Mechatronics System Design
MTRE 4800 – Spring 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: Spring 2019
Course name: Mechatronics System Design
Course number: MTRE 4800
Section number(s): 01
Meeting times: Lecture TR 9:30 am - 10:20 am, Laboratory F 9:30 am - 3:15 pm
Room number: Lecture Q 109, 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

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)
- 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 organizing team efforts and managing communication with the instructor.

Grading Policy

Textbook chapter presentation	5%
Ethics case study	5%
Quizzes	15%
Weekly reports	5%
Gantt chart	5%
SCR/SRR	10%
PDR	15%
CDR	10%
Final presentation	5%
Demonstration	25%
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 a summary of the major points in the chapter as well as a connection to how the material relates to course design projects.

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.

Weekly reports

Team leaders will submit a report at the end of each week (due Fridays at noon) containing a specific task for each team member to complete in the upcoming week, as well as a concise summary (no more than a couple sentences) for what each team member completed during the current week and whether or not their task was successfully completed. Note: completed tasks are not required in the report for the first week. Once the project Gantt chart is completed, weekly tasks should be formulated so that milestones can be completed on time.

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

Grades for weekly reports will typically be either zero or full credit, and assigned to all team members. However, the fraction of times an individual team member fails to complete their weekly task (as documented in the weekly reports) will scale the raw score on subsequent SCR/SRR, PDR, or CDR submissions. Breakdown of which reports affect which scores are:

- Reports for weeks 2-5: SCR/SRR
- Reports for weeks 6-9: PDR
- Reports for weeks 10-14: CDR

For example, if team member A completed their tasks in weeks 6, 7, and 9 but failed to complete in week 8, then their final PDR score would be ¾ = 75% of the raw PDR grade.

Gantt chart

Each team is expected to produce a Gantt chart time plan for their design project.

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 (April 26), 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.

Course Expectations

Attendance Policy

Students are expected to attend every class session, both lecture and laboratory. Each unexcused absence after the second will count as a missed task in the weekly report.

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	Laboratory
Tue	Jan 08	Course introduction	Weekly report expectations
Thu	Jan 10	Chapter 1 presentation	
Tue	Jan 15	Chapter 3 presentation	SCR/SRR expectations
Thu	Jan 17	Chapter 4 presentation	
Tue	Jan 22	Quiz 1 and guest student presenter	Safety training
Thu	Jan 24	Planning and Gantt charts	
Tue	Jan 29	Realistic design constraints	
Thu	Jan 31	Engineering standards	
Tue	Feb 05	Chapter 7 presentation	SCR/SRR presentations due
Thu	Feb 07	Chapter 8 presentation	
Tue	Feb 12	Industry guest lecturer on safety	PDR expectations
Thu	Feb 14	How to work a career fair and resume writing – Gantt chart due	
Tue	Feb 19	Chapter 13 presentation	
Thu	Feb 21	Quiz 2	
Tue	Feb 26	Interview skills	
Thu	Feb 28	Job search strategies	
Tue	Mar 05	Graduate education	PDR report and presentations due
Thu	Mar 07	Ethics	
Tue	Mar 12	Industry guest lecture on engineering profession	CDR expectations
Thu	Mar 14	Ethics	
Tue	Mar 19	Ethics	
Thu	Mar 21	FE exam	
Tue	Mar 26	FE exam – Ethics case study due	
Thu	Mar 28	FE exam	
Tue	Apr 09	Quiz 3	
Thu	Apr 11	No class – NCUR conference	
Tue	Apr 16	Project work	CDR report due
Thu	Apr 18	Project work	
Tue	Apr 23	Project work	
Thu	Apr 25	Exit “interviews”	

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.