Code No: RR322101 **RR** **Set No. 2**

III B.Tech II Semester Examinations,December 2010
AIRCRAFT STABILITY AND CONTROL
Aeronautical Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. The geometrical and aerodynamic characteristics of a glider are given as follows; Wing AR=8(NACA 23012, a_0 = 0.104),α_{0L} = -1.2),Hor.Tail AR = 4 (NACA 0009.a0 = 0.110), Tail volume ratio $\overline{V}$ =0.6 ,rate of change of down wash 2.$\frac{d\varepsilon}{d\alpha}$ = 0.5, tail efficiency η_t = 0.9,Aerodynamic centre at 0.24c , $\left(\frac{dC_m}{dC_L}\right)_{Fus}$ = 0.08 Elevator area ratio S_e/S_t= 0.35.Calculate the Stick fixed neutral point.As shown in the Figure4 [16]

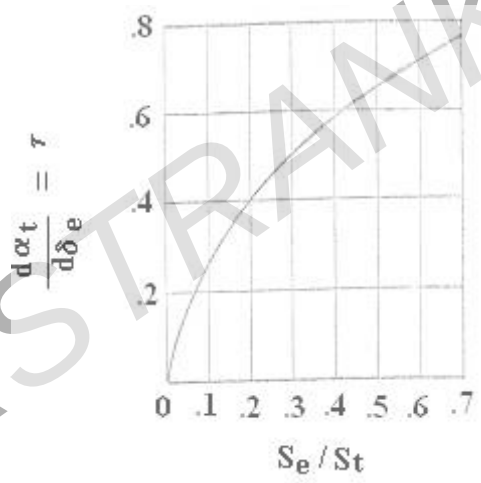

Figure 4

2. Consider the directional stability of an airplane, and develop an expression for $C_{n\beta}$ Hence bring out the requirement of dorsal fin from the contribution of vertical tail-fuselage combination. [16]

3. The characteristic equation of dynamic longitudinal stability of an airplane was obtained as below; $A\lambda^4 + B\lambda^3 + C\lambda^2 + D\lambda + E = 0$, where A =0.3739, B = 1.9002 ,C = 4.9935 ,D =0.1642 , E = 0.2296 . Work out the period, $N_{1/2}$ and $t_{1/2}$of the phugoid oscillations .Provide the basis of your recognizing the oscillation to be as such. [16]

4. Explain the aerodynamics of the recovery from spin. What are the geometrical modifications possible for improving spin resistance of an airplane? [16]

5. Describe with sketches /plots the occurrence of hinge moments on the horizontal tail from the pressure distribution due to angle of attack α and the deflections $\delta_e and \delta_t$ from elevator and tab. Hence define the terms floating tendency and restoring tendency. Describe ways and means to alleviate or control these hinge moments. [16]

6. Explain the terms static and dynamic stability associated with an airplane. Is the stability part of the airplane design and operation? Does the pilot apply control in this respect? Please illustrate. [16]

7. An airplane with positive dihedral develops left rolling moments when it meets right side slip. Prove that $C_{l'_\beta} = -\frac{2\Gamma}{57.3}\frac{dC_L}{d\beta}\frac{\overline{y}}{b}\frac{S_\Gamma}{S}$,with standard notations. [16]

8. Show that for unaccelerated flight of airplane ,with standard notations that the control force is given by; $F_S = K\frac{1}{2}\rho V^2(A + C_{h\delta t}\delta_t) - K\frac{W}{S}\frac{C_{h\delta}}{C_{m\delta}}[\frac{dC_m}{dC_L}]_{free}$ .Further establish the value of stick force gradient $\frac{dF_s}{dV}$. [16]

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Code No: RR322101 **RR** **Set No. 4**

III B.Tech II Semester Examinations,December 2010
AIRCRAFT STABILITY AND CONTROL
Aeronautical Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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3. Show that for unaccelerated flight of airplane ,with standard notations that the control force is given by; $F_S = K\frac{1}{2}\rho V^2(A + C_{h\delta t}\delta_t) - K\frac{W}{S}\frac{C_{h\delta}}{C_{m\delta}}[\frac{dC_m}{dC_L}]_{free}$ .Further establish the value of stick force gradient $\frac{dF_s}{dV}$. [16]

4. The characteristic equation of dynamic longitudinal stability of an airplane was obtained as below; $A\lambda^4 + B\lambda^3 + C\lambda^2 + D\lambda + E = 0$, where A =0.3739, B = 1.9002 ,C = 4.9935 ,D =0.1642 , E = 0.2296 . Work out the period, $N_{1/2}$ and $t_{1/2}$of the phugoid oscillations .Provide the basis of your recognizing the oscillation to be as such. [16]

5. An airplane with positive dihedral develops left rolling moments when it meets right side slip. Prove that $C_{l'\beta} = -\frac{2\Gamma}{57.3}\frac{dC_L}{d\beta}\frac{\overline{y}}{b}\frac{S_\Gamma}{S}$,with standard notations. [16]

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7. The geometrical and aerodynamic characteristics of a glider are given as follows; Wing AR=8(NACA 23012, a_0 = 0.104),α_{0L} = -1.2),Hor.Tail AR = 4 (NACA 0009.a0 = 0.110), Tail volume ratio $\overline{V}$ =0.6 ,rate of change of down wash 2.$\frac{d\varepsilon}{d\alpha} = 0.5$, tail efficiency $\eta_t = 0.9$,Aerodynamic centre at 0.24c , $\left(\frac{dC_m}{dC_L}\right)_{Fus} = 0.08$ Elevator area ratio S_e/S_t= 0.35.Calculate the Stick fixed neutral point.As shown in the Figure4 [16]

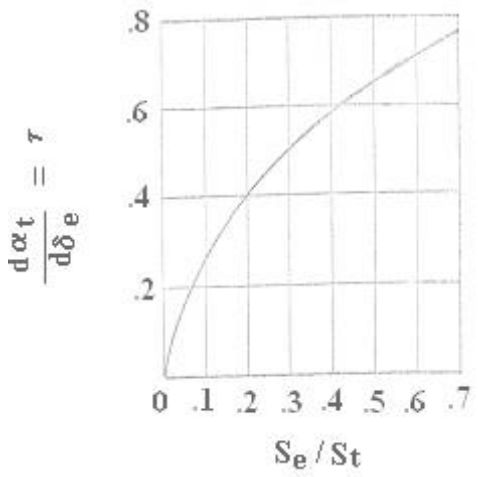

Figure 4

8. Consider the directional stability of an airplane, and develop an expression for $C_{n\beta}$ Hence bring out the requirement of dorsal fin from the contribution of vertical tail-fuselage combination. [16]

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Code No: RR322101 **RR** **Set No. 1**

III B.Tech II Semester Examinations,December 2010
AIRCRAFT STABILITY AND CONTROL
Aeronautical Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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2. The characteristic equation of dynamic longitudinal stability of an airplane was obtained as below; $A\lambda^4 + B\lambda^3 + C\lambda^2 + D\lambda + E = 0$, where A =0.3739, B = 1.9002 ,C = 4.9935 ,D =0.1642 , E = 0.2296 . Work out the period, $N_{1/2}$ and $t_{1/2}$of the phugoid oscillations .Provide the basis of your recognizing the oscillation to be as such. [16]

3. Consider the directional stability of an airplane, and develop an expression for $C_{n\beta}$ Hence bring out the requirement of dorsal fin from the contribution of vertical tail-fuselage combination. [16]

4. The geometrical and aerodynamic characteristics of a glider are given as follows; Wing AR=8(NACA 23012, a_0 = 0.104),α_{0L} = -1.2),Hor.Tail AR = 4 (NACA 0009.a0 = 0.110), Tail volume ratio $\overline{V}$ =0.6 ,rate of change of down wash 2.$\frac{d\varepsilon}{d\alpha}$ = 0.5, tail efficiency η_t = 0.9,Aerodynamic centre at 0.24c , $\left(\frac{dC_m}{dC_L}\right)_{Fus}$ = 0.08 Elevator area ratio S_e/S_t= 0.35.Calculate the Stick fixed neutral point.As shown in the Figure4 [16]

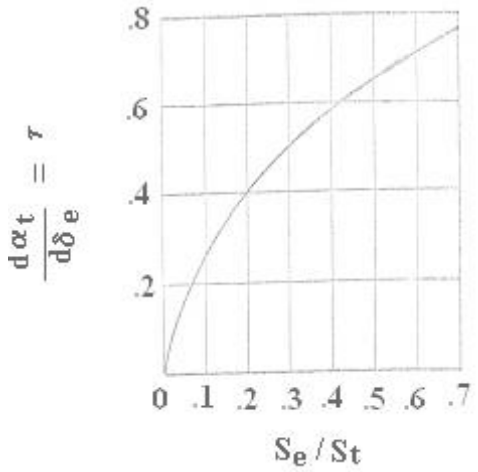

Figure 4

5. Explain the terms static and dynamic stability associated with an airplane. Is the stability part of the airplane design and operation? Does the pilot apply control in this respect? Please illustrate. [16]

6. Describe with sketches /plots the occurrence of hinge moments on the horizontal tail from the pressure distribution due to angle of attack α and the deflections $\delta_e and \delta_t$ from elevator and tab. Hence define the terms floating tendency and restoring tendency. Describe ways and means to alleviate or control these hinge moments. [16]

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8. Explain the aerodynamics of the recovery from spin. What are the geometrical modifications possible for improving spin resistance of an airplane? [16]

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Code No: RR322101 **RR** **Set No. 3**

III B.Tech II Semester Examinations,December 2010
AIRCRAFT STABILITY AND CONTROL
Aeronautical Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. Describe with sketches /plots the occurrence of hinge moments on the horizontal tail from the pressure distribution due to angle of attack α and the deflections $\delta_e and \delta_t$ from elevator and tab. Hence define the terms floating tendency and restoring tendency. Describe ways and means to alleviate or control these hinge moments. [16]

2. Show that for unaccelerated flight of airplane ,with standard notations that the control force is given by; $F_S = K\frac{1}{2}\rho V^2(A + C_{h\delta t}\delta_t) - K\frac{W}{S}\frac{C_{h\delta}}{C_{m\delta}}[\frac{dC_m}{dC_L}]_{free}$ .Further establish the value of stick force gradient $\frac{dF_s}{dV}$. [16]

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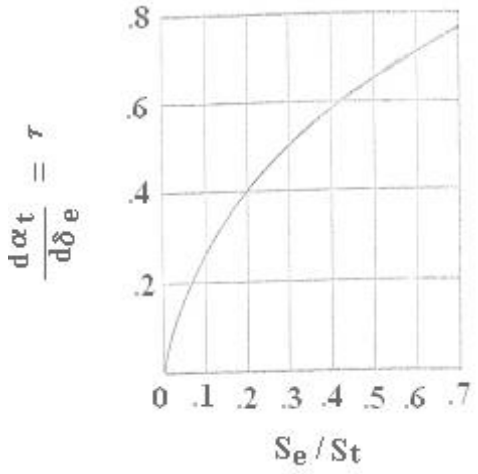

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5. Explain the terms static and dynamic stability associated with an airplane. Is the stability part of the airplane design and operation? Does the pilot apply control in this respect? Please illustrate. [16]

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