

**B.Tech. AEROSPACE ENGINEERING  
(BTAE)**

**Term-End Examination**

**December, 2018**

00473

**BAS-017 : FLIGHT MECHANICS**

*Time : 3 hours*

*Maximum Marks : 70*

**Note :** Attempt seven questions in all. Question no. 1 is compulsory. Attempt any six questions from the remaining questions. Use of scientific calculator is permitted. Use given data for solving numerical problems.

Data for questions no. 2, 3, 4, 5 and 6.

<b>Wing Data</b>	<b>Horizontal Tail Data</b>	<b>Fuselage Data</b>
$C_{L_{0w}} = 0.21$	$C_{L_{\alpha_t}} = 4.5$ per rad	$C_{m_{0f}} = -0.01$
$C_{L_{\alpha_w}} = 5.5$ per rad	$S_t = 5$ m <sup>2</sup>	$C_{m_{\alpha_f}} = 0.1$ per rad
$C_{m_{ac_w}} = -0.10$	$l_t = 5.5$ m	$\tau = 0.5$
$b_w = 15$ m	$\eta_t = 0.9$	$C_{L_{trim}} = 0.3$
$\bar{C}_w = 1.75$ m	$i_t = -1.5$ deg	
$\lambda_w = \text{Taper ratio} = 1$	$C_{h_{\alpha_t}} = -0.015$ per rad	
$X_{ac} = 0.25 \bar{C}_w$	$C_{h_{\delta_e}} = -0.025$ per rad	
$X_{cg} = 0.30 \bar{C}_w$	$C_{L_{\delta_e}} = 0.25$ per rad	
$i_w = 1.5$ deg	$e = \text{Oswald's efficiency} = 0.9$	

1. Distinguish between the following using sketches : 4+3+3
  - (a) Static stability and Dynamic stability
  - (b) Floating and Restoring characteristics
  - (c) Primary and Secondary control surfaces
  
2. Calculate (i) pitching moment coefficient at zero lift ( $C_{m_0}$ ), and (ii) pitching moment curve slope ( $C_{m_\alpha}$ ) for complete aircraft for stick-fixed case using given data. 5+5
  
3. Calculate (i) pitching moment coefficient at zero lift ( $C'_{m_0}$ ), and (ii) pitching moment curve slope ( $C'_{m_\alpha}$ ) for complete aircraft for stick-free case using given data. 5+5
  
4. Define neutral point. Calculate neutral points for stick-fixed and stick-free cases using given data. 2+4+4
  
5. Define elevator control power. Derive expression for elevator control power and calculate its value using given data. 2+4+4
  
6. Define the elevator angle to trim and calculate its value using given data. 2+4+4

$$\text{Take } C_{L_{\alpha_w}} \cong C_{L_\alpha}$$

7. Explain the following using sketches (if required): 3+3+2+2
- (a) Dihedral effect
  - (b) Weathercock stability
  - (c) Adverse yaw
  - (d) Trim tab
8. Write notes on the following: 5+5
- (a) In-flight measurement of stick-fixed maneuver point
  - (b) Methods of aerodynamic balancing
9. (a) Discuss the cross-coupling of lateral and directional effects. 5
- (b) Define rudder power. Explain the uses of a rudder. 2+3
10. Write short notes on any *two* of the following: 5×2
- (a) Power Effects
  - (b) Aerodynamics Balancing
  - (c) Phugoid
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