Design for Electrical and Computer Engineers

Theory, Concepts, and Practice

Instructor's Solution Manual

Ralph M. Ford and Christopher S. Coulston

This document was prepared with LaTeX.

Contents

Preface: How to Use This Manual

This manual provides solutions to the problems found in Design for Electrical and Computer Engineers: Theory, Concepts, and Practice. For guidance to instructor's we identify problems as either: review, application, and project. Review-type problems usually ask the student to restate an important concept from the text, whereas application problems are those where the students are required to solve a more in-depth project that demonstrates an understanding of the concepts learned to a new scenario. Project problems are important steps in the completion of a senior capstone design project. Each particular problem is categorized in this solutions manual as to the type of problem it is by using the key [R], [A], and [P].

Furthermore, we also provide our guidance (identified in the manual as Notes), from experience teaching the material, with pointers on how we present the material and apply it to student projects. Selected project assignments are also supplied.

We also ask that instructor's keep this manual for instructor use only and do not post or otherwise distribute our solutions in any form. Unfortunately, it is becoming all too common for solutions to be copied and distributed over the Internet, thus hurting other instructors using the book.

Feedback

Feedback and suggestions concerning any aspect of this manual, that would likely benefit the overall presentation, would be much appreciated. Please send your comments via email to Ralph-Ford@psu.edu or coulston@mines.edu

0.1 Problems

1. In your own words, describe the difference between prescriptive and descriptive design processes. Cite examples of each.

   [R] *Prescriptive design processes "prescribe" an exact sequence of steps and decisions for realizing a design. There are often decisions that must be made in prescriptive processes for determining whether to move from one stage to the next, or to move to the next phase. Descriptive processes describe the general steps needed to achieve a design, but do not explicitly layout the steps which should be followed to achieve the design.*

2. Describe the relationship between the Problem Identification, Research, and Requirements Specification phases of the design process.

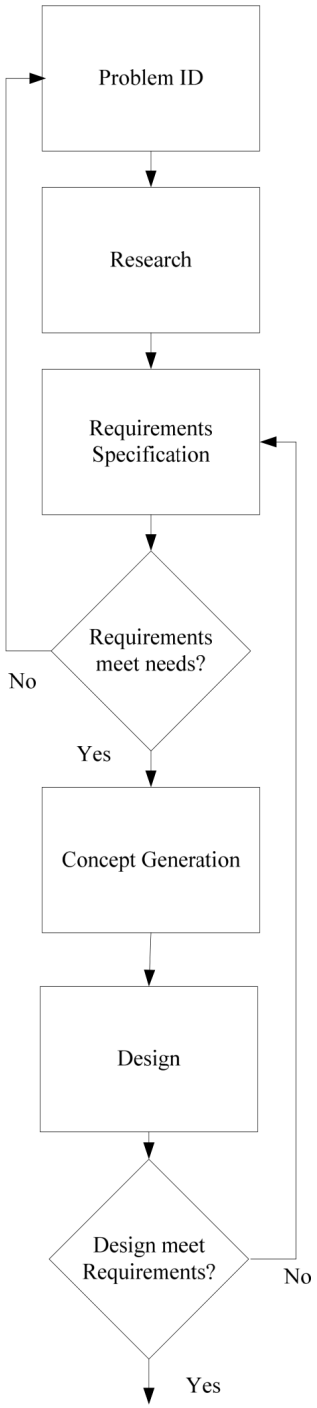
   [R,A] *Problem Identification, Research, and Requirements Specification are three early phases of the design process. The overall objective of these phases is to identify a problem, analyze it, and develop requirements for its solution. The Problem ID phase is where the end-user needs are determined, while further analysis occurs in the research phase. Both problem and research phases are used to develop a Requirements Specification that provides the requirements for those elements that must be satisfied in order for a successful design.*

3. Describe the relationship between the Concept Generation and Design phases of the design process.

   [R,A] *In Concept Generation, different technical options for solving the design are given – one is selected to pursue. In the Design Phase, the option selected from Concept Generation is further clarified and the design architecture is more clearly defined.*

4. Construct a prescriptive design process for the Problem Identification, Research, Specification, Concept, and Design phases of the design process. The result should be a flow chart that contains decision blocks and iteration as necessary.

   [A] *In the prescriptive design process, shown in the figure below, there are two decision points, one of which occurs after the requirements are determined. The objective in this decision is to determine whether the requirements satisfy the end-user needs. If not, the needs must be re-examined and the requirements must be updated as necessary, in order to meet the customer needs. The other decision occurs after the design is generated. Here, the objective is to determine if the design satisfies the requirements. If not, a new design*



concept must be generated.

5. Describe the main differences between the VLSI and embedded system design processes.

   [**A**] *VLSI and embedded systems design share similarities and contain differences. They are both similar in that they have phases for requirements specifications, system architecture design, and technical design. The difference between them lies in the technical*

design, where the steps depend upon the technology that is being developed. In the case of VLSI, steps are used to successively refine the design to meet develop a layout level circuit; however, embedded design requires that the technical design phase consists of software and hardware co-design.

6. Using the library or Internet, conduct research on the spiral software design process.

   a) Outline the significant elements of the spiral software design process.

   b) Describe the advantages and disadvantages of this relative to the waterfall model?

   Cite all reference used.

   [A] *The spiral methodology reflects the relationship of tasks with rapid prototyping, increased parallelism, and concurrency in design and build activities*[1] *The spiral process recognizes that errors will occur in all stages of the production process and proceeds on this basis*[2]*. It is agreed that the development processes will have to be revisited multiple times as the design furthers completion; therefore, unlike the Waterfall model, this methodology incorporates an iteration cycle, which is continued until the design is fully complete. A Spiral Development Model diagram can be found at http://www.hyperthot.com/pm_sdm.htm as well at other sites on the Internet. Embedded in spiral design is the process of refactoring – changing software in such a way as to improve structure, but not affect the end result*[3]*. Overall, the spiral software design model is not as rigid, concrete, and strict as the Waterfall model; however, this method should still be planned methodically, with tasks and deliverables identified for each step within the spiral. The table below lists the advantages and disadvantages of the spiral design model in reference to the waterfall model.*

	Advantages		*Disadvantages*
1	*Increased time-to-market*	*1*	*Revisiting the same stages*
2	*Incremental & Iterative*	*2*	*Requirements are not fully identified*
3	*Promotes increase in documentation*	*3*	*Project goal is not initially established*
4	*No set structure or phase routine*		
5	*Non-idealistic*		
6	*Not as costly to revisit process steps*		
7	*Primitive to more intricate design*		
8	*Allows development to begin w/o full understanding*		

(1.) Chapman, James. "Spiral Methodology." Software Development Methodology. *2005. 20 May 2005 http://www.hyperthot.com/pm_sdm.htm*

(2.) Culwin, Fintan. "The Production Process." LAW – Learn Ada On the Web. *1998. 20 May 2005 http://www.scism.sbu.ac.uk/law/Section1/chap1/s1c1p3.html*

(3.) Hean, Daniel. "Design through to testing." Content & Document Management System. *2005. 20 May 2005. http://www.yedit.com/web-content-management-system/400-design-through-to-testing.html*

7. **Project Application.** In preparation for project and team selection, develop a personal inventory that includes a list of five favorite technologies or engineering subjects that you are interested in pursuing. Also, list the strengths and weaknesses that you bring to a project team.

[**P**] *Note: We find this exercise an important step in starting students on the path of team formation and project selection and usually assign it on the first day of class. We setup an electronic bulletin board for the students and have them post this information publicly for the whole class to see. Students are then encouraged to review this and identify potential team-mates. We have also done a variation where each student is required to determine this information and then make a short oral presentation (2 minute pitch) to the class, in which they describe what types of projects they are interested in and what strengths/skills they can bring to a team.*