Intro to ECSE

Did you fill out the pre-semester survey?

Prof. Santiago Paternain
paters@rpi.edu

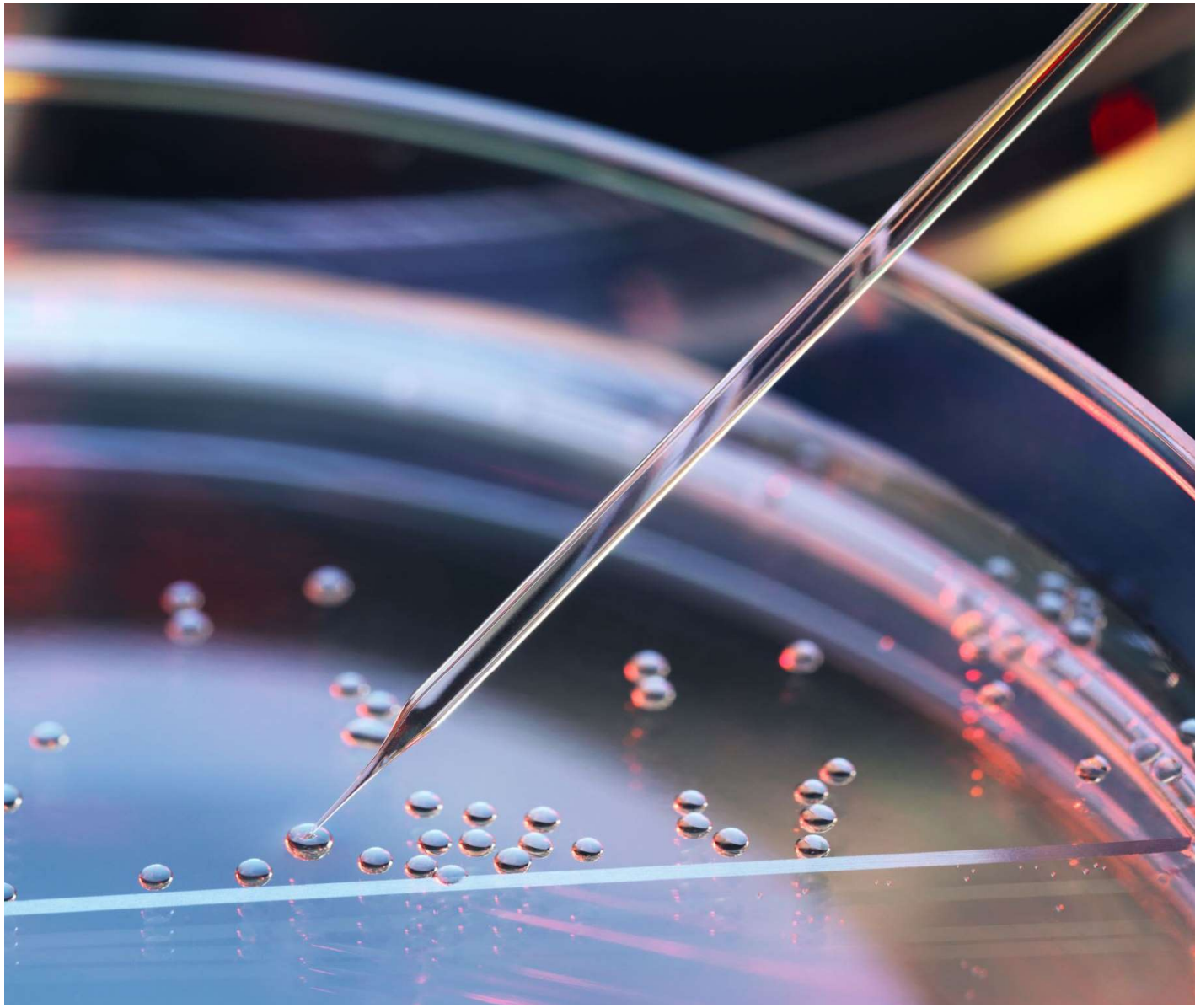
Thanks to Alex Patterson for the slides

Rensselaer

Agenda

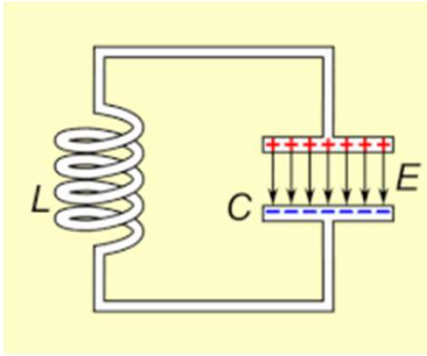
- ECSE's Pedagogical Experiment
- Course Website and Syllabus Review
- Your Immediate Assignment (Prep for Proof of Skills Day!)
- Brainstorming Group Activity: ECSE and Society's Challenges
  - Join WebEx Teams Space
  - Collaborate!

ECSE's Pedagogical Experiment



ECSE's Ongoing Pedagogical Experiment

1. **ECSE has an experiment with a narrative to tell**
2. We are developing ideas, processes, and tools across our courses to give students
    1. Hands on design opportunities
    2. Opportunities to explore theories, ideas, or concepts
    3. Student Agency (student choices)
    4. Recognize Student Identity as a part of our growing knowledge



Inductor
Individualism

Capacitor
Collectivism

How do open-ended problems (hands-on design opportunities) and rigorous fundamentals in traditional methods affect student learning and ECSE culture?

Find the resonance!

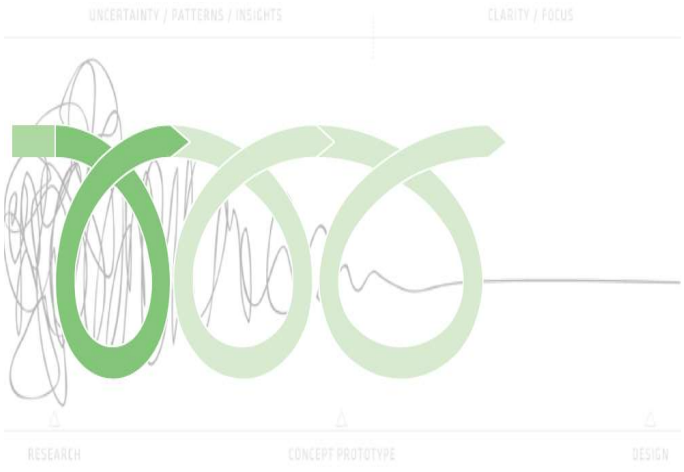
ECSE's Ongoing Pedagogical Experiment

Supporting an Ownership Mentality

Fostering an environment to help students mature rapidly…..

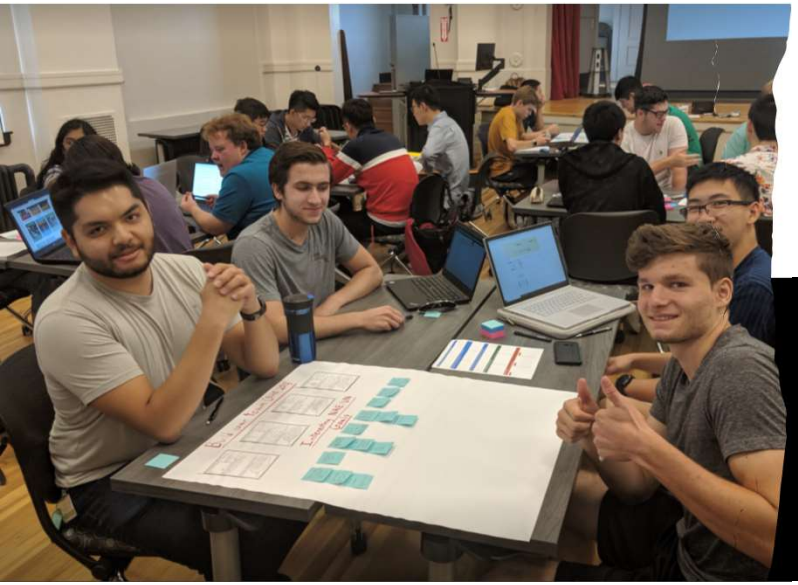
- Opportunities to
  - **ELIMINATE "Is this right?"** from their engineering vocabulary.
  - **develop their own ideas** about how fundamentals are applied to support learning. **Design in non-binary and inclusive!**
  - **better utilize resources on a network of campuses** that support student-led innovation.
  - learn to "fail" well through **iteration and recovery.**

Learning to "fail" well. Optimize.



https://www.epsilontheory.com/kobayashi-maru/

Modified from Olin Engineering Summer Institute Workshop Materials, 2019.



Look to the left and right of you….

- You don't have to work alone…
- Be a part of the learning community!

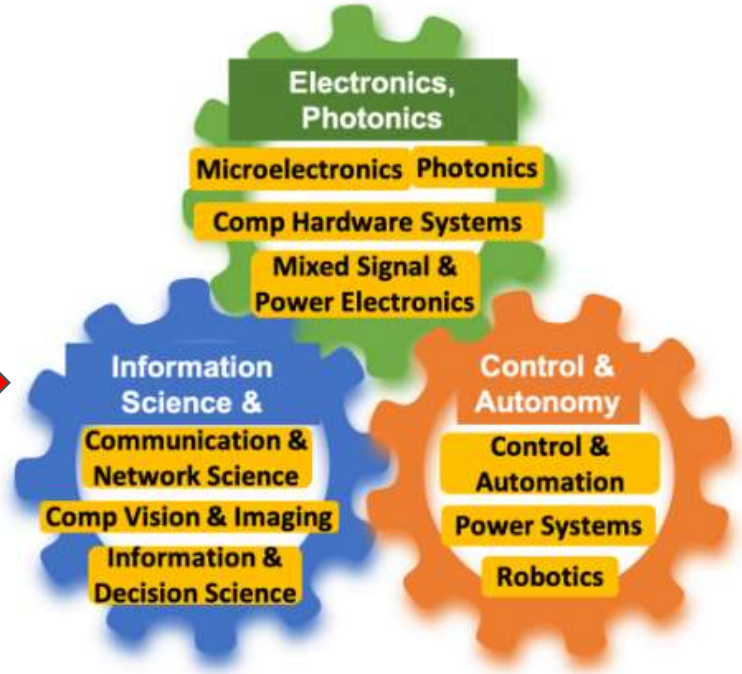
Intro to ECSE

Prof. Santiago Paternain

- **"I (we) don't like to lecture…"**

interactive, designed chaos leads to learning! - Prof. Sawyer

- I plan to **learn who you are**…what motivates you…
- Plan to give you the **choice to explore**….
- Plan to give you a chance to **FAIL well** and iterate…..
- Plan to involve you in OUR experiment…..as participants in ***creating something new***…
- Plan to learn the difference between tinkering and engineering!!! (**Math works for you** like a faithful employee…)



Equipment required for the class

- **ADALM2000 (M2K board)** Wiki link

OR

- **Analog Discovery 2** Getting started link

https://sites.ecse.rpi.edu/courses/S24/ECSE-1010/resources/instrumentation/Personal_Instrumentation.pdf

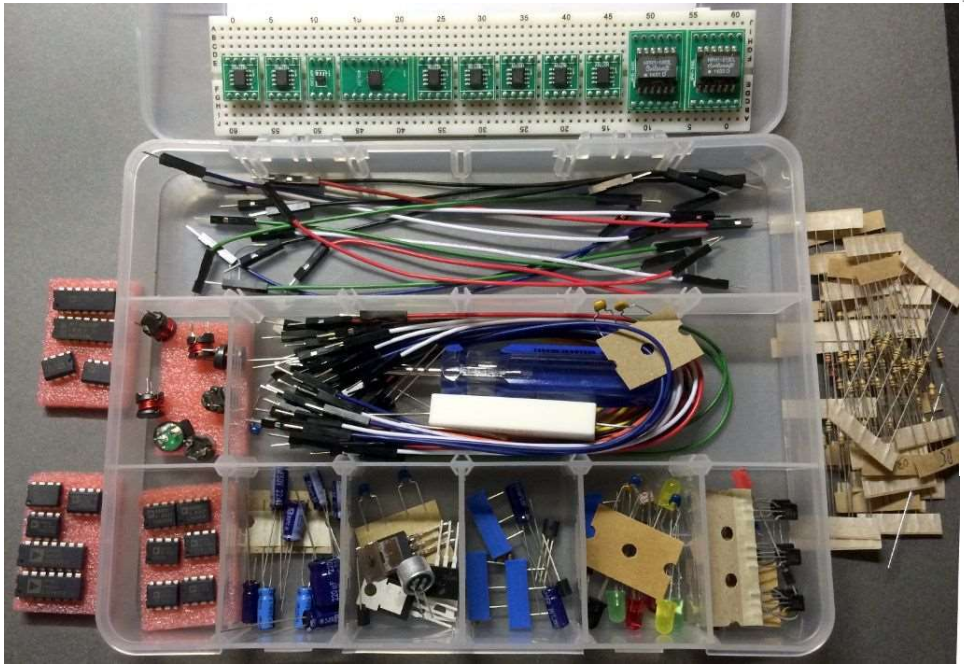
ADALM2000 (M2K) Board IT'S $180-$300 depending on where you buy…better!

- Now being used in ECSE 2010, ECSE 2050, likely other future courses
- Will likely switch Intro to ECSE to this in future semesters with the back up plan of using the M1K
- Has a current limitation that may prohibit circuit that draws a lot of current >50mA
- RPI Bookstore $300 https://www.bkstr.com/rpistore/product/adalm2000-board-817836-1
- Mouser $180 https://www.mouser.com/ProductDetail/Analog-Devices/ADALM2000?qs=xbccQsLEe0e03sUxIHWPSw%3D%3D
- These change every year…no idea why…

Analog Discovery Board 2 $400…they know they are the BEST one…

- It just works for every class, every time…very little bugs…better current limit 750mA
- Higher frequency limits
- Better GUI for all functions: Scope, Function Generator, Spectrum Analyzer…
- https://digilent.com/shop/analog-discovery-2-100ms-s-usb-oscilloscope-logic-analyzer-and-variable-power-supply/

ADALP2000 parts kit (description link)



ANALOG DEVICES

ADALP2000 Analog Parts Kit

wiki.analog.com/ADALP2000

ICs

Qty.	Description
Amplifiers	
1	AD8226 instrumentation amp (BOB*)
1	ADTL082 JFET op amp (BOB*)
1	AD8542 CMOS rail-to-rail op amp (BOB*)
2	OP482 high speed JFET op amp (14-lead PDIP)
1	OP484 precision rail-to-rail I/O op amp (14-lead PDIP)
2	OP27 low noise, precision op amp (8-lead PDIP)
2	OP37 precision op amp (8-lead PDIP)
2	OP97 low power, high precision op amp (8-lead PDIP)
1	LTC1541 micropower amp, comparator, reference (BOB*)
Sensors	
1	AD8210 current shunt monitor (BOB*)
1	AD22151 magnetic field sensor (BOB*)
1	ADXL327 3-axis accelerometer (BOB*)
2	AD22100 voltage temperature sensor (TO-92)
1	AD592 current temperature sensor (TO-92)
1	TMP01 temperature controller (8-lead PDIP)
1	Electret microphone
1	10 kΩ thermistor
1	OP999 PIN photodiode
Power	
1	ADP3300 3.3 V, 50 mA, LDO linear regulator (BOB*)
1	LT3092 programmable current source (BOB*)
1	LTM8067 isolated dc-to-dc converter (BOB*)
1	LT3080 adjustable, 1.1 A LDO (TO-220)
1	LT1054 switched-capacitor regulator (8-lead PDIP)
Data Conversion	
1	AD654 voltage-to-frequency converter (8-lead PDIP)
1	AD5626 12-bit *nano*DAC+ (BOB*)
1	AD7091R-5 12-bit, 4-channel, I²C ADC (BOB*)
Misc ICs	
1	AD584 programmable V_{REF} (8-lead PDIP)
2	AD8561 comparator (8-lead PDIP)
1	LTC1485 differential bus transceiver (8-lead PDIP)
1	LTC1043 precision switched-cap block (8-lead PDIP)

*Breakout board for surface-mount device.

Resistors

Qty.		Band 1	Band 2	Band 3
5	1.1 Ω	brown	brown	gold
5	10 Ω	brown	black	black
5	47 Ω	yellow	purple	black
5	68 Ω	blue	gray	black
5	100 Ω	brown	black	brown
5	470 Ω	yellow	purple	brown
5	1 kΩ	brown	black	red
5	1.5 kΩ	brown	green	red
5	2.2 kΩ	red	red	red
5	4.7 kΩ	yellow	purple	red
5	6.8 kΩ	blue	gray	red
5	10 kΩ	brown	black	orange
5	20 kΩ	red	black	orange
5	47 kΩ	yellow	purple	orange
5	68 kΩ	blue	gray	orange
5	100 kΩ	brown	black	yellow
5	200 kΩ	red	black	yellow
5	470 kΩ	yellow	purple	yellow
5	1 MΩ	brown	black	green
5	5 MΩ	green	brown	green
1	6.2 Ω (10 W power resistor)			

Potentiometers

Qty.	Description
1	5 kΩ
2	10 kΩ
1	50 kΩ

Capacitors

Qty.	Description
2	39 pF
2	100 pF
2	0.001 µF
2	0.0047 µF
2	0.01 µF
2	0.047 µF
2	0.1 µF
2	1 µF
2	4.7 µF
2	10 µF
2	22 µF
2	47 µF
1	220 µF

Transistors

Qty.	Description
3	2N3904 small signal NPN
3	2N3906 small signal PNP
1	IRF510 power MOSFET
1	TIP31CFS NPN power
1	TIP32CFS PNP power
1	ZVN2110A N-channel DMOS FET
2	ZVN3310 N-channel MOS FET
2	ZVP2110A P-channel MOS FET

Logic

Qty.	Description
1	SN74HC08 quad AND gate (14-lead PDIP)
1	SN74HC32 quad OR gate (14-lead PDIP)
1	SN74HC273 octal FF (14-lead PDIP)
1	SN74HC04 hex inverter (14-lead PDIP)

LEDs

Qty.	Description
2	Green
2	Yellow
2	Red

InfraRed

Qty.	Description
1	QED123 infrared LED
1	QSD123 infrared transistor

Diodes

Qty.	Description
1	1N3064 small signal diode
1	1N4001 general-purpose plastic rectifier
1	1N4735 1 W Zener diode
4	1N914 fast switching diode

Inductors

Qty.	Description
2	RFB0807-1R0L 1.0 µH
2	RFB0807-100L 10 µH
2	RFB0807-101L 100 µH
2	RFB0807-102L 1 mH
2	RFB0807-103L 10 mH
1	HPH1-1400L Hexa-Path magnetics (BOB*)
1	HPH1-0190L Hexa-Path magnetics (BOB*)

Coilcraft

coilcraft.com/students

Other

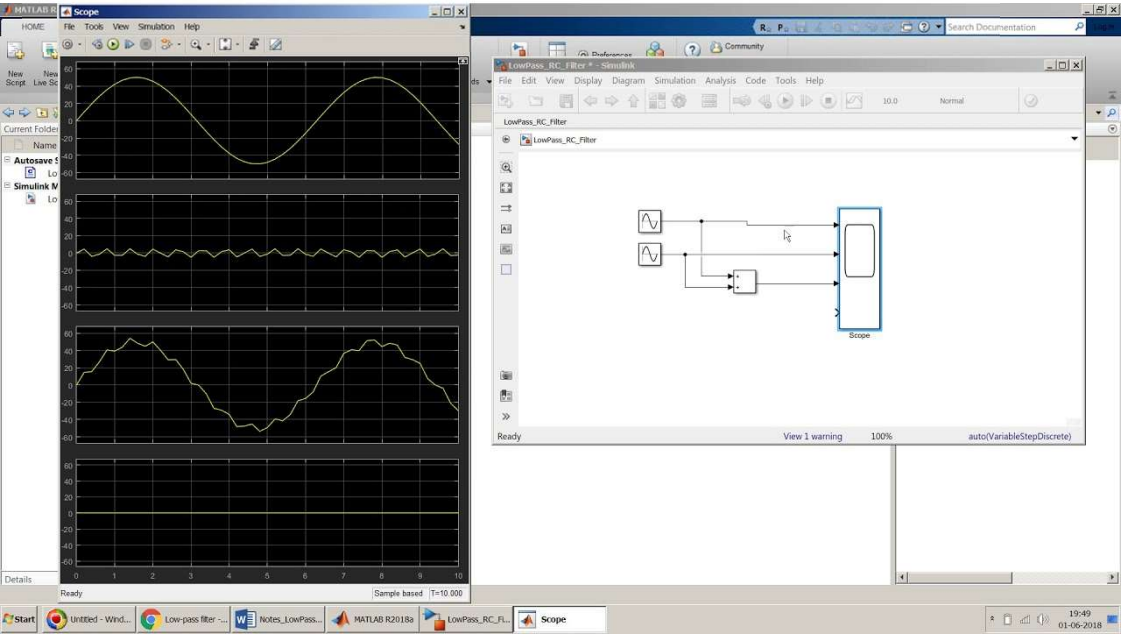
Qty.	Description
1	Speaker
1	Solderless breadboard
1	Screwdriver: flathead
1	USB connector (BOB*)
1	Audio connector (BOB*)
45	Jumper wires with pin ends

RoHS Compliant

YES! You need to Purchase this! RPI Bookstore…$132.99

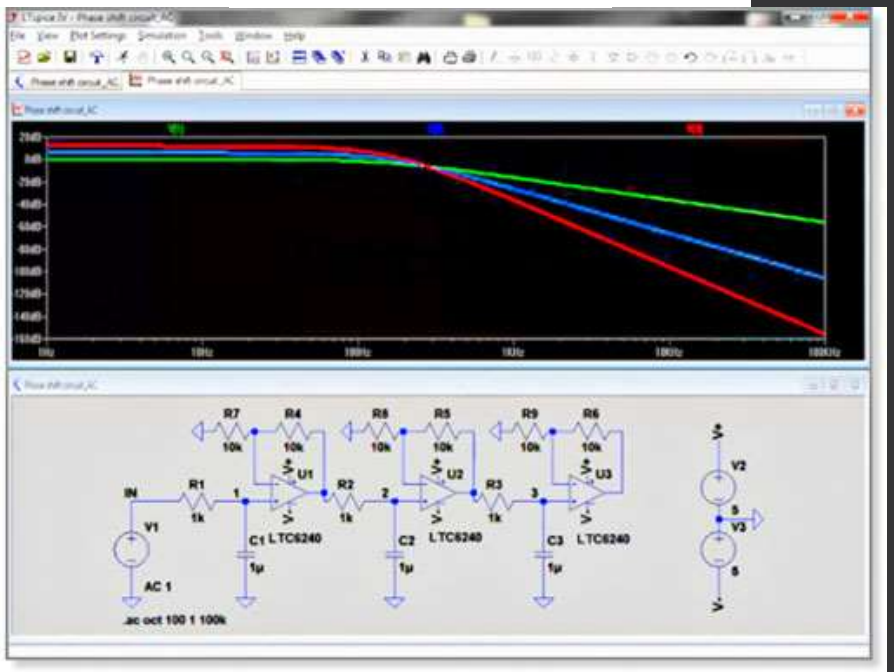
https://wiki.analog.com/university/tools/adalp2000/parts-index

MATLAB®
SIMULINK®



https://www.youtube.com/watch?v=MNcu3TfPPQ8

LTspice®



https://www.analog.com/en/design-center/design-tools-and-calculators/ltspice-simulator.html

BEYOND GPA

Learn to represent yourself and your demonstration of expertise! Develop a portfolio!

https://sites.ecse.rpi.edu/courses/S24/ECSE-1010/resources/Portfolio_Instructions_S24.pdf

Examples of Student Portfolios

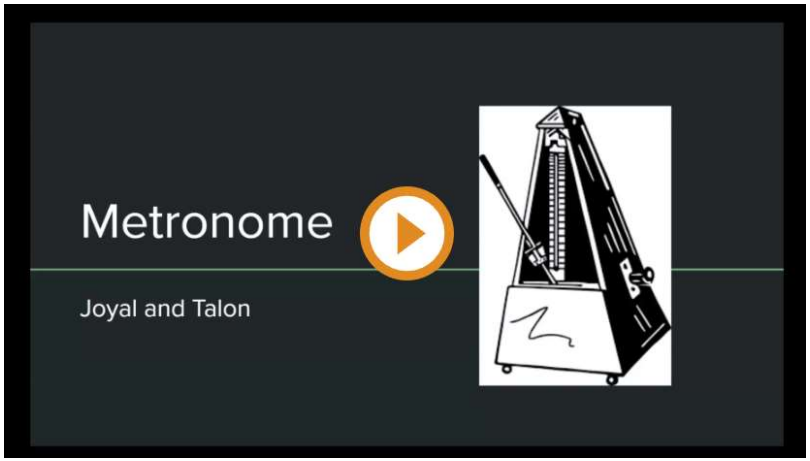
- Om Anavekar
- https://omanavekar.wixsite.com/ommakes/portfolio

- Joshua Pratt
- https://www.joshuapratt.net/

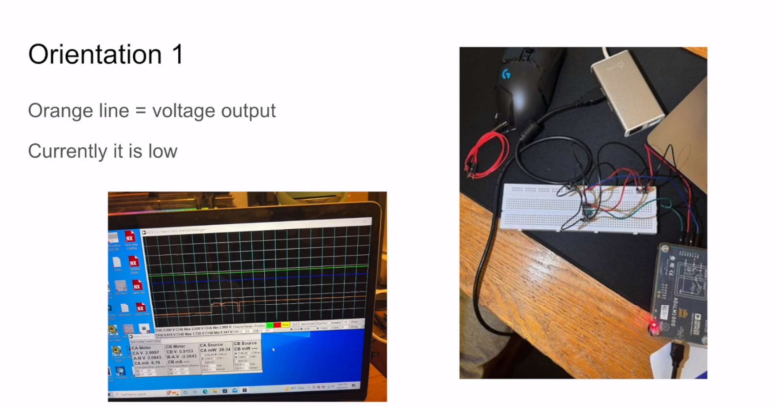
- Colin Kilburn
- https://colinkilburn.wordpress.com/

- George Rizos
- https://georgerizos.com/projects

YOUR FUTURE…Omega Lab example videos



[Metronome Project]



[Simple Circuit Heating System Control]

Course Website and Syllabus

Course Website

https://sites.ecse.rpi.edu/courses/S24/ECSE-1010

Course Information

Course Credits:	4 credit hours
Class Time:	Mondays & Thursdays: 12:00PM to 1:50PM
Class Location	Sage 3510
Course Website:	https://ecse.rpi.edu/courses/S24/ECSE-1010/

Teaching Staff

Prof. Santiago Paternain

Contact information: paters@rpi.edu
Office Hours: Wednesday 2pm – 4pm in JEC 6034

Section	Name	Email	Role	Hours	Open Shop Hours

All open shop hours held in JEC 4201 unless otherwise noted

The overall goal of this course is to help EE and CSE students **build a broad analysis skill set** so that through experimentation, simulation and the application of science, mathematics and engineering fundamentals, they can develop useful systems models that enable engineered solutions addressing a ***broad array of societal needs.***

www.rpi.edu/~sawyes
sawyes@rpi.edu

Student Learning Outcomes

1. **Experimental Methodology**: Students will be able to **build and make reliable time-dependent measurements of simple analog and digital circuits**, exporting data to display and analysis tools (e.g. Excel, MATLAB), and demonstrate understanding of results by describing key data features and comparing with simulation and analysis. Extract useful information from component datasheets.

2. **Simulation Methodology**: Students will be able to **create circuit simulations using a commercial SPICE program** and produce reliable voltage and current plots (functions of both time and frequency), exporting simulated data to display and analysis tools and demonstrate understanding of results by describing key data features and comparing with experiment and analysis.

Student Learning Outcomes

3. **Mathematics and Analytic Methodology**: Students will be able to **apply precollege circuit knowledge to real circuits, analyze simple circuits based on voltage dividers and inverting/non-inverting op-amps, apply phasor analysis to simple combinations of R, L and C components** and apply all analysis skills to demonstrate understanding of experimental and simulated data for simple circuits. Apply the basic matrix arithmetic used in circuit analysis, circuit simulation and in the display and analysis of data using tools like Excel and MATLAB.

4. **Design Methodology**: Students will be able to **modify existing circuit designs for specific applications and fully characterize the operation of the circuit using experimental, simulation and analytic methods.**

Course Assessment Measures

Assessment	Due Date	Learning Outcome #s
Quiz 1	**February 20th, 12pm – 1:50pm, Sage 3510**	1, 2, 3, 4
Quiz 2	See course calendar for deadlines	1, 2, 3, 4
Quiz 3	See course calendar for deadlines	1, 2, 3, 4
Final Quiz	See course calendar for deadlines	1, 2, 3, 4
Proof of Skills	See course calendar for deadlines	1,2,3
Laboratories	After Proof of Skills: daily except quiz days	1, 2, 3, 4
Problem Sets	When indicated (on course calendar)	1, 2, 3

Exam dates may change very soon! I'm trying to schedule a combined quiz block for both sections!

Grading Criteria

Category	Percent
Quizzes	30%
Final Quiz	15%
Laboratories	30%
Proof of Skills	15%
Problem Sets	5%
Attendance and Participation	5%

• **WebEx Teams:** WebEx Teams for this class will be created for group work outside of class, office hours, and open shop hours. Make sure to download the app on your desktop or Smartphone. The browser doesn't have as much functionality. Please check to see if you've been added to an Intro to ECSE WebEx Teams Space.

• **Gradescope:** All Labs, activities, homeworks and quiz submissions and grading will be done through this platform. If you aren't familiar with this tool, we'll go over submission in class.

- https://www.gradescope.com/courses/695921

- **YouTube:** Playlist to host pre-recorded video content that students are required to watch before the class when Labs begin. Video links are on the course website (under Resources by Class Day).
  - **Link** https://www.youtube.com/playlist?list=PLlutgI5N-Pzvy4xqbdwAGR7xQ95gCUZ8d

Required Software

(Installation instructions on in the Skills Development Document from the Proof of Skills)

1. LTspice (circuit simulation)
2. Waveforms (if using Analog Discovery 2)
3. Scopy (if using M2K)
4. Matlab (numerical analysis and Simulink)

Lecture Format

- Students are required to learn introductory information at home through course videos and/or reading of course materials BEFORE lecture times
- Short summary lecture given (<40 minutes on average)
- Class incorporates discussion and class problems worked in groups of 2-4 people
- Remainder of class time meant for students to work on Proof of Skills or Labs
- **We'll get in small groups for discussion time and activities!**

- **LIFE PRO TIP:**
  - **Stay ahead of the professor by one lecture…**

- **BEFORE EACH LECTURE:**
  - Go to lecture videos on website
  - Take notes from videos and/or provided course materials
  - Attempt problem sets when offered
  - Start or Iterate a Skill in Proof of Skills
  - Bring notes from video to lecture

Examples of contributions to the work your group do include:

1. Preparation for class (problem set, involved in discussions, helping others, ready for labs)
2. Adding helpful content to the Skills Development document;
3. Well documented good failures and success highlighted in your portfolio;
4. Effectively getting help when needed;
5. Consistent and insightful writing in your metacognition journal;
6. Feedback on course materials that were particularly helpful;
7. Providing answers to questions on WebEx Teams
8. Identifying errors or points of confusion in course materials, including homework; etc.

From this list, you can see that participation is just being engaged in the course, helping your partner and other students learn and the TAs and instructor do their job better.

Attendance will be taken daily via either via in-class activities or questions at the beginning of class on the lecture videos you were assigned to watch

Intro to Metacognition

What Is Metacognition?

Metacognition is thinking about thinking, typically to improve or control thought. Students with better metacognition perform better in school, work, and social groups. Here is an example of how living with metacognitive skills can impact your life:

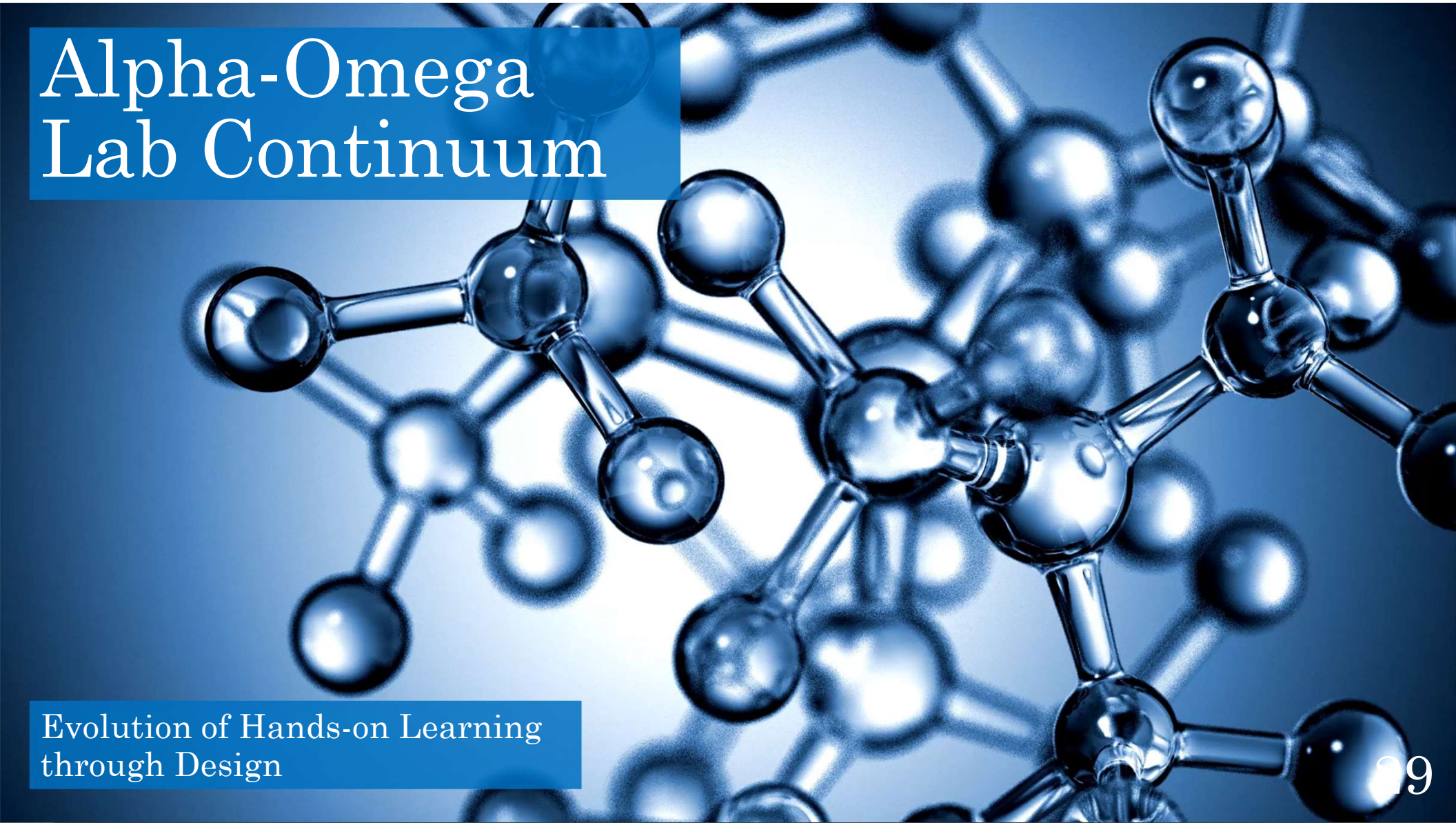
> *When Rollo was in college, he had difficulty paying attention in lectures. He asked his friends what they did to pay attention in class. He tried their advice of taking notes, drinking lots of caffeine, recording the lecture, but found they only helped a little. Eventually, Rollo realized he didn't care about what the professor was saying, but he did care about how he could apply the concepts to his personal projects. This made the lectures interesting, and helped him learn the material.*

Rollo applied metacognition by:

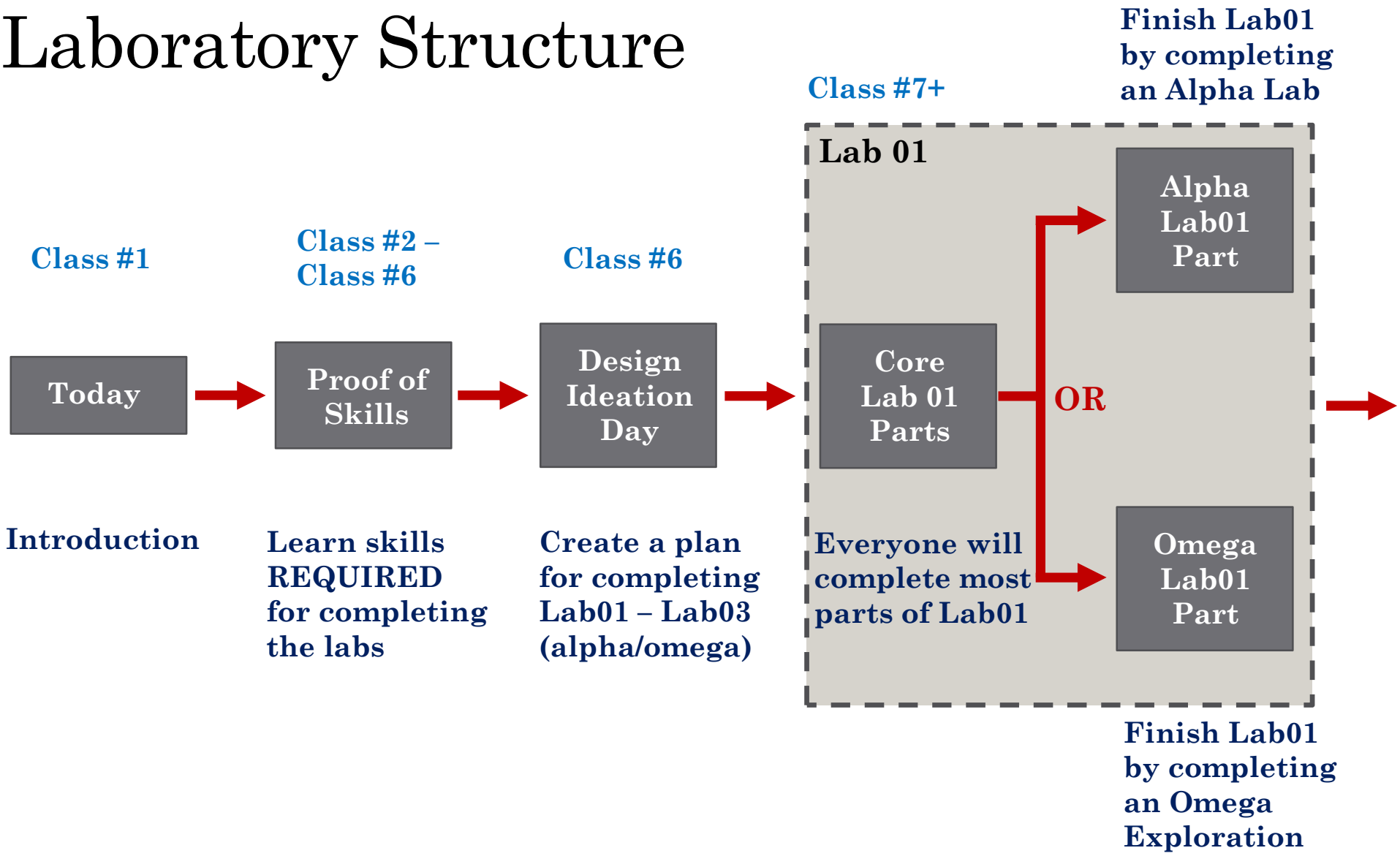
1. **Identifying** the problem: He couldn't pay attention
2. **Learning**: he talked to his friends
3. **Trying**: doing new things
4. **Reassessing**: reviewing what worked and why

It's easy to miss how mistakes relate to each other. Struggling to do your homework? It might be related to motivation, attention, or time management. You can promise yourself to 'try harder next time' but unless you take time to recognize the pattern and look for solutions, the underlying problem will remain. Understanding why you're making mistakes and addressing them early helps you improve in many aspects of life, including this course. Metacognition takes practice, so in this course we'll practice explicitly. However, we also encourage you to practice this in other classes and in life in general.

https://sites.ecse.rpi.edu/courses/S24/ECSE-1010/resources/Metacognition_Journal_S24.pdf


Alpha-Omega
Lab Continuum
Evolution of Hands-on Learning
through Design

Laboratory Structure



Laboratories

- Labs begin **AFTER the Proof of Skills Days** and Alpha/Omega Planning Days.
- All students must follow each lab and at the end of each lab students have a choice between Alpha Design Experiments and Omega Design Explorations.
- Three Laboratories are scheduled throughout the semester:
  1. Lab01: Basic Analysis and Engineering Practices,
  2. Lab02 Part A: Linear Systems and Beyond....
  3. Lab03: The Signals and the Noise
- with check points to keep with in the course schedule on the website.
- Student groups can decide to switch back and forth between Alpha and Omega between each Lab

Alpha Experiment and Omega Explorations

Highlighted Differences	Alpha Experiments	Omega Explorations
Learning Approach	Bottom-up Step by Step, Guided Design	Open Ended Explorations of Design Ideas
Relationship to Concepts in Class	Automatically written to be directly related	Student must create and show how the design in directly related
Documents/Assessment Required	Proof of Concepts	1. Proof of Concepts 2. 5-minute or less Demonstration Video (Presentation) 3. Exploration Map
Planning Need	Just keep up with class schedule	Be sure to look ahead and plan for the work over the semester
Benefits	Learn how to design after step-by-step experiments, some iteration required	• Learn to design with high risk, failure, more iteration Get out of final IF all requirements met.
Portfolio Content?	Yes! Your design belongs in your portfolio. Don't forget to add it!	Yes! Your design belongs in your portfolio. Don't forget to add it!

We'll set up your lab groups and have an Alpha Omega Planning day AFTER your Proof of Skills Days…so you have time to decide!

Omega Exploration Final Exam Opt Out

- Omega Design Explorers can choose to opt out of the final if:
  1. They complete the following assessments with a combined grade of 80% or above:
     - Proof of Concepts
     - 5-minute or less Demonstration Video (Presentation)
     - Exploration Map
  2. They complete 100% of your individual Proof of Skills
  3. They complete 2 out of 3 Omega Lab explorations (meaning you can switch to Alpha one time!)

- If you qualify to opt-out you have 2 options:
  1. Do not take the final – your grade remains as it is.
  2. Take the final and it only affects your grade if the final improves your grade. If your grade on the final would impact your grade negatively it doesn't count and your grade remains the same as it was before the final.

Proof of Skills Days starts with Class 02!

- https://sites.ecse.rpi.edu/courses/S24/ECSE-1010/resources/proof_of_skills/Proof_of_Skills_Progress_Rubric_S24.docx
- Purpose: To ensure every individual student has ***the same basic skill set BEFORE Proof of Concepts*** for your Labs!
- Right Now!…choose a category to start with in here: https://sites.ecse.rpi.edu/courses/S24/ECSE-1010/resources.html#proof_of_skills
- By Class 02 do the **minimum requirement** in your section (at bottom of category)!
- Be ready with questions for TAs, SAs, Professors
- Be ready to be a Team Skills Leader if you mastered a skill..(help others).
- **You are competing against other semesters as a collective group!**
  - **What percentage of this class can complete their Proof of Skills by the end of Proof of Skills days?**

Design Ideation – ECSE and Society

Group Brainstorming

Find a Group of 5-7 People…sit together anywhere in or near the classroom

- **Bring your laptops and cell phones with you!**
- **Open a Google Doc**
- **Get into the Intro to ECSE WebEx Teams Space**

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Progress Bar
5:00 minutes

Individual Activity (5 minutes)

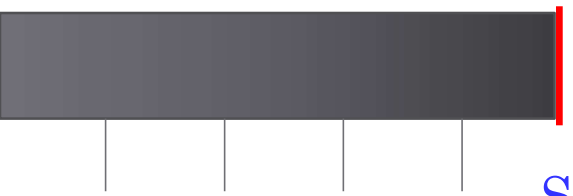
PERSONAL PROFILES

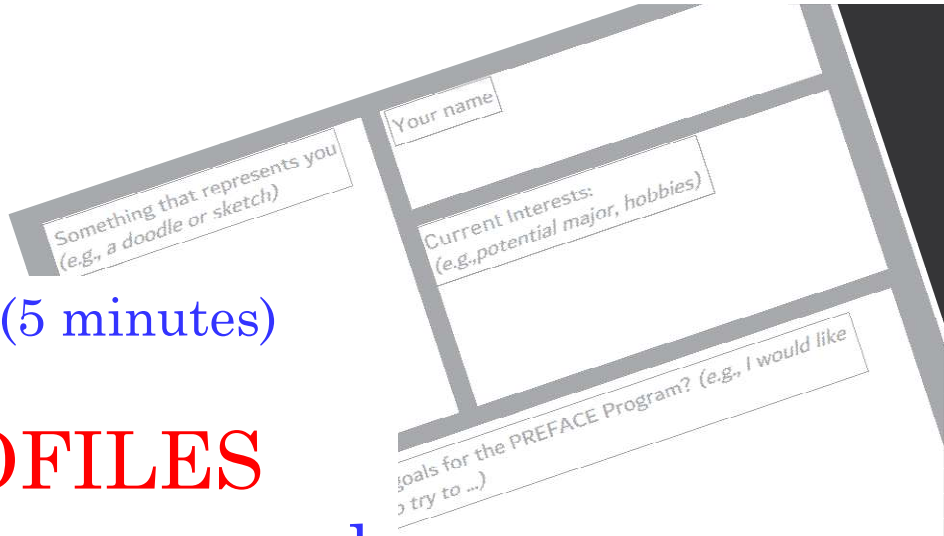
Fill out your personal card. (ppt version link)

Capture your goals, hopes and wishes over the Intro to ECSE course.

Save for your team poster!

Progress Bar
5:00 minutes



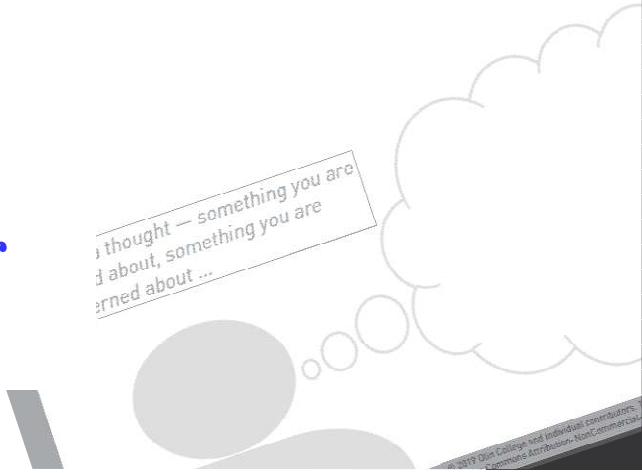


Share your Card Activity (5 minutes)

PERSONAL PROFILES

Exchange or say your personal card one by one until everyone reads it.

Collect and put on poster….(electronic poster or write in Google doc)



Progress Bar
5:00 minutes

Individual Ideation

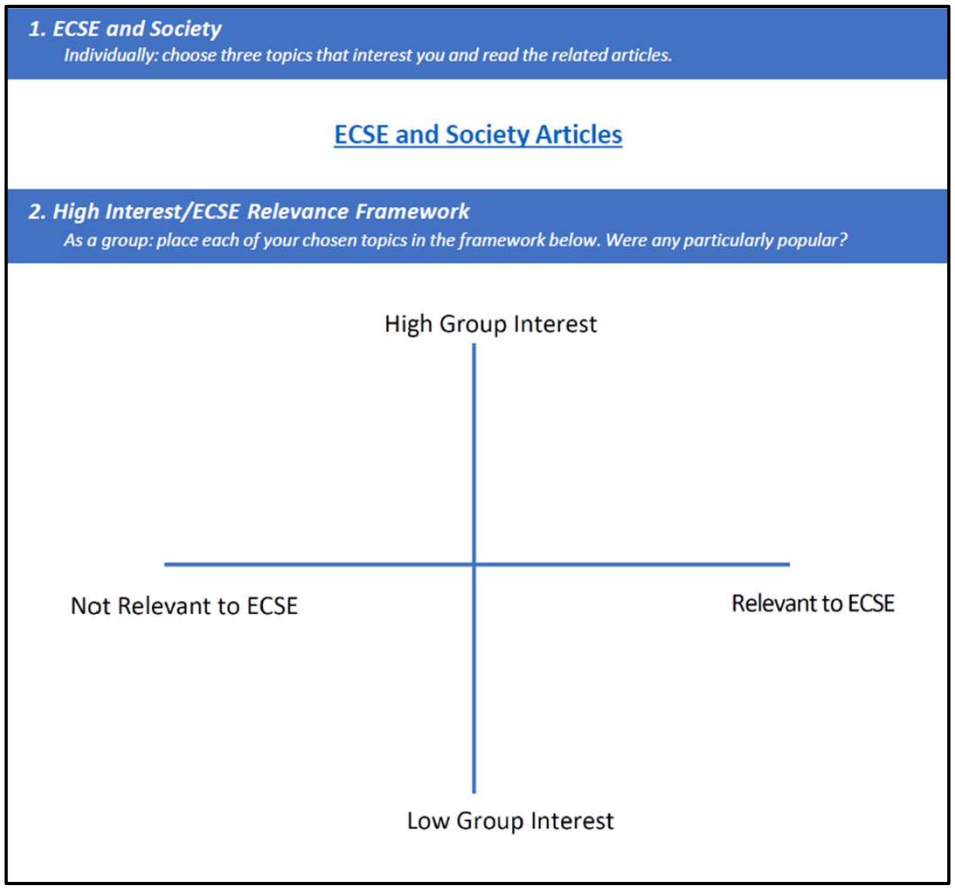
1. Choose YOUR TOP INTERESTS in the ECSE and Society Articles…consider how related they are to ECSE

Work alone with no discussion for now….

Write down the topics that interest you and WHY!!!! (One word or short phrase)

Link to ECSE and Society Articles and Ideation Poster

(ppt version link)



Progress Bar
10:00 minutes

Group Ideation

Share now with groups of 4-5!

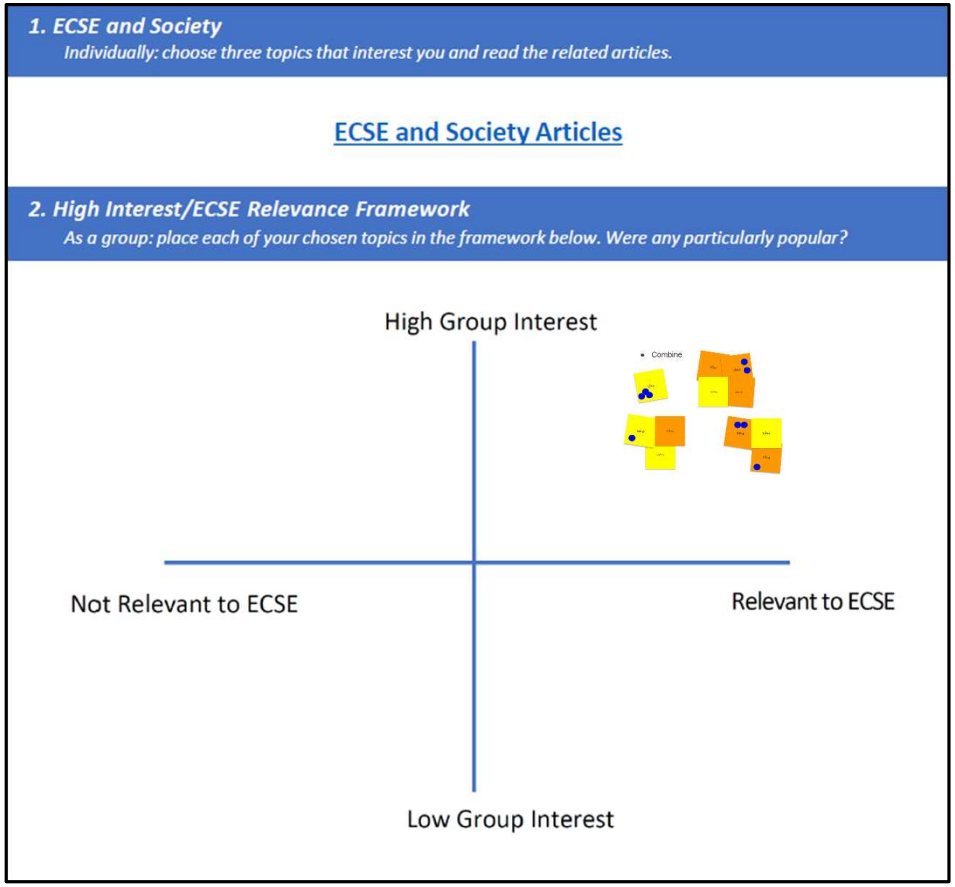
Process (one-by-one):

1. Read one person at a time and ONE PERSON post-it on framework
2. Read it aloud
3. Does it interest you?
4. If someone else picked the same one, place it on top
5. NEXT PERSON!!!
6. Add new ideas on framework

2. Choose three top topics by placing them in the framework!

Link to ECSE and Society Articles and Ideation Poster

(ppt version link)



Progress Bar
2:00 minutes

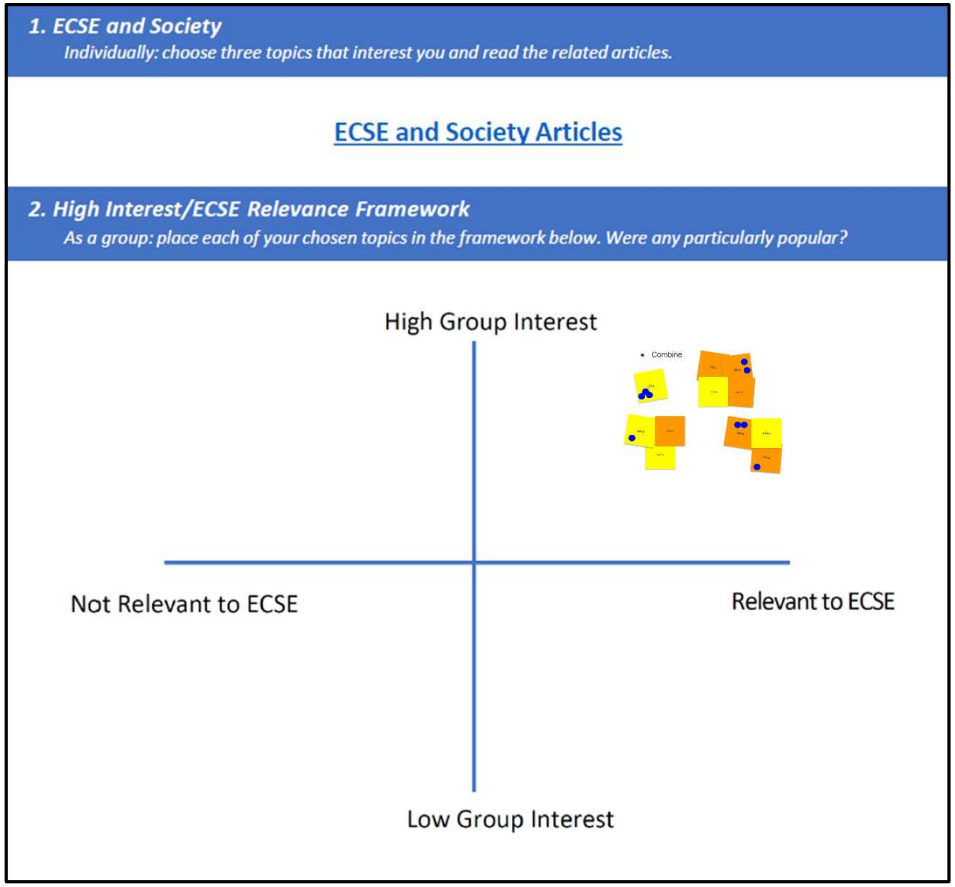
Individual Ideation

3. Write down challenges for the top right topic. Think big or small. Think about practical uses in the class and society. . What's the big deal? Why is it so hard?

Work alone with no discussion for now….

Link to ECSE and Society Articles and Ideation Poster

(ppt version link)



Progress Bar
10:00 minutes

Group Ideation

Share now in your groups!

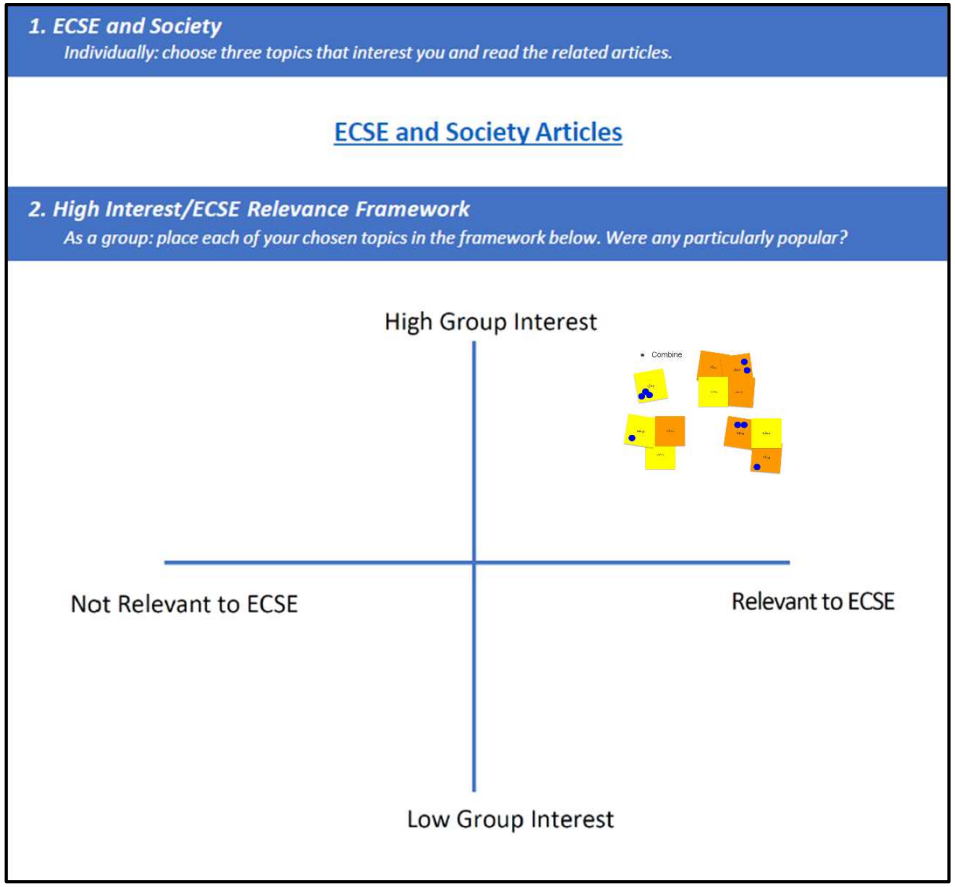
Process (one-by-one):

1. Read your ideas about why the topic is challenging
2. NEXT PERSON
3. Repeat
4. Discuss as a group

See if any of your group mates came up with the same goals or challenges! Follow process…one at a time!!!

Link to ECSE and Society Articles and Ideation Poster

(ppt version link)



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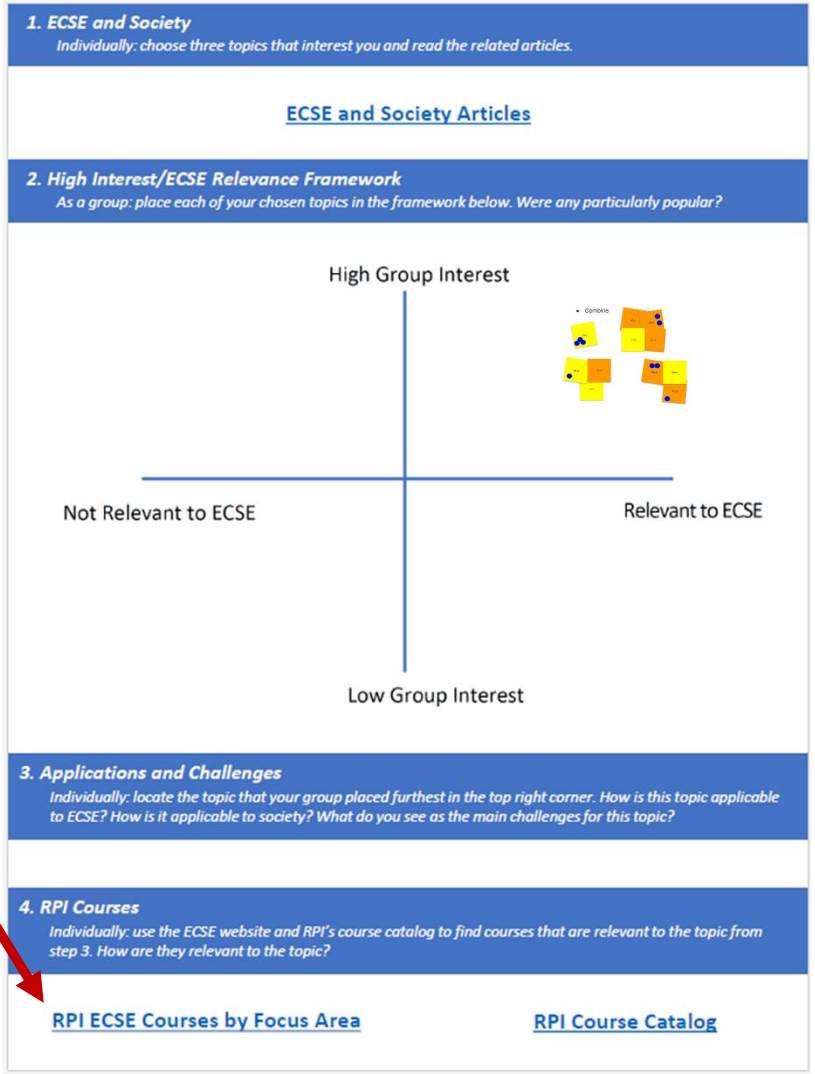
10:00 minutes

https://ecse.rpi.edu/academics/undergraduate-programs



Group Ideation

4. Find RPI courses that are relevant to the topic and explain how you think they're related.

Testing Gradescope Submission

1. With Laptop sign into Gradescope: https://www.gradescope.com/courses/695921
2. How to upload: https://sites.ecse.rpi.edu/~ssawyer/videos/AdditionalResources/gradescope_tips.pdf
3. One person upload your poster and add group mates → you must submit the assignment first (with only one name), then go to "View or edit group" in your submission to add more group members

What do I need to do for Class 02?

1. Sign up for a proof of skills category
2. Start on your minimum skill work and help others if you've already completed yours. – be in class!
3. Reflect on your first day via your first metacognition journal entry (link)
4. Submit your Design Ideation Activity documents from the ECSE and Society activity
5. If you haven't already, purchase an instrumentation board and the ADALP2000 parts kit

What's due is also located on the course website under Resources by Class Day

Minimum Proof of Skill

Proof of Skills Day 1 Section 1

File Edit View Insert Format Data Tools Extensions Help Last edit was yesterday at 5:24 PM

Name

	A	B	C	D	E	F
1	Name	Professional Accountablity	Circuit Simulation	Experimental Measurement and Personal Instrumentation	MATLAB Basics and Simulink	Community, Communication and Asking for Help
2	1					
3	2					
4	3					
5	4					
6	5					
7	6					
8	7					
9	8					
10	9					
11	10					
12	11					
13	12					
14	13					
15	14					
16	15					
17	16					
18	17					
19	PREPARATION BEFORE CLASS (read all skills in your section!)	Start your Plan of Study!	Minimum: Install LTSpice	Minimum: Install software for M1K and/or M2k or Analog Discovery 2 Board	Minimum: Complete MATLAB and SimulinkOnramp Tutorial	Learn to do ONE skill in the list! **Be ready to teach someone!** OR be ready to ask a question!!!!!