AOE 3104 Problem Sheet 5

Due 26 February, 2003

Read Chapters 3 and 4, Marchman

23. Using the DATCOM formula for calculating the lift curve slope, and considering a wing with constant aspect ratio of 4.0, make the following two plots:

   a) plot how the lift curve slope varies vs Mach for a constant (half chord) sweep angle of 45 degrees. Mach numver range from 0 - 0.95

   b) plot how the lift curve slope varies vs sweep angle for a constant Mach number of 0.7 Sweep angle range from 0 to 75 degrees

Note: The Euler integration scheme outlined in class can be implemented if you use Fortran, C, Matlab or some other programming code. You can also do these problems with Mathematica, Mathcad, and Matlab using built in integration schemes (typically a fourth order Runge-Kutta or one similar). With imagination, you can also do these problems with a spread sheet and using Euler Integration. The minimum requirement is to use Euler integration.

24. Write a computer code that will numerically integrate the equations of motion. Write it so that you can provide any thrust and normal load factor time histories. Use your computer code to solve the problem started in class. That is, find the maximum speed of the aircraft by letting the time grow large for the case of level flight. The parameters of the problem are: Weight = 10,000 lbs., S = 200 ft^2, T = 1,000 lbs., and it is flying level at sea level so that the load factor is 1 and the flight path angle is 0. The drag polar of the aircraft is given by $C_D = C_{D0L} + K C_L^2 = 0.02 + 0.05 C_L^2$. Start the problem with initial conditions of V = 300 ft/s, h = 0, x = 0 (really don't need the x equation unless you want to know how far it travels before it reaches the max speed).

25. Use your code to determine the trajectory starting with the above initial conditions with the thrust at maximum, (T_{max} = 3,000 lbs. but with the load factor equal to 2. Feel free to experiment with initial conditions and load factors to see if it is possible for this aircraft to do a loop! Note that velocity cannot go negative, if that happens, stop your program!

Extra problem - assuming a constant thrust at any level required, can you find a load factor “schedule” (e.g. lad factor as a function of flight path angle, or load factor as a function of time, or load factor as a function of some other variable), that will cause the loop to be a circle? (I don’t know the answer to this problem)

26. Verify the terminal speed obtained in prob 24. analytically by solving the thrust = drag equation for speed with T = 1000, and find the maximum aircraft speed for $T = T_{max}$ = 3,000 lbs.

27. Determine the speed for minimum drag, and the drag at that speed. Set the initial speed to 50 ft/sec less than the minimum drag speed, and the thrust level to 1000 lbs. Set the load factor to n = 1, use your code to determine what happens to the aircraft. Summarize the results, I don’t want to see printout.