



EE 490: Senior Electrical Engineering Design I

Term: Fall 2026

Credits: 3.0

Seminar Times & Location: Tuesday & Thursday 8:00–9:15 a.m., Lovell Hall 310

Modality: In-Person Seminar

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Instructor Information

- **Instructor:** Dr. Julien Pierce (Assistant Professor of Electrical & Computer Engineering)
- **Email:** jpierce@university.alkimi.ai
- **Office:** Rowan Engineering Center 218
- **Office Hours:**
 - Monday & Friday: 11:30 a.m.–1:00 p.m. (In person, Rowan Engineering Center 218)
 - Wednesday: 3:00–4:00 p.m. (Virtual via Zoom; link posted in Canvas)
 - Also available by appointment.

Course Description

First semester of the capstone design sequence: requirements, system architecture, component selection, engineering standards, and a preliminary design review. EE 490 is the first course in the two-semester electrical and computer engineering capstone design sequence. Working in multidisciplinary teams under faculty and industrial sponsorship, students translate open-ended technical challenges into rigorous engineering requirements, architect multi-domain hardware and software systems, and conduct comprehensive component trade studies. The semester emphasizes standards compliance (IEEE, FCC, UL), design for testability, power and thermal budgets, and risk mitigation, culminating in a formal Preliminary Design Review (PDR) and comprehensive engineering package.

Prerequisites

EE 310, EE 330, and senior standing.

Measurable Student Learning Outcomes

Upon successful completion of EE 490, students will be able to:

1. **Establish Engineering Requirements:** Translate ambiguous client and stakeholder needs into measurable, verifiable engineering target specifications that satisfy technical, economic, and safety constraints.
2. **Architect Electrical Systems:** Partition complex electrical systems into modular functional subsystems, specifying electrical, thermal, mechanical, and software interface protocols.
3. **Select Components and Perform Trade Studies:** Conduct quantitative trade-off analyses, evaluate component datasheets, formulate power and timing budgets, and verify component availability and lead times.

4. **Apply Standards and Ethical Codes:** Integrate applicable engineering standards (IEEE, FCC Part 15, UL) and adhere to the IEEE Code of Ethics in engineering decision-making and public safety considerations.
5. **Deliver Technical Design Reviews:** Author professional preliminary design documentation and present defensible technical arguments during formal design review panels before faculty and industry practitioners.

Required Course Materials & Approximate Costs

1. **Ford, Ralph M., and Chris S. Coulston. *Design for Electrical and Computer Engineers: Theory, Concepts, and Practice*. McGraw-Hill, 2007.** Approx. \$65 digital rental (\$140 purchase; reserve copies available in Alkimi Library).
2. **Altium Designer / KiCad EDA Suite and Project Management Software (Jira/GitHub).** Free educational access provided through university engineering site licensing.
3. **Total estimated cost:** Approx. \$0 (library reserve & campus tools) to \$65 (textbook rental).

Generative AI Policy (AI Level 2: AI Permitted with Disclosure for Specified Tasks)

In accordance with Alkimi University Academic Policies (Student Handbook §5.8), EE 490 operates under **AI Level 2**.

- **What is permitted:** Students may utilize AI tools for technical writing refinement, requirement formatting, exploring electronic component alternatives, and generating draft Python or MATLAB testbench automation scripts.
- **What is prohibited:** AI models must not be used to fabricate schematic designs, generate unverified circuit simulations, synthesize client requirements without stakeholder engagement, or bypass rigorous engineering calculations. Using generative AI to author capstone deliverables without team oversight is strictly prohibited.
- **Disclosure:** Every formal capstone deliverable must contain a dedicated AI disclosure statement detailing any tools consulted, the precise prompts utilized, and the engineering validation methods employed to verify component specifications and safety constraints.

Grading Components and Weights

- **Team Charter & Problem Definition Document:** 10% (Due Friday, September 11 at 11:59 p.m.)
- **System Requirements & Specifications Document:** 15% (Due Friday, October 2 at 11:59 p.m.)
- **System Architecture & Component Selection Report:** 15% (Due Friday, October 23 at 11:59 p.m.)
- **Preliminary Design Review (PDR) Presentation:** 20% (In class, Thursday, December 3)
- **Sprint Cadence, Standups & Peer Evaluation:** 15% (Evaluated through biweekly team sprint logs, sponsor status reports, and confidential peer evaluations)
- **Preliminary Design Package & Detailed Engineering Report:** 25% (Due by the end of the final exam period, Thursday, December 17, 2026, 10:30 a.m.–12:30 p.m.)

Grading Scale (Alkimi University Standard)

- **A:** 93–100% | **A-:** 90–92%
- **B+:** 87–89% | **B:** 83–86% | **B-:** 80–82%
- **C+:** 77–79% | **C:** 73–76% | **C-:** 70–72%
- **D+:** 67–69% | **D:** 60–66% | **F:** Below 60%
- **Extra credit:** No extra credit assignments are available in EE 490.

Course Schedule (Fall 2026)

Week	Dates	Topics & Readings	Assignments & Deadlines
Week 1	Aug 27	Capstone Introduction and Project Selection: Course scope and objectives, review of industry client project proposals, intellectual property policies, and multidisciplinary team formation procedures. <i>Reading: Ford & Coulston Ch. 1</i>	<i>First day of classes: Wed Aug 26.</i>
Week 2	Sep 1, 3	The Engineering Design Process and Project Management: Design life cycle phases, Agile vs. Waterfall frameworks for hardware engineering, work breakdown structures (WBS), Gantt scheduling, and team charters. <i>Reading: Ford & Coulston Ch. 2–3</i>	<i>Wed Sep 2: Add/section change deadline.</i>
Week 3	Sep 8, 10	Problem Formulation and Stakeholder Needs: Voice of the customer, user stories, identifying operational environments, defining boundaries, and submitting the Team Charter (due Friday). <i>Reading: Ford & Coulston Ch. 4</i>	<i>Mon Sep 7: Labor Day (no classes). Wed Sep 9: Census date (last day to drop without a W). Team Charter & Problem Definition Document due Fri Sep 11 at 11:59 p.m.</i>
Week 4	Sep 15, 17	Engineering Requirements and Specifications: Converting qualitative customer needs into quantitative engineering specifications, tolerance budgeting, and establishing measurable verification metrics. <i>Reading: Ford & Coulston Ch. 5</i>	—
Week 5	Sep 22, 24	Functional Decomposition and Subsystem Architectures: Block diagramming, signal and power flow architectures, modular chunking, defining hardware and software subsystem interface control documents (ICDs). <i>Reading: Ford & Coulston Ch. 6</i>	—
Week 6	Sep 29, Oct 1	Trade Studies and Concept Screening: Weighted decision matrices, multi-criteria trade-offs, feasibility matrices, and submission of the Requirements and Specifications Document (due Friday). <i>Reading: Ford & Coulston Ch. 7</i>	System Requirements & Specifications Document due Fri Oct 2 at 11:59 p.m.
Week 7	Oct 6, 8	Component Selection and Power Budgeting: Datasheet critical parameter extraction, component derating, power supply architecture sizing, quiescent current analysis, and battery life estimation. <i>Reading: Ford & Coulston Ch. 8</i>	—
Week 8	Oct 15	Engineering Ethics and Professional Responsibility: IEEE Code of Ethics, ethical dilemmas in technology deployment, autonomous systems safety, and conflict-of-interest disclosures. <i>Reading: IEEE Code of Ethics and case studies</i>	<i>Oct 12–Oct 13: Fall break (no classes).</i>
Week 9	Oct 20, 22	Schematic Capture and Printed Circuit Board Design: EDA workflows (KiCad/Altium), schematic best practices, decoupling capacitor placement, and System Architecture Report (due Friday). <i>Reading: Ford & Coulston Ch. 9</i>	System Architecture & Component Selection Report due Fri Oct 23 at 11:59 p.m.
Week 10	Oct 27, 29	Electromagnetic Compatibility (EMC) and Thermal Design: FCC Part 15 electromagnetic interference regulations, grounding loops, shielding techniques, and thermal dissipation calculations for power components. <i>Reading: Selected EMC design standards</i>	—
Week 11	Nov 3, 5	Design for Testability and Firmware Co-Design: Test point allocation, JTAG and SWD debug headers, hardware-in-the-loop (HIL) testing concepts, and sensor interface protocol verification. <i>Reading: Ford & Coulston Ch. 10</i>	<i>Fri Nov 6: Last day to withdraw (W) or elect Pass/No Pass.</i>
Week 12	Nov 10, 12	Safety, Standards, and Failure Mode Analysis: UL safety certifications, NFPA/NEC electrical codes, and conducting Design Failure Mode and Effects Analysis (DFMEA) to establish risk priority numbers. <i>Reading: Selected industry safety standards</i>	—
Week 13	Nov 17, 19	Bill of Materials and Supply Chain Logistics: Detailed BOM compilation, distributor sourcing (DigiKey/Mouser), lifecycle	—

Week	Dates	Topics & Readings	Assignments & Deadlines
		risk (obsolescence/EOL), and long lead-time procurement for spring prototyping. <i>Reading: Ford & Coulston Ch. 11</i>	
Week 14	Nov 24	Verification and Validation Planning for EE 491: Formulating detailed test matrices, pass/fail acceptance criteria, test equipment requirements, and finalizing the spring Senior Design Showcase roadmap. <i>Reading: Ford & Coulston Ch. 12</i>	<i>Nov 25–Nov 27: Thanksgiving break (no classes).</i>
Week 15	Dec 1, 3	Preliminary Design Review (PDR) Presentations: Formal oral design reviews presented before faculty panels, industry clients, and peer engineers with technical defenses of architecture and component choices. <i>Reading: Review PDR presentation rubrics</i>	Preliminary Design Review (PDR) Presentation (in class).
Week 16	Dec 8	PDR Feedback Integration and Project Sign-Off: Revising engineering packages based on review critique, establishing design freezes, securing client approvals, and archiving the comprehensive technical package. <i>Reading: Review faculty critique notes</i>	<i>Wed Dec 9: Last day of classes. Thu Dec 10: Reading Day.</i>
Finals	Dec 17	Preliminary Design Package & Detailed Engineering Report due by the end of the scheduled final exam period, Thursday, December 17, 2026, 10:30 a.m.–12:30 p.m.	No final examination.

Course Policies

Attendance Policy

Attendance at all senior design seminar sessions, team sprint standups, and sponsor meetings is mandatory. Senior capstone demands collaborative accountability and professional reliability. If an unavoidable absence arises due to illness or approved career interview travel, notify Dr. Pierce and your team at least 24 hours in advance. Students who miss the first two class meetings without notifying the instructor may be dropped. Students may miss class for religious observance without penalty if they notify the instructor in writing within the first two weeks of the semester (by Wednesday, September 9, 2026). Absences for university-sponsored activities (athletics, performances, conferences) are excused with a letter from the sponsoring office at least one week in advance.

Late Work Policy

Capstone milestone documents are subject to strict project deadlines. Late submissions will incur a 10% penalty per 24 hours up to 48 hours late, after which submissions are not accepted without prior written instructor consent. Preliminary Design Review presentation slots cannot be rescheduled.

Final Exam Policy

EE 490 has no final examination. The preliminary design package & detailed engineering report takes its place. Nothing is due on Reading Day (Thursday, December 10, 2026).

Academic Integrity

Alkimi University is an academic community devoted to rigorous scholarship, open intellectual inquiry, and uncompromising ethical conduct. All students are subject to the regulations of the Alkimi University Academic Integrity Policy. Academic dishonesty—including plagiarism, cheating on examinations, unauthorized collaboration, fabrication of empirical data, and unauthorized submission of academic work generated by artificial intelligence—undermines the integrity of the university and carries severe disciplinary sanctions. Sanctions range from a failing grade on an assignment or exam to an administrative course failure recorded as an 'XF' on the official transcript, academic suspension, or expulsion. Suspected violations are formally investigated and resolved through the Office of Academic Integrity in accordance with Faculty Handbook §6. For detailed information, consult the Office of Academic Integrity, Lovell Hall 315, (555) 555-0163, integrity@university.alkimi.ai.

Accessibility Services

Alkimi University is committed to providing equitable educational access and reasonable accommodations for all students with documented disabilities, including physical, sensory, psychological, learning, and chronic health conditions. Students requesting academic accommodations must formally register with the Office of Accessibility Services, Harlan Hall 204, (555) 555-0155, access@university.alkimi.ai. Once approved, students will receive an official Faculty Accommodation Letter detailing approved accommodations. Students should present this letter to the instructor as early in the semester as possible, and at least one week prior to any exam or assignment requiring accommodation. Accommodations cannot be applied retroactively.

Student Wellness and Mental Health

Your physical health, psychological well-being, and mental health are essential to your academic success. If you experience heightened stress, anxiety, depressive symptoms, personal trauma, or academic burnout, free, confidential counseling and medical care are available through the Hollis Health & Counseling Center, located in the Hollis Center. Routine appointments are available Monday–Friday 8:00 a.m.–6:00 p.m. and Saturday 10:00 a.m.–2:00 p.m. during the semester by calling (555) 555-0190 or emailing health@university.alkimi.ai. Urgent, 24/7 crisis psychological counseling is accessible immediately at (555) 555-0199.

Campus Student Support Services

- **Academic Advising Center:** Lovell Hall 101 | (555) 555-0158 | advising@university.alkimi.ai
- **Writing Center:** Whitcombe Library 3rd Floor | Free consultations on papers, reports, and research projects at any stage.
- **Whitcombe Library:** Whitcombe Library, Main Floor | (555) 555-0170 | askalibrarian@university.alkimi.ai
- **Hollis Health & Counseling Center:** Hollis Center | (555) 555-0190 | 24/7 Counseling Line: (555) 555-0199 | health@university.alkimi.ai
- **Electrical Engineering Capstone Workstations:** Rowan Engineering Center 150 | Dedicated electronics prototyping benches, soldering stations, and mixed-signal oscilloscopes accessible weekdays 8:00 a.m.–9:00 p.m.