TAIF UNIVERSITY
COLLEGE OF ENGINEERING
DEPARTMENT OF CIVIL ENGINEERING

GUIDELINES FOR SENIOR GRADUATION PROJECT

2018

1440 H

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I. ABET Criteria

ABET Definition of Engineering Design

- Process of devising a system or process to meet desired needs. It is a decision-making process, in which the basic sciences, mathematics, and engineering sciences are applied to convert resources optimally to meet a stated objective.
- Fundamental elements: Establishment of objectives and criteria, synthesis, analysis, construction, testing, and evaluation.
- Engineering design includes development of creativity, use of open-ended problems, use of modern design theory and methodology, formulation of design problem statements and specifications, and consideration of alternative solutions.
- Include a variety of realistic constraints such as economic factors, health and safety, and environment considerations.
- All design work should not be done in isolation by individual students; team efforts are encouraged where appropriate.

II. Introduction

The main aim of the senior graduation project is to provide students with an opportunity to practically apply concepts, rules, methods and techniques learned in their undergraduate education to a real world civil engineering project.

Senior graduation project should be a comprehensive and meaningful effort, focusing on a major area of Civil Engineering and integrating design skills that students acquire in major areas of Civil Engineering in the curriculum. It should mainly be design as opposed to analysis.

A senior graduation project should include:

- Determination of design objectives and functional requirements based on needs statement, identification constraints on the design problem, and establishing criteria for acceptability and desirability of solutions.
- Formulation of the design problem based on objectives and constraints
- Development of a design strategy, including an overall plan of attack, decomposition of design problem into subtasks, prioritization of subtasks, establishment of timetables and milestones by which progress may be evaluated. This plan will be used to guide the course of action during design implementation.
- Considering alternative ideas/solutions systematically
- Evaluation/analysis of alternative solutions to obtain the best solution based on their feasibility by considering the realistic constraints.
- Selection the most feasible and suitable solution among design alternatives.
- Realizing the selected/best solution in a working model or prototype.
- Documentation design work properly in a standard formal report

III. Learning objectives

By the completion of the course, the students should be able to:

1. Analyze a project statement, brief, or proposal to identify the real problem and the most relevant needs and operational constraints.
2. Identify potential customers, their needs, and their operational constraints.
3. Collect and review related data such as technical information, regulations, standards, and operational experiences from credible literature resources.
4. Integrate previous knowledge from mathematics, basic sciences, engineering fundamentals and discipline related courses to address the problem.
5. Discuss all applicable realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
6. Define design objectives, design constraints, measures of design viability, and the evaluation criteria of the final project, and reformulate the problem based on collected data.
7. Generate possible solutions; compare alternatives, and select one alternative based on evaluation criteria and feasibility analysis.
8. Plan an effective design strategy and a project work plan, using standard project planning techniques, to ensure project completion on time and within budget.
9. Implement a planned design strategy for an Experimental Design Project, if applicable:
    - 9.1. Identify experimental variables and parameter with ranges and desired accuracies.
    - 9.2. Select appropriate experimental tools such as sensors, instruments and software.
    - 9.3. Explain a reliable experimental setup and experimental procedure that solves the problem.
    - 9.4. Explain efficient measures to deal responsibly with safety issues and environmental hazards.
    - 9.5. Use appropriate measurement techniques to ethically collect and record data.
    - 9.6. Analyze experimental data using appropriate tools such as data reduction and statistical analysis.
    - 9.7. Perform uncertainty analysis.

9.8. Judge, verify, and validate the experimental result by comparing them with theory and/or previous experimental works.

10. Implement a planned design strategy for a Product-Based Design Project, if applicable:

10.1. Identify design parameters as well as assumptions.

10.2. Carry out initial design calculations using modern engineering tools.

10.3. Use constraint analysis and trade-off studies of the design parameters to refine the initial design and obtain a final optimized design.

10.4. Evaluate the project related environmental, social, health and safety issues as well as hazards anticipated by the project.

10.5. Evaluate project success in satisfying customer's needs, design criteria and operational constraints.

11. Demonstrate ability to achieve project objectives while acting as an effective member of a multidisciplinary team.

12. Communicate design details and express thoughts clearly and concisely, both orally and in writing, using necessary supporting material, to achieve desired understanding and impact.

IV. Design Project Essentials

- The project must be a design project (Capstone design project).
- The project can either be proposed by advisors, a group of students, or an industry/sponsor.
- The project must satisfy the ABET requirements.
- The project should expose the students to real life and open- ended problems and encourage them to find their solutions.
- Project must be related to a known process with an available flow sheet.
- Each project should be undertaken by a group of 2-6 students.
- Each project should be supervised by a group of 2-3 faculty members.
- The tasks of each student must be well-defined at the beginning of the project.
- The project duration is two consecutive semester of 14 weeks each.
- A copy of the proposal must be attached in the final report.

V. Capstone Implementation Procedures

Implementation of Senior Graduation Project in the CE department is done using the following procedures.

1. **Startup: Registration & Teams Formation**

   1.1 Each specialized group in the CE program will nominate at least one faculty member to work as students' supervisor/s.

   1.2 The nominated senior project supervisors from different specializations will meet as early as possible to formulate multidisciplinary supervising teams for different projects. Each multidisciplinary supervising team has to nominate its coordinator from its members and may select at least one industry professional as an external advisor to form the project advisory team.

   1.3 Each project advisory team shall prepare a clear situation description for a real life project and fill the Senior Project Proposal Form, Appendix A.

   1.4 Students shall register for the senior project course in sections of two or three students. Each section will be supervised by one faculty member according to the enrolled students chosen specialization.

   1.5 Number of sections in each specialization will depend on different projects requirements.

   1.6 Upon registration, a public lecture will be given to the registered students and attended by at least the coordinator of each project. During this lecture, each coordinator will present his project requirements including the number of disciplines involved. A project may address at least two specializations. Based on that, project student teams will be formed and it may range in size depending on the number of specializations addressed by the project.

2. **First Semester Tasks**

   Upon formulation of Projects Advisory and Student Teams, the following implementation steps should be followed by student team members:

   2.1 Attend and participate in scheduled project meetings.

   2.2 Keep a notebook that contains a log or record of significant events, analyses, designs, laboratory test data (if any), telephone conversations, meeting minutes, and results.

   2.3 Present status of project progress during the project team meetings.

2.4 Prepare a project proposal identifying scope, resources, budget, and implementation schedule.
2.5 Get the advisor approval on the proposal.
2.6 Prepare detailed problem definition that include but not limited to:
  2.6.1 Students understanding of the problem,
  2.6.2 Project objectives.
  2.6.3 A review of the fundamental background knowledge and principles related to the problem.
  2.6.4 An identification of the data and information needed to solve the problem as well as the appropriate data collection methods.

2.7 Suggest alternative solutions for the problem and identify the project realistic constraints such as constructability, cost, time,…etc.
2.8 Evaluate feasibility of alternatives or proposed solutions by considering project constraints.
2.9 Select the most feasible and suitable concept among design alternatives.
2.10 Develop work plan for implementing the selected alternative.

3. <u>First Semester Deliverables & Grade</u>

3.1 On week ***eleven*** of the first semester, each project team has to submit a written progress report summarizing the work completed by the team and the remaining part of the work required to complete the project.
3.2 On week twelve of the first semester, students should give an oral presentation about the progress report. All the projects advisory teams will attend these presentations.
3.3 The aforementioned presentation is mandatory and failing to conduct it will result in an (F) grade for the faulty student(s).

4. <u>Second Semester Tasks</u>

Upon passing the previous step, based on the consent of the project advisory teams, each student team can start the implementation phase of its project during which they will:

4.1 Create a list of project deliverables that will be submitted to the project advisory team, according to the milestones indicated in the project implementation work plan.

4.2 Exchange required information between team members.
4.3 Prepare the project deliverables and the final project documents including, design notebook, drawings, fair cost estimate, detailed time schedule for construction, among others.
4.4 Order and procure all materials needed for the project.
4.5 When required, design and fabricate those parts that cannot be purchased.
4.6 When required, assemble and test components of the project.
4.7 Analyze test results and modify solution as appropriate.
4.8 Submit the final report at the specified due date according to the required format.
4.9 Prepare a poster describing their work.
4.10 Present a final oral report.
4.11 Return all materials to proper places, and clean up the areas used.

5. Second Semester Deliverables & Grade

5.1 The final project report is due by week 11 of the second semester.
5.2 Final report presentations should be conducted by week 13 of the second semester.
5.3 Failing to fulfill requirements stated above, will result in an (IC) grade.

6. General Expectations

6.1 During the execution of the work in the project, every student in the project team has to demonstrate the following:
6.2 Attend all team meetings or work sessions.
6.3 Contribute a fair share to the project workload.
6.4 Be prepared for the group meetings with clearly formulated ideas.
6.5 Cooperate with others (outside his specialization).
6.6 Share credit for success and accountability for team results with others team members.
6.7 Share information with others and provide assistance to others.
6.8 Demonstrate the ability to assume a designated role in the group.
6.9 Value alternative perspectives and encourage participation among all team members
6.10 Remain non-judgmental when disagreeing with others and work on conflict resolution.

6.11 Do not "point fingers" or blame others when things go wrong.
6.12 Is courteous to his fellow group member.
6.13 Has knowledge, technical skills, issues and approaches pertained to disciplines of civil engineering addressed by the project?

VI. Professional Practice Constraints

This capstone course, will offer the student an early exposure to engineering practice. Hence, it incorporates other considerations such as project management, and communication experiences, in addition to design.

The following constraints should be emphasized:

a. Constructability Constraints: Limits placed on the structural form, the building materials, and the construction methods employed so as to provide for ease of construction.
b. Economic Constraints: Limits placed on fiscal, temporal and manpower resources in developing alternative design solutions.
c. Sustainability: Limits placed on the design and use of products and processes in recognition of their true lifecycle and long-term costs to society.
d. Environmental Effect Constraints: Restrictions that limit the adverse effects of human activity on the quality of all life on Earth.
e. Health and Safety Standard Constraints: Standards that serve to protect or maintain human life by minimizing risks from injury or disease.
f. Ethical Standards: Principles of conduct and integrity, which govern the behavior of an individual or group toward other individuals or groups within a community.
g. Social Values Constraints: Limits which society places on the research and development of new technology and advanced products according its own prescribed set of values.
h. Political Implication Constraints: Restrictions instituted by society, as expressed through its governing bodies, which reflects the prevailing political will of its constituents.

VII. General Requirements and Responsibilities

1. General Requirements

1.1 Design is to be on system or multi-component design; not about a research topic, survey, or review of a certain subject area.
1.2 English must be used in writing and presentation.
1.3 Reports should be prepared using word-processing and computer graphics.
1.4 Drawings should be prepared using AutoCAD.
1.5 Design reports must reflect students' work, including editing.

2. Responsibilities

2.1 Student Duties:

2.1.1 Students must meet and consult with their supervisors periodically.
2.1.2 Perform the work assigned and put significant individual effort towards the completion of the group task.
2.1.3 Maintaining honesty and personal conduct when searching for and obtaining relevant information.
2.1.4 Submitting all reports on time as specified by project supervisors.
2.1.5 Attend weekly meeting scheduled by the common advisor.
2.1.6 Appear for oral examination at the end of the term.

2.2 Advisor's Duties:

2.2.1 Regularly meet with the students and provide assistance.
2.2.2 Approve the schedule of the different project tasks.
2.2.3 Control and monitor the progress of the project.
2.2.4 Assess students both collectively as well as individually.
2.2.5 Ensure that the team keeps the project binder up-to-date.
2.2.6 Correct and evaluate the final report.
2.2.7 Approve the submission of the final project report.

VIII. Senior Project Examining Committee and Grading

Examining Committee

The examining committee will consist of the senior project advisor (as a chairman, the Project coordinator and an industry professional, if applicable. The examining committee will evaluate the student based on the items listed in Appendix C of this document. The advisor will be responsible for entering the final grade in the Computer system. The examining committee will take into consideration any delay by the student in submitting any of the required documents and may penalize the student for that delay.

Grading

Grading for the course will be based on accomplishment of all of requirements as well as the quality of the effort. The grade will be distributed on the efforts and deliverables during two semesters. Attendance and participation during meetings will be taken into consideration.

Grades are assigned by the Course Faculty Advisor. The student should discuss grading criteria with your advisor. In the event of problems you should first discuss the matter with your advisor. If you are unsatisfied, you should then discuss the matter with the Senior Project Coordinator. The senior project grade is divided as follows:

Work Item	Grade
1. Follow up meetings	15%
2. Report Format and organization.	10%
3. Report Content.	50%
4. Oral Presentation.	15 %
5. Team Work	10%
Total	**100%**

Assessment of items 2 to 5 will be done using attached assessment forms (see Appendix C)

IX. Contents and Format of the Capstone Project Report

The final design report will contain the following:

- Cover Page
- The approval page
- Abstract
- Acknowledgement (optional)
- Table of Contents
- List of Figures
- List of Tables
- Problem Definition
- Literature Review
- Objectives
- Alternative Solutions
- Design Criteria and Realistic Constraints
  - Design code(s)
  - Cost
  - Constructability
  - Environmental, Social Impacts, etc…
- Selection of Recommended Solution
- Methodology of Implementation
- Implementation of Recommended Solution (Preparation of detailed design for the selected alternative)
- Conclusions and Recommendations
- References
- Appendices

Final Report Format

- **Typing Specifications**
  - *Page Format*
    - Line Spacing: one and half spacing
    - Font Size: 12 point for the body text, maximum of 14 point Bold for section headings
    - Left/Right Margins: 2.54 cm
    - Top/Bottom Margins: 2.54 cm
  - *Page Limit*
    - The page limit for the report is 80-120.
    - There is no page limit to Appendices.
    - Title Page: Title of the project, followed by names of team members, department, Fall/Spring AY 201x – 201x, and date of submission.

CONTENTS AND FORMAT OF THE CAPSTONE PROJECT REPORT

- *Units*
  - Units of all quantities must always be mentioned, e.g., 5 kg, 3 lbs, etc
  - Use the same unit system throughout the report (SI units, British units, etc.)
- *Figures*, Tables, and References
  - All Figures, Tables, and Graphics should be inserted close to where they are described and numbered. A list of figures is also required.
  - Figure Captions should be below the figures.
  - Table Captions should be above the Tables.
  - References: a list of references must be provided at the end of the report and arranged in the order of citation in the text.
  - Number Reference citation consecutively in square brackets.
  - The references must be complete and precise, e. g., name of the author (Book, Encyclopedia); Title, volume, page number, year month, editor, and electronic address.
- *Calculations*
  - All calculations must be hand calculated, detailed, explained, and referred to figures and illustration whenever necessary.
  - Software Packages can be used in addition to hand calculations but must not replace hand calculations.
  - All symbols must be defined in nomenclature.
  - All equations must be numbered and typed using equation editor with font size of 12 and Times New Roman italic type

APPENDIX A - TITLE PAGE FORMAT EXAMPLE

Taif University

College of Engineering

Department of civil Engineering

Project Title (Arial Black Font 18)

By

Student#1 name (student ID)

Student#2 name (student ID)

Student#3 name (student ID)

A Senior Graduation Project Submitted to the Department of Civil Engineering
in partial fulfillment of the requirements for the degree of
Bachelor of Science

College of Engineering
Taif University

AY 20xx-20xx

143x – 143x H

APPENDIX B – APPROVAL PAGE EXAMPLE

We hereby approve the report entitled:

Project Title (font 14)

Prepared by: Student#1 name (Student ID)

Student#1 name (Student ID)

Student#1 name (Student ID)

Advisors: Dr. ******* Signature _____

Dr. ******* Signature _____

Date:_____

201x -201x (143x – 143x H)

XII. Appendix C: Senior Project Assessment Forms