Study Guide 02: Exam 02 08 March 2023

Design Concepts for Engineers, Horenstein, 5th edition

Chapter 03: Project Management and Teamwork Skills 08–13 February 2023

CHAPTER OBJECTIVES

- The importance of project management in ensuring design success
- Teamwork as an essential element of engineering design
- How engineers determine the tasks that will lead to a finished product
- Scheduling and managing design tasks
- The role of the project manager
- How members of a design team interact
- Documentation and its vital role in the design process
- Legal issues and their relevance to the design engineer

VOCABULARY AND CONCEPTS

Build An Effective Team

- Agree upon goals
- Define clear roles
- Define procedures
- Develop good interpersonal relationships
- Define leadership roles

Redundancy The duplication of critical components or functions of a system with the intention of increasing reliability of the system. In the context of teamwork, overlapping the responsibilities of each team member so that if one member cannot meet their obligations, another member is prepared to step in and complete the necessary tasks

Gantt Chart Two-dimensional plot in which the horizontal axis reflects time measured in days, weeks, or months, and the vertical axis represents either the tasks to be completed or the individuals responsible for those tasks

PERT Chart Project Evaluation and Review Technique chart consists of numbered milestone circles and pathway branches. Each branch is labeled by a time interval allocated to the completion of the task to which the branch leads

Engineer's Logbook A permanent record that includes all ideas, calculations, innovations, and test results that emerge from the design effort

Intellectual Property Any product of the human intellect that the law protects from unauthorized use by others. For example: patents, trademarks, copyrights, and trade secrets

Ground Rules for Brainstorming

- No holding back.
  Any idea may be brought to the floor at any time.
- No boundaries.
  An idea is never too outrageous to mention.
- No limit.
  Another idea is never one too many.
- No criticizing.
  An idea may not be criticized until the final discussion phase.
- No dismissing.
  An idea may not be discounted until after group discussion.
- No restrictions.
  Participants may generate ideas from any field of expertise.
- No shame.
  A team participant should never be made to feel embarrassed for contributing an idea.

QUESTIONS

Can you answer these questions? If so, you should have a good grasp of the Chapter 03 concepts.

You are a member of a team of electrical and mechanical engineers developing a radio-controlled educational robot for school-age children (https://sphero.com/). Do some advance thinking and planning (see page 93 of your textbook!).

- List a set of goals for your project. Identify at least three realistic goals. Goals can be either concrete (Our team will develop a working prototype in 30 days.) or abstract (Our team will create an environment that encourages creativity.).
- Define clear roles for each member of your team. You can construct a chart similar to Figure 3.2, but you should be explicit in assigning at least two tasks or responsibilities to each team member. A single phrase or title is not sufficient.
- Explain your team's leadership structure. What sort of leadership does your team want? Single authority? Distributed responsibility? Why? Explain how you came to a decision/consensus.

Example 3.1 in the textbook (page 103) shows how to construct a PERT chart for constructing a house. Assume that construction will start on October 01, 2022, and that the plans have been approved by the architect, the builder, the homeowner, and all necessary permits have been obtained. The home is a single-family residence, to be built in a brand-new subdivision on an approximately 0.25-acre lot.

- Using the provided PERT chart as your guide, construct a Gantt chart for the same project. Be sure to include each of the tasks enumerated on the PERT. Examine the time frames given in the example, and modify if you think they are unreasonable. If you alter a time frame, be sure to note this.
- Add three new tasks to the Gantt chart which are not given in the example, but which will need to be completed before the home can be occupied (for example, the rooms will need to have some kind of flooring installed, but "tile kitchen floor" and "carpet all bedrooms" are not two different tasks).
- Based on your Gannt chart above, what is your estimate for the total time of the build? Why, then, does it typically take much longer than that for new home construction? Cite three possible reasons for this. Your reasons must be different (i.e., "bathroom tile on backorder for 6 weeks" and "kitchen tile on backorder for 3 weeks" are not two different reasons; they are two different examples of the same reason for delay).
- How can a television program like "Extreme Makeover: Home Edition" construct a new home from the ground up in seven days? How would your Gantt change if your project had to be completed in only 7 days?.
- Briefly distinguish between a technical report and a peer-reviewed journal article. Why is the peer review process important?
- The textbook uses a case study (Section 3.3.7) to illustrate the importance of meticulously keeping a good engineering log book. Summarize the case briefly and explain why the logs kept by Heartthrob engineer Dr. Maven ended up being so important.
- Do a little bit of googling on intellectual property.
  - What are some forms of intellectual property? Give two examples.
  - If you were an engineer employed (with a written contract) by a client to design Object X, what happens to your engineering log books at the end of the project? Who owns them?

Chapter 04: Engineering Tools 15–27 February 2023

CHAPTER OBJECTIVES

- Learn the importance of estimation in engineering design
- Examine the important role of the engineering prototype
- Read about the role of reverse engineering in the design process
- Examine the role of the computer in engineering design
- Learn about the Internet and several software programs that are central to the engineering profession
- Learn when and when not to use the computer
- Discuss several examples of computer use for analysis, data collection, simulation, and computer-aided design

VOCABULARY AND CONCEPTS

Estimation	An approximate value for some quantity based on the best knowledge and experience of the person performing the calculation
Why You Estimate	Because sometimes you cannot perform the actual calculation until you have done the experiment or built the part—but you need to know ahead of time whether it's feasible to perform the experiment or build the part
How You Estimate	Sometimes you just happen to know a quantity because you have direct experience. Sometimes you can accurately estimate an unknown quantity because you have experience with a similar known quantity. Sometimes you have to synthesize a final estimate by identifying multiple parameters affecting the problem and estimating the contribution of each
SI Units	Système International d'Unitès, aka the metric system. The standard system used by the entire planet, with the exception of the United States, Liberia, and Myanmar
Fundamental Unit	Cannot be broken down into a combination of simpler dimensions (i.e., length, mass, time, electric charge)
Derived Unit	Composed of a combination of fundamental dimensions (i.e., speed = length/time)
Dimensional Analysis	Examine both sides of an equation and determine the dimension of each. If the dimensions do not match, the equation cannot be correct

Unit Analysis	Examine both sides of an equation and determine the units of each. An equation might be dimensionally correct, but not accurately applied because of unit discrepancies
Significant Digits	Any nonzero digit, or any zero other than a leading zero. Why is this significant? Because you should never report results that are more precise (more sig figs) than the tools used to make the measurements
Add or Subtract	Keep the least number of decimals in your result
Multiply or Divide	Keep the least number of sig figs in your final result
Tolerance	Specifies the degree of error that will be acceptable for the finished part
Prototype	A mock-up of the finished product that embodies all its salient features but omits nonessential elements, such as a refined appearance or features not critical to fundamental operation
Reverse Engineering	The process by which an engineer dissects someone else's product to learn how it works. A good way to avoid patent infringement and other legal problems by specifically avoiding an approach taken by a competitor

Questions

Can you answer these questions? If so, you should have a good grasp of the Chapter 04 concepts.

- Estimate! How much money does the Starbucks™ in the Torreyson Library here on campus make on any random/typical Tuesday during the semester? Assume gross, not net (don't try to estimate expenses). List your assumptions clearly, and the values you are assigning them. Show your cipher! Be explicit in showing how you calculate your final estimate.
- Demonstrate whether the equation below is dimensionally correct:

  $$x = v_o t + \frac{1}{2}at$$

  Assume x is a distance in meters, v_o is a speed in m/s, t is time in seconds, and a = acceleration (m/s^2). Show your work!
- Perform the following computation:

  $$(56 + 7.3) \times 65.45 \div 9.2$$

  Follow order of operations and report your answer with the proper number of significant digits.
- Google "Tucker 48" and go deeper than the first hit to the Wikipedia page!
  - Find two different websites that you think have reliable information. List the URL for each website and cite two reasons or features of the site that give you confidence in the credibility of each.
  - List five facts about the "Tin Goose" prototype.
  - Identify two features of the prototype which did not make it into the production model.
- Identify four things or features that you think are red flags, or warning signs that a website is not presenting credible or reliable information.

At some point during your engineering education or career, you might need to acquire some skills and experience with a CAD program. There are many, many programs out there, but you might be constrained by your environment; if your university or workplace is site-licensed, you'll use what's available to you. However, let's say that you are tasked with making the decision for your small (5-10 people) research group (if you're in grad school) or office (if you're employed by an engineering firm).

- List at least three program features or functions that your CAD program absolutely must have or must do.
- Locate at least three available software packages which meet your selection criteria.
- Compare your choices and come to a decision. Justify how well your candidate CAD programs meet your criteria (or fall short), and *why* you made the selection you did. Without copy/paste-ing, create a convincing table or chart that illustrates how you made your decision.