Aircraft Stability and Control

HW-1 Due 24-3-2024

1. With the aid of a diagram showing a generalized set of aircraft body axes, define the parameter notation used in the mathematical modeling of aircraft motion1.

2. In the context of aircraft motion, what are the Euler angles? If the standard right handed aircraft axis set is rotated through pitch θ and yaw ψ angles only, show that the initial vector quantity (x0, y0, z0) is related to the transformed vector quantity (x, y, z) as follows:

$$\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} \cos\theta\cos\psi & \cos\theta\sin\psi & -\sin\theta \\ -\sin\psi & \cos\psi & 0 \\ \sin\theta\cos\psi & \sin\theta\sin\psi & \cos\theta \end{bmatrix} \begin{bmatrix} x_0 \\ y_0 \\ z_0 \end{bmatrix}$$

3. Define the span, gross area, aspect ratio and mean aerodynamic chord of an aircraft wing.

4. Choose correct answer, Describe your selection :

1. Which of the following is correct?

a) Lift is equal to weight always   b) Thrust is only proportional to nose of aircraft
c) Aircraft which is statically stable may or may not be dynamically stable
d) Drag is useful during takeoff

2. How do you define the lift coefficient?
a) Ratio of aerodynamic lift to the dynamic lift   b) Lift to drag
c) Wing lift to weight of aircraft   d) Thrust to weight

2. Which of the following is correct?
a) $D = q*S*C_D$ b) $D = q*S*C_D*\rho$ c) $D = q*C_D$ d) $D = q$

3. For an incompressible flow, if local area velocity decreases then, the dynamic pressure will _____

a) decrease   b) increase   c) constant   d) independent of velocity

4. If an aircraft is operating with dynamic pressure of the free stream q=20Pa and has area of wing is 10m^2 then evaluate drag experience by the aircraft. Given drag coefficient

is 0.9.

a) 345 N   b)   180 N   c) 234 N   d) 567 N

5. If static air pressure is 0.5 bar and dynamic pressure is 0.85 bar then, find total pressure acting on a body.   a) 1.35   b) 5   c) 7   d) 8.56

6. Skin friction drag is defined as _____

   a) wing lift drag   b) such drag does not exist.
c) lift induced   d) drag due to friction between skin and fluid flow.

7. The change in local air flow velocity will produce small change in skin friction drag.
b) False   a) True

8. Dynamic stability is more concerned about time.
a) True   b) False

9. Which of the following is an example of longitudinal mode?
a) Dutch   b) Lateral   c) Phugoid   d) Aileron