AOE 3134 Stability and Control - Problem Sheet 4

Due 12 March, 2002

Read Chapter 2 all of it (again!)
Read Chapter 3 (3.1,3.2)

13-17. Attached is a three view drawing of an aircraft (F-104 Starfighter) This aircraft was the first to fly above Mach 2 in level flight. Although a military aircraft, it was primarily used by other countries for that purpose, but used in the US by NASA as a test aircraft for high speed flight. (It was also used to test the concept of reaction jet controls for attitude control of reentering space vehicles before they reached the denser part of the atmosphere).

The aircraft characteristics are given by

S = 196.1 ft^2 b = 21.94 ft $\bar{c}$ = 9.55 ft h = 0.07

W = 16,300 lbs

There are two flight conditions that we want to study

1) Sea level, Mach 0.257 $\rho = 0.002378 slugs / ft^3$ Speed of Sound = 1116.45 ft/sec

and

2) 55,000 ft, Mach 1.8 $\rho = 0.000286 \ slugs / ft^3$ Speed of Sound = 968.08 ft/sec

a) Determine (estimate) for each flight condition

1) C_L 3) C_{L_α}

2) C_{m_α} 4) h_n Aerodynamic center (neutral point of aircraft)

5) Stick-fixed static margin

b) Determine (estimate)

1) $C_{m_{\delta_e}}$ (Note that the tail is a “full flying” tail, i.e. no elevator surface, the whole tail moves

2) C_{m_q} Pitch damping derivative.

Use rulers, protractors, or what have you, to scale off the drawing the necessary dimensions that are not given. Estimate what you need, assume what you must. However you must document all estimations, and justify assumptions. Show all calculations. Indicate the mean aerodynamic chord, the cg position, and the neutral point on the top view drawing. Attached are charts that are not in your book that apply to supersonic flight. They can be used for parts of this problem, but should be considered an additional resource for estimating aerodynamic properties.

Note that this is an unusual plane and can have non conventional characteristics (it is stable though)