

SYSTEMS THINKING (30)

1. Modeling the dynamics of a multi-rotor air vehicle (e.g. a quadcopter) (20 pts)
 - a. Draw a free-body diagram of a multi-rotor air vehicle in the x and z axes (i.e. forward and up axes)
 - i. Label the x and z axes
 - ii. Label the angle(s) between the vehicle frame and the axes
 - iii. Draw the forces vectors acting on the vehicle (Thrust, Weight, Drag) for motion on the x-axis only. Label the forces.

 - b. Using Newton's Laws derive the equation for Thrust for a vehicle in a **station-keeping hover** (i.e. no forward or up motion) In words describe each term in the equation for Thrust.

- c. Using Newton's Laws derive the equation for the Angle of the Frame to the X-axis in terms of Thrust, Drag and Weight for a vehicle in **constant speed forward in level flight**. (Hint: $a_x = a_y = 0$) In words describe each term in the equation for Thrust.
- d. Using Newton's Laws derive the equation for the Angle of the Frame to the X-axis in terms of Thrust, Drag and Weight for a vehicle in **vehicle accelerating forward in level flight**. (Hint: $a_x > 0, a_y = 0$) In words describe each term in the equation for Thrust.
- e. For which condition is the Angle of the Frame to the X-axis greater: Explain.
- Vehicle at constant speed in level flight
 - Vehicle accelerating forward in level flight

SYSTEM ENGINEERING PROCESS/COMMUNICATION: A/C ASSEMBLY

WRITE LEGIBLY.

1. Identify the topic of the project. (5 points)

Project Topic: _____ **A/C Assembly** _____

2. What is the problem addressed by the simulation model used on this project?

3. What is the physical process(es) modeled?

4. What is the boundary of the model (inputs and outputs)?

5. What factors are exogenous? What factors are endogenous?

6. Which “soft variables” are included? Explain.

7. Are feedback loops properly taken into account? Which ones?

SYSTEM ENGINEERING PROCESS/COMMUNICATION: NSPDAV

WRITE LEGIBLY.

1. Identify the topic of the project. (5 points)

Project Topic: _____ **Nice Small Package Delivery Air Vehicle** _____

2. What is the problem addressed by the simulation model used on this project?

3. What is the physical process(es) modeled?

4. What is the boundary of the model (inputs and outputs)?

5. What factors are exogenous? What factors are endogenous?

6. Which “soft variables” are included? Explain.

7. Are feedback loops properly taken into account? Which ones?

SYSTEM ENGINEERING PROCESS/COMMUNICATION: HF Certification

WRITE LEGIBLY.

1. Identify the topic of the project. (5 points)

Project Topic: _____ **Human Factors Certification** _____

2. What is the problem addressed by the simulation model used on this project?

3. What is the physical process(es) modeled?

4. What is the boundary of the model (inputs and outputs)?

5. What factors are exogenous? What factors are endogenous?

6. Which “soft variables” are included? Explain.

7. Are feedback loops properly taken into account? Which ones?