ASEN 3728 Aircraft Dynamics
Written Homework 6

Due date listed on Gradescope.

Question 1. TRUE or FALSE and Justify:

1. Consider an aircraft designed with typical stabilizing dihedral effect. If the wind that this aircraft is flying into suddenly changes so that the sideslip angle β suddenly becomes positive, the immediate reaction of the aircraft in the roll direction will be a positive roll ($p > 0$) into the wind.

2. Consider an aircraft that is designed to be statically stable. The sign of the stability derivative C_{l_p} is negative.

3. Consider a typical aircraft with the center of gravity of the vertical tail being located above and behind the center of gravity of the entire aircraft. If the aircraft is suddenly hit by a gust of wind such that it now has a positive yaw rate ($r > 0$), then the immediate reaction of the aircraft will be to increase the roll rate.

Question 2.

1. Estimate the required bank angle, ϕ, *in degrees* that are needed for a Boeing 747 to maintain a steady level coordinated turn that completes a full circle every three minutes at sea level and a speed of 221 ft/s (Case I in Appendix E).

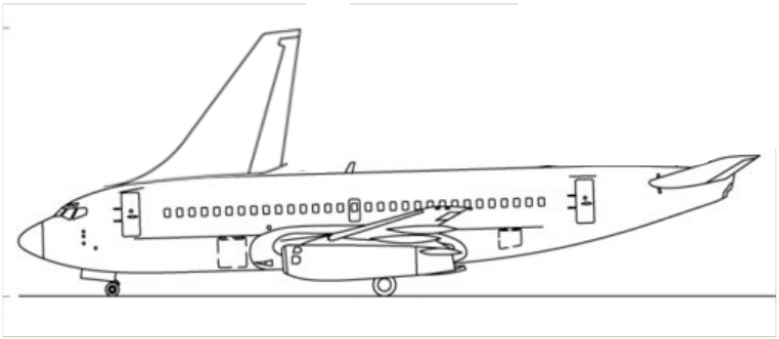
2. Find the wind angles, $\Delta\alpha$ and β, and control inputs δ_a, δ_r, and $\Delta\delta_e$, *all in degrees* needed to maintain this turn. The nondimensional derivatives can be found in Table 6.1, 6.6, and 7.3, and physical parameters can be found in Appendix E of the textbook. The following lines of code can be copied and pasted to save some typing if you can figure out how to use them:

```
[-0.8771  0.1146 0; -0.2797  6.976e-3 -1.368e-2; 0.1946 -0.1257 -1.973e-4]
[-1.023 -1.444; 4.920 0.3648]
[0 0; -0.3295   0.304; -0.04073 -0.2737]
[-23.92; 5.921]
```

   You can either include code in your submission or describe, with equations, how you calculated these angles without submitting code.

3. Does the sign of the aileron input required to *sustain* this turn match the sign of the aileron input required to *initiate* the turn from steady level flight?

Question 3. Consider the experimental aircraft shown below with a vertical stabilizer located a distance l_F forward of the center of gravity. [Comment: Be more clear about the sign of l_f since some treated it as a value which could be negative and others as magnitude]



1. Re-derive the yaw stiffness contribution from the vertical stabilizer, $C_{n_{F\beta}} = \frac{\partial C_{n_F}}{\partial \beta}$. Let the sidewash angle, σ, and $\frac{\partial \sigma}{\partial \beta}$ be 0. Thus, $\alpha_F = -\beta$. What is the sign of $C_{n_{F\beta}}$?
2. Re-derive the "rudder power" $C_{n_{\delta_r}}$.
3. Is this a good aircraft design? Why or why not?