ME 4182 Capstone Design

Instructions

Summer 2020

Dr. Roger Jiao

(Courtesy of Drs. Ken Cunefare & Amit Jariwala)

Capstone Design - ME4182/MSE4723

Scheduled Meeting Times (Capstone Design - 56545 - ME 4182 - A)					
Time	**Days**	**Where**	**Date Range**	**Schedule Type**	**Instructors**
5:00 pm - 6:15 pm	MW	Online: BlueJeans or WebEx	May 11, 2020 - Jul 30, 2020	Studio*	Roger Jiao, rjiao@gatech.edu Amit Jariwala, amit.jariwala@gatech.edu David Smith, david.smith@me.gatech.edu

- **Capstone Schedule:** https://mecapstone.gatech.edu/schedule-summer-2020/
- **Use your GT login for online access:**
  - BlueJeans: https://bluejeans.gatech.edu/
  - WebEx: http://webex.gatech.edu/

Scheduled Meeting Times (Capstone Design - 56546 - ME 4182 - A01)					
Time	**Days**	**Where**	**Date Range**	**Schedule Type**	**Instructors**
12:30 pm - 2:40 pm	TR	Online: BlueJeans or WebEx	May 11, 2020 - Jul 30, 2020	Mixed Laboratory*	Roger Jiao, rjiao@gatech.edu Amit Jariwala, amit.jariwala@gatech.edu
3:30 pm - 5:40 pm	TR	Online: BlueJeans or WebEx	May 11, 2020 - Jul 30, 2020	Mixed Laboratory*	David Smith, david.smith@me.gatech.edu

- **From the 1st Thursday onwards, the Lab sessions will go with your respective instructors/time slots with separate BlueJeans/WebEx links to be set up.**

What is ME 4182 all about?

Application of the design process:

1. **To solve an engineering *problem*…**
2. **Which includes interdisciplinary parameters…**
   i. **Materials, controls, fluids, structures, heat transfer, ….**
   ii. **Human factors, engineering economy, safety, etc.**
3. **In a team structure…**
4. **To design a *solution…***
   i. **A mechanical device**
   ii. **A machine**
   iii. **A system**
   iv. **An app,**
5. **That performs the functions established by a project description derived from the *problem*.**

Each team produces detailed drawings, detailed specifications, presentations, and a proof-of-concept (virtual or physical) of the proposed design *solution*.

ME4182 Course Expectations

- Complete a “Capstone” group design project
  - A group of around 6 students
  - Develop project from conception to “reality”
    - Set goals and criteria
    - Determine necessary tasks
    - Complete tasks
    - Communicate and document results
      - Written reports (Progress and Final; fabrication package)
      - Proof of feasibility/Prototype (Only if design so warrants!)
      - Presentations (Oral and Poster)
  - Capstone Expo (Virtual Expo in Summer 2020)
- Follow the Guidance documents (best practice):
  - https://mecapstone.gatech.edu/schedule-summer-2020/

Schedule and Course Expectations

- You MUST have the following elements (https://mecapstone.gatech.edu/schedule-summer-2020/):
  - Report & presentation #1 ~~(week 5)~~ (due on Sunday 6/21)
  - ~~Report & presentation #2 (week 10)~~
  - Final presentation & Expo (final week, Tuesday July 21)
    - Submit final presentation video and poster before 9:00am on July 21
    - Final class presentations in the Lab session at noon on July 21
    - Virtual Capstone Design Expo (Expo.gatech.edu) from 4:00pm on July 21
  - Submission of final report & validation package (final week, Sunday July 26)
  - Peer evaluation (final week, Sunday July 26)

  - Formal weekly deliverables & participations

Lab Schedule and Expectations
(Dr. Jiao's Section)

- Weekly lab session schedule:
  - One week for meeting with each team (Telecom, specific schedule for each team will be informed in advance)
  - The other week for group presentations to the entire class (Telecom)
- Weekly lab progress milestones/deliverables (https://mecapstone.gatech.edu/students/syllabus/):

Week #	Suggested Lab Deliverable
1	Team Formation. Problem statement and Organization
2	User Needs, Stakeholder and Prior Art Analysis
3	Ideation Report
4	Market Research, Applicable Codes and Standards, Risk Analysis
5	Feasibility Analysis and Preliminary CAD
6	Interim Report Oral Presentation and Report Submission
7	Engineering analyses, CAD and prototyping update
8	Engineering analyses, CAD and prototyping update
9	Engineering analyses, CAD and prototyping update
10	Update on Engineering analyses and CAD
11	Final Report Oral Presentation and Virtual Capstone Design Expo
12	Final Report, Fabrication Package and Peer-Evaluation

Student Assessment

https://mecapstone.gatech.edu/students/syllabus/

1. Team component of grade (75%)
   - Weekly lab team meetings, weekly deliverables* (10%)
   - Oral presentations and written reports (65%)
2. Individual Component of Grade (25%)
   - Peer evaluations (15%)
   - Individual participation during weekly meetings and progress presentations (10%)

- All team members MAY not receive the same grade.

The Roles of Capstone Advisors

- A facilitator to “supervise” the design process – map the course expectations/outcomes to the unique project needs
- **Not** designers; **not** decision makers – Students are the key players
- Serve as “subject matter experts” to provide knowledge of general design theory, processes, and methods
- **Ask** good questions to inspire students independent thinking
- **Require** analysis – Engineering knowledge and deep thinking
- **Require** alternatives and justification – verification & validation
- Coordinate sponsors’ scoping, advice, expectation management

Understand Expectations of Capstone Design

- The team should focus on design of the **product**, not design of the (physical) prototype
  - Design is all about decisions per se
  - Building a physical prototype is not the main learning goal of the capstone design course
  - Design a product vs. manufacturing/make a product
    - So please think about your project scope and expected deliverables, in particular elaborate what is the (technical) problem/issue that you are going to address underlying whatever the product (supposed to deliver certain functions) you want to design.
      - e.g., If the BOM/Design lists parts from Amazon, e-bay, etc., it's for the prototype, not your product! (lesser clue to use with caution: McMaster & Grainger, but those sources could apply to one-offs or low-volume products)

Proof-of-Feasibility/Prototype
– Design Validation

- Priority upon detailed **modeling** & **analysis**
- Virtual prototype vs. Physical prototype
- ***Prototype for an explicit purpose!***
- A prototype without analysis or purpose is mere junkyard design, and should not be reimbursed
  - Corollary: FEM analysis of components with available textbook solutions is wasted effort (But for what design purpose, e.g., design refinery by iterative structural analysis)

~~• Prototyping resources (not for online mode)~~

~~– Invention Studio! (encourage students to become PIs)~~

~~– ME/Student machine shop~~

~~– On-line machining resources (e.g., mfg.com)~~

(Physical) Prototypes…

- ….**are not required**
  - In fact always means cost and should be justified carefully
- Teams do **NOT** have to build something!
- Demonstration of feasibility by
  - Analysis FIRST
  - Prototype only if justified and/or for specific design process purpose
    - e.g., Prototype of a subsystem/module, not necessary to have to be the entire product, de[ending what you want to validate1
- Team must show *feasibility*, and that doesn't require a physical prototype – Validation!

Reports and presentations…

- Follow the Guidance Documents!
- Reports and presentations **should not be chronologies – Articulation is needed**
  - Tell a story of how you managed to solve a technical problem successfully underlying the product you designed, rather than simply a logbook of laborious workload
  - What would be the design innovation you would like to claim if your design is so good that you want to apply for a patent, e.g., a technical title instead of the product name
- Should be substantive **engineering reports** – enable others to understand and replicate in detail – repeatability, generality and validity

- Because of unique project timing, reports #1 and #2 may have differing topic content between teams; all final reports should have most/all topics.
- Guidance Documents are flexible as to structure and content, appropriate to their state of knowledge and project scope at report time -- Emphasize the *communication objective!*

Sponsored Projects

- Match teams-to-projects-to-faculty
- ~~Students may be moved across sections as per their team/project assignment (will be informed before the next lab session)~~
- Current projects available here: http://mecapstone.gatech.edu/marketplace
- ~~Faculty project preference list available here: https://goo.gl/kyDS7w~~
- Submit your team & Bids by noon on Wednesday May 13
  - The instructor team will discuss about project-team allocation and inform the teams before the second studio session at 5pm Wednesday May 13
    - This way the team would have some time to put together the problem understanding deliverable due on next day, May 14 during the supervised labs

Barriers to success

- Lack of commitment
- Lack of innovation
- Design process flaws
  - Jumping to a “design” without considering alternatives
  - Dithering over alternatives and not selecting a final design
- “Is this what you want?” – expecting to be told what to do, rather than acting independently
- Lack of consideration of alternatives
- Lack of consideration of implications/justification
- Lack of questioning assumptions, preconceived notions, etc.
- Lack of anticipation
- Lack of initiative

Barriers to success

- Team dysfunction
  - Lack of leadership
  - Lack of coherent vision
  - Lack of progress
  - Personality conflicts
  - Inability to agree on common vision
  - And on and on…
- What would happen in the real world?

Peer Evaluation Form

- Google form online
- See an example of Dr. Jiao's Section

ME4182 (Spring 2020) Capstone Design -- Team Member Performance Peer Review

* Required

Your Team Name *

Your answer

Your Name *

Your answer

1. Your Team Member 1:

1.0 His/Her name *

Your answer

1.1 Team Member 1 - Motivation *

1 2 3 4 5 6 7 8 9 10

Least motivation ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ Very well motivated

1.2 Team Member 1 - Participation *

1 2 3 4 5 6 7 8 9 10

Absent from most meetings, etc. ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ Very actively involved in all the activities

1.3 Team Member 1 - Effort *

1 2 3 4 5 6 7 8 9 10

Least effort ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ Very diligent, committed, etc

1.4 Team Member 1 - Collaboration *

1 2 3 4 5 6 7 8 9 10

Poor in teamwork ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ Very collaborative, supportive, etc.

1.5 Team Member 1 - Technical soundness *

1 2 3 4 5 6 7 8 9 10

Lack of technical sense, not solid, poor engineering skills ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ Technically knowledgeable, rigorous in engineering decision making

1.6 Team Member 1 - Overall Performance in your Project *

1 2 3 4 5 6 7 8 9 10

Little contribution, far below average ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ Substantial contribution above average

1.7 Team Member 1 - Your Comment *

Your answer

2. Your Team Member 2:

Schedule and follow up

- The schedule is front-loaded
  - Structured to walk through design process
  - Lectures on key design issues
  - Milestones and Deliverables
  - Expo & final presentations
- Course schedule and lecture materials posted on https://mecapstone.gatech.edu/
- **Action items:**
  - Team up and register your teams **by 3pm, end of the first lab session on Tuesday May 12** on Doodle: https://doodle.com/poll/eqmmpwgrbi6nf423, and then immediately to
  - Work as teams to submit bids for sponsored projects **by noon on Wednesday May 13** on the site: https://mecapstone.gatech.edu/marketplace, or
  - Work as teams to brainstorm project ideas if you choose not to bid a sponsored project
- **Next in the first week…**
  - **2nd Studio on Wednesday**: Lecture on User Needs and design specification
  - **2nd Lab session on Thursday**: Problem Statement and Organization
    - From Thursday, the Lab sessions will go with your respective instructors/time slots
    - Please send an email list of all your team members to your respective instructor!