| BAS-017 |

# B.Tech. AEROSPACE ENGINEERING (BTAE)

## Term-End Examination

ロロ4己弖     **June, 2018**

## 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 scientific calculator for numerical calculations. Use given data for solving numericals.*

Data for Question nos 3, 4, 5 and 6

| Given : Data for Wing | Data for Horizontal Tail | Fuselage Data |
|---|---|---|
| $C_{L_{0_w}} = 0.25$ | $C_{L_{\alpha_t}} = 0.09$ per deg | $C_{m_{0fus}} = -0.01$ |
| $C_{L\alpha_w} = 0.10$ per deg | $S_t = 5 \text{ m}^2$ | $C_{m_{\alpha fus}} = 0.1$ per rad |
| $C_{m_{acw}} = -0.10$ | $l_t = 5.5 \text{ m}$ | $C_{L_{trin}} = 0.4$ |
| $S_w = 25 \text{ m}^2$ | $\eta_t = 0.9$ | $\tau = 0.5$ |
| $AR_w = 9$ | $i_t = -1.5 \text{ deg}$ | |
| $\lambda_w = \text{Taper ratio} = 1$ | $C_{h_{\alpha_t}} = -0.015$ per rad | |
| $X_{ac} = 0.25 \, \overline{C}_w$ | $C_{h_{\delta_e}} = -0.025$ per rad | |
| $X_{cg} = 0.30 \, \overline{C}_w$ | $C_{L_{\delta_e}} = 0.25$ per rad | |
| $i_w = 1.5 \text{ deg}$ | $e = 0.9 = \text{Oswald's efficiency}$ | |

1.  Show the following with the help of labelled diagrams : $1\frac{1}{2}+2+2+2\frac{1}{2}+2$

    (a)  Primary control surfaces

    (b)  Lift curve and moment curve for symmetrical airfoil

    (c)  Typical moment curves for stable and unstable aircraft

    (d)  At least 5 high lift devices

    (e)  Hinge moment characteristics for elevator

2.  (a)  Define weathercock stability and derive expression for the same.

    (b)  Write a note on 'Rudder Lock' using relevant sketches.                                    *5+5*

3.  Calculate $C_{m_0}$ (pitching moment coefficient at zero lift) and $C_{m_\alpha}$ (pitching moment curve slope) for complete aircraft for stick-fixed case using given data.                                    *10*

4.  Calculate $C'_{m_0}$ (pitching moment coefficient at zero lift) and $C'_{m_\alpha}$ (pitching moment curve slope) for complete aircraft for stick-free case using given data.                                    *10*

5.  Define neutral point. Calculate stick-fixed and stick-free neutral points using given data.    *2+4+4*

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**6.** Define elevator angle for trim. Derive expression for elevator angle required for trim and calculate its value using given data. *2+4+4*

**7.** Define maneuver point. How can stick-fixed and stick-free maneuver points be measured experimentally ? Explain with the help of sketches. *2+4+4*

**8.** Define the following terms : *5×2*

    (a) Static margin

    (b) Stick force gradient

    (c) Dynamic stability

    (d) Flutter

    (e) Damping in pitch

**9.** What do you mean by balancing of control surfaces ? Explain various methods for balancing control surfaces. *2+8*

**10.** (a) Explain the various uses of rudder. *5*

    (b) Discuss dihedral effect with the help of a sketch. *5*