Mechatronics System Design
MTRE 4800 – Fall 2019

Instructor

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Course Description

Catalog Description

The design of mechanical and electrical devices and systems, and cost considerations are covered. The course focuses on reliability, safety, energy and environmental issues, ethics, patents, product liability, time value of money, return on investment, and breakeven analysis. The design project is a capstone for the Mechatronics Engineering program. Projects are assigned based on interest, equipment and software availability, and the specific background of the student. Projects require planning, proposal presentation, scheduling, engineering, implementation, and written and oral presentations of project results. Students are encouraged to "design and build" and utilize concepts learned from courses throughout the program.

Course Details

Term: Fall 2019
Course name: Mechatronics System Design
Course number: MTRE 4800
Section number(s): 01
Meeting times: Lecture WF 3:55 pm - 4:45 pm, Laboratory M 12:30 pm - 6:15 pm
Room number: Lecture Q 314, Laboratory Q 118

Learning Outcomes

By the end of this course, students should:

- Be able to apply mathematics, science, and engineering to the project.
- Be able to design systems, components and processes to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
- Be able to function in multi-disciplinary teams.
- Be able to identify, formulate and solve engineering problems (analysis, design, verification, validation, implementation, application, and maintenance of a system).
- Understanding professional and ethical responsibility.
- Be effective communicators – oral & written (i.e. presentation & report).
- Be able to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Textbook

Required: *Engineering Design*, 2nd Ed, Rudolph J. Eggert, High Peak Press, ISBN 978-0-615-31938-4
Required: *The Scrum Guide*, K. Schwader and J, Sutherland,
https://www.scrumguides.org/docs/scrumguide/v2017/2017-Scrum-Guide-US.pdf

Design Project

The primary deliverable in this course is a physical prototype of a functional mechatronic system. The actual systems can vary greatly, and examples of previous projects appear in a YouTube playlist[1]. However, all projects must include the following elements:

- Mechanical design
- Data acquisition from sensor(s)
- A programmable computing device
- Actuation control

Teams will consists of 3 or 4 members, one of which will be designated as the team lead who is responsible for managing communication with the instructor. The team lead will also serve as the product owner on the Scrum team. A different member will be assigned the role of scrum master, responsible for ensuring the team remains true to the scrum method and serving as the single point of contact to the instructors with respect to scrum questions.

Grading Policy

Textbook chapter presentation	5%
Ethics case study	5%
Quizzes	15%
Initial product backlog	5%
Sprint review, retrospective, and planning	5%
SCR/SRR	10%
PDR	10%
CDR	10%
Demo day presentation	5%
Demonstration	30%
Total	**100%**

Grade Conversion: A: (90-100), B: (80-89), C: (70-79), D: (60-69), F: (0-59)

Textbook chapter presentation

Each team will be assigned a portion of a chapter from the textbook, whose content they will present to the class. The presentation will include provide an overview of the content, examples of how to apply it to the capstone project, and contrasting it with agile project management.

Ethics case study

Students will be presented with an ethical dilemma in the engineering profession and develop an appropriate response to the situation.

Quizzes

Three in-class quizzes will be administered where the first two test understanding of the material from the textbook and the third involves questions for sample Fundamentals of Engineering (FE) exams.

[1] https://www.youtube.com/playlist?list=PLiAXye54pUSa_cAqUE8SSpSBQgRWPG4lA

Initial Product Backlog

The product backlog will be submitted with entries for all the features and sub-features necessary to complete the project. Each entry will be described by a sentence, accompanied with a definition of “done”, assigned a story point estimation, and receive a rank ordered priority.

Sprint Review, Retrospective, and Planning

At the end of each sprint, the team must submit documentation of the results of the sprint review (how the product backlog is updated), sprint retrospective (assessment of sprint activity effectiveness), and sprint planning (what will be completed and how).

System Concept Review (SCR)

It aims to assure that the objectives and requirements of the item being designed are understood and that the proposed approach will meet these requirements. The emphasis should be on the requirements, how they flow down, the proposed design concept, and the definition of the major system interfaces. The review should also present the major design alternatives considered, the relative risk for each, and the reasons for the approach chosen by the design team. The output from the SCR is a baseline design subject to the closure of any action items resulting from the review. This then becomes the baseline for the detailed design.

System Requirements Review (SRR)

SRR is a formal review conducted to ensure that system requirements have been completely and properly identified. It ensures that the system under review can proceed into initial systems development. SRR assesses the system requirements captured in the system specification and ensures that the system requirements are consistent with the approved materiel solution, Initial Capabilities Document (ICD), enabling concepts, and available technologies. SRR is important in understanding the system performance, cost, and scheduling impacts that the defined requirements will have on a system.

Preliminary Design Review (PDR)

PDR is a formal inspection of the high-level architectural design of a system and its software, which is conducted to achieve confidence that the design satisfies

- The functional and nonfunctional requirements
- Overall project status, proposed technical solutions, evolving software products, and associated documentation

The review is at a high level

- To determine completeness and consistency with standards
- To raise and resolve any technical and/or project-related issues
- To identify and mitigate project, technical, security, and/or business risks affecting continued detailed design and subsequent development, testing, implementation, and operations & maintenance activities.

Critical Design Review (CDR)

The CDR will

- Ensure that the "build-to" baseline contains detailed hardware and software specifications that can meet functional and performance requirements.
- Ensure that the design has been satisfactorily audited by production, verification, operations, and other specialty engineering organizations
- Ensure that the production processes and controls are sufficient to proceed to the fabrication stage

- Establish that planned Quality Assurance activities will establish perceptive verification and screening processes for producing a quality product
- Verify that the final design fulfills the specifications established at PDR

Demonstration Day Presentation

On demonstration day (December 6), each team will have 5 minutes to present their project to a non-technical audience. The presentation will include a short (no longer than 2 minutes) video documenting project progress and demonstration of the working prototype.

Prototype Demonstration

The general public and campus community will be invited to observe the working prototypes on demonstration day. Prototypes not meeting the minimum success criteria on demonstration day will receive a zero grade for this item. The score for this item on successful teams will be scaled dependent on a peer evaluation of team members as follows:

- Assign each team member (not yourself) a "grade" of 100%, 90%, 80%, 70%, or 60%
- Each grade must be distinct, i.e. two members cannot both receive 100%
- Teams of four drop the lowest "grade" received from their peers
- Team members are evaluated on the average "grade"
- Points for the prototype demonstration portion of the course are scaled by this average

Course Expectations

Attendance Policy

Students are expected to attend every class session, both lecture and laboratory. Each unexcused absence from a "daily" scrum or sprint review/retrospective/planning beyond the first will count against them. The fraction of meetings beyond the first missed will scale the raw score on subsequent SCR/SRR, PDR, or CDR submissions. The breakdown of which scrums affect which scores are:

- Meetings for weeks 2-3 (five meetings): SCR/SRR
- Meetings for weeks 4-7 (eleven meetings): PDR
- Meetings for weeks 8-15 (twenty two meetings): CDR

For example, team member A would receive 100% of their SCR/SRR grade even with a missed scrum in week 2. However, a missed scrum in each week 5 and 6 would result in a final PDR score at 8/11 = 72.7% of the raw grade.

Course Communication

Course material will be disseminated in D2L. All official course announcements, including instructions when class may be cancelled, will be posted in the D2L course news. Be sure to check D2L regularly.

Course Outline

Day	Date	Lecture
Mon	Aug 19	No lab meeting
Wed	Aug 21	Introduction and team finalization
Fri	Aug 23	Implementing Scrum
Mon	Aug 26	Initial product backlog due, sprint planning*
Wed	Aug 28	Project management life-cycles
Fri	Aug 30	Agile project management
Mon	Sep 02	No class – Labor day
Wed	Sep 04	Implementing Scrum
Fri	Sep 06	Realistic design constraints and engineering standards
Mon	Sep 09	SCR/SRR presentations*
Wed	Sep 11	Chapter 1 presentations
Fri	Sep 13	Chapter 3 presentations
Mon	Sep 16	Safety training
Wed	Sep 18	Chapter 4 presentations
Fri	Sep 20	Quiz 1
Mon	Sep 23	Sprint review/retrospective/planning*
Wed	Sep 25	Chapter 7 presentations
Fri	Sep 27	Chapter 8 presentations
Mon	Sep 30	Project work
Wed	Oct 02	Guest speaker - Interview skills and job search strategies
Fri	Oct 04	Chapter 13 presentations
Mon	Oct 07	PDR presentations and report due*
Wed	Oct 09	Quiz 2
Fri	Oct 11	System integration
Mon	Oct 14	System integration
Wed	Oct 16	Ethics
Fri	Oct 18	Ethics
Mon	Oct 21	Sprint review/retrospective/planning*
Wed	Oct 23	FE exam
Fri	Oct 25	FE exam
Mon	Oct 28	Project work
Wed	Oct 30	Quiz 3
Fri	Nov 01	Guest speaker – safety in the workplace
Mon	Nov 04	Sprint review/retrospective/planning*
Wed	Nov 06	Guest speaker – working in start-up companies
Fri	Nov 08	Guest speaker – transition from college to engineering position
Mon	Nov 11	Project work
Wed	Nov 13	Guest speaker – documentation in an industry setting
Fri	Nov 15	Graduate education
Mon	Nov 18	CDR report due, sprint review/retrospective/planning*
Wed	Nov 20	Project work
Fri	Nov 22	Project work
Mon	Dec 02	Project work
Wed	Dec 04	Exit “interviews”
Fri	Dec 06	No class – demo day

* These laboratory meetings mark the beginning of a new sprint. The Development Team will need to schedule the sprint review/planning outside of laboratory time on SCR/SRR/PDR presentation days.

Every lecture and laboratory meeting beginning August 28 that does not mark a new sprint will end with a “daily” scrum.

Federal, BOR, & KSU Course Syllabus Policies

Information contained in the links below constitutes the Federal, BOR, and KSU course syllabus policies and procedures and may be referenced by faculty members in their course syllabi. These policies are updated on the Academic Affairs Website annually.

Academic Affairs - Federal, BOR, & KSU Policies

Academic Affairs - KSU Student Resources for Syllabus

Note to Faculty: The KSU faculty handbook requires the Academic Integrity Policy in the course syllabus.

Note to Faculty and Students: The Office of the Provost will work to keep the policies and links in this document as accurate as possible.

Academic Integrity Statement

Every KSU student is responsible for upholding the provisions of the Student Code of Conduct, as published in the Undergraduate and Graduate Catalogs. Section 5c of the Student Code of Conduct addresses the university's policy on academic honesty, including provisions regarding plagiarism and cheating, unauthorized access to university materials, misrepresentation/falsification of university records or academic work, malicious removal, retention, or destruction of library materials, malicious/intentional misuse of computer facilities and/or services, and misuse of student identification cards. Incidents of alleged academic misconduct will be handled through the established procedures of the Department of Student Conduct and Academic Integrity (SCAI), which includes either an "informal" resolution by a faculty member, resulting in a grade adjustment, or a formal hearing procedure, which may subject a student to the Code of Conduct's minimum one semester suspension requirement. See also KSU Student Code of Conduct.

Electronic Communication

The University provides all KSU students with "official" email accounts with the addresses "students.kennesaw.edu" and "kennesaw.view.usg.edu" (in D2L). As a result of federal laws protecting educational information and other data, these are the sole email accounts you should use to communicate with your instructor or other University officials.