### Module-3

- 5 a. Show the effects of advancing blade compressibility and retreating blade stall on the performance of a Helicopter Rotor. (10 Marks)
- b. Define critical pressure coefficient and prove that;

$$C_{p,c} = \frac{2}{\gamma(M^*)^2} \left[ \left( (M^*)^2 \left( \frac{\gamma-1}{\gamma+1} \right) + \frac{2}{\gamma-1} \right)^{\frac{\gamma}{\gamma-1}} - 1 \right] \quad (10 \text{ Marks})$$

OR

- 6 a. Write short notes on the different types of flow visualization techniques. (10 Marks)
- b. Explain the characteristics of Rotor Wake in Hover. (10 Marks)

### Module-4

- 7 a. Explain the following :
  - (i) Pitch angular velocity disturbance.
  - (ii) Side slip disturbance.
  - (iii) Yawing disturbance. (14 Marks)
- b. Explain forward speed disturbance in a helicopter. (06 Marks)

OR

- 8 a. Explain the levels of handling qualities and Cooper-Harper Rating scale. (10 Marks)  
b. Explain the main Rotor and Tail rotor control of helicopter. (10 Marks)

**Module-5**

- 9 a. Explain the general and operational requirements that must be taken into account for a helicopter. (10 Marks)  
b. Explain the effect of Tip Speed and blade twist on the design of main rotor. (10 Marks)

OR

- 10 a. Explain the effect of vertical drag recovery and fuselage side force on the fuselage design. (10 Marks)  
b. Explain the effects of horizontal stabilizer and vertical stabilizer on empennage design. (10 Marks)

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