



Spring 2004

# Systems Problem 8

## Design II

### Propulsion, Payload, Operations

Handed out:	Thursday, 8 April 2004
Answers due:	Thursday, 15 April 2004, 5:00 p.m.

#### **Objectives**

At the end of this systems problem you should be able to:

- Perform system module and component design
- Report system module and component designs against requirements and strategy.

#### **Discussion**

It's time to start bringing all the pieces of your system (People, Process, Product) together as we approach the aerial competition. In this assignment you will design the propulsion module of your aircraft. You will also design your competition operational strategy and procedures, and your payload accommodation designs and strategies.

This is a design by redesign effort. You have assembled and tested a baseline out-of-the-box model aircraft. Your task now is to redesign the propulsion, payload and operations in such a way that your flight performance in the competition will be maximized, subject to the constraints imposed by the competition rules.

#### **Assignment**

This is a group assignment. Division of labor will be key to completing this system problem within the allotted time budget. For any computations or estimates you must describe your procedure in order to earn full credit:

You will have access to a number of different propeller choices. You are tasked with choosing a design that optimizes your anticipated performance. You have the opportunity to consider people, procedure and product in the design of a payload and operation procedure that give your team a competitive advantage in achieving the functional requirements of the competition.

#### **Deliverables**

#### **Propulsion**

1. Discuss the goals of your propulsion design effort. Tie your discussion to aspects related to your functional requirements document, your strategy for competing successfully in the contest, and any other practical considerations. There should be both qualitative and quantitative aspects of your discussion.
2. Define your propulsion system by providing a propeller choice. To enable you to do this, a static motor test unit is available in the Gelb laboratory. With this unit, you will be able to measure thrust, voltage, current, and propeller RPM simultaneously. Use this equipment to characterize commercial propellers which will be made available to you. There will be a signup in the lab to schedule usage of this test unit.
3. Justify your choices regarding your propulsion system design in 2. Tie your choice of propeller size to the design goals through engineering calculations and other rational means. Specifically discuss how propeller choice was influenced by wing design.
4. Estimate performance parameters for your aircraft based on your propulsion system choice. Specifically discuss static thrust, ground roll, stall speed, cruise velocity weighted and empty,  $C_{L,cruise}$ ,  $C_{L,Max}$

### **Payload Accommodation**

1. Discuss the goals of your payload accommodation design effort. Tie your discussion to aspects related to your functional requirements document, your strategy for competing successfully in the contest, and any other practical considerations. There should be both qualitative and quantitative aspects of your discussion.
2. Communicate your payload accommodation design by providing an engineering drawing and a narrative discussing operation.
3. Justify your payload accommodation design in 2. Tie your choice of payload accommodation design to the design goals through engineering calculations and other rational means.
4. Estimate payload loading time in seconds.

### **Operational Procedures**

1. Discuss the goals of your competition operational procedures. Tie your discussion to aspects related to your functional requirements document, your strategy for competing successfully in the contest, and any other practical considerations. There should be both qualitative and quantitative aspects of your discussion (e.g. Discuss quantitative time goals.).
2. Document your competition operational procedures through narrative and checklists. Specifically include detailed pilot and crew operational procedures.
3. Justify your operational procedures in 2. Tie your procedures to the system design goals.
4. Estimate your aircraft's competition score based on all your current design choices.

Original: CPColeman, Spring 2001  
Modified: GBarter, CEJohnson, PWYoung, CPColeman, Spring 2002  
CPColeman, OdeWeck, PWYoung, JPixley, Spring 2003  
CPColeman, Spring 2004

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<b>Group Number</b>	<b>Group Name</b>
<b>Name</b>	<b>Time Spent</b>