The University of British Columbia
Electrical & Computer Engineering

ELEC 391 - Design Project

Project Logistics

Teams

You will work in TEAMS of 4, subdivided into two GROUPS of 2:

Motor Group

Design, build and optimize an actuator. Refer to your ELEC 342/343 notes for ideas on how to design the requested style of motor, comprising:

1. Stator
   - Poles
   - Housing & mechanical support
2. Rotor
   - Windings
   - Commutator

Control Group

Simulate the system and design a real-time controller and the supporting electronics. You may use any micro-controller you choose. Refer to your ELEC 341 notes to model and simulate your system and design your controller. Use commercial motors in Parts I & II while your team-mates develop their motor(s). The control project comprises:

1. Computer
   - System model with open-loop and closed-loop simulations
   - Real-Time Controller
2. Electronics
   - Optical encoder
   - Digital electronics
   - Current amplifier

Integration Task

The integration project is largely open-ended. You may implement any mechanism you want to satisfy the requirements. It generally consists of the following:

1. 2nd copy of custom motor & integrated encoder
2. Mechanism
3. Adapted system model to match new electronics, motors & mechanism
4. Adapted & tuned controller for new electronics & hardware
5. Finalized electronics implemented on PCB
6. Coordinated motion task

Evaluation

The Project is evaluated in three demos. The following is a ROUGH GUIDELINE of what you must deliver a high grade. Due to the open-endedness of the project, this in not a rigid rubric and final marks will be determined on a case-by-case basis.

In Demo I, you only need to show that you have made enough progress that you are on track to satisfy the >80% criteria in Demo II. You do not need to show the same level of progress in all areas. It is fine to have made additional progress in some areas, at the expense of others.

During each demo, show the DESIGN WORK that led to what you are demonstrating.

- A pared down version of your slide deck with graphs, equations, values & sketches
- Previous versions of your design

Mark Distribution

1. Demo I - **Progress**
   - Demonstration: 10%
2. Demo II - **Component**
   - Demonstration: 25%
   - Slide Deck: 5%
3. Demo III - **System**
   - Demonstration: 50%
   - Slide Deck: 10%

Peer-Evaluation

- All members must agree and sign (otherwise determined by oral exam)
- Applied to all parts (demo + slide deck)
- Part I & II
  - 200 points per group
  - Cumulative contribution for parts I & II
- Part III
  - 400 points per team
  - Cumulative contribution for parts I, II & III

Demo Guideline (subject to change based on individual results)

1. Demo I (Week 5): Proof-of-Concept
   - **Control Group**
     - Functioning micro-controller
     - System model started (some values determined)
     - Digital / Power electronics on breadboard or proto-board
     - Functioning encoder (some parts built)
   - **Motor Group**
     - Initial stator/rotor design (some parts built)
     - Rotor supported on bearings & moves on its own
2. Demo II (Week 9): Component
   - **Control Group**
     - 80% - 89%
       - Simulink motor model (can show how values were derived)
       - Simulated OL step/impulse response overlayed on real response
       - PID (starting values + tuned values)
       - Simulated CL step response overlayed on real response
       - Stable PID controlled motor (compenstates for external disturbances)
     - 90% +
       - All of the above implemented for 2 motors
       - Custom PCB
       - Digital electronics for reading encoder
       - Other extra features
   - **Motor Group**
     - 80% - 89%
       - One working motor with final design implemented
       - Magnetic circuit desined (metal laminations / case)
       - Magnets configured & mounted
       - Commutation problem solved
       - Motor parameters identified
     - 90% +
       - Two motors implemented (may have different parameters)
       - One packaged & ready to use high-performance motor with integrated encoder
       - Other extra features
3. Demo III (Week 13): System Integration & Evaluation
   - 80 - 89%
     - Integrated mechanism with two custom motors
     - System model of each individual axis
     - 2-axis coordinated control achieves desired task
     - All circuits implemented on PCB
     - All mechanical / circuits / wiring neat, clean & reliable
   - 90% +
     - High performance coordinated motion
     - System model of coordinated system
     - Extra features

Slide-Deck Mark Distribution

1. Quality 5%
   - All required components
   - Good mix of pictures & text
   - Self-explanitory
   - Spelling & grammar
2. Title Slide 5%
   - All required components
3. Problem Description 10%
   - RCGs
   - Clear & measurable
   - Satisfied or not
4. Design 45%
   - All design components shown and clearly explained
   - Experimental setups
   - Design drawings
   - Equations & graphs
   - Brief explanations
5. Results 30%
   - All results measured and shown
   - Clearly annotated, explained and motivated
6. Summary Slide 5%
   - Repeat of most impactful picture / result in slide deck

Slide-Deck Grading Guidelines

1. 80% - 89%
   - All requirements met
2. 90% +
   - All requirements met with very high quality standards

Slide-Deck Submission Guidelines

1. Save slide deck in PDF
   - 2 slides per page
2. Rename PDF file
   - For example, group A3 should name their file as follows
     - A3m.pdf (Demo II - motor group)
     - A3c.pdf (Demo II - control group)
     - A3.pdf (Demo III)
3. Email PDF file to Marking TA specified on TA webpage
   - Subject line should be the file name
     - eg. A3m
   - The grade will be sent as a reply
   - The sender is responsible for sharing feedback with remainder of the team