



# CBCS SCHEME

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15AE743

## Seventh Semester B.E. Degree Examination, June/July 2023 Helicopter Dynamics

Time: 3 hrs.

Max. Marks: 80

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

### Module-1

- 1 a. Define rotor solidity, blade loading and figure of merit. (06 Marks)  
b. Derive momentum theory analysis during hovering flight. (10 Marks)

OR

- 2 a. Explain Blade flapping, lead-lag and coning of blades. (04 Marks)  
b. Derive blade element theory. (12 Marks)

### Module-2

- 3 a. Derive an expression for relationship between the induced velocity and in the plane of the rotor and the velocity in the viva controller. (10 Marks)  
b. Mention the forces acting on helicopters in forward flight and explain about methods of achieving translating flight. (06 Marks)

OR

- 4 a. Write notes on the following:  
i) Effect of gross weight  
ii) Effects of density altitude  
iii) Lift to drag ratio (10 Marks)  
b. Discuss the factors affecting maximum attainable forward speed. (06 Marks)

### Module-3

- 5 a. Explain with neat graph rotor air foil requirement. (08 Marks)  
b. Define critical pressure coefficient and prove that ;

$$C_p^* = \frac{2}{\gamma(M^*)^2} \left[ \left( (M^*)^2 \left( \frac{\gamma-1}{\gamma+1} \right) + \frac{2}{\gamma-1} \right)^{\frac{\gamma}{\gamma-1}} - 1 \right]. \quad (08 \text{ Marks})$$

OR

- 6 a. Explain in details flow visualization technique. (08 Marks)  
b. Discuss about characteristics of rotor wake in hover with neat diagram. (08 Marks)

### Module-4

- 7 a. What do you mean by dynamic stability? Explain briefly incidence disturbance and forward speed distance of static stability. (10 Marks)  
b. Brief about yawing disturbance and side slip disturbance. (06 Marks)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.  
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

OR

- 8 a. What are the factors that can affect the handling characteristics during take-off, lower low speed maneuvers and landing and for which flight test must be carried out? (10 Marks)  
b. Explain the general maintenance requirement that must be taken into account for a helicopter. (06 Marks)

Module-5

- 9 a. Explain rotor craft vibration in details. (08 Marks)  
b. Briefly explain structural strength design. (08 Marks)

OR

- 10 Briefly explain :  
a. Design of main rotor diameter (08 Marks)  
b. Design of Tip speed. (08 Marks)

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