



# CBCS SCHEME

17AE73

## Seventh Semester B.E. Degree Examination, Dec.2023/Jan.2024 Aircraft Stability and Control

Time: 3 hrs.

Max. Marks:100

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

### Module-1

- 1 Derive an expression for wing contribution for the longitudinal static stability of an airplane and discuss about the significance of CG position with respect to wing aerodynamic centre. (20 Marks)

OR

- 2 Derive an expression for tail contribution towards the longitudinal static stability of an airplane and discuss about downwash at the tail. (20 Marks)

### Module-2

- 3 a. With a help of diagram and expression, explain the control surface floating characteristics and aerodynamic balance. (10 Marks)  
b. Derive the equation for stick-free neutral point. (10 Marks)

OR

- 4 a. Briefly explain the requirements for direction control and obtain the expression for rudder control effectiveness. (10 Marks)  
b. Obtain an expression for stick force gradient :

$$\frac{dF}{dV} = K\rho V \left( A + Ch_{\delta_t} \delta_t \right)$$

(10 Marks)

### Module-3

- 5 a. Derive an expression for the contribution of dihedral wing towards static lateral stability. (10 Marks)  
b. Obtain an expression for Roll control power. (10 Marks)

OR

- 6 a. Briefly explain the following terms with relevant sketches:  
i) Phugoid mode  
ii) Short period mode. (10 Marks)  
b. Explain briefly about Aileron reversal. (10 Marks)

**Module-4**

- 7 a. Starting with X-force equation, use the small disturbance theory to determine the linearized force equation. Assume a steady level flight for the reference flight condition. (10 Marks)  
b. Derive the equation for motion of a rigid body. (10 Marks)

**OR**

- 8 a. Obtain the derivative due to rolling rate P. (10 Marks)  
b. Deduce that the coefficient  $C_{MU}$  depends on the Mach number and is also affected by the elastic properties of the airframe. (10 Marks)

**Module-5**

- 9 Write short notes on the following :  
i) Dutch roll.  
ii) Spiral instability.

(20 Marks)

**OR**

- 10 a. Explain briefly about the Cooper-Harper scale.  
b. Briefly, explain about the Routh's criteria.

(10 Marks)

(10 Marks)

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