BAS-017

B.Tech. AEROSPACE ENGINEERING (BTAE)

Term-End Examination

00254

June, 2017

BAS-017 : FLIGHT MECHANICS

Time : 3 hours *Maximum Marks : 70*

Note : *Attempt any* ***seven*** *questions. All questions carry equal marks. Use of scientific calculator is permitted.*

1. (a) Define trim. How can trim condition of an aircraft in longitudinal mode be changed ? *2*

(b) Derive the expression for C_{m_o} (pitching moment at zero lift angle of attack) and C_{m_α} (pitching moment curve slope) for an aircraft with controls fixed. *4+4*

2. (a) Define neutral point. Explain how stick fixed neutral point can be estimated experimentally. Use suitable diagrams. *2+3*

(b) Define weathercock stability with the help of a sketch. Derive the expression for static directional stability. *2+3*

3. (a) Define static margin and maneuver margin. Explain their importance. *3*

(b) Distinguish between the following : *4+3*

(i) Static and Dynamic Stability (longitudinal)

(ii) Floating and Restoring Characteristics

4. Calculate stick-fixed and stick-free neutral points using the following data :

$C_{L_{\alpha_w}} = 0{\cdot}1$ per degree $\quad x_{ac} = 0{\cdot}25\ \bar{c}$

$C_{L_{\alpha_t}} = 0{\cdot}09$ per degree $\quad S_w = 30\ m^2$

$C_{m_{\alpha_{fus}}} = 0{\cdot}12$ per rad $\quad S_T = 5\ m^2$

$C_{L_{\delta_e}} = 0{\cdot}31$ per rad $\quad l_t = 6\ m$

$C_{h_{\delta_e}} = -0{\cdot}025$ per rad $\quad \bar{c} = 2\ m$

$C_{h_{\alpha_t}} = -0{\cdot}015$ per rad $\quad AR_w = 7{\cdot}5$

$\eta_t = 0{\cdot}9$

where symbols/notations have usual meanings. *5+5*

5. Write short notes on the following using sketches : *4+4+2*

(a) Rudder Lock

(b) Forward and Aft C.G. Limits

(c) Adverse Yaw

6. (a) Define flutter. How can flutter be controlled ?

(b) Explain the various uses of rudder.

(c) Explain dihedral effect with the help of a sketch. *4+3+3*

7. Write short notes on the following : *3+4+3*

(a) Cross Coupling of Lateral and Directional Effects

(b) Power Effects

(c) Aerodynamic Balancing

8. (a) Calculate the elevator power and the elevator angle to trim using the following data :

$W = 28000$ N	$l_t = 6$ m
$V_w = 110$ m/s	$V_t = 100$ m/s
$S_w = 30$ m^2	$S_t = 5$ m^2
$\rho = 0{\cdot}9$ kg/m^3	$\bar{c} = 2$ m
$C_{m_0} = 0{\cdot}06$	$C_{L_{\delta_e}} = 0{\cdot}3$ per rad
$C_{m_\alpha} = -0{\cdot}4$ per rad	$C_{L_\alpha} = 5{\cdot}1$ per rad
$C_{L_{\alpha_t}} = 4{\cdot}5$ per rad	$\tau = 0{\cdot}5$

where symbols/notations have usual meanings. *3+5*

(b) Explain damping in yaw. *2*

9. Define maneuver point. Derive the expression for elevator angle per 'g' for pull up maneuver. Write the expression for stick-fixed maneuver point. *2+6+2*
