EE/CprE/SE 491 – Senior Design I and Professionalism

Introduction and Overview

Akhilesh Tyagi

Electrical and Computer Engineering

Software Engineering

Iowa State University

About Senior Design

E E / CPR E / S E 491: Senior Design Project I and Professionalism. (2-3) Cr. 3. *Prereq: varies by major*
Preparing for entry to the workplace. Selected professional topics. Use of technical writing skills in developing project plan and design report; design review presentation. First of two-semester team-oriented, project design and implementation experience.

E E / CPR E / S E 492: Senior Design Project II. (1-3) Cr. 2. *Prereq: E E 491, CPR E 491, or S E 491*
Second semester of a team design project experience. Emphasis on the successful implementation and demonstration of the design completed in 491 and the evaluation of project results. Technical writing of final project report; oral presentation of project achievements; project poster.

- During the first semester (EE/CprE/SE 491), students work in project teams to **design a system/product** responsive to an industry, faculty, or student proposed engineering problem, and use their technical writing skills to produce a project plan and design report. 491 also includes several learning modules on professionalism.
- During the second semester (EE/CprE/SE 492), students **implement the 491 design** and deliver a final report, a project poster, and an oral presentation.

ABET – Accreditation Board for Science & Technology

Engineering Design
Engineering design is a process of devising a system, component, or process to meet desired needs and **specifications** within **constraints**. It is an **iterative**, creative, decision-making process in which the basic sciences, mathematics, and engineering sciences are applied to convert resources into solutions. Engineering design involves identifying opportunities, developing **requirements**, performing analysis and synthesis, **generating multiple solutions**, **evaluating solutions against requirements**, **considering risks**, and **making trade- offs**, for the purpose of obtaining a high-quality solution under the given circumstances. For illustrative purposes only, examples of possible constraints include accessibility, aesthetics, codes, constructability, cost, ergonomics, extensibility, functionality, interoperability, legal considerations, maintainability, manufacturability, marketability, policy, regulations, schedule, standards, sustainability, or usability.

ABET – Capstone/Senior Design

- a culminating major engineering design experience that 1) incorporates **appropriate engineering standards** and **multiple constraints**, and 2) is based on the knowledge and skills acquired in earlier course work.

Senior Design Emphasis

(1) Design; (2) Professionalism (soft skills);

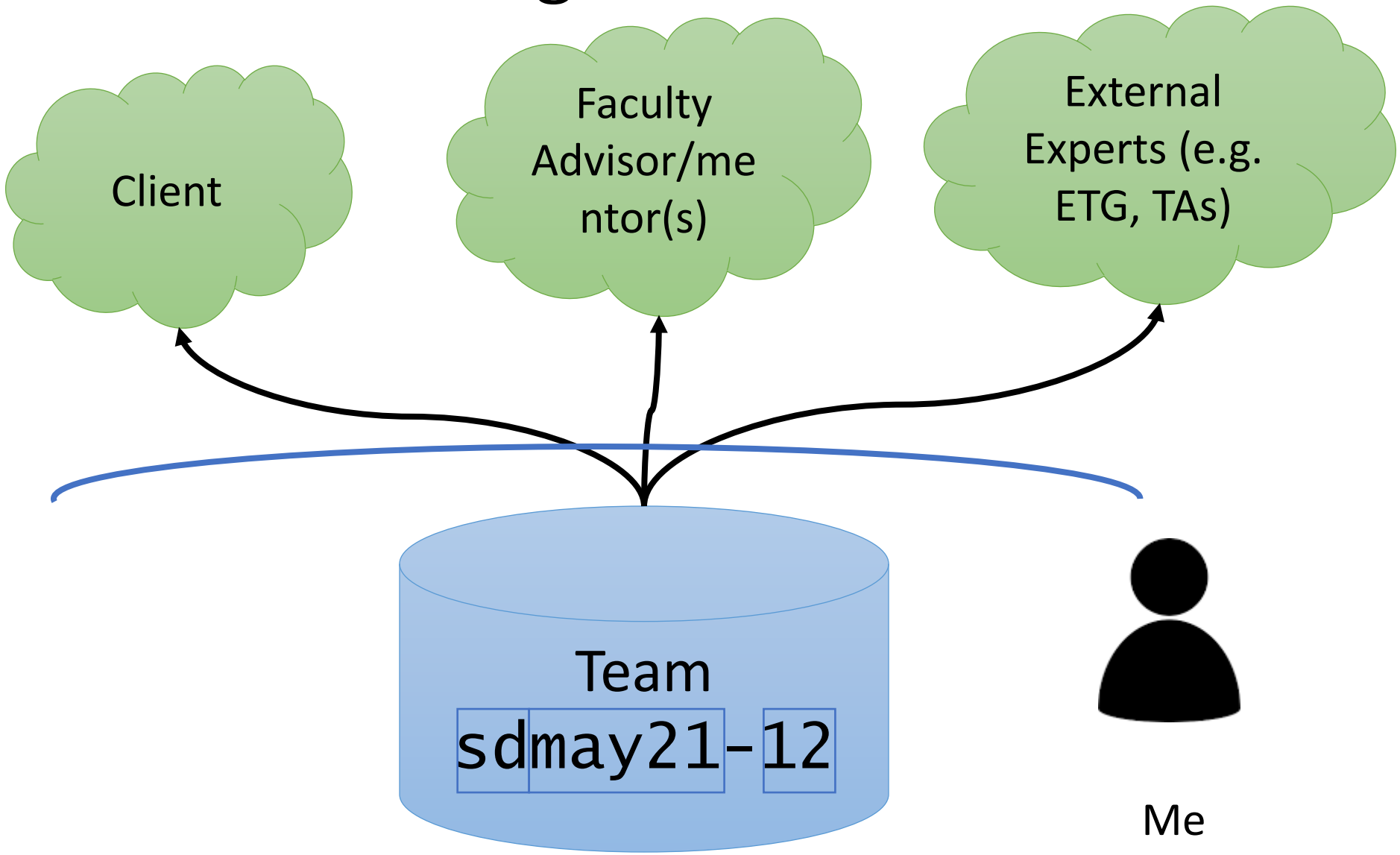
3 credits: Approx 9-12 hours of effort/week. You can assume that roughly half of it (1.5 cr) is towards professionalism (4.5/6 hours per week – 1.5 hours in the classroom – rest in various reflections, lightening talks, design report.

4.5/6 hours per student per week towards actual design (a 6 person team should be spending ~30 person hours/week towards design.

ABET 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
3. an ability to **communicate** effectively with a range of audiences
4. an ability to recognize **ethical and professional responsibilities** in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
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
7. an ability **to acquire and apply new knowledge** as needed, using appropriate learning strategies.

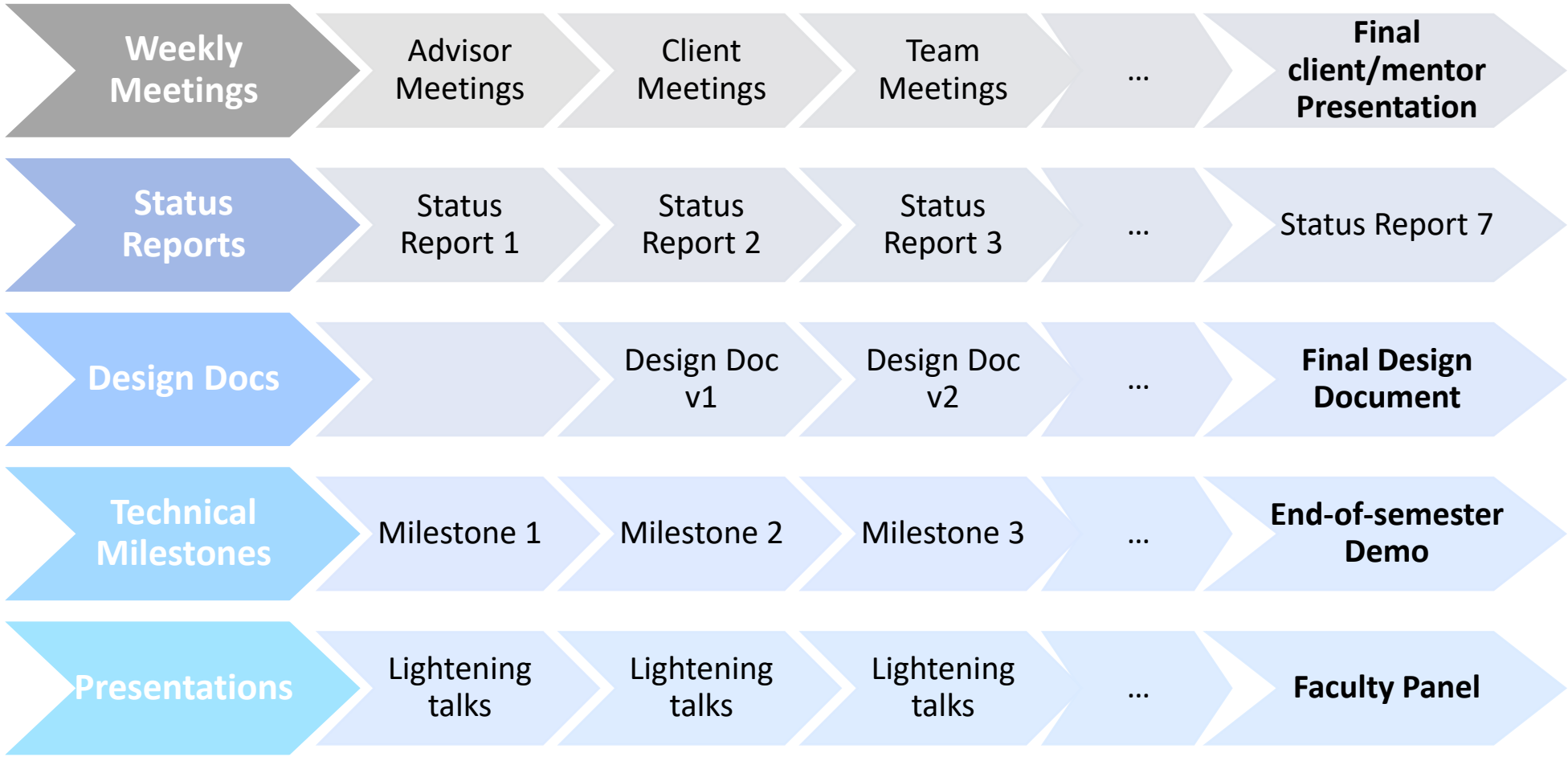
General Course Organization



Different Roles

- **Client:** specifies the problem; end-user; main provider of requirements; critical filter for acceptability testing.
- **Faculty advisor/mentor:** interface between you and the client for technical issues. Technical expert in your project area. May recommend other experts. Provides a technical grade for your project.
- **External experts:** provide technology, engineering, specific skill, or other kind of help.

A Typical 491 Schedule



491 Grading (Tentative)

- 40%: Class activities
  - 15%: In-class and reflection assignments
  - 5%: Bi-Weekly status reports (7x)
  - 15%: Instructor evaluation of the design document
  - 5%: Class participation (talk awareness question)
- 25%: Final project review, performed by a faculty panel
- 35%: Advisor grading of individual student contributions

Expected Work Components

- Talk awareness question answers
- Reflections
- Lightening talks
- Bi-weekly status reports
- Design document v1, v2, final

All submitted on Canvas.

In addition, actual design work will be graded by the faculty panel and faculty mentor.

Late Submission Policy

- Unless excused for an unforeseen emergency or with prior excuse:

- 10%/day penalty for first 2 days
- 20%/day penalty for first 2 days
- 40%/day penalty for the fifth late day

Design Document

- Requirements – you need to design against requirements → needs to be unambiguous, quantitative enough so that you know you have met them.

- Clients may/may not be able to formulate the requirements in the form, you need them for the design. It is your job (within first week to 10 days) to come up with clean, quantitative, unambiguous requirements (first lightening talk).

Design Document – Technical Approach

- This probably is the next in the thought process – how would you go from requirements to a design.
- Usually, there might be a small number of alternatives. You may be able to evaluate them through thought experiments and quantitative reasoning, modeling, or actual prototyping. By the end of 491 – cut it down to one design with arguments, testing, and analysis for why it is the best at meeting your requirements.

Design Document – Other things

- **Project plan** – how would you allocate your resources (person-hours)?
- What are the major tasks and sub-tasks, and their dependence (divide and conquer)?
- Can you map requirements into each task/subtask?

- Which of the tasks/subtasks appear to be risky w.r.t. requirements? (low probability of meeting the requirements). Why? (**Risks)**

- If in 3 months from now, certain task/subtask does not meet requirements – do you have a **risk-mitigation plan**? A redundant component could be added to achieve those requirements? Increase the cost.

Some Other ABET Relevant Aspects – Design Document

- **Engineering standards** relevant to your approach.
- **Iterative aspect of design** – typically requirements (such as execution or response time) are only a model in an abstract specification (program or algorithm specifications; a circuit diagram), hence inaccurate. Once you start composing these timing models across design flows, inaccuracy increases. All of a sudden, end-product does not meet response time requirements. Iterate to change some blocks in the design – and so on.

Design Document – Design Handover

- A good filter to apply to your design document (final):

  If we swapped out your design team from Sem 1 (491) to Sem 2 (492) – have you provided sufficient design details that the other team would be able to implement it?

Project Management Style

- Water-fall (sequential task flow graph with dependences) – some kind of breadth first search of this graph.
- Agile – iterations are built into the model. Agility could be at the task level; or agility could be at the product level. It changes how you make progress.

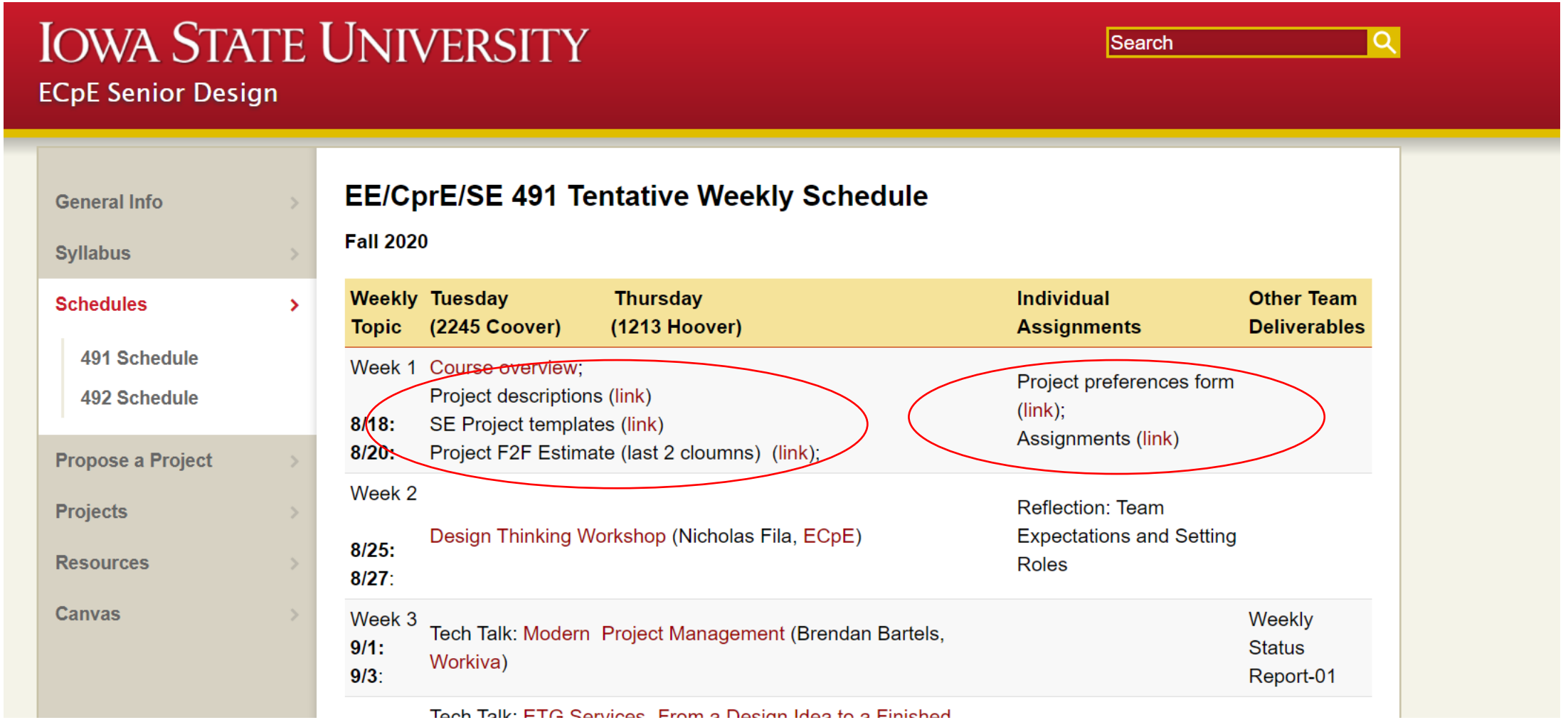
- I will ensure that the design document template can accommodate both styles of project management.

Project Management Process

- Requiring all these lightening talks and Design Document versions is meant to teach you a process!
- It is not irrelevant grunge work that we are making you do – taking time away from the project. This is how your employers would want you to approach a project; this is how ABET want to make sure that we teach you to approach a project.

TO DO: Project Preference Form

- seniord.ece.iastate.edu/schedule.html



IOWA STATE UNIVERSITY
ECpE Senior Design

Search

General Info
Syllabus
Schedules
491 Schedule
492 Schedule
Propose a Project
Projects
Resources
Canvas

EE/CprE/SE 491 Tentative Weekly Schedule

Fall 2020

Weekly Topic	Tuesday (2245 Coover)	Thursday (1213 Hoover)	Individual Assignments	Other Team Deliverables
Week 1 **8/18:** **8/20:**	Course overview; Project descriptions (link) SE Project templates (link) Project F2F Estimate (last 2 cloumns) (link);		Project preferences form (link); Assignments (link)	
Week 2 **8/25:** **8/27:**	Design Thinking Workshop (Nicholas Fila, ECpE)		Reflection: Team Expectations and Setting Roles	
Week 3 **9/1:** **9/3:**	Tech Talk: Modern Project Management (Brendan Bartels, Workiva)			Weekly Status Report-01
	Tech Talk: ETG Services - From a Design Idea to a Finished			

TO DO: Project Preference Form

Your comfort level with Face-to-Face interaction is an important criterion for project matching.

F2F interaction: all projects classified into 3 granularities:

(a) None ; (b) Moderate (2-4 F2F interactions with the team or lab equipment); (c) High (5 or more lab/team/client/advisor F2F interactions) (second to last column in http://seniord.ece.iastate.edu/sdmay21.pdf)

Be sure to note it!

Project Preference form at https://bit.ly/2kgSZir

Other Constraints

- http://seniord.ece.iastate.edu/approved-projects-sdmay21.pdf - For project descriptions
- Team would be from the same section.
- Some major balance (CPRE, EE, SE) based on project needs will be maintained. (last column in http://seniord.ece.iastate.edu/sdmay21.pdf). When putting down your preferences, keep your major in mind.

Other Constraints

- Will like to retain the flexibility to maintain team diversity, major (discipline) balance, and F2F match. Hence specification of large pre-formed teams is discouraged. You are allowed to specify **upto** 2 more people who you would like to be with in a team. Other considerations take priority over keeping a specified team together.

Project Preference Deadline

- August 21 (Friday) mid-night
- We hope to have assignments done by Monday August 24.

- SE students can also look at SE project templates (http://seniord.ece.iastate.edu/SEProjects-template.pdf). If you prefer an SE template project – specify in the last question/comments in the preferences form.