Capstone Design

Engineering Design II

Definition (ABET)

- Engineering design is the process of devising a system, component, or process to meet desired needs.
  - It is a decision-making process (often iterative), in which the basic science and mathematics and engineering sciences are applied to convert resources optimally to meet a stated objective
  - Among the fundamental elements of the design process are the establishment of objectives and criteria, synthesis, analysis, construction, testing and evaluation
- Taken (and edited) from http://en.wikipedia.org

Engineering Design Steps (ABET)

- This process can be divided up into a ten-step process, which includes:
  - Identifying a need
  - Defining the problem
  - Conducting research
  - Narrowing the research
  - Analyzing set criteria
  - Finding alternative solutions
  - Analyzing possible solutions
  - Making a decision
  - Presenting the product/design
  - Communicating and selling the product/design

Finding alternative solutions

- In the next step, step six, we examine various (alternative) solutions to the problem
- In this step, a list of the possible solutions is made
  - The pros and cons of each solution are considered
- May create a checklist of characteristics of the possible solutions and decide what could be changed to improve the final result
- "Brainstorming" is a great way to decide what is good about the solution and what could be changed to better the solution

Analyzing possible solutions

- At step seven, we analyze the possible solutions
- To find the best solution, analyze all possible alternative solutions to determine their potential
  - Condense the possible solutions
  - Analyze the potential performance of the solution to determine if the solution is physically possible

Making a decision

- For step eight, it is time to make a decision
- Some decisions are easily made through analyzing and constraining from the previous steps, but at other times the decision on which solution to choose can be close to impossible
  - What makes decision making so tough is the trade offs of choosing one solution over the other
  - Often engineers can come up with impeccable solutions, detailing the strengths and weaknesses of all solutions, but in the end cannot make the decision of which is better on their own
    - Attempt/desire to "over-engineer" a solution

Making a decision (continued)

- One tool that can be helpful in the decision making process is to be organized
  - Having as much information possible about all the alternative solutions will make it easier to evaluate the product efficiently
- Another crucial tool is to have the objective for the problem and important criteria clear in mind
  - Frequently when working on a problem, you may find yourself sidetracked, so it's important to remember the purpose of the solution

Presenting the product

- Step nine in the design process is clearly to specify the product to others
  - Here it is important clearly to define exactly what the solution is
- Details about the product can be given visually through sketches
  - It's important to have accurate sketches in order to describe your ideas to technicians and drafters
- Successful engineers have to communicate accurately through written, spoken and graphical languages in order to develop and interpret specifications

Communicating and selling the product

- Communication and selling the product is step ten
  - In the end, the engineer is going to have to sell the design of his or her product
  - Have to sell and explain the product in a persuading manner
- Selling the product takes place all along the design process
- Another form of communication is the written report
  - May be read by both management and clients
- These written reports can vary in formality, but usually contain:
  - An appropriate cover page, abstract, table of contents, body, conclusion and recommendations, and appropriate appendices

Communicating and selling the product

- Another common way of communicating the new product is through an oral presentation which presents the information convincingly to the listener
- The key to a good oral presentation is:
  - Be prepared, have good posture, good eye contact and project your voice loud and clearly
- It's important that the oral presentation gives enough information to get the idea across to the desired audience but not too much information to become overwhelming, and confusing
  - Technical presentations
  - Executive presentations