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BAS-017

B.Tech. AEROSPACE ENGINEERING (BTAE)

Term-End Examination

00138

June, 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. (a) Define longitudinal static stability. Show the conditions for static stability and the condition for making the aircraft trimmed at positive angle of attack with the help of a plot. *3*

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

(c) Explain the term 'damping in pitch' with the help of a figure. *3*

(d) Show with the help of sketches, how trim condition of an aircraft can be changed without changing stability. *2*

2. (a) Define stick-fixed neutral point. Explain how the stick-fixed neutral point can be calculated experimentally. Use sketches wherever required. *2+6*

(b) Define static margin. What is its importance ? *2*

3. Explain the following in brief : *2×5=10*

(a) Aerodynamic balancing and balancing methods

(b) Flutter and its control

4. (a) Derive the expression for elevator angle to trim. *5*

(b) Calculate the elevator angle to trim from the following data of an aircraft : *5*

$W = 25000$ N $\quad C_{m_\alpha} = -0{\cdot}4$ per rad

$V = 120$ m/s $\quad C_{m_{\delta_e}} = -0{\cdot}7$ per rad

$S = 30\ m^2$ $\quad C_{L_{\delta_e}} = 0{\cdot}3$ per rad

$\rho = 0{\cdot}95\ kg/m^3$ $\quad C_{m_0} = 0{\cdot}06$

$C_{L_\alpha} = 5{\cdot}2$ per rad

5. Define the following terms : *5×2=10*

(a) Elevator control power

(b) Adverse yaw

(c) Floating characteristics

(d) Dynamic stability

(e) Dihedral effect

6. Calculate C'_{m_0} (pitching moment at zero lift) and C'_{m_α} (pitching moment curve slope) for stick-free longitudinal case using the following data : *10*

$C_{L_{0_w}} = 0{\cdot}3$ $\quad C_{m_{ac_w}} = -0{\cdot}11$

$C_{Lse} = 0{\cdot}31$

$C_{L\alpha_w} = 0{\cdot}1$ per deg $\quad \eta_t = 0{\cdot}9$

$C_{L\alpha_t} = 0{\cdot}09$ per deg $\quad l_t = 6$ m

$X_{Cz} = 0{\cdot}3\ \bar{C}$ $\quad S_w = 27\ m^2$

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

$AR_w = 7{\cdot}5$ $\quad \bar{C} = 2$ m

$C_{m_{0_{fus}}} = 0{\cdot}01$ $\quad C_{m_{\alpha_{fus}}} = 0{\cdot}11$ per rad

$i_w = +\ 1{\cdot}5$ deg $\quad C_{h_{\delta_e}} = -\ 0{\cdot}025$ per rad

$i_t = -\ 1{\cdot}5$ deg $\quad C_{h_\alpha} = -\ 0{\cdot}015$ per rad

7. Derive the expression for rudder power. What is rudder lock ? How can rudder lock be taken care of ? *5+2+3*

8. What is maneuver point ? Derive the expression for elevator angle per 'g' for pull-up and turn maneuver. *2+8*

9. Explain the following in brief :

   (a) Cross-coupling of lateral and directional effects. *5*

   (b) Sketch of C.G. range for stick-fixed and stick-free cases for static and maneuvering longitudinal cases. *5*