University of Dayton

Department of Mechanical and Aerospace Engineering

MEE 440/AEE 521 – Flight Vehicle Performance/Dynamics

Homework-4

1. For the aircraft assigned to you and use the corresponding aircraft data, provided drawings. Extract the relevant geometric parameters and provide estimates for all the longitudinal coefficients. Make sure to have all the necessary parameters required to compute the following parameters. Submit the homeowrk as a **MATLAB CODE**.
   Display only the required parameters.

Vertical Parameters

- $c_{T_V} =$
- $c_{R_V} =$
- $b_V =$
- $b_{2V} = 2 \times b_V$
- $\Lambda_{LE_V} =$
- $\lambda_V = \frac{c_{T_V}}{c_{R_V}} =$
- $S_V = \frac{b_V}{2} c_R (1 + \lambda_V) =$
- $S_{2V} = \frac{b_{2V}}{2} c_R (1 + \lambda_V) =$
- $AR_V = \frac{b_{2V}^2}{S_{2V}} =$
- $\bar{c}_V = \frac{2}{3} c_{R_V} \frac{1+\lambda_V+\lambda_V^2}{1+\lambda_V} =$
- $x_{MAC_V} = \frac{b_{2V}}{6} \frac{(1+2\lambda_V)}{(1+\lambda_V)} \tan(\Lambda_{LE_V}) =$
- $y_{MAC_V} = \frac{b_{2V}}{6} \frac{(1+2\lambda_V)}{(1+\lambda_V)} =$
- $\tan(\Lambda_x) = \tan(\Lambda_{LE_V}) - \frac{4x(1-\lambda_V)}{AR_V(1+\lambda_V)}$
  - $\Lambda_{0.5_V} =$
  - $\Lambda_{0.25_V} =$

Horizontal Tail Parameters

- $r_1 =$
- $Z_H =$
- $\frac{b_V}{2*r_1} =$
- From Fig. 4.15 $\Rightarrow c_1 =$
- $\frac{-Z_H}{b_V} =$
- $x_{AC_{H\to V}} = x_{MAC} + (0.25 \times \bar{c}_H)$
- $\frac{x_{AC_{H\to V}}}{\bar{c}_V} =$
- From Fig. 4.16 $\Rightarrow c_2 =$
- $\frac{S_H}{.5*S_{2V}} =$
- From Fig. 4.18 $\Rightarrow K_{HV} =$
- $A_{R_{V_{eff}}} = c_1 \times AR_V \times (1 + K_{HV} * (c_2 - 1)) =$
- $k_V =$
- $c_{L_{\alpha_V|_{Mach}}} =$
- $mach \times \cos(\Lambda_{0.5}) =$
- $\frac{AR}{\cos(\Lambda_{0.5})} =$
- From Fig. 4.40 $\Rightarrow K_{M_\Lambda} =$
- $A =$
- $\frac{A}{b} =$
- From Fig. 4.41 $\Rightarrow K_f =$

- Using $\lambda, AR, \Lambda_{\frac{c}{2}}$ From Fig 4.39 $\Rightarrow \left(\frac{c_{l_\beta}}{c_{L_1}}\right)_{\Lambda_{c/2}} =$
- Using λ, AR From Fig 4.42 $\Rightarrow \left(\frac{c_{l_\beta}}{c_{L_1}}\right)_{AR} =$
- $\Gamma_W =$

- Using $\lambda, \Lambda_{0.5}$ From Fig 4.43 $\Rightarrow \left(\frac{c_{l_\beta}}{\Gamma_W}\right) =$
- $mach \times \cos(\Lambda_{0.5}) =$
- $\frac{AR}{\cos(\Lambda_{0.5})} =$
- From Fig. 4.44 $\Rightarrow K_{M_\Gamma} =$
- Fuselage Average Height $=$
- Fuselage Average Width $=$
- $S_{f_{AVG}} = \pi \times \frac{FuselageAverageHeight}{2} \times \frac{FuselageAverageWidth}{2} =$
- $d = \sqrt{\frac{S_{f_{AVG}}}{0.7854}} =$
- $\left(\frac{\Delta c_{l_\beta}}{\Gamma_W}\right) = -0.005 \times AR \times \frac{d^2}{b^2} =$
- $Z_W =$
- $\left(\Delta c_{l_\beta}\right)_{Z_W} = \frac{1.2 \times \sqrt{AR}}{57.3} \times \frac{Z_w}{b} \times \frac{2d}{b} =$
- $\varepsilon_W = 2^\circ$ deg
- Using Λ, AR From Fig 4.46 $\Rightarrow \left(\frac{\Delta c_{l_\beta}}{\varepsilon_W \tan \Lambda_{c/4}}\right) =$
- Using $\frac{b_V}{2r_1}$,From Fig 13 $\Rightarrow k_{Y_V} =$
- $\eta_V \cdot \left(1 + \frac{d\sigma}{d\beta}\right) = 0.724 + 3.06\frac{S_V/S}{1+\cos\left(\Lambda_{c/4}\right)} + 0.4\frac{Z_W}{d} + 0.009 \cdot AR =$
- $X_V =$
- $Z_V =$
- $\alpha_1 =$
- $d =$
- $S_{P \to V} =$
- Using $\frac{Z_W}{d/2}$ and Fig. 4.8 to get $K_{int} =$
- $\eta_V =$
- $y_{R_I} = \qquad \Rightarrow \eta_I = \qquad \Rightarrow K_{R_I} =$
- $y_{R_F} = \qquad \Rightarrow \eta_F = \qquad \Rightarrow K_{R_F} =$
- $\Delta K_R =$
- $\frac{\bar{c}_{Rudder}}{\bar{c}_{Vert.Tail}} = \qquad$, using Fig. 4.26 $\tau_R =$
- $X_R =$
- $Z_R =$

- $y_{A_I} = \qquad \Rightarrow \eta_I = \qquad \Rightarrow RME_I =$
- $y_{A_O} = \qquad \Rightarrow \eta_O = \qquad \Rightarrow RME_O =$
- $\Delta RME =$
- $\beta = \beta_H = \sqrt{1 - mach^2} =$
- $\Lambda_\beta =$
- $k_A = \frac{(c_{l_\alpha})_{WingSection}\big|_{Mach} \cdot \beta}{2\pi} =$
- $\frac{\beta \cdot AR}{k} = \qquad$, Using $\Lambda_\beta, \frac{\beta \cdot AR}{k}, \lambda$ and Fig. 4.51
- $\frac{\bar{c}_{Aileron}}{\bar{c}_{Wing_{aileron}}} = \qquad$, using Fig. 4.55 $\tau_A =$
- $l_{CG} =$
- $l_B =$
- $S_{B_S} =$
- $Z_1 =$
- $Z_2 =$
- $Z_{max} =$
- $W_{max} =$
- $Re_{Fuselage} = \frac{V \times l_B}{v} =$
- Using Fig. 4.68 $K_N =$
- $K_{Re_l} =$
- Using Fig. 4.73, $\Delta K_{n_A} = K_{n_0} - K_{n_I} =$
- $\frac{\beta \cdot AR}{k}, \Lambda_\beta, \lambda$ using Fig's. 4.80 & 4.81 $RDP =$
- $k_{A_H} = \frac{(c_{l_{\alpha_H}})_{WingSection}\big|_{Mach} \cdot \beta_H}{2\pi} =$
- $\Lambda_{\beta_H} =$
- $\frac{\beta_H \cdot AR_H}{k_{A_H}}, \Lambda_{\beta_H}, \lambda_H$ using Fig's. 4.80 & 4.81 $RDP_H =$
- B $= \sqrt{1 - Mach^2 \cos(\Lambda_{\frac{c}{4}})^2} =$
- $C = \frac{\left[AR + 4\cos\left(\Lambda_{c/4}\right)\right]}{\left[AR \cdot B + 4\cos\left(\Lambda_{c/4}\right)\right]} \cdot \left\{ \frac{AR \cdot B + \frac{1}{2}\left[AR \cdot B + 4\cos\left(\Lambda_{c/4}\right)\right] \cdot \tan^2\left(\Lambda_{c/4}\right)}{AR + \frac{1}{2}\left[AR + 4\cos\left(\Lambda_{c/4}\right)\right] \cdot \tan^2\left(\Lambda_{c/4}\right)} \right\} =$
- $\left(\frac{c_{np}}{c_{L_1}}\right)\Big|_{\substack{\text{Mach }=0 \\ C_L=0}} = -\frac{1}{6} \cdot \frac{AR + 6\left(AR + \cos\left(\Lambda_{c/4}\right)\right) \cdot \left[\left(\bar{x}_{CG} - \bar{x}_{AC}\right)\frac{\tan\left(\Lambda_{c/4}\right)}{AR} + \frac{\tan^2\left(\Lambda_{c/4}\right)}{12}\right]}{\left(AR + \cos\left(\Lambda_{c/4}\right)\right)} =$
- λ, AR and using Fig. 4.83 $\frac{\Delta c_{np}}{\varepsilon_W} =$

- $D = \frac{1+\frac{AR\left(1-B^2\right)}{2B\left[AR\cdot B+2\cos\left(\Lambda_{c/4}\right)\right]}+\frac{\left[AR\cdot B+2\cos\left(\Lambda_{c/4}\right)\right]}{\left[AR\cdot B+4\cos\left(\Lambda_{c/4}\right)\right]}\cdot\frac{\tan^2\left(\Lambda_{c/4}\right)}{8}}{1+\frac{\left[AR+2\cos\left(\Lambda_{c/4}\right)\right]}{\left[AR+4\cos\left(\Lambda_{c/4}\right)\right]}\cdot\frac{\tan^2\left(\Lambda_{c/4}\right)}{8}} =$

- $\lambda, AR, \Lambda_{\frac{c}{4}}$, using Fig. 4.85, $\left(\frac{c_{lr}}{c_{L_1}}\right)\Big|_{\substack{Mach=0\\C_L=0}} =$

- λ, AR and using Fig. 4.87, $\frac{\Delta c_{l_r}}{\varepsilon_W} =$

Aerodynamic Parameters

- $C_{Y_\beta} =$
- $C_{Y_{\delta_A}} =$
- $C_{Y_{\delta_R}} =$
- $C_{n_\beta} =$
- $C_{n_{\delta_A}} =$
- $C_{n_{\delta_R}} =$
- $C_{l_\beta} =$
- $C_{l_{\delta_A}} =$
- $C_{l_{\delta_R}} =$
- $C_{l_p} =$
- $C_{Y_p} =$
- $C_{n_p} =$
- $C_{l_r} =$
- $C_{Y_r} =$
- $C_{n_r} =$