ODE	PROJECT PROPOSAL GUIDELINES
ME 555 DESIGN OPTIMIZATION	**PANOS Y. PAPALAMBROS WINTER 2004**

GENERAL GUIDELINES

Each team will submit a single proposal about the system to be designed. Each team member will be responsible for an individual subsystem and the team as a whole will study how the subsystem designs must be coordinated to achieve an overall system optimum. Clearly, the team must work together from the beginning but the idea is to assume the viewpoint of individual designers working concurrently on their portion of a larger system.

Each subsystem design problem should have at least 4-5 variables and about twice as many constraints. The overall system should comprise at least two subsystems, which will likely share some common variables.

Each student will be graded separately for their individual subsystem design.

SPECIFIC SECTION GUIDELINES

The project proposal must be formulated to have the following sections.

ABSTRACT

This is a 200-word description of the design project, the motivation for performing an optimization study, and the anticipated results.

1. INTRODUCTION

This section introduces a *qualitative* statement of the system design project. Describe the system design problem, the anticipated trade-offs that motivate the optimization study, and the previous work that has been done by others. Identify the individual subsystems and explain *qualitatively* how they are linked. Specifically, explain if you expect that improving the design of each subsystem independently may not lead you to an overall optimal system design.

2. SUBSYSTEM DESIGN

For each subsystem identified in the introduction you must develop the full analytical model, as described in detail below. Each subsystem will be a single section. Within each such section, the individual team member will write the relevant subsections for the individual subsystem.

2.1 Problem Statement

This section contains a more detailed *qualitative* statement of the subsystem design problem. Building on the introductory description above, you now describe in more detail the anticipated trade-offs that motivate the *subsystem* optimization study. You also comment on previous work that has been done by others.

2.2 Nomenclature

Define *all* symbols used and give units for each quantity. Coordinate with the other subsystem designers so you all use the same symbols for the same quantities and avoid nomenclature inconsistencies.

2.3 Mathematical Model

Objective function
Describe the objective function in words and then *derive* its analytical expression in terms of design variables and parameters.

Constraints
Describe *each* constraint in words and then *derive* its analytical expression in terms of design variables and parameters. Try to group the constraints in two categories: *physical* constraints that express natural laws and engineering specifications, e.g., conservation of mass, energy, strength and deflection requirements, etc; *practical* constraints that may express limitations of current engineering practice, rules of thumb, etc. — these will often have the form of upper/lower bounds on the design variables.

Design Variables and Parameters
Define and list the design variables and parameters. Give a set of typical values for the parameters that you can use for the particular application. Count and state the number of degrees of freedom. Find a set of values for the design variables that satisfy *all* of the constraints, i.e., show that there is at least one feasible solution in the model as stated.

Summary Model
At the end of the model development summarize the entire problem in one page, if possible, stating the objective and all the constraints in standard form.

In the derivation of expressions for the objective and constraint functions be as explicit as possible. If you do not have yet an explicit functional form, state it implicitly, e.g., $x_1 = f(x_2, x_3)$, and explain how you will calculate the function f. Examples of that may be curve-fitting from tables or a separate subroutine (structural analysis). If you have performed curve fitting already, give the details in an Appendix. Throughout the derivations you may cite the references that you used, so that you do not have to re-derive everything in the proposal.

There may be information that you have not obtained yet, for example, appropriate values for all of the parameters. In such cases, state how you expect to get this information.

3. ACKNOWLEDGMENTS

Occasionally models used for design optimization in this class are created in other courses or in student research work. Acknowledge any such links and the assistance of any individuals that helped you in the preparation of the reported work.

4. REFERENCES

List all references in alphabetical order, complete with author, title, publisher, year, and page number. In the document text give the citation as e.g., (Johnson, 1980).

SUGGESTED SOURCES FOR PROJECT IDEAS

Ideally, you should choose some problem that is of particular interest to you. The problem may be from any discipline, i.e., you are not limited to mechanical design problems. Projects from previous years and published articles are a good source of ideas.
See that archive in http://eode.engin.umich.edu/~web/projects/.
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You may use an existing model developed elsewhere as the basis for your project, but you must take responsibility for it, namely, you must understand all the details of its derivation so you can accept it as your own.

A CAUTIONARY NOTE

It is easy to begin an optimization project with great expectations and try to use a large, complicated nonlinear model with many parameters and design variables. As your model becomes more concrete, modeling difficulties and numerical shortcomings will become evident. It is a good idea to start with the simplest model that can provide you with meaningful insights into the design tradeoffs. On the other hand you can start with a more complex problem statement and pare it down if you realize that the modeling work will be excessive. For the course, should aim for subsystem models that have 5-10 design variables and 10-20 constraints, and expand later as needed.

REPORT SUBMISSION AND FORMAT

It is strongly recommended that your reports are created using Framemaker or LaTex, both available on CAEN computers. The report must be submitted in electronic form uploaded to the course website, along with one hard copy.

An appropriate text style is Times 12-point font with one-inch margins all around and double spacing. If you have extensive equation manipulations, you can show these handwritten in an appendix and only type the main steps/results in your text. However, these pages will have to be scanned so they can be included in the electronic version.

Keep in mind that the project proposal will become the first part of your final report, after appropriate editing. Early planning will make final report production much easier.

1/2004