



ENGR 7A Introduction to Engineering Quadcopter Design

Fall Quarter 2018

Instruction Team



- Instructor:
 - Dr. Lawrence Kulinsky
 - Email: lkulinsk@uci.edu
- Lab Manager: Edward Lau
- TAs: Dorsa Shirazi, Peng Fei, Zoe Chao, Kristin Roher
- Undergraduate Assistants: Youssef Gorge, Makayla Campbell, Kevin Flaieh, Huy Ho, Nicholas Oune
- Text Book:
 - Dally, J.W., et.al. Introduction to Engineering Design. Book 11: Engineering Skills and Quadcopter Missions, 4th Edition, College House Enterprises, 2017
 - UCI Instructional Staff does not get profits from book sales

Office Hours



Office Hour Location: Engineering Tower 408

	Monday	Tuesday	Wednesday	Thursday	Friday
9:00 AM					
10:00 AM					
11:00 AM					
12:00 PM		Kevin	Youssef	Huy	
1:00 PM		Nicholas	Dorsa		
2:00 PM		Makayla			Zoe
3:00 PM				Kristin	Peng
4:00 PM	Lawrence Kulinsky CalIT2, room 3418				

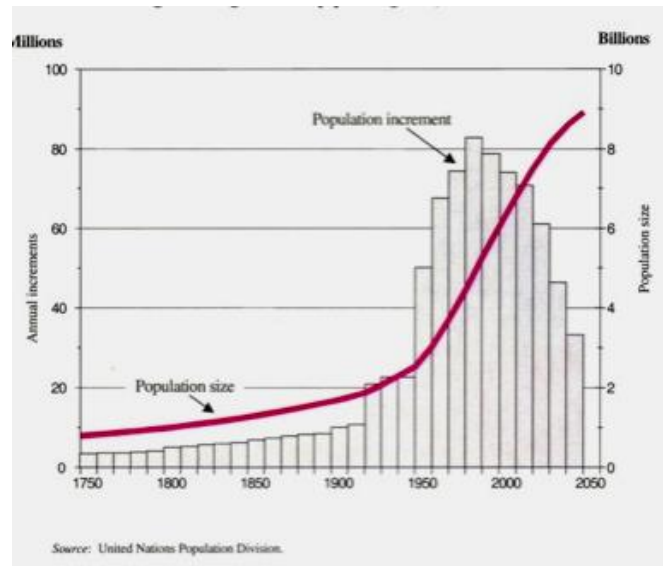
Outline

- Grand Challenges
- Course Objectives
- Course Logistics
- Useful Course Links
- Team Work (Skit from your dedicated Instructors)
- Safety Training
- Lab Notebook

Grand Challenges

Population Growth !

1960- 1975 a billion people added
1975-1987 another billion added



Entered the 20th Century with 1.6 billion
Exited the 20th Century with 6.1 billion

2000 ➡ 6 Billion
2018 ➡ 7.6 Billion

Courtesy of Prof. Diran Apelian

Grand Challenges

**In a period of 20 years - 1990 to 2010 –
Standard of life increased dramatically
in ~ 35% of our World**

**A profound change with
Consequences that cannot
be ignored. Sustainable
Development is a serious issue.**

Grand Challenges

- Since 1700' s the volume of goods traded
Increased 800 fold
- 1910-2010: the World' s industrial production
Increased 100+ fold
- 1900-2000: global consumption of fossil fuel
Increased by 50 fold

Grand Challenges

- *20% of the world population is living in **absolute** poverty (about 1.4 billion people out of 7 billion today)*
- *18% of the world's population lacks **access to safe drinking water***
- *40% has no access to **sanitation***
- *It is projected that by 2030 about **50%** of the world's population will live in **water-stressed areas**.*

Grand Challenges

- “This world is roughly divided into three kinds of nations:
those that spend lots of money to keep their weight down,
those whose people eat to live; and
those whose people do not know where their next meal is coming from”



Rwamwanja Refugee Camp, Uganda

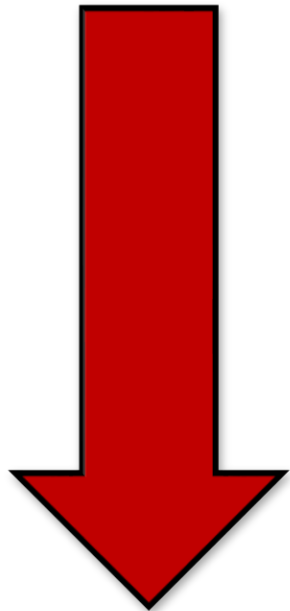


Kampala, Uganda

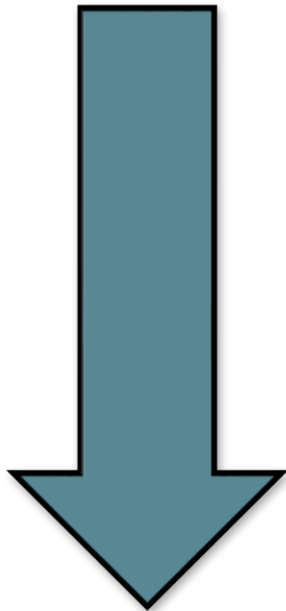
Economic Historian, David Landes

Grand Challenges

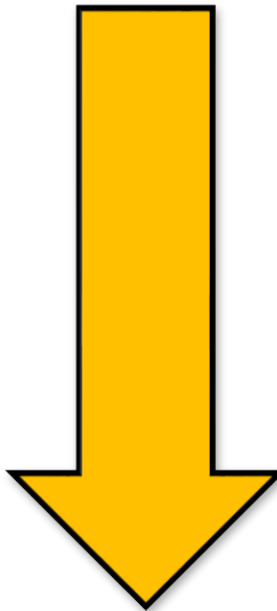
SUSTAINABLE DEVELOPMENT *SOCIETAL NEEDS - CHALLENGES*



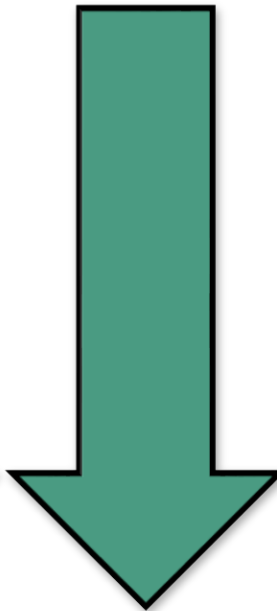
ENERGY &
CLIMATE CHANGE



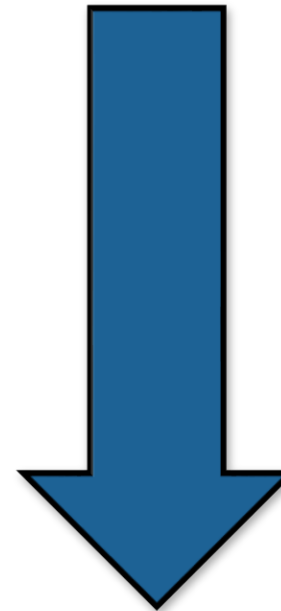
FOOD &
WATER



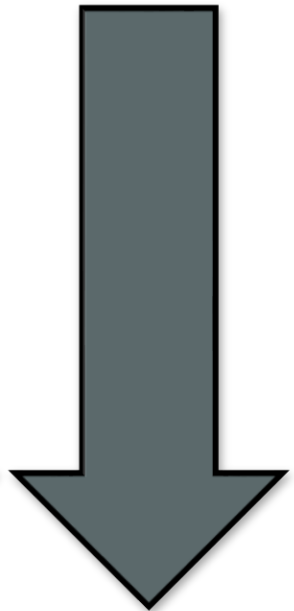
HOUSING



MOBILITY
Transportation Recovery- Reuse



MATERIALS
Recovery- Reuse



HEALTH

How Engineers Can Help?

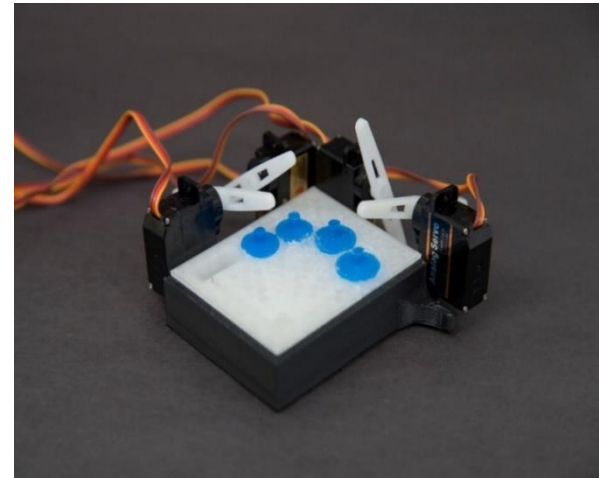
LifeStraw by Vestergaard Frandsen



The LifeStraw is a water filter designed to be used by one person to filter water for drinking. It filters a maximum of 1000 litres of water, enough for one person for one year. It removes almost all of waterborne bacteria and parasites.

<https://en.wikipedia.org/wiki/LifeStraw>

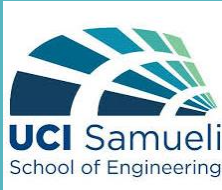
Automated Smartphone-controlled 3D Printed Colorimetric Bioassay Platform to Detect Malaria



The 3D Printed platform performs automated bioassay test for malaria. Smartphone is used to control servomotors to perform testing and report color change of assay.

M. Bauer, L. Kulinsky, UC Irvine

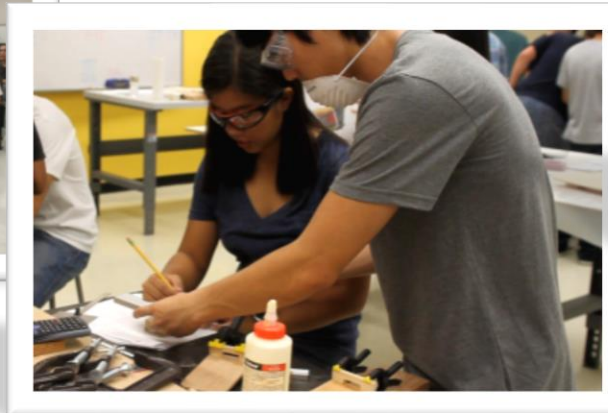
Engr. 7 Objectives



- Objectives:
 - Engineering Design
 - Product Development
 - Team Work
 - Innovation and Creativity
 - Problem Solving Skills
- Students Learning Outcomes:
 - Principles of Engineering Designs **theory** and **application**
 - Essentials of **fabrication** and team engineering skills by working on a **remote** controlled quadcopter
 - Programming skills to write **control software** (Winter Quarter)
 - Product design **report** and **presentation**
 - **Evaluation** of self and team performance
 - Teamwork and **group dynamics**
 - Business Plan (Winter Quarter)
- Quadcopter Competition During 10th week.

The Structure of the Course

- Three Major Components
 - Technical lectures (theories and formulas for the quadcopter design)
 - Introduction lectures from different engineering departments and industry leaders (online)
 - Lab sessions (design, fabrication, and testing)



Course Plan

Fall 2018						
Week	Date	Content	Online	Date	Lab Content	Homework
0					No Lab	1. Online Safety Training (by 10/12/2018) 2. Install Solidworks student 2018 version 3. Buy and register i>clicker
1	10/1/2018 10/3/2018	Course and Project Overview		10/2-10/5/2018	Safety Training, Handtools training, Scope of Project, Demo of quadcopter, Intro to Solidworks	1. Team formation Form
2	10/8/2018 10/10/2018	Intro to Engineering & Engineering Design	Project Management/Product Development	10/9-10/12/2018	Solidworks (3 Tutorials), Team Formation, Contact Sheet	1. HW#1 Design Battery Plate Due 10/15/2018- 10/18/2018 before midnight PST - 6 days after each team's lab (electronic copy is uploaded to class' Canvas assignment space) 2. Name Team and Choose Captain
3	10/15/2018 10/17/2018	Project Overview on Quadcopter, Center of Gravity	CEE Overview (R. Jayakrishnan)	10/16-10/19/2018	Fabrication Training (making Battery Plate)	1. HW#2 Center of Gravity Calc and Thrust Calc is assigned 2. Read Electrical Safety (Quiz during week 4 lab)
4	10/22/2018 10/24/2018	Thrust Thrust Demo during the lab	EECS Overview (Lee Swindlehurst)	10/23-10/26/2018	Electrical Training, Circuitry for thrust testing	1. Thrust produced by motor/propeller Calculation in lab 2. Motor selection 3. Design of Quadcopter (Drawing) 4. HW #2 due 10/26/2018 at 5 pm (hardcopy is placed in the marked assignment box in ET 408)
5	10/29/2018 10/31/2018	Flight Dynamics Demo: Quadcopter and demo quad behaviors, Stability demo	MAE Overview, Derek Dunn-Rankin	10/30-11/2/2018	Validating thrust calculation using thrust testing. Solidworks design of the quadcopter. TA/Instructor approve the design. Start fabrication.	1. SDW Design Due 11/2/2018 at 5 pm 2. HW #3 Assigned
6	11/5/2018 11/7/2018	Basic Electronics A parallel and serial circuit they will solder in class	ChEMS Overview, Allon Hochbaum	11/6-11/9/2018	Preliminary presentation (50 minutes), Fabrication of quadcopter	1. HW #3 is due 11/9/2018 at 5 pm (hardcopy) 2. PO Form Due 11/9/2018 at 5 pm
7	11/14	Quadcopter power/electrical system (No 11/12/2018 Mon lecture due to Veteran's Day)	BME Overview, Jarad Haun	11/13-11/16/2018	Fabrication, Structural Inspection Due	1. Quadcopter Structure is due for inspection 11/16/2018 at 5 pm
8	11/19/2018 11/21/2018	Guest Speaker		11/20-11/23/2018	Structural Inspection, Quality of Fabrication, Workmanship, Thanksgiving (No Lab on Thurs and Fri - affected teams utilize make-up Monday labs)	
9	11/26/2018 11/28/2018	Iris Adams, Communications and Leadership Development		11/27-11/30/2018	Electrical Inspection	
10	12/3/2018 12/5/2018	Final Presentation		12/4-12/7/2018	Final Testing of RC Quadcopter	12/7, RC quadcopter Final Competition
11	12/10-12/12/2018	Final Presentations				

Grading Policy

Grading

- Each student must keep a Lab Notebook and update after each Lab session. Apart from Lab notes any action items assigned must be recorded.
- **Cheating is NOT tolerated in class!**

Individual Grades	
Team Evaluation + Laboratory Notebook/Attendance + iQuizzes	25%
Homework	15%
Team Grades	
Design Report	20%
Design Presentations	20%
Quadcopter Structure Testing	20%
Extra Credit Opportunities: Surveys (3%), Winning Quadcopter (4%), Project Video(3%), Top 5 Facebook Helpers (2%)	

Useful Links

- **Facebook Forum:**
 - <https://www.facebook.com/groups/2089750207723681>
- **SolidWorks (SDW) Installation**
 - <http://laptops.eng.uci.edu/software-installation/solidworks>
 - ECT 123 (24/7), ET 201 and ET 204 (7am-midnight), SDW Available
- **Mac Users**
 - **Bootcamp Installation**
 - <http://laptops.eng.uci.edu/instructional-computing/incoming-students/information-for-mac-users/how-to-bootcamp-to-windows-7>
 - **Virtual Machine Installation and SolidWorks Installation, Please contact Ms. Lisa Preble, lpreble@uci.edu, if your UCI net ID is blocked.**
 - <https://youtu.be/Wo2b9Q8nzAs>
 - **OnShape – Cloud based CAD similar to SolidWorks**
 - <https://www.onshape.com/>

Course Communications and Help



- ❖ **For general logistic questions and specific technical (software etc.) questions use Facebook Class Forum to get help from TAs and fellow students**
- ❖ **For more in-depth technical questions and homework help go to office hours**
- ❖ **Study groups are encouraged (based on your lab team or beyond)**
- ❖ **For urgent questions and notice you can e-mail your Tas**
- ❖ **For questions related to material covered in lectures contact your professor (office hours visits are preferred over e-mails)**

Email Communications



Example 1:

"i have been feeling under the weather the past few days and i heard u felt awful this morning so i decided to stay home and get some rest i did the assignments That were due today in class an i was wondering if i was allowed to turn those on on Monday for late credit and i was also wondering if i had missed anything important in class today?"

Example 2:

"Hey, I'm having trouble opening these files. I can open them but they end up looking like a mess! What's up with that? Can you go ahead and reformat these? Okay, so hopefully that isn't too much of a problem but if you could resend these when they are fixed that would great! And now that the assignment is due tomorrow, can u hurry and get these to me?"

Email Communications



A Decent Email Example:

Email Subject Line: EE 10, Book in Library

Dear Prof. Smith:

My name is Derek Wright, and I am currently enrolled in the ENGR 10 course. I went to the library trying to find the textbook on reserve, but couldn't find it even with the help of a librarian. Could you please help check the status of the book and suggest the possible time that it will be available in the library?

Thank you.

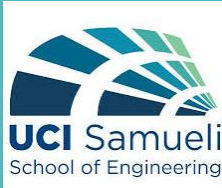
Regards,
Derek

Three Pillars of Engineering Excellence

- Knowledge
- Technical Skills
- Interpersonal Skills
Teamwork and Communication



ENGR Design and Team Work

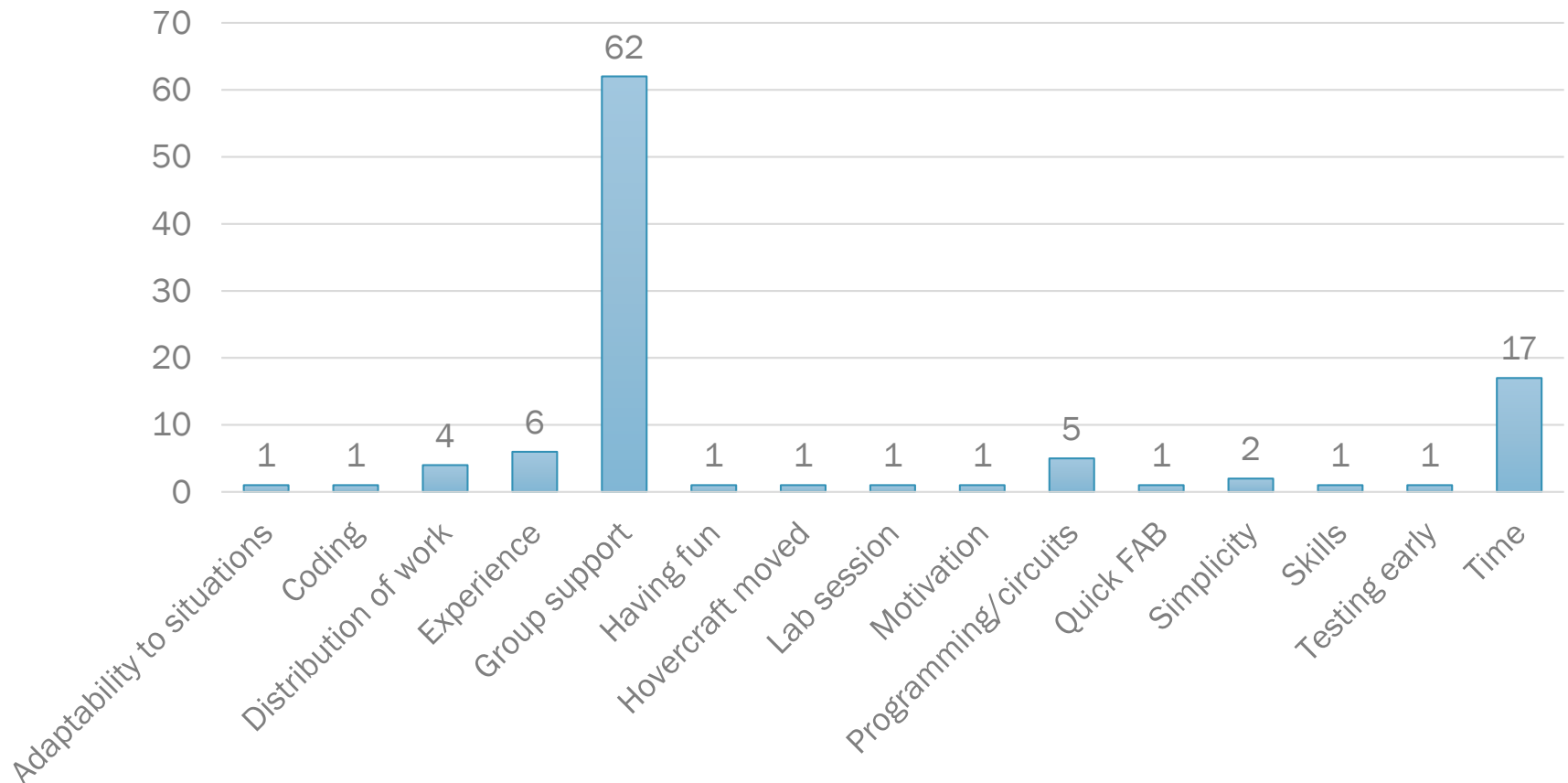


- Victim (Scenario 1)
 - Dysfunctional
 - Emotional
 - Excuses
 - Complain
 - Blaming
 - *Repeating the above ineffective behavior*
- Engineering Design Process (Scenario 2)
 - Define problem
 - Brainstorm solutions
 - Try best solution
 - Evaluate
 - If fail, take alternative approach
 - Evaluate
 - *Iterations on different solutions if necessary*

ENGR Design and Team Work

- Team Work – Effective Project Management, Taking Responsibility

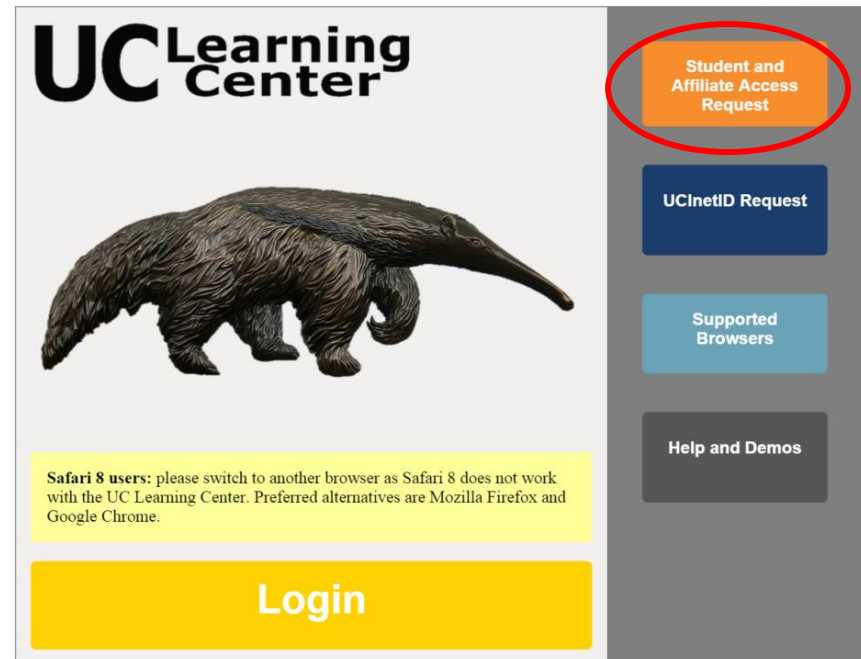
Factors to Success



Safety Training

1. Go to uclc.uci.edu, click on *“Student & Affiliate Access Request Form”*. Select *“All Other Campus Students”* and Search and Select supervisor *“Lawrence Kulinsky”* or *“Edward Lau”*.
2. Upon completion, you will be informed at what point you should be able to access the system (typically 24-48 hours)
3. Log in through the main page uclc.uci.edu, search for *“Safety Fundamentals”* in the search box under *“Find a Course”*. It should be the first item appeared after search.
4. Click *“Select”* then *“Register”* for *“Safety Fundamentals”*
5. Select *“eCourse Safety Fundamentals”*, Click Next, then Click Submit
6. Start the Course.
7. Save the Certificate page at the end of the training as an JPEG or PDF file, and rename with your full name to upload on Canvas.

 uclc.uci.edu



Safety Training



The image is a screenshot of the UC Learning Center homepage. At the top is a dark blue navigation bar with icons for user profile, group, and books on the left, the 'UNIVERSITY OF CALIFORNIA Learning Center' logo in the center, and a search icon on the right. Below the navigation bar is a large banner with a video player showing an interior view of a building with hanging lanterns. The text 'Welcome to the UC Learning Center' is overlaid on the video. Below the banner is a row of seven colored buttons, each with an icon and text. The third button, 'Find A Course', is circled in red. Below this row are three more buttons: 'Safety Training Self-Assessment - Campus Only', 'How Do I? / FAQ', and 'Contact Us'.

UNIVERSITY OF CALIFORNIA Learning Center

Welcome to the UC Learning Center

Assigned Training

Manage or Cancel My Registrations

Find A Course

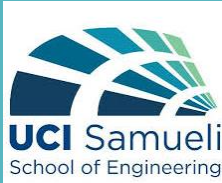
Transcript & Certificates

Safety Training Self-Assessment - Campus Only

How Do I? / FAQ

Contact Us

Safety Training



Learning
Center



 / Search

WHAT ARE YOU LOOKING FOR TODAY?

LEARNING ▾

Sa






Select a specific item
or more unspecified



- safety fundamentals
- saline/heparin lock - direct observation
- saline/heparin lock - document
- saline/heparin lock - interview
- saline/heparin lock - med surge


supports the use of the asterisk (*) wild card to represent one
search will return any results that closely match what you

Safety Training



UNIVERSITY OF CALIFORNIA Learning Center



FILTER YOUR RESULTS 

ACTIVITY TYPE

- Topic (34)
- ILT Class (15)
- eCourse (12)
- ILT Course (4)
- Document (1)
- + Add

DELIVERY METHOD


- eLearning (6)
- Classroom Training (4)
- + Add



LOCATION



- Room 122B - Ramazzini R... (11)
- Adcom Training Room 162 (2)
- Test Kitchen/Classroom - ... (1)
- + Add


MEDIA TYPE


- eLearning (6)


 / Search


LEARNING  safety fundamentals 


SHOWING 20 OF 66 RESULTS FOR "SAFETY FUNDAMENTALS" Sort By **RELEVANCE**  





Safety Fundamentals
This course covers the following workplace safety topics: Ergonomics, Emergency Preparedness, Earthquake Safety, Fire & Electrical Safety, Hazard
 Topic ■ IRC-EHS-LT-SF-2018






Laboratory Safety Fundamentals
This Topic replaces the old LSF topic.
 Topic ■ IRC-EHS-LT-LSF





Concussion Safety



Safety Training



SAFETY FUNDAMENTALS

This course covers the following workplace safety topics: Ergonomics, Emergency Preparedness, Earthquake Safety, Fire & Electrical Safety, Hazard Awareness, and Environmental Stewardship.

[View More](#)

Activity 1

▼ SELECT AT LEAST 1 ACTIVITIES; MULTIPLE SELECTION IS ALLOWED

1 ACTIVITIES



eCourse

IRC-EHS-eC-...

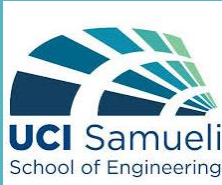
Safety Fundamentals

CANCEL

NEXT

SUBMIT

Canvas Assignment Upload



- Go to Canvas , under Week 1 see Assignment “Online Safety Certificate” and upload your certificate’s jpg or pdf
- Deadline is 10/12/2018, 5PM



☰ ENGR 7A Lec A & Lec B > Assignments

Fall 2018

Search for Assignment

SHOW BY DATE

SHOW BY TYPE

Home

Assignments

Discussions

Grades

People

Pages

Files

Syllabus

Modules

Conferences

Collaborations

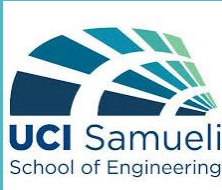
▼ Undated Assignments



Safety Certificate

-/5 pts

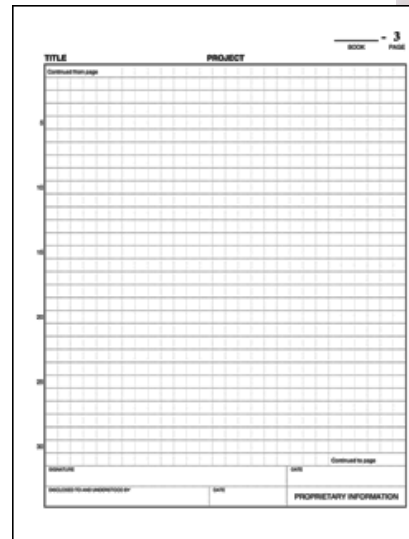
ENGR Lab Notebook



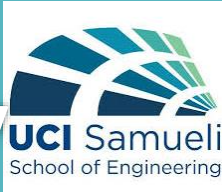
- Individual Lab Note Book
- Lab Note Book will be inspected by TA's for thoroughness, neatness and attendance
- The purpose of a lab notebook is to keep a record of the experiment so you or someone else could repeat your work or understand exactly how it was done.
- Each laboratory notebook must be written as an **individual effort**, never as a group project.

ENGR Lab Notebook

- Bound (stitched) pages to ensure integrity
- Numbered pages
- Grid Format
- Always Written in Pen.



Tips to Preserve Data Integrity



- Never, ever, remove a page
- Fill consecutive pages
- Cross out unused parts of pages
- Record all info as accurately as possible.
- Do NOT omit any result, no matter how odd.
- Cross out mistakes lightly (might need to recover)
- Write legibly
- Put a full date (international date problems...) with month spelled out.

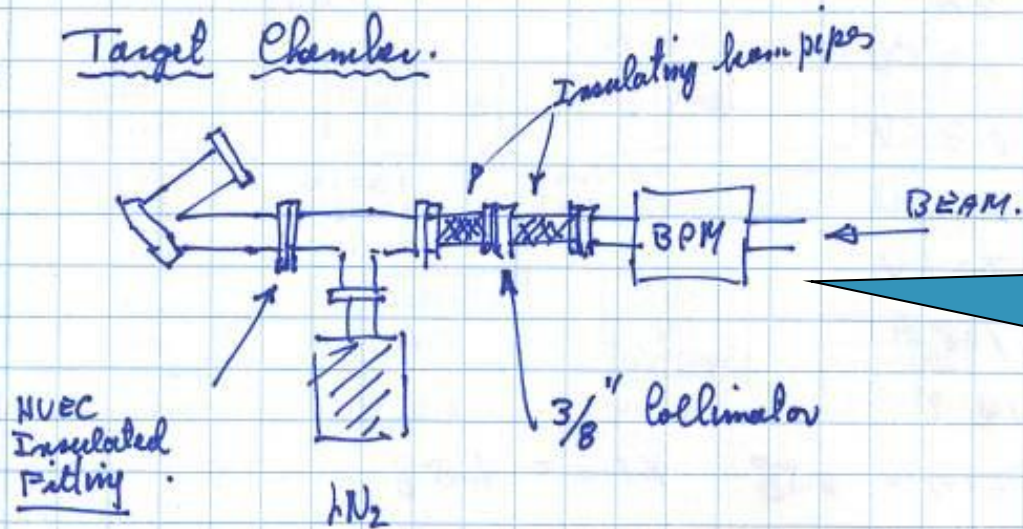
EXAMPLE LAB NOTEBOOK ENTRIES

$^9\text{Be}(\text{p}, \alpha)^{10}\text{B}$

Jan 21/88

CALTECH SET-UP

1. Target Chamber.



The experiment apparatus set-up is sketched.

2. Preliminary Vacuum Test

Pump down overnight for FIRST TIME

$$\text{VAC} = 2 \times 10^{-6} \text{ Torr.}$$

- Bake Out started at 11:00 AM.
- Max press. of 8.2×10^{-6} reached at 3:00 PM
- Press. now begins to drop.
- Bake Out turned OFF 4:30 P.M. Press 7×10^{-6}

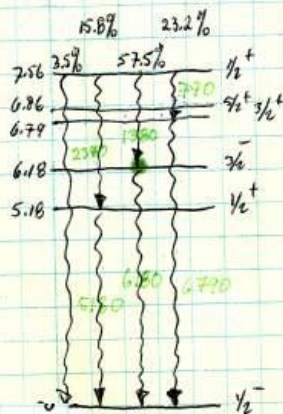
Note careful way that times are recorded as apparatus is pumped down for first time

RUN INFO MANUALLY INSERTED
INTO CHANNELS 3 → 6

CHANNEL 3 = ENERGY (keV) = E_K
 CHANNEL 4 = M TARGET = 3
 CHANNEL 5 = M FINAL = 7
 CHANNEL 6 = DISPERSION (ev/ch) = 115

Efficiency Calibration

$He^{14}W(p,r)^{11}O$ Reaction $E_p = 278$ keV



ECAL Energy Channel
 7560 2745
 511 237

$$\frac{\Delta E = 7049}{\Delta C = 2508} = 2.811 \text{ keV/channel}$$

$$b = -155.20 \text{ keV}$$

Use EFW to insert
calibration into ANAL.

Some theory
and
calculations
are shown.

Note data circled in red
with line running
off the right margin;
next page shows where
that line connects.

NORMALIZED
TO ARG. EFF.
of 1380 = 1.2x10
from source test

	Trans	Energy	Rel. Int	AREA (PP)	AREA/REL. INT.
R → 0	7560	6.09	55 ± 8	633 ± 29	23.02
R → 5180	2380	27.5	3792 ± 67	37.32	1.03 × 10 ⁻¹
R → 6180	1380	100.0	2245 ± 60	55.71	1.67 × 10 ⁻¹
R → 6790	770	40.3	339 ± 26	12.58	2.5 × 10 ⁻¹
5180 → 0	5180	27.5	346 ± 28	7.71	0.56 × 10 ⁻¹
6180 → 0	6180	100	771 ± 32		0.35 × 10 ⁻¹

Do not use this because of summing problems.

Some problems
clearly noted.

Nov 22/87

QUEEN 3 DATA

First Step

We have TWO archived Queens data disks

QE1.ARC

QE2.ARC

Both have been unarchived and read into \HANAL\QUEENS.

C>cd\hanal\queens

C>dir/w

Volume in drive C has no label
Directory of C:\HANAL\QUEENS

005	DAT	006	DAT	007	DAT	008	DAT	009	DAT
010	DAT	011	DAT	012	DAT	013	DAT	014	DAT
015	DAT	016	DAT	017	DAT	018	DAT	019	DAT
020	DAT	021	DAT	022	DAT	023	DAT	024	DAT
025	DAT	026	DAT	027	DAT	028	DAT	101	DAT
102	DAT	103	DAT	104	DAT	105	DAT	106	DAT
107	DAT	108	DAT	109	DAT	110	DAT	111	DAT
112	DAT	113	DAT	114	DAT	115	DAT	116	DAT
117	DAT	118	DAT	119	DAT	120	DAT	121	DAT
122	DAT	123	DAT	124	DAT	125	DAT	126	DAT
127	DAT	128	DAT						

57 File(s) 4411392 bytes free

U.B. All speeches have some ALPHANUMERIC data at beginning of file. Must be removed to read into DAISYFILE.

File Name	LT	RT	ch	MAX	SAVED	WRITE TO QUE AS "NAME"	SUM
003.DAT	0	0	4096	28143	✓	033	(NOTE ERROR)
004.DAT	0	0	4096	29092	✓	004	2,584,504
005.DAT	0	0	4096	42154	✓	005	3,415,973
006.DAT	0	0	4096	33181	✓	006	4,841,094
007.DAT	0	0	4096	37435	✓	007	6,515,009
008.DAT	0	0	4096	41122	✓	008	8,274,187

Note that page has the date

Note computer printout is glued into notebook

Note that error is clearly marked

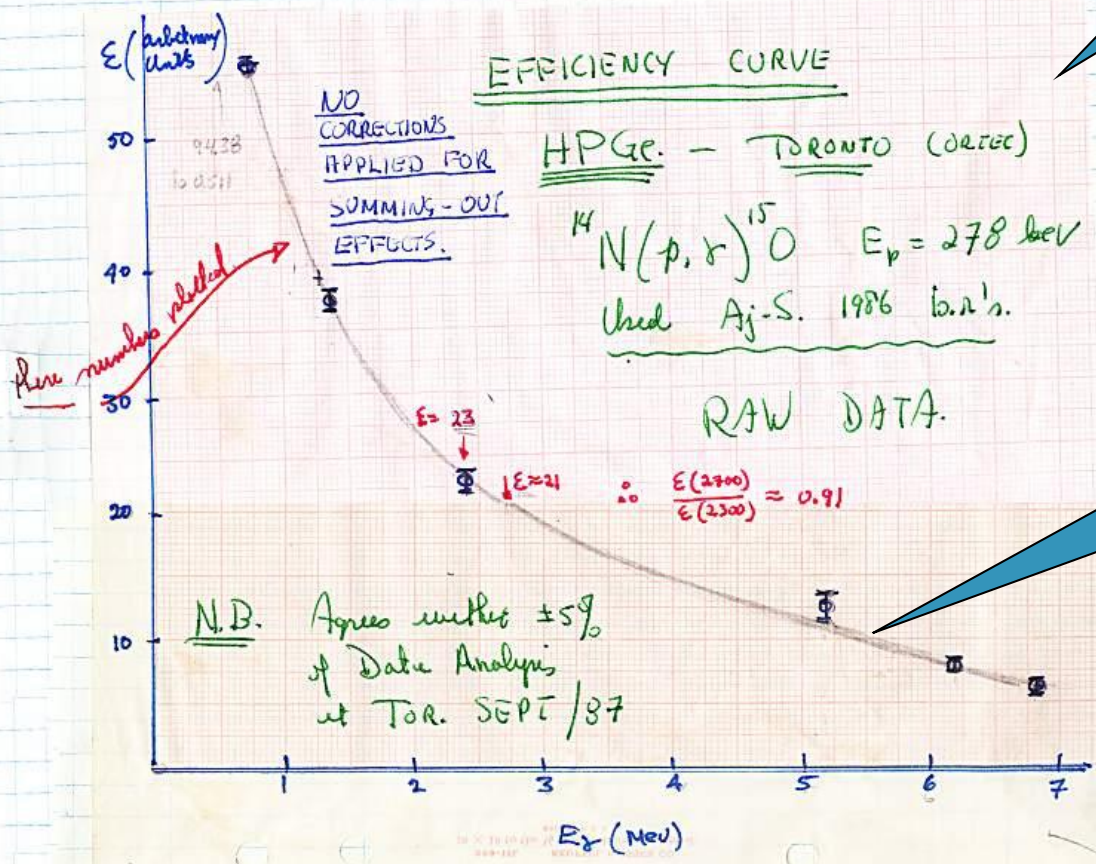
BRD.DAT

Tagword	E ₀	Q
A33	800	500,176
A34	600	700,216
A35	350	1,310,262
A36	250	4,000,288
A37	600	
A38	720	
A39	430	
A40	600	
A41	850	
A42	1050	
A43	600	
A44	600	
A45	600	

BR2.DAT

EIN
ENERGY CAL^m
 OFFSET = - 0.1552 MeV
 DISP^m = 0.002811 MeV/ch.
 QUAD = 0.
 FOR CAL SPECTR ???
¹⁴N(p, r)¹⁵O

Note graph paper used for plot and glued onto page.



Note graph of final results including error bars!

Assignments and Deadlines



- ❖ **Team Formation survey (received via e-mail from CATME)
due by Oct 7, 2018 5 pm**
- ❖ **Class survey at
<https://eee.uci.edu/survey/engr7presurveyLecAB>
file by Oct 7, 2018 5 pm**
- ❖ **Safety Certificates upload to Canvas by Oct 12, 2018 5 pm**