THE UNIVERSITY OF BRITISH COLUMBIA

FACULTY OF APPLIED SCIENCE (Engineering)

ELEC 391: Electrical Engineering Design Studio II **Updated**: Jul, 2025

Contact Information:

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1. Calendar Entry

ELEC 391: Engineering Design Studio II (6) [2-6-0]

Introduction to project management. Problem definition. Design principles and practices. Implementation techniques including circuit design, software design, solid modelling, PCBs, assembling, and packaging. Testing and evaluation. Effective presentations.

Pre-requisite: One of {CPEN 291, ELEC 291, ELEC 292} and two of {ELEC 301, ELEC 341, ELEC 311, ELEC 342}.
Co-requisite: None.

2. Course Structure

The 13-week term comprises 1 introductory week, 6 design phase weeks, and 6 integration phase weeks. There is no final exam.

Each week comprises 2 lecture hours which are devoted to developing students' prototyping skills. They include electro-mechanical design lectures, live software demos, and student-led tutorials. All associated engineering theory is pre-requisite material, and is not presented in class.

Each week comprises 6 lab hours, but students are provided 24/7 access to the lab. During scheduled lab hours, TAs are available to consult, and to supply certain physical resources. Access to any departmental maker spaces are managed separately, by technical support staff.

Evaluations take place during scheduled lecture and lab hours. When the students in a team do not all share a common lab section, those students are expected to resolve any time conflicts to attend their team evaluation.

3. Course Motivation

This course satisfies the 3rd year design studio requirement of a BASc in Electrical Engineering.

The project provides an opportunity to exercise skills obtained in the following 3rd year courses.

- ELEC 341 – System & Control
- ELEC 301 – Electronic Circuits
- ELEC 342 – Electro-Mechanical Energy Conversion and Transmission
- ELEC 311 – Electromagnetic Fields and Waves

A physical electro-mechanical control system is designed and built. Pre-requisite knowledge is used to design the associated sub-components, which are then integrated into a working prototype. Both the design and integration are presented during live demonstrations.

4. Course Learning Outcomes

By the end of the course the students should be able to:

A. Formalize an Engineering Design Project in terms of Requirements, Constraints and Goals (RCGs).
- Derive product and component specifications based on project requirements and constraints. (GA 4.3)
- Identify and mitigate risks that impact the project design process. (GA 11.3)

B. Apply Scientific Theory and Engineering Design Principles to optimally satisfy the RCGs.
- Evaluate system / sub-system design alternatives to identify the best solution based on the project requirements. (GA 4.4)
- Implement the product design using best practices. (GA 4.5)
- Compare experimental measurements with theory / simulation tools to justify design decisions. (GA 3.4)
- Evaluate a curated list of course references to address personal knowledge gaps. (GA 12.3)

C. Evaluate demonstrated level of success in satisfying the RCGs.
- Collect product data using state of the art tools to assess performance specifications. (GA 5.1)
- Verify their product design based on the project requirements including tolerances or confidence levels. (GA 2.4)

D. Effectively deliver results using written and verbal communication techniques.
- Document the project design in sufficient detail to allow an undergraduate engineer to reproduce the results. (GA 7.2)
- Justify the most significant design decisions through an oral presentation. (GA 7.3)

E. Work effectively in a team environment.
- Create and follow a team plan that meets the course project milestones. (GA 6.3)
- Impartially assess individual and peer contributions to the project tasks. (GA 6.2)
- Formulate a team charter that promotes equitable contribution of all team members. (GA 10.3)

F. Identify and mitigate safety hazards to both product developers and end-users.
- Identify hazards associated with prototyping equipment and implement appropriate risk mitigation steps. (GA 8.2)
- Identify how the design impacts health, safety and productivity in the context which it is deployed. (GA 9.1)

5. Course Content

<u>Part I – Introductory Phase (1 Week)</u>

- Project Specification
- Design Project Specifications
- Team Formation & Grade Distribution Policy
- Lab Conduct & Safety Training
- Introduction to Requirements, Constraints & Goals

<u>Part II – Design Phase (6 Weeks)</u>

- Drivers & Stubs
- Electrical Prototypes & PCBs
- Mechanical Prototypes & Manufacturing Resources

<u>Part III – Integration Phase (6 Weeks)</u>

- Student-led Tutorials
- Lecture Topics by Request

6. Course Activities

The course has 2 activities, each allocated approximately 6 weeks to complete.

1. Sub-System Design (teams of 1 or 2)
2. System Integration (teams of 5 or 6)

Sub-System Design

Each sub-system design team is responsible for 1 sub-system.

1. Software
   i. PID controller running on micro-controller
   ii. Matlab model of electro-mechanical system
   iii. MBK stub
2. Circuits
   i. All electronics integrated onto PCB daughter-board
   ii. Micro-controller based driver
   iii. Passive RLC load stub
3. Hardware
   i. Physical mechanism
   ii. Custom actuator
   iii. Micro-controller based driver

Design work is presented in a live demonstration. Mandatory drivers & stubs must be developed to show proof-of-concept functionality of all sub-systems.

System Integration

The system integration team collaborates to integrate all sub-systems into a working prototype. Integration details are presented in a live demonstration.

7. Assessment Policies

- Attendance is optional at lectures and labs.
- Attendance is mandatory at demonstrations. Any accommodation must be requested in advance. Failing to attend a scheduled demonstration without permission results in a grade of 0.
- Demonstrations take place during scheduled lecture or lab hours.
- Students must make accommodations to be available for their scheduled demonstration, even if it is not during the particular lab hour they are registered in.
- All graded documentation is submitted on Canvas.
- Individual contributions are used to adjust individual grades, based on team grades.
- Meetings are held to resolve unresolvable differences regarding individual contributions.

8. Assessment

The following is the weighting of all assessed activities:

- System Design 50%
- System Integration 50%

For each activity, the deliverables consist of a live demonstration, with supporting documentation submitted on Canvas. Details of the deliverables are provided in the class notes.

Any AI-generated content triggers a grade penalty.

System Design
The quality of the system design is based on:

- Technical requirements & constraints (input formulation)
- Steps taken to satisfy stated requirements
- Proof-of-concept prototype to demonstrate results

System Integration
The quality of the system integration is based on:

- Satisfaction of technical requirements
- Design content
- Implementation quality & reliability
- Extra features (goals)

9. Texts and Bibliography (including any required materials)

- Course notes and resources are provided on Canvas. These include:
  - Software tutorials and examples
  - Links to department resources

- There is no text for this course. All technical content comes from pre-requisite courses.

- Certain materials and prototyping services are provided by the department. All other parts and material are the responsibility of the students. It is the responsibility of each team to ensure all monetary costs are shared equally by all team members.

10. UBC Academic Honest and Standards

The academic enterprise is founded on honesty, civility, and integrity. As members of this enterprise, all students are expected to know, understand, and follow the UBC codes of conduct regarding academic integrity. At the most basic level, this means submitting only original work done by you and acknowledging all sources of information or ideas and attributing them to others as required. This also means you should not cheat, copy, or mislead others about what is your work. Violations of academic integrity (i.e., misconduct) lead to the breakdown of the academic enterprise, and therefore serious consequences arise and harsh sanctions are imposed. For example, incidents of plagiarism or cheating may result in a mark of zero on an assignment or exam and more serious consequences may apply if the matter is referred to the President's Advisory Committee on Student Discipline. Careful records are kept in order to monitor and prevent recurrences.

For more information, see: http://www.calendar.ubc.ca/vancouver/index.cfm?tree=3,286,0,0

11. Non-Academic Misconduct

Whether you are a student, faculty member, or staff member, mistreatment towards anyone in our Engineering community is not acceptable. Mistreatment is disrespectful or unprofessional behavior that has a negative effect on you or your learning environment, or conduct that is contrary to the principles that support a respectful environment. This includes making demeaning, offensive, belittling, and disrespectful comments, using abusive language, engaging in bullying, harassment, and discrimination. If you have witnessed or been subject to mistreatment, there are people and support resources here to help. Find out how to get support or discuss an issue related to discrimination, bullying, harassment, or sexual misconduct through the non-academic misconduct link below:
https://academicservices.engineering.ubc.ca/degree-planning/non-academic-misconduct-discrimination-and-edi-i-support/

ECE students, faculty, and staff are also welcome to submit comments, suggestions, and requests around Equity, Diversity, Including and Indigeneity (EDII) in the ECE Department to our EDII Suggestion Box. Submissions can be anonymous, and are received directly by the ECE EDII.
Committee for review: https://ece.ubc.ca/engage-with-ece/edii-suggestion-box/

12. Health and Wellness

UBC provides resources to support student learning and to maintain healthy lifestyles, while recognizing that challenges and crises can arise for students. There are resources in ECE and at UBC where students can find can help and support, including wellness, equity, inclusion and indigineity, resources for survivors of sexual violence, and health. Some frequently used resources are as follows:

- ECE Wellness Hub: https://ece.ubc.ca/student-life/student-wellness/
- ECE has an EDI.I committee whose goals are to improve equity, diversity and inclusion in the ECE Department, and support the UBC Indigenous Strategic Plan. The committee welcomes feedback from all students, and can be contacted by emailing help@ece.ubc.ca.
- Central resource for supporting student success (medical and crisis support, Centre for Accessibility, and support for survivors of sexual violence): https://senate.ubc.ca/policies-resources-support-student-success/
- UBC Office of the Ombudsperson for Students: https://ombudsoffice.ubc.ca/how-we-can-help/

UBC values respect for the person and ideas of all members of the academic community. Harassment and discrimination are not tolerated nor is suppression of academic freedom. UBC provides appropriate

accommodation for students with disabilities and for religious, spiritual and cultural observances. UBC values academic honesty and students are expected to acknowledge the ideas generated by others and to uphold the highest academic standards in all of their actions. Details of UBC's respectful environment policies, which all students, staff and faculty are expected to follow, can be found here: https://hr.ubc.ca/working-ubc/respectful-environment

13. Academic Concession

The University is committed to supporting students in their academic pursuits. Students may request academic concession in circumstances that may adversely affect their attendance or performance in a course or program. Students who intend to, or who as a result of circumstance must, request academic concession must notify their instructor, dean, or director as specified in the link below. https://www.calendar.ubc.ca/vancouver/index.cfm?tree=3,329,0,0

Students seeking academic concession due to absence from the final exam for any reason must apply to Engineering Academic Services (EAS) within 72 hours of the missed exam. This is a standard practice for all final examinations at UBC. For more information, see:
https://academicservices.engineering.ubc.ca/exams-grades/academic-concession/

14. Land acknowledgment

This course is held on the UBC Point Grey (Vancouver) campus, which sits on the traditional, ancestral, unceded territory of the the Coast Salish Peoples, including xʷməθkʷəy̓əm (Musqueam) First Nation, Squamish, Tsleil-Waututh, Stz'uminus, and Stó:lō First Nations. UBC is implementing its Indigenous Strategic Plan, taking a leading role in the advancement of Indigenous peoples' human rights. To learn more about the Faculty of Applied Science's role in building upon the Indigenous Strategic Plan and committing to Truth and Reconciliation, please visit: https://apsc.ubc.ca/EDI.I