

ENGR 100-950 Lab Redesign

Cayetano Wagner (cowagner@umich.edu), Aaron Ridley (ridley@umich.edu)

Weeks	Topics
1-7	Skills labs
8	Spring break
9-11	Build labs
12-13	Launch

Current Labs

1. Introduction to Arduino
2. Temperature Sensing
3. Humidity, Pressure, and Acceleration
4. Power (aspects of EECS 215)
5. GPS (aspects of EECS 280 and 281)
6. Altium I (aspects of EECS 473)
7. Altium II (aspects of EECS 473)
- 8.
9. Assembly and Testing
10. Assembly and Testing (cont.)
11. Assembly and Testing (cont.)
12. Go / No Go Presentations

Major Changes

- Replace advanced topics with tutorials
- Introduce shock testing and thermal modelling to guide physical design
- Eliminate lab reports. Use postlab quizzes to check comprehension of important concepts
- Integrate postlab deliverables with major assignments
- Eliminate lab reports. Use postlab quizzes sparingly to check comprehension of important concepts
- Add thermal and shock requirements to Assemble and Testing lab

Reformulated Labs

1. Introduction to Arduino
2. *Digital Sensors and Calibration*
3. *Openlog Guide / Analog Sensors*
4. *GPS Guide / Shock Experimentation*
5. *Power Guide / Thermal Modelling*
6. Altium I
7. Altium II
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12. Go / No Go Presentations

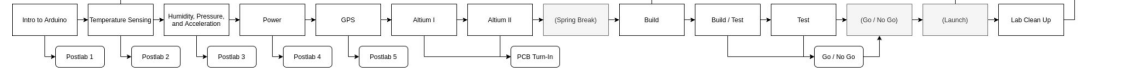


Element	Intent	Side effects	Alternatives
Skills Labs	<ul style="list-style-type: none"> - Teach foundational concepts - Build interesting and confidence in engineering skills 	<ul style="list-style-type: none"> - Overemphasis on EECS can alienate students with other interests - Material isn't absorbed due to rapid pace -- labs are instead being followed as tutorials 	<ul style="list-style-type: none"> - Lean in to "tutorial" nature of complex circuitry and code - Replace most advanced material with content centered on physical design
Postlab Reports	<ul style="list-style-type: none"> - Reiterate important concepts from lab - Build report writing skills 	<ul style="list-style-type: none"> - Report quality is poor early in the semester because those skills aren't taught til later - Students are frustrated with report length and quality expectations 	<ul style="list-style-type: none"> - Replace lab reports with quizzes when concepts are important to lock in - Require graphics and data to be used in major assignments to be postlab deliverables
Build Labs	<ul style="list-style-type: none"> - Ensure student designs are flight ready - Let students have fun with designs to make launch memorable 	<ul style="list-style-type: none"> - Unstructured nature leaves students confused and without adjacency - Majority of teams copy the "stock" design for simplicity 	<ul style="list-style-type: none"> - Introduce physical design concepts earlier - Formalize physical design with technical requirements - Explicitly encourage fun designs with budget for orders

Discussion



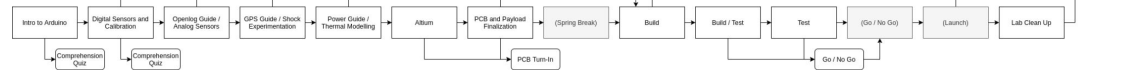
Labs



Discussion



Labs



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ENGR 100-950 Overview

ENGR 100 Goals:

- Engineering design process
- Written, oral, and visual communication deliverables
- First (required) major team project
- Explore the role of engineering in society

Section 950 Topic:

- Atmospheric sensing and weather balloons
 - Design, build, test, and fly a payload with atmospheric sensors
 - Collect and analyze data from a real balloon flight



Lab Overview

Weeks	Topics	Goals
1-7	Skills labs	<ul style="list-style-type: none">- Explore underlying technologies and concepts- Design electronic components of payload
8	Spring break	
9-11	Build labs	<ul style="list-style-type: none">- Design physical components of payload- Meet testing requirements for launch
12-13	Launch	

Lab Overview

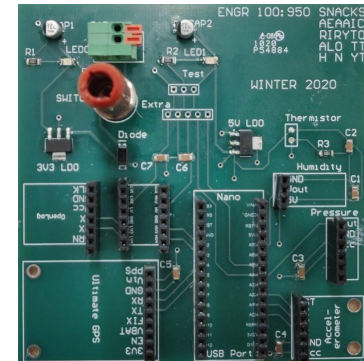
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5. GPS (aspects of EECS 280 and 281)
6. Altium I (aspects of EECS 473)
7. Altium II (aspects of EECS 473)

Each lab has a corresponding postlab report

Outcomes:

- Diverse array of technical skills in the electrical engineering and computer science fields
- Self-designed PCB



Lab Overview

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12. Assembly and Testing (cont.)
13. Go / No Go Presentations

Lab 9 outlines testing requirements

Go / No Go presentations allow students to report on their readiness for launch

Outcomes:

- Flight-ready payload



Redesign Goals

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Skills Labs	<ul style="list-style-type: none">- Teach foundational concepts- Build interesting and confidence in engineering skills	<ul style="list-style-type: none">- Overemphasis on EECS can alienate students with other interests- Material isn't absorbed due to rapid pace -- labs are instead being followed as tutorials	<ul style="list-style-type: none">- Lean in to "tutorial" nature of complex circuitry and code- Replace most advanced material with content centered on physical design
Postlab Reports	<ul style="list-style-type: none">- Reiterate important concepts from lab- Build report writing skills	<ul style="list-style-type: none">- Report quality is poor early in the semester because those skills aren't taught til later- Students are frustrated with report length and quality expectations	<ul style="list-style-type: none">- Replace lab reports with quizzes when concepts are important to lock in- Require graphics and data to be used in major assignments to be postlab deliverables
Build Labs	<ul style="list-style-type: none">- Ensure student designs are flight ready- Let students have fun with designs to make launch memorable	<ul style="list-style-type: none">- Unstructured nature leaves students confused and without adjacency- Majority of teams copy the "stock" design for simplicity	<ul style="list-style-type: none">- Introduce physical design concepts earlier- Formalize physical design with technical requirements- Explicitly encourage fun designs with budget for orders

Redesign - Skills Labs

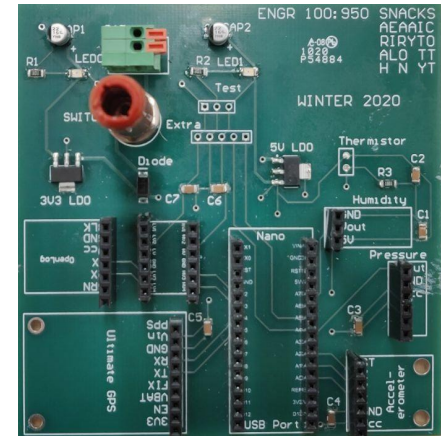
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Major Changes

1. Replace the following labs with tutorials
 - a. Advanced circuitry
 - b. Power
 - c. GPS
2. Introduce following concepts to guide physical design
 - a. Shock testing, using the impulse equation
 - b. Thermal modelling, using Newton's Law of Cooling



Redesign - Postlab Assignments

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Postlab Reports	<ul style="list-style-type: none">- Reiterate important concepts from lab- Build report writing skills	<ul style="list-style-type: none">- Report quality is poor early in the semester because those skills aren't taught til later- Students are frustrated with report length and quality expectations	<ul style="list-style-type: none">- Replace lab reports with quizzes when concepts are important to lock in- Require graphics and data to be used in major assignments to be postlab deliverables

Redesign - Postlab Assignments

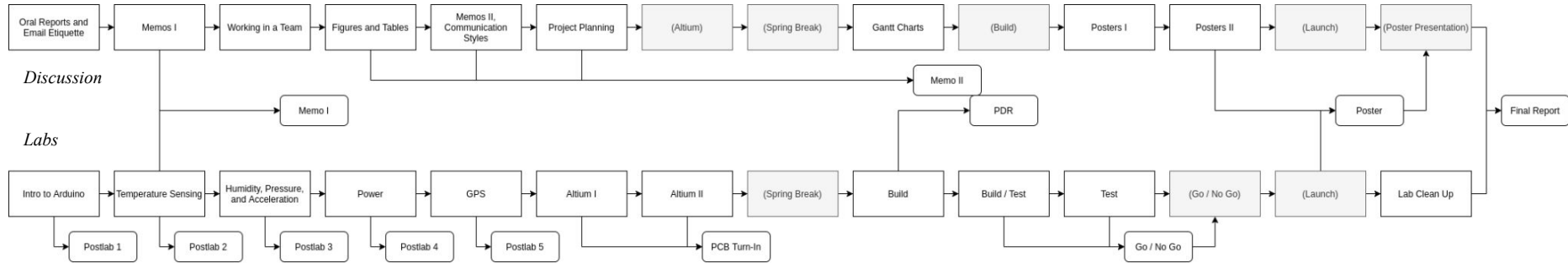
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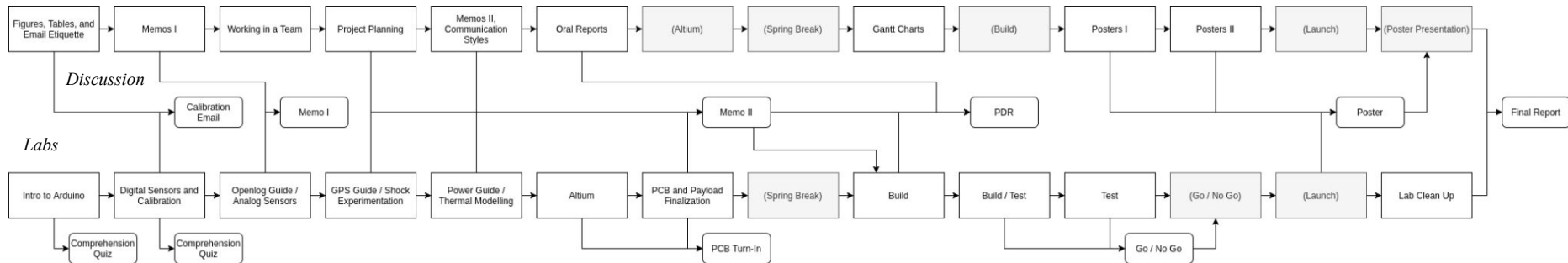
3. Eliminate lab reports. Use postlab quizzes sparingly to check comprehension of important concepts
4. Integrate postlab deliverables with major assignments in the class

Redesign - Postlab Assignments

Current schedule



Future schedule



Redesign - Build Labs

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Major Changes

5. Add thermal and shock requirements to Assembly and Testing Lab

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Additional Quality of Life Changes

Minor Changes

1. Lab styling for improved clarity and explicit instructions
2. Walkthrough videos for altium
 - a. Introduction
 - b. Exporting PCB
3. Staff organization using Trello
 - a. Retain institutional knowledge from lapse due to Covid
 - b. Make IA onboarding process easier