BSECE Capstone Design Course Requirements

Approved by the Curriculum Committee
Approved by the ECE Faculty

Courses and course sequences which are to be used for satisfying the major design experience in a given concentration must comply with all of the following requirements:

1. Open Ended

The design problem must have multiple reasonable and feasible solutions, without an obvious single best solution. The solution space must have a high dimensionality. Substantially different problem solutions must be possible. Design problems might have many different optimal solutions. The design process must require tradeoffs, balancing of conflicting constraints, and the use of engineering judgment.

2. Creative

The design problem must require innovation, exploration and synthesis of ideas on the part of the students. It should not be a straightforward application of material directly from lecture, text or the Internet.

3. Major

While multi-quarter design projects are preferred, the design project must be pursued over a majority of the quarter, and involve a substantial amount of student effort. There must be at least seven weeks of open ended design from design proposal to final project report. Course grading must be at least 70% based on the design project grade. Lecture material in the design course must be specific to the design project, and not teach unrelated new material. Quizzes, homework and laboratory experiments must also specifically support the design project. Non-project student work should be minimized in favor of open ended design. The design project may be presented as a single problem or assigned and solved in a succession of related steps.

4. Rigorous

Design projects must involve significant engineering design at the senior electrical engineering level. The problem must require the application of skills and tools taught in earlier coursework associated with the topic area. The design project must also require the team to acquire and apply new knowledge not covered in formal coursework. Physical prototyping of the design is preferred, if possible. Detailed and accurate

simulation of design performance in lieu of physical prototyping is acceptable when physical prototyping is not possible.

5. Teamed

The project must be undertaken by teams, not individually. All members of each team must be engaged on the same design project. Each team must be required to provide their own leadership, create collaboration and inclusivity, establish goals, plan tasks, and meet objectives. All members of the team are expected to contribute to the technical design work, project management, and final documentation.

6. Communicative

A comprehensive final report is required of all projects. Design files such as drawings, layouts, schematics, or code are not a substitute for a final written project report, although they may preferably be included as part of the overall project documentation. Oral presentations and/or design reviews are strongly encouraged, and class or section size should be limited as necessary to enable such presentations. Design project reports must explicitly include a discussion of how engineering standards were considered and how multiple, realistic constraints were involved in the design. Building final reports from intermediate design reviews is recommended.

7. Assessed

Design projects must be critically assessed and graded on the quality of the design rather than the effort. Assessment may necessarily have a high subjective component. Involvement of outside expertise (industrial mentors, for example) and other students in the class in the assessment process is encouraged. Grading should have a significant team component, and a significant individual component.

8. Realistic

Design projects should be as close to real world design problems as the topic area and time and resource limitations allow. They should, whenever possible, require designs to conform to appropriate engineering standards adopted by recognized standard-setting organizations. IEEE, IEC, ISO, NERC, and ANSI numbered standards are preferred where appropriate. Problem solutions should reflect the state of the art in the topic area, but not necessarily attempting to advance it. Assessment should favor the more pragmatic solution.

9. ABET-Compliant

Capstone design courses should, at minimum, address the following ABET Criterion 5 student outcomes:

(1) *An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics*

(2) *An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.*
(5) *An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.*
(6) *An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions (Experiment & Analyze data)*

(7) *An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.*

Capstone design projects must produce written student work products which allow assessment of the above student outcomes as part of the continuous improvement plan (CIP). The use of recommended report guidelines is strongly encouraged.

Capstone design projects must provide a major design experience conforming to that described in ABET Criterion 5: "*a culminating major design experience that 1) incorporates appropriate engineering standards and multiple constraints, and 2) is based on the knowledge and skills acquired in earlier coursework.*"