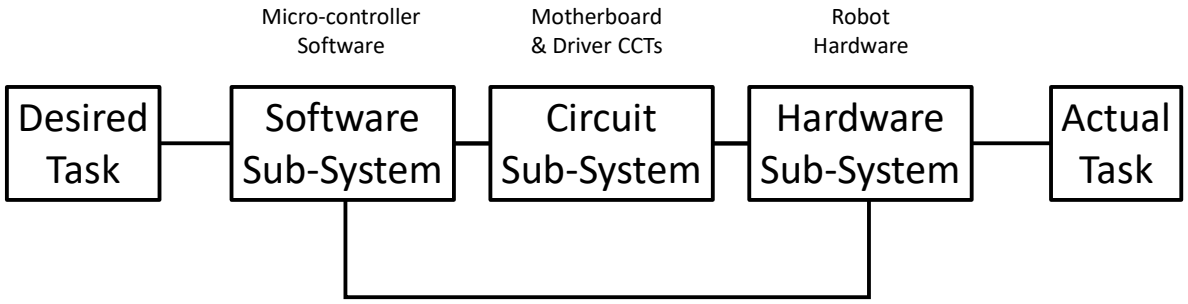
Elec 391
Academic Year: 2025-W2

Syllabus Summary

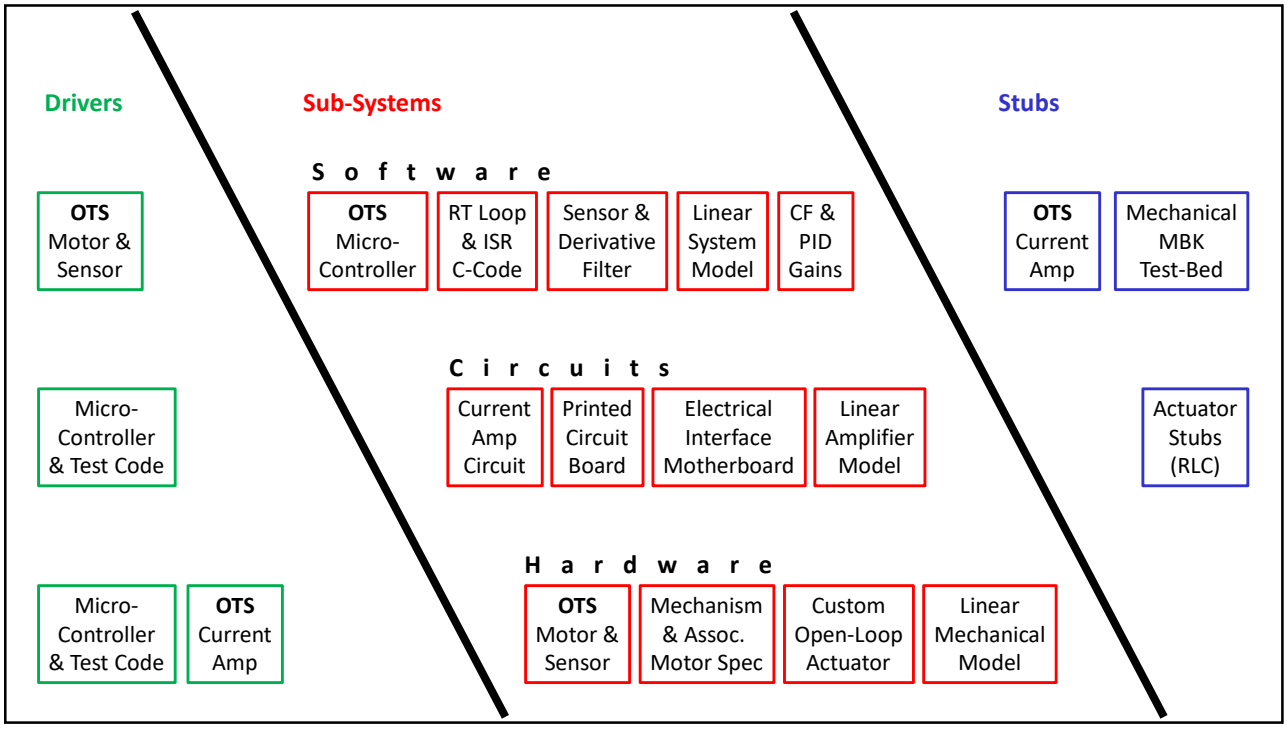
System & Sub-Systems



Project Phases

- Sub-System Design
  - 50% of final grade
  - SW Group (1-2 Students)
  - CCT Group (1-2 Students)
  - HW Group (1-2 Students)
  - Equally Weighted
    - Option to **IMPEACH**
    - **Individual presentations**
    - **Grade < 50% = final grade**
- System Integration
  - 50% of final grade
  - Team (5-6 Students)
  - Weighted by Peer Evaluation
    - Consensus
    - **Independent Review**

Week	Class Time	Deliverable
1	Intro	
2	Lectures & Tutorials	
3		
4		
5		
6		
---	**Spring Break**	
7	Design Demo	Design Paper
8	Tutorials	
9		
10		
11		
12		
13	Integration Demo	Integration Paper



Specification - RCGs

- Defines the **TECHNICAL** problem to be solved
- Updated to describe the **TECHNICAL** accomplishments
  - when associated with a practical benefit
- Requirements
  - **MANDATORY**
  - **UN-AMBIGUOUS**
    - Output to motor **MUST BE** able to deliver **10A at 10V (100W)**.
    - Footprint of PCB **MUST BE** no larger than **10cm x 10cm**.
- Constraints
  - **EXTERNALLY IMPOSED**
    - Motor is a **Maxon RE90** motor, which is provided.
- Goals
  - Desired but **NOT MANDATORY**
  - Often **AMBIGUOUS**
    - Footprint of PCB **SHOULD BE AS SMALL AS POSSIBLE**.

Software Group

High-level Requirements

- PID Controller
  - Sensor filter parameters
  - Derivative filter parameters
  - Duty cycle
  - Output
    - PWM (driver)
    - Digital (project)
- MBK Stub
  - Adjustable mass
  - Adjustable damping
  - Measurable values
- Homing Procedure

Low-level Requirements

- Encoder spec
- Response time
- Digital pin-out
- Micro-controller mechanical parameters
- MBK Test-Bed
  - parameter range
  - parameter resolution
  - joint / task space
- Matlab simulation

Circuits Group

High-level Requirements

- Daughter boards
  - Micro-controller (1), motor (1), solenoid (2)
  - Motor & solenoid drivers
    - Digital input level
    - No integrated circuits
    - PLD ok (no micro-controllers)
  - Pin & socket connections (no cables)
- Cable connections
  - Power (1), motor (1), solenoid (2) encoder (1), home sensor (1)
  - OTS cables only

Low-level Requirements

- Power (voltage / current)
- Digital input range/resolution
- Motor I/O spec
- Solenoid I/O spec
- Cable pin-out
- Cable gauge
- Mechanical dimensions
- Mechanical connections
- Analog simulation

Hardware Group

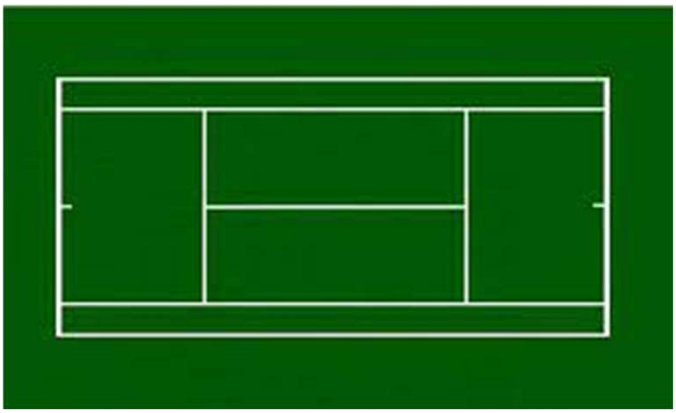
High-level Requirements

- Robot
  - Main joint
    - Motion range
  - Mechanical interface
    - Application constraint
    - Connection constraint
    - Home sensor
    - PCB & cable housings
- Actuator
  - Solenoid
  - Variable force

Low-level Requirements

- Robot
  - Mech parameter (M & B)
  - Motion range
  - Encoder range
  - Encoder resolution
- Solenoid
  - Strike & hold force
  - Elec parameter (R & L)
  - Return spring constant
- Mechanical assembly simulation

AI Slop



"Motorcycle jumping a tennis court"
- Gemini Imagen

Deliverables (each phase)

Functional Demo

- 5 Minutes (max)
  - Requirements achieved
    - Live only
    - No recorded evidence
  - Goals achieved
  - Internals
    - implementation quality
    - early versions

Design Demo

- 5 Minutes (max)
  - Design process
    - Live software demo
    - Source files only
    - No static results
- Design Paper (2 pages)
  - Summary
  - System photo
  - Design screen-shots

Technical Work

- Design
  - Motivated by RCGs
- Implementation / Integration
  - Turn design into reality

INCLUDE

- Hacking
  - Try stuff & see what happens
  - Investigation & learning

OMIT

Grading

Content – 50%

- Demonstration
  - Functionality
  - **NO** video evidence 
- Requirements
  - Rigorous
  - Design work
  - All addressed
- Goals
  - Extra features

Quality – 50%

- Implementation
  - Clean
  - Reliable
- Presentation
  - Pace
  - Clear & organized
- Paper
  - Complete summary 

Teams

Organization

- Your Choice
  - Any Lab Section OK
- Complementary Skills
  - RT Software Design
  - Control & System ID
  - Circuit Design
  - Electro-Magnetic Design
  - Mechanical Design
- Attendance
  - **ALL** demos
  - Zoom by special permission only

Formation

- Register on Canvas
- Team Consolidation
  - After add/drop deadline
  - Incomplete teams (<6 students)
  - High team numbers (Team #37)

Resources

Spaces

- Labs
  - Attend any sections
- Maker Space
  - Consult posted schedule for hours
  - Conduct
    - Cleanliness
    - Safety Training (done)
    - Violations = **Suspension**
- Install & learn
  - Matlab & Simulink
  - SolidWorks (Parts & Assemblies)
  - Altium / MultiSim & UltiBoard
  - Altera GUI

Costs

- Incidentals Provided
  - Monitored for abuse
  - Stocked electrical components (as available)
  - Wire & solder
  - Materials (metals & filaments)
  - Services (3D printing, waterjet & laser cutting)
- $600+ CAD Lab Fee
  - $100+ CAD per student (**NOT** reimbursed)
  - Micro-Controllers
  - Mechanical components
  - PCBs
  - Whatever else …