

Elec 391

Academic Year: 2022-W2

Syllabus Summary

Modules

- Mini-Project
  - Individual Effort
  - Pass / Fail
- System Design
  - Collaborative Effort
  - 2 Sub-Systems / System
- System Integration
  - Team Effort
  - Individual grades adjusted by Duty Roster

Week	Class Time	Deliverable
1	Intro	
2	Lectures (Mon / Wed)	Mini-Project
3		Mini-Project
4		Mini-Project
5		Mini-Project
6	ALL TEAMS FORMED	
Spring Break		
7	Tutorial (Monday)	
8	System Demos	Design Document
9	Tutorial (Monday)	
10	Tutorial (Monday)	
11	Tutorial (Monday)	
12	Final Demos	Slide Deck & Duty Roster

## Grade

Deliverable	Grade
Mini-Project (SW)	10%
Mini-Project (HW)	10%
Sub-Sys Design Document	30%* 10%*
Final Demo	35%*
Slide Deck	5%*

Individual (Pass / Fail)

→ Self

→ Partner

**Opt-out**  
option

Submit duty roster  
Grade adjusted

\*Marks awarded for **design** work only

## Design Document

- 50%
  - Sub-System Design Document (SSDD)
  - Clear, complete & professional
- 50%
  - 5 **Performance Related** RCGs (10% each)
    - Identify RCG
    - Work Done to Satisfy RCG
    - Measure RCG

**Not acceptable:**

- Cost
- Effort
- Completion Time
- Subjective Measures

# Mini-Project

- Must pass **BEFORE** Deadline
- Must pass to join team
- 10% x 2 = 20% of Course Grade

Week #	Pass Grade
<= 4	10 / 10
5	8 / 10
Each Week Past Deadline	-2 / 10

```
graph TD; MP[Mini Project] --> PD{Pass Demo?}; PD -- No --> MP; PD -- Yes --> BD{Before Deadline?}; BD -- No --> SSD[2 Sub-System Design Docs]; BD -- Yes --> CT[Choose Team]; CT --> TP[Team Project];
```

# Choose Team

```
graph TD; MP[Mini Project] --> PD{Pass Demo?}; PD -- No --> MP; PD -- Yes --> BD{Before Deadline?}; BD -- No --> SSD[2 Sub-System Design Docs]; BD -- Yes --> CT[Choose Team]; CT --> TP[Team Project];
```

Team 1	Team 2	Team 3	Team 4
Mr. Bean	Donny	Jung	Tuco
	Bubbles	Kimchee	Sol
		Janet	Tucker
		Shannon	

Sarah

Donny & Bubbles NOT Consulted

## Software System Group

### System Identification

- Develop mechanism (SolidWorks)
- Identify mechanical parameters
- Generate linear model (Matlab)
- Generate non-linear model (Simscape)
- Compare step responses
- Add non-linearities

### Optimal Control

- Develop System ID stub
- Develop decoder stub
- Identify motor parameters
- Generate linear model (Matlab)
- Design feedback path
- Design control algorithm & ISR
- Select micro-controller
- Port to C/C++ (API)

## Hardware System Group

### Digital

- Develop PLD logic (WinCupl)
  - Implement on proto-board
  - Verify Missed Pulses
  - Verify Counter Overflow
  - Verify Latch & Read Command Sequence
- Develop C logic
  - Subroutine
  - Returns angle in deg or rad
- Develop Daughter Board (NI)

### Analog

- Develop Driver CCT (NI)
  - Implement on Proto-Board
  - Verify Source Spec
  - Verify Output Current / Power
- Develop Linear Model (Matlab)
  - Loaded Step Response
- Develop Daughter Board (NI)
- Develop Mother Board (NI)
  - Verify Connectivity

## System & Sub-System Design

### Software System Group

- Mech Design & System ID
  - Matlab
  - SolidWorks
  - Simscape
- Controller Design
  - Matlab
  - C/C++ API

### Hardware System Group

- Digital Circuit Design
  - WinCUPL
  - C/C++ API
  - NI Suite
- Analog Circuit Design
  - Matlab
  - NI Suite

## System Integration

### Prototype Demo

- High level RCGs
- System demo
- Extra features
- Design & integration work
- Evidence of iterations
  - Early versions

### Slide Deck

- Photo of prototype
- Supporting evidence to clarify presentation
- DO NOT repeat sub-system design documents
  - Necessary elements only

# Resources

- Labs
  - Attend any section
- Maker Space
  - Consult posted schedule for open hours
  - Conduct / Cleanliness
    - Closure
    - Student Volunteer to address issue
- Safety Training
  - Register ASAP
  - Violations
    - Suspension
    - Grade Cap

Rest of term

67 (C+)

- Budget
  - \$800 UBCD
    - Per team (\$200 UBCD / student)
    - PCB
    - Elec components (DigiKey)
    - Mech components (McMaster-Carr)
    - Materials (metals & filaments)
  - \$100 CAD
    - Per student (NOT reimbursed)
    - Micro-Controller
    - Whatever else you need

# Start Today

Visit

https://people.ece.ubc.ca/leos

Install & Learn

Matlab / Simulink / Simscape

SolidWorks (Parts / Assemblies)

MultiSim / UltiBoard

WinCUPL

Dr. Leo Stocco, PhD. PEng.

ece

Electrical and Computer Engineering

UBC

home

tools

ELEC341

ELEC391

EECE597

Schedule

Gen Resources

Proj Resources

TAs

ELEC 391

Project Resources

Design Tools

1) link Engineering Services page for software distribution

2) link Matlab & Simulink tutorials

3) Help / Getting Started MultiSim & UltiBoard tutorials - help menu

4) link MultiSim & UltiBoard tutorial (quick-start)

5) link Ultiboard tutorial (complete)

6) Help / Tutorials SolidWorks tutorial - help menu

Micro-Controller

1) link Arduino IDE

2) link Arduino Leonardo step file

3) link Spec of micro-controller

4) pdf List of Arduino instruction clock cycles

Instructional Videos

1) link Introduction to low-ratio gears

2) link Introduction to high-ratio gears