Instructor

• John Vesecky (yours truly)
• Office: BE-239
• Office Hours: M 2:30 until class, Tu 5 - 6 PM, Fr after class until 5:30 PM
• Phone: (831) 459- 4099
• E-mail: vesecky@soe.ucsc.edu
Why are you here?

- Reasons not to take this class
  - It is a prerequisite
  - Your uncle is an engineer
  - Keep out of the rain
  - You would like to have an engineering degree
  - Engineers are better lovers

- The reason is that you want to become a competent engineer.
Teaching Assistants

• Ali Adabi & Patrick Ellis
  – E-mail: aadabi@gmail.com
  – E-mail:
    • Currently pellis@mail.bradley.edu
    • New UCSC email TBD, as a guess pellis@soe.ucsc.edu
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EE101 Labs

• Location: Baskin Engr 150 (Jack’s Lounge)
• Lab Sections:
  – EE 101L - 04 Mon 5:00PM-7:00PM (limit 20)
  – EE 101L - 01 Tues 6:00PM-8:00PM (limit 20)
  – EE 101L - 02 Wed 9:00AM-11:00AM (limit 20)
  – EE 101L - 04 Wed 5:00PM-7:00PM (limit 20)
Course Details

• Course number: 20849
• Course website:
  • https://courses.soe.ucsc.edu/courses/ee101/Fall11/01
    – Website is under construction -- hope to have basics up this weekend
      – User Name: ??
      – Password: ??
      – Lecture slides and homework will be posted on the website
• Classroom: Physical Sciences 114
• Time: MWF 3:30 PM-4:40 PM
• Must enroll concurrently in course 101L
• Prerequisites:
  – Physics 5C/N or 6C/N
  – Applied Mathematics and Statistics 20 or 20A (or Math 24)
Textbook and References

• Required Text (You are responsible for having this book.)
  – Your opinion of the text counts - review it on Amazon

• Supplemental Texts
  – **The Art of Electronics** by Paul Horowitz, Winfield Hill, 2nd edition (1989); Cambridge Univ Press; ISBN: 0521370957 (This is a great reference and widely respected -- a new edition would be welcome, but Paul says not yet)
Syllabus

1. Fundamentals of Electrical Engineering (Current, Voltage, Resistance, Conductance, Ohm’s Law)
2. Circuit Analysis (Kirkoff’s Voltage & Current Laws, Voltage & Current Dividers, Node/Loop Analysis)
3. Equivalent Circuits (Thevenin, Norton, Source Transformations, Superposition)
4. Amplifiers (Single Stage, Cascaded, Power Supplies)
5. Operational Amplifiers (Summing Point Constraint, Feedback, Inverting, Non-Inverting, Summing, Voltage/Current)
6. First Order Transient Response (Inductance (L), Capacitance (C), RC/RL Circuits)
7. Second Order Transient Response (Series, Parallel, Step Response)
8. AC Analysis (Sinusoidal Signals, Complex Numbers, Phasors, Phasor Circuits, AC Power, AC Thevenin)
9. Filters (Fourier Analysis, Low-Pass, High-Pass, Decibels, Bode Plot)
10. Magnetic Circuits (Materials, Self-Inductance, Mutual-Inductance, Transformers)
## EE 101 Syllabus

<table>
<thead>
<tr>
<th>Class</th>
<th>Lecture</th>
<th>Date</th>
<th>Topic</th>
<th>Reading Ahead</th>
<th>Homework</th>
<th>Quiz</th>
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<td>Review Math</td>
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12-2-11 Review for Final at normal class time and place
Final Exam Thursday, December 8th (noon to 3 pm)
Grading

• Midterm 1 15% (10-12-11)
• Midterm 2 15% (11-4-11)
• Final Exam 30% (12-8-11 noon- 3 pm)
• Homework 20%
• Quizzes 20%

If you are not going to be able to take the midterms and the final exam on these dates you should take this class at a later date!
Homework

- Will be posted weekly on the course website on Friday
- Will be due the following week at the beginning of class on the next Friday. If there is a holiday it will be due at the next class.
- No late homework will be accepted!
- Solutions will be posted after class
Quizzes

• The quizzes will cover the topics covered in the previous lectures and the topics from the reading assignments
• The quizzes will be given at the beginning of class so please be on-time!
• We will have a pre-req evaluation next class to assess your preparation for EE101
Evaluation Quiz

- Solution of simultaneous equations
- Determinants
- Differential equations
- Electricity and Magnetism
- Complex numbers
Midterms and Final

• You will be provided with a sheet of key formulas that you can use on the midterms and final exam
• These sheets will be posted on the class website before the tests so that you can familiarize yourself with them
• No additional information will be allowed
• Calculators with memory will be required to be cleared prior to the exam
How to make this course the first step toward being a competent engineer

- Read each assignment of the text before class
- Work out each example as you read through the text (before class)
  - I will work through the examples in class
- Do the homework by yourself
- Be sure to understand any example or homework problem you got wrong
  - Bring questions to your TA’s section
Academic Dishonesty

• Any confirmed academic dishonesty including, but not limited to, copying homework or cheating on exams, will result in a no-pass or failing grade and automatic referral of the case of suspected policy violation to your college for further disciplinary action. You are encouraged to read the campus policies regarding academic integrity.

• Examples of cheating include (but are not limited to):

  – * Sharing results or other information during an examination.
  – * Working on an exam before or after the official time allowed.
  – * Submitting homework that is not your own work.
  – * Reading another student's homework solution before it is due.
  – * Allowing someone else to read your homework solution before the assignment is due.
Labs

Core lab exercises:

0. Understanding safety and lab instruments
1. Resistive Circuits
2. Equivalent circuits and load matching
3. Transients in circuits
4. AC circuits and filter design
5. Amplifiers and op amp circuit design
Introduction

1. What it means to be an engineer.
2. Recognize interrelationships of electrical engineering with other fields of science and engineering
3. List the major subfields of electrical engineering
4. Circuits
5. Current & voltage
5. Waveforms, ac & dc
5. Reference directions
Electrical systems have two main objectives:

- To gather, store, process, transport, and present *information*

- To distribute and convert *energy* between various forms
Electrical Engineering Subdivisions

- Communication systems
- Computer systems
- Control systems
- Electromagnetics

- Electronics
- Photonics
- Sustainable Energy & Power systems
- Signal processing
Electrical Circuits

The headlight circuit in a car. (a) The actual layout of the circuit. (b) The circuit diagram
Where you come into the picture
Fluid Analogy

**Pump**

- High pressure
- Low pressure
- Poiseuille's Law
  \[ F = \frac{\Delta P}{R} \]

**Reservoir**

- Volume flowrate: e.g., cm³/sec

**Battery**

- Charge flowrate = current = \( \frac{\text{coulombs}}{\text{second}} \) = amperes

- High voltage: 12 volts \( \approx 12 \) volts
- Low voltage: 0 volts \( \approx 0 \) volts

**Ground**

- Ohm's Law
  \[ I = \frac{\Delta V}{R} \]
Electrical Current

Electrical current is the time rate of flow of electrical charge through a conductor or circuit element. The units are amperes (A), which are equivalent to coulombs per second (C/s).
André Ampère (1775-1836)

http://www-groups.dcs.st-and.ac.uk/~history/PictDisplay/Ampere.html
Electrical Current

Current in circuit analysis is flow of + charge. What really happens is that electrons flow in the opposite direction.

$$i(t) = \frac{dq(t)}{dt}$$

$$q(t) = \int_{t_0}^{t} i(t) \, dt + q(t_0)$$
An electrical circuit consists of circuit elements such as voltage sources, resistances, inductances and capacitances that are connected in closed paths by conductors.
In analyzing circuits, we frequently start by assigning current variables such as $i_1, i_2, i_3$. 

**Current Variables**
When a current is constant with time, we say that we have **direct current** (I), abbreviated as dc. A time varying current is $i(t)$. A current that varies with time, reversing direction periodically, is called **alternating current**, abbreviated as ac.
Examples of dc and ac currents

(a) Dc current

(b) Ac current

\[ i_a(t) = 2 \]

\[ i_b(t) = 2 \cos 2\pi t \]
Examples of ac waveforms

(a) Triangular waveform

(b) Square waveform
Reference Directions

Reference directions can be indicated by labeling the ends of the circuit elements and using double subscripts on the current variables. The reference direction for $i_{ab}$ points from $a$ to $b$. On the other hand, the reference direction for $i_{ba}$ points from $b$ to $a$. $i_{ab} = -i_{ba}$
Voltages

The **voltage** associated with a circuit element is the energy transferred per unit of charge that flows through the element. The units of voltage are volts (V), which are equivalent to joules per coulomb (J/C).

\[ V_{ab} = \frac{dw}{dq} \]

- \( w \) is the energy in Joules
- \( q \) is the charge in Coulombs
Alessandro Volta (1745-1827)

This device was made of alternating disks of zinc and copper with each pair separated by brine soaked cloth. Attaching a wire to either end produces a continuous current of low intensity.

http://www.corrosion-doctors.org/Biographies/VoltaBio.htm
Reference Directions

Energy is transferred when charge flows through an element having a voltage across it.

“uphill: battery”

“downhill: resistor”
Reference Directions

The voltage $v_{ab}$ has a reference polarity that is positive at point $a$ and negative at point $b$. 
Reference Directions

The positive reference for $v$ is at the beginning of the arrow. A positive voltage drives current in the direction of the arrow.