

# Functional Division Report

## Format Instructions

**Title Page**, with authors in alphabetical order

**Table of Contents** (Word will do this for you if you use Heading Styles correctly)

Each page in the report should be numbered. I prefer sequential numbering rather than number-by-chapter. The prefatory material should be numbered using lower case Roman numerals (title page is *i* but not actually numbered; first page of ToC is *ii* and is numbered). First page of Chapter 1 is page 1.

**List of Figures** (Word might do this, but you'll probably need to do it manually)

This list starts on a new page. Each figure in the report should have a caption and a figure number (below the figure, numbered 1 through *N* in order of appearance in the report). The caption should have a short part and possibly a longer description. The short part is what appears in the List of Figures. For example,

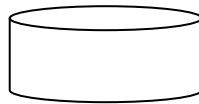


Figure 1. Cylinder. This cylinder represents an oblate axisymmetric rigid body, such as might be used to model a spin-stabilized satellite.

**List of Tables** (ditto)

This list starts on a new page. Each table in the report should have a caption and a table number (above the table, numbered 1 through *N* in order of appearance in the report). Tables should be as simple as possible. I prefer the “Simple1” style in Word rather than the default style that has horizontal and vertical lines between every “cell” of the table. The caption should have a short part and possibly a longer description. The short part is what appears in the List of Tables. For example,

Table 1. Typical Temperature Ranges for Selected Spacecraft Components. Adapted from Table 11-40 of Ref. 1

<b>Components</b>	<b>Typical Temperature Range, °C</b>
Electronics	0 to 40
Batteries	5 to 20

### **List of Abbreviations** (make this as you go, alphabetical order)

This list starts on a new page. Each abbreviation in the text should be defined where first used, and included in this list. For example,

ADCS	Attitude Determination and Control System
NiCd	Nickel-Cadmium batteries
SMAD	<i>Space Mission Analysis and Design</i> (Ref. 1)

### **List of Symbols** (ditto)

This list starts on a new page. Each symbol in the text should be defined where first used, and included in this list. You should make the list alphabetical order, and you can either make it two parts (one Greek, one Roman) or put the Greek and Roman together. For example,

$a$	semi-major axis
$\beta$	angle between sun vector and normal to spacecraft face
$I_{sp}$	specific impulse

## **Chapter 1: Introduction**

Introductory paragraph, Sections and Subsections, Summary and Overview (of rest of the report)

This chapter should describe how the particular functional areas are important to spacecraft, including how they're used and some information about what goes into them. The 2004 Functional Division Reports and other materials should be cited as references. Provide enough detail in this chapter to make it clear that you understand the relationships between this functional area and the others.

This chapter should also describe the specific new technologies and concepts that are going to be included here.

## **Chapter 2: Modeling and Analysis**

Introductory paragraph, Sections and Subsections, Summary (and transition to next chapter)

This chapter should describe how the particular new technologies and concepts are modeled, including what equations are used, what tables or charts are applicable, and what information is needed in making calculations. This chapter is where you'll want to describe *in detail* how subsystem A interacts with subsystem B. Figure 11.2 in Ref. 5 is an excellent example of how to think about these interactions. If every functional team develops such interaction matrices, you can share them and everybody can benefit from them, and nothing important will be missed. ***I think understanding these relationships is one of the most important elements of design as these interactions define the interfaces.***

This chapter should include some equations. For example, the equation of a straight line is

$$y = m x + b \tag{1}$$

We then refer to this equation as Eq. (1). (Use Equation (1) if you're beginning a sentence.) If you're using Word to create the document, then you can use a simple one-line table to create the format for displaying the equation. I highly recommend using LaTeX instead.

### **Chapter 3: Examples**

Introductory paragraph, Sections and Subsections, Summary (and transition to next chapter)

At the end of the day, a design engineer has to select components, purchase them, and assemble them into the appropriate subsystem. You have to know what's available in order to make these decisions. So, the purpose of this chapter is to get you to find out what's out there. Who makes the widgets that are needed for your subsystem? How much do they cost? How much do they weigh and how much room do they take? Do they use materials that have desirable outgassing properties? Are they space-rated? Have they flown before (heritage)? How long does it take to get them after you place the order? What precautions do you need to take in handling them? What new technologies are coming along that may eventually replace the current favorites? These are the sorts of questions that you should be attempting to answer in this chapter.

This chapter should also include some example applications, calculations, graphs, tables, and so forth. These examples can be taken from your initial work on your specific Design Projects if you'd like, or they can be examples similar to those included in design texts (but not just repeating them), or from the micro- and mini-projects of this course. The purpose of these examples is to get you to go through some of the modeling and document your work. Be sure to include lessons learned so you can remember next semester how you got past any hurdles. You *may* want to make this a separate chapter (Chapter 4: Example Applications), but I'll leave the organization up to you (reserving the right to recommend changes, of course).

### **Chapter 4: Summary and Conclusions**

Introductory paragraph, Sections and Subsections, Summary (and transition to next chapter)

Okay, you did all this work. What did you learn? This chapter should **summarize** the report: as a group decide what the major important points are and summarize those. It should draw **conclusions**: as a group, what

can you conclude about what's important in designing the subsystems described in this report? It should make **recommendations**: as a group, where do you think you'll need to do more research, where do you think you might run into difficulties, what steps can you take to ensure success?

In all of these, if you have more than one or two major points to make, put them in a bullet or numbered list rather than running them together in a long paragraph. (This applies throughout any technical writing.)

## References

A simple bibliography, numbered, in alphabetical order by first author's last name. Examples of book, book/website, conference paper, journal article:

1. V. V. Beletsky and E. M. Levin, *Dynamics of Space Tether Systems*, Univelt, Inc., San Diego, 1993
2. M. L. Cosmo and E. C. Lorenzini, *Tethers in Space Handbook*, Third Edition, December 1997. Available at the NASA Marshall Space Flight Center website:  
<http://infinity.msfc.nasa.gov/Public/ps01/ps02/space.html>
3. M. R. Long and C. D. Hall, "Attitude Tracking Control for Spacecraft Formation Flying," in *Proceedings of the 1999 Flight Mechanics Symposium*, Goddard Space Flight Center, May 18-20, 1999, pp. 319–332
4. J. D. Thorne and C. D. Hall, "Minimum-Time Continuous Thrust Orbit Transfers," *Journal of the Astronautical Sciences*, Vol. 45, No. 4, 1997, pp. 411–432
5. W. J. Larson and J. R. Wertz (editors), *Space Mission Analysis and Design*, 3rd edition, Microcosm, 1999

## Appendices

These should include information that supports or amplifies the material in the main text. You may not have any appendices, or you may have several. Usually these are "numbered" using capital letters A, B, C, *etc.*