**Requirement 5A Capstone**

**Design Project II: ECE458**

**Course Overview: Catalog Description**

Continuation of ECE 457. Goals of this course are for the student to conduct, successfully complete, and professionally present the results of his/her capstone design project under the oversight of his/her faculty advisor. The objects of this course include executing the design project plan prepared in ECE 457, conducting group activities associated with the execution of the design project, participating in design reviews, preparing the project report, and presenting and demonstrating the results of the project activities to a group of faculty, students and industry representatives. Included in this course are three major written reports, and three major oral presentations as well as other minor reports and presentations.

**Learning Outcomes:**

**Course-Specific Learning Outcomes:**

*The first part includes the learning outcomes for the course that have been agreed upon amongst the department’s faculty and which are not directly linked to the University Studies curriculum.*

Program Outcome 9: Graduates will have an ability to work as a contributing member of a multidisciplinary team.

**University Studies Learning Outcomes:**

***5A. Capstone Study***

*Approved courses will give students the opportunity to integrate their learning and produce an original expression of knowledge or understanding. Students will also demonstrate mastery of both written and oral communication.*

*Upon completion of the capstone study, students will be able to:*

*1. Synthesize the knowledge and skills gained within major courses, independently complete a research-based project or creative work and integrate the results of both in an open-ended project or experience (projects within the major are encouraged).*

Satisfied through Program Outcome 6 and 8 and course assignments a-g

*2. Integrate knowledge and principles from the field of study with those of the broader University Studies curriculum.*

Satisfied through Program Outcomes 12d and course assignments d, e and g

*3. Demonstrate advanced information literacy skills by selecting, evaluating, integrating and documenting information gathered from multiple sources into discipline-specific writing.*

Satisfied through Program Outcome 10b and course assignments a-g

*4. Communicate effectively, both orally and in writing, the results of the project or experience.*

Satisfied through Program Outcomes 10a and 10b and course assignments a-g

**ECE Department ELE and CPE Program Learning Outcomes**

Program Outcome 6: Graduates will have effective laboratory skills

a) Design of experiments

b) Construction, debugging and execution of experiments

c) Collection, analysis and interpretation of data

d) Documentation of experimental process and results

Program Outcome 8: Graduates will be able to design a system, component, process or computer program to meet design needs using design principles, techniques and engineering tools.

a) Design Issues such as reliability, practicality, cost and meeting specifications

b) Process Methods such as planning, progress reviews, reporting, scheduling

Program Outcome 10: Graduates will be able to communicate and express ideas coherently, professionally and effectively.

a) Orally

b) Written

Program Outcome 12: Graduates will have an understanding of contemporary issues and an understanding of engineering on society

d) Impact of engineering solutions

**Examples of Texts and/or Assigned Readings:**

*Design for Electrical and Computer Engineers: Theory, Concepts, and Practice*, by Ralph M. Ford and Chris S. Coulston, published by McGraw-Hill, ISBN 978-0-07-338035-3

*Electronics Project Management and Design*, 2nd edition, by D. Joseph Stadtmiller, published by Pearson Prentice Hall, ISBN 0-13-111136-1

Course reading are listed in the course outline section

**Example Course Assignments and Requirements**

1. Critical Design Review (oral presentation and written report week 5 )

Satisfies Program Outcomes 8a, 8b, 10a and 10b and US 5.A.1, 5.A.3 and 5.A.4

1. Status Review (oral presentation and written report week 9)

Satisfies Program Outcomes 8a, 8b, 10a and 10b and US 5.A.1, 5.A.3 and 5.A.4

1. Customer Acceptance Test Plan (written report week 14)

Satisfies Program Outcomes 8a, 8b, 10a and 10b and US 5.A.1, 5.A.3 and 5.A.4

1. Project Final Report (week written report14)

Satisfies Program Outcomes 8a, 8b, and 10b and US 5.A.1, 5.A.3 and 5.A.4

1. Final Design Presentation (oral presentation week 14)

Satisfies Program Outcomes 8a, 8b, and 10a and US 5.A.1, 5.A.3 and 5.A.4

1. Project Notebooks (written daily log due week 14)

Satisfies Program Outcomes 8a, 8b, and 10a and US 5.A.1, 5.A.3 and 5.A.4

1. Reflection essay (due week 14)

Satisfies US 5.A.1, 5.A.2, 5.A.3 and 5.A.4

**a) Critical Design Review (CDR)**

The CDR will be used to assess whether or not your project is on time, within budget and able to satisfy your customer’s needs. The status review will update all of the material you covered in the PDR (requirements, technical design, risk management, EVA, budget and schedule.) You are NOT to come up with new schedules, budgets, or requirements. You are to present your status relative to your project plan. Emphasis should be placed in explaining your design at the component level and how you have progressed in mitigating your risks including prototyping results. You are also to present your status relative to your project plan, and any corrective actions to get back on plan. Proper business attire should be worn.

Deliverables: PowerPoint presentation and a short report.

**b) Status Reviews (SR)**

The status reviews will be used to assess whether or not your project is on time, within budget and able to satisfy your customer’s needs. The status review will update all of the material you covered in the CDR (requirements, technical design, risks, EVA, budget and schedule.) You are NOT to come up with new schedules, budgets, or requirements. You are to present your status relative to your project plan. Emphasis should be placed in explaining your design at the component level and how you have progressed in mitigating your risks. You are also to present your status relative to your project plan, and any corrective actions to get back on plan. Proper business attire should be worn.

Deliverables: PowerPoint presentation and a short report.

**d) Project Final Report**

1. Requirements:
   1. Customer requirements, including performance, accuracy, power, weight, thermal, environmental and safety requirements as accepted
   2. System requirements
   3. Derived requirements
   4. Results of the ATP.
2. Task statements, statement of work and work breakdown structure:
   1. Task breakdown (what tasks are necessary to accomplish your project)
3. Technical approach:
   1. a functional block diagram of the system
   2. detailed hardware design including schematics and PCB layout diagrams
   3. software structure breakdown
   4. detailed software design
4. Schedule:
   1. Show all tasks with start and end dates, including reviews, presentations, and report dates.
   2. Schedule will be given using a Gantt chart.
   3. The schedule must be presented as planned and actually executed
5. Budget
   1. Present three budgets: actual cost, production cost and cost plus labor
   2. The budget must be presented as planned and actually executed.
6. Earned Value Analysis
   1. Completed EVA graph
7. Risk analysis:
   1. Risk analysis will include the likelihood, potential impact, and mitigation strategy for three categories of risk: 1) technical performance risk, 2) schedule risk, and 3) cost risk.
   2. Identify areas that benefited from prototyping (hardware and/or software) and explain how you will these efforts were conducted and how they affected the design efforts.

Deliverables: Written report.

**e) Final Design Presentations**

The final design presentation will cover all of the material in the final report, plus a demo of your project. The demo may be “live” or in the form of a video. These presentations will be open to the general public. Proper business attire is required.

Deliverables: PowerPoint presentation.

**f) Project Notebooks**

Lab notebooks will be maintained in ink by each student. Notebooks will be bound (no spiral or ring-type binders) with the front of each page numbered in ink. There should be no erasures (cross out unwanted entries) and all entries (or pages) should be dated. Include all requirements, design decisions (with rationale for each) all calculations, preliminary designs, test set-ups, and test results. Data sheets and other material may be taped or stapled into these books. Work that represents group effort will be documents as such, with a clear accountability of who was responsible for each piece. These are due with the formal report.

**g) Reflection**

Write a one-page essay "Describing the way this project connected to the world; identify the cultural impact; and specifically state what courses you drew knowledge from to do this project."

**Sample Course Outline and Readings:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Week | Topic | Design for Electrical and Computer Engineers (Ford book) | Electronics Project Management and Design (Stadtmiller book) | Other handouts |
| 1 | Intro |  |  |  |
| 2 | Engineering design and component selection |  | Chapter 9, 10 & 11 |  |
| 3 | Discuss CDR  Review systems engineering process | Chapters 1, 5, 6 |  | EIA/ANSI 632  IEEE Std 1220 |
| 4 | PCB layout and prototyping, part I |  |  | Notes and files |
| 5 | CDR |  |  |  |
| 6 | PCB layout and prototyping, part II |  |  | Notes and files |
| 7 | EMI/RFI |  |  | Notes |
| 8 | Testing | Chapter 7 | Chapter 12 |  |
| Spring break | | | |  |
| 9 | Status review |  |  |  |
| 10 | Intellectual property | Chapter 11 |  |  |
| 11 | Industry speakers |  |  |  |
| 12 | Industry speakers |  |  |  |
| 13 | Industry speakers |  |  |  |
| 14 | Final Presentations |  |  |  |