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BAS-017

B.Tech. AEROSPACE ENGINEERING (BTAE)

Term-End Examination

December, 2016

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.*

1. Explain the following terms and their importance : *3+3+4*

(a) Trim Tab

(b) Wing dihedral

(c) Rudder power

2. Derive the expression for pitching moment curve slope and pitching moment at zero lift for stick-free longitudinal case, i.e., for C_{m_α}' and C_{m_0}' for complete aircraft. *10*

3. (a) Define adverse yaw. How can it be taken care of ? Explain the design criteria for rudder in adverse yaw. *2+2+4*

(b) Define weathercock stability with the help of sketches. *2*

4. Define stick-fixed and stick-free neutral points. Calculate stick-fixed and stick-free neutral points using the following data : *2+2+3+3*

$X_{ac} = 0{\cdot}25\ \bar{C}$ $\quad C_{L_{\alpha_w}} = 0{\cdot}11$ per deg

$\bar{C} = 1{\cdot}7$ m $\quad C_{L_{\alpha_t}} = 0{\cdot}091$ per deg

$l_t = 7$ m $\quad \eta_t = 0{\cdot}95$

$S_w = 30$ m $\quad C_{m_{\alpha_f}} = 0{\cdot}12$ per rad

$S_t = 4{\cdot}5$ m $\quad C_{h_{\alpha_t}} = -0{\cdot}016$ per rad

$AR_w = 8$ $\quad C_{h_{\delta_e}} = -0{\cdot}027$ per rad

$C_{L_{\delta_e}} = 0{\cdot}25$ per rad

5. (a) Define dihedral effect. How does dihedral affect the lateral stability of the aircraft ? *2+4*

(b) Derive the expression for aileron power. *4*

6. Define stick force gradient and explain its importance. How can you estimate maneuver point (stick-fixed) experimentally ? *2+3+5*

7. Define the following terms : 5×2

(a) Damping in yaw

(b) Restoring characteristics

(c) Elevator effectiveness

(d) Trim condition

(e) Stability

8. Write short notes on the following : 2×5

(a) Methods of Aerodynamic Balancing

(b) Control of Wing Torsional Diversion

9. Define static stability. Calculate C_{m_0} (pitching moment coefficient at zero lift) and C_{m_α} (pitching moment curve slope) for complete aircraft for stick-fixed condition using the following data : 2+4+4

$C_{L_{0_w}} = 0{\cdot}31$ $C_{m_{ac_w}} = -0{\cdot}11$

$C_{L_{\alpha_w}} = 0{\cdot}11$ per deg $C_{m_{0_{fus}}} = -0{\cdot}01$

$C_{L_{\alpha_t}} = 0{\cdot}091$ per deg $C_{m_{\alpha_{fus}}} = 0{\cdot}12$ per rad

$X_{C_\delta} = 0{\cdot}29\ \bar{C}$ $S_w = 30\ m^2$

$X_{ac} = 0{\cdot}25\ \bar{C}$ $S_t = 4{\cdot}5\ m^2$

$AR_w = 8$ $l_t = 5{\cdot}5$ m

$i_w = 1{\cdot}1$ deg $\eta_t = 0{\cdot}92$

$i_t = -1{\cdot}1$ deg

$\bar{C} = 1{\cdot}9$ m