ELE 212
Linear Circuit Theory

Spring 2025

Administrivia

ELE212 – Linear Circuit Theory
ELE215 – Linear Circuits Laboratory

ELE 212

Kirchhoff's Laws, DC resistive networks, dependent sources, natural and forced response of first- and second-order circuits, sinusoidal steady-state response, phasors, AC power.

ELE 215

Laboratory exercises relevant to ELE212.

First ELE 215 meeting is this Friday at 2 PM

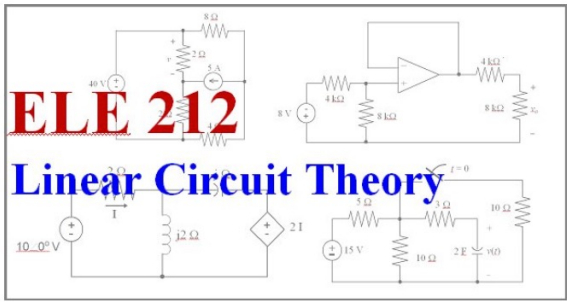
- Contact info:
  - Prof. Swaszek: office is Fascitelli 492
  - Office hours (nominal):
    - F2F: Mon & Fri 10-11 AM or by appointment
  - Best contact is via email swaszek@uri.edu

- Course websites:

  https://www.ele.uri.edu/~swaszek/ele212/

  class resources; sub-pages are password protected (212student, rhody)

  Brightspace: link to the page above; grades will be posted in its gradebook



Kirchhoff's Laws, DC-resistive networks, dependent sources, natural and forced response of first- and second-order circuits, sinusoidal steady-state response, phasors, AC power. (Lecture, 4 credits)

This course is usually taken concurrently with ELE 215 Linear Circuits Laboratory.

NOTICES:

- none so far

Basic information for Spring 2025:

- Instructor: Prof. Peter F. Swaszek, 492 Fascitelli Center
  Office hours: face-to-face Mon and Fri 10:00-10:50 or by appointment; virtual by appointment only

- Lectures: Mon, Wed, and Fri 9:00-9:50 AM, Kirk Aud.; Mon 2-2:50 PM, Edwards Aud. (weekly assessment period)

- Text: **Fundamentals of Electric Circuit** by Alexander and Sadiku, McGraw-Hill, 5th ed. or equiv. (chapters 1 through 11 plus 14)

- Scientific calculator for quizzes - NO phones, tablets, or computers allowed.

- Grading scheme:
  - 49 online homeworks (total of 5000 points) - 20%;
  - 15 weekly quizes (including two on the final exam day) - 80%

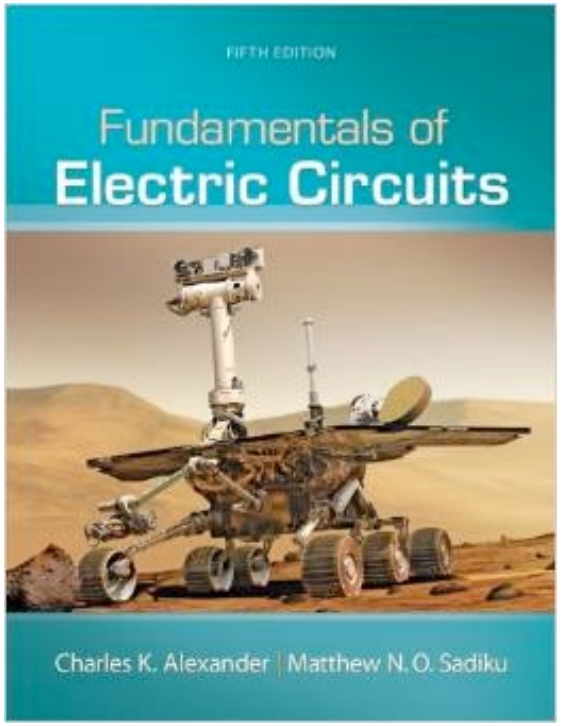
- On-line homework:
  - When the web page asks for your "Homework ID" enter the 9 digit number posted in the Brightspace gradebook (no commas), not your URI ID; also see here for more details including FAQs
  - Use 3 significant digits for each answer unless stated otherwise; see here if you need more help
  - Include standard units unless stated otherwise

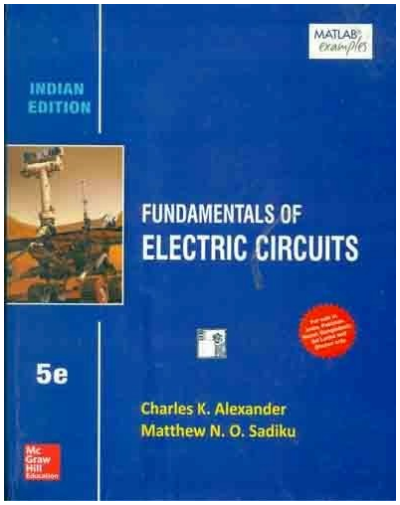
- Useful links:
  - Textbook errata for 5th edition of Alexander and Sadiku; search online if you have a different version or other text.
  - Syllabus for spring 2025

Daily materials and homeworks; additional material:

	Monday	Wednesday	Friday
Week 1	Jan 20	**Wed Jan 22** Basics 1: administrivia; circuit variables (A&S chap 1) Lecture slides, annotated copy HW 1 on basics - due 8:55 AM Fri Jan 24	**Fri Jan 24** Basics 2: time variation; sources; resistors (A&S chap 1) Lecture slides, annotated copy HW 2 on basics - due 8:55 AM Mon Jan 27
Week 2	**Mon Jan 27** Basics 3: circuits; Kirchhoff (A&S chap 1 & 2) Lecture slides, annotated copy HW 3 on basics - due 8:55 AM Wed Jan 29	**Wed Jan 29** Basics 4: series/parallel resistance; voltage/current divison (A&S chap 2) Lecture slides, annotated copy HW 4 on basics - due 8:55 AM Fri Jan 31	**Fri Jan 31** Basics 5: equivalent resistance (A&S chap 2) Lecture slides, annotated copy HW 5 on basics - due 8:55 AM Mon Feb 3 Written material on solving simultaneous equations in real variables HW 6 on simultaneous equation, 2 variables - due 8:55 AM Fri Feb 7 HW 7 on simultaneous equation, 3 variables - due 8:55 AM Fri Feb 7
Week 3	**Mon Feb 3** Basics 6: circuit analysis; dependent sources (A&S chap 2) Lecture slides, annotated copy HW 8 on basics - due 8:55 AM Wed Feb 5 Delta-Wye transformations: • Written material • Recorded mini-lecture • HW 9 on Delta-Wye (200 pts) - due 8:55 AM Wed Feb 19	**Wed Feb 5** Basics 7: odds and ends (A&S chap 2) Lecture slides, annotated copy HW 10 on basics - due 8:55 AM Fri Feb 7	**Fri Feb 7** Node 1: basic comcepts (A&S chap 3) Lecture slides, annotated copy HW 11 on nodes - due 8:55 AM Mon Feb 10
Week 4	**Mon Feb 10** Node 2: more complex branches (A&S chap 3) Lecture slides, annotated copy HW 12 on nodes - due 8:55 AM Wed Feb 12	**Wed Feb 12** Node 3: vector/matrix form (A&S chap 3) Lecture slides, annotated copy HW 13 on nodes - due 8:55 AM Fri Feb 14	**Fri Feb 14** Node 4: dependent sources (A&S chap 3) Lecture slides, annotated copy HW 14 on nodes - due 8:55 AM Wed Feb 19 Written material on complex numbers HW on complex number manipulation - all due 8:55 AM Mon Mar 3: HW 15, HW 16, HW 17, HW 18, HW 19, HW 20, HW 21
Week 5	Feb 17 holiday	**Wed Feb 19** Node 5: supernodes (A&S chap 3) Lecture slides, annotated copy HW 22 on nodes - due 8:55 AM Fri Feb 21	**Fri Feb 21** Node 6: examples (A&S chap 3) Lecture slides, annotated copy HW 23 on nodes - due 8:55 AM Mon Feb 24

Text: Alexander and Sadiku 5th edition; other editions are fine as are **other** books



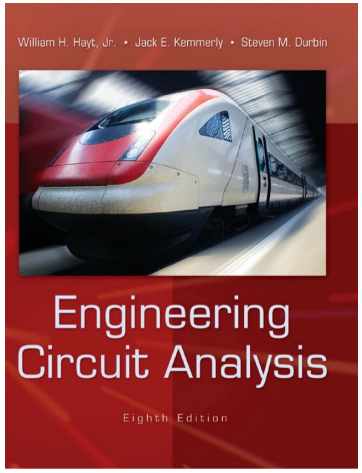


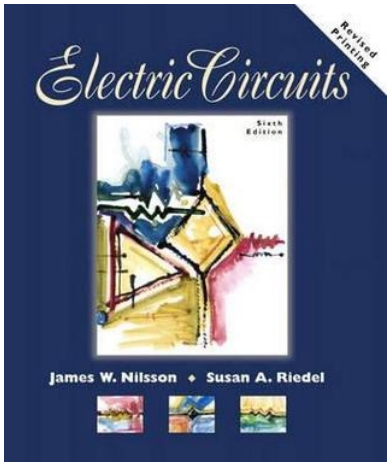
Review:

Appendices A, B, C

Note:

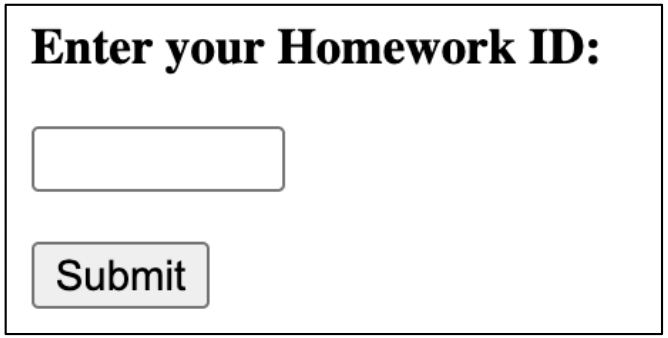
Appendix D has some answers – **use them!**





- Daily on-line homework: **20%** of the course grade
  - **Unique login ID**

    (in the Brightspace gradebook)

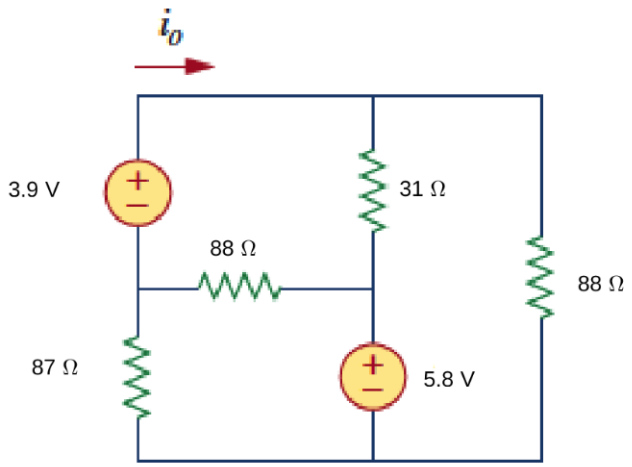


  - 5000 total points
    - 39 days at 100 pts for each problem set
    - 10 extra problem sets (10 are 100 pts, one is 200)
  - Immediately auto-graded
    - Typically need both values **and** units for the answer(s)
  - Due by the **start** (8:55 AM) of the next class day
  - Can resubmit a new answer to get a better score
    - Typically, 100%, 100%, 90%, 80%, 60%, 60%, …
    - Late option at 50% will be available
  - Working with classmates is fine

ELE212 Homework 022

LOGOUT

Part #1 - Score: 0/100



Use nodal analysis, with a supernode, to find i_0, the negative of the source current.

i_0:

SUBMIT

- Weekly quizzes: **80%** of the course grade
  - Mondays at 2 PM in Edward's Auditorium
  - 300 total points:
    - 1st two – 10 pts each
    - Next 11 – 20 pts each
    - 2 during final exam slot (May 5,7) – 20 + 40 pts
  - Nominally 30-ish minute duration; a problem or two relevant to recent material (prior week or earlier)
  - Closed book; one page (double sided) of notes allowed
    - Bring a **working** scientific calculator; no computers/ tablets, or phones allowed
  - Grading includes both the answer **and** the process

- Expected existing skills (some reviewed in HW):
  - Manipulating and graphing simple functions:
    - Polynomials
    - Sinusoids
    - Exponentials
  - Rooting polynomials (quadratic equation)
  - Complex numbers
  - Simple linear algebra
  - Simple calculus – integration and differentiation
    - Optimizing by setting derivative to zero
  - Knowledge of MatLab

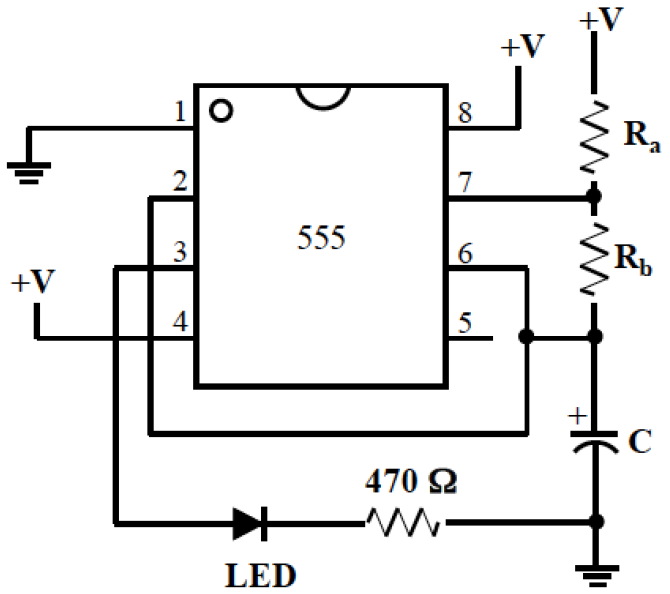
Basics – 1

intro; circuit variables

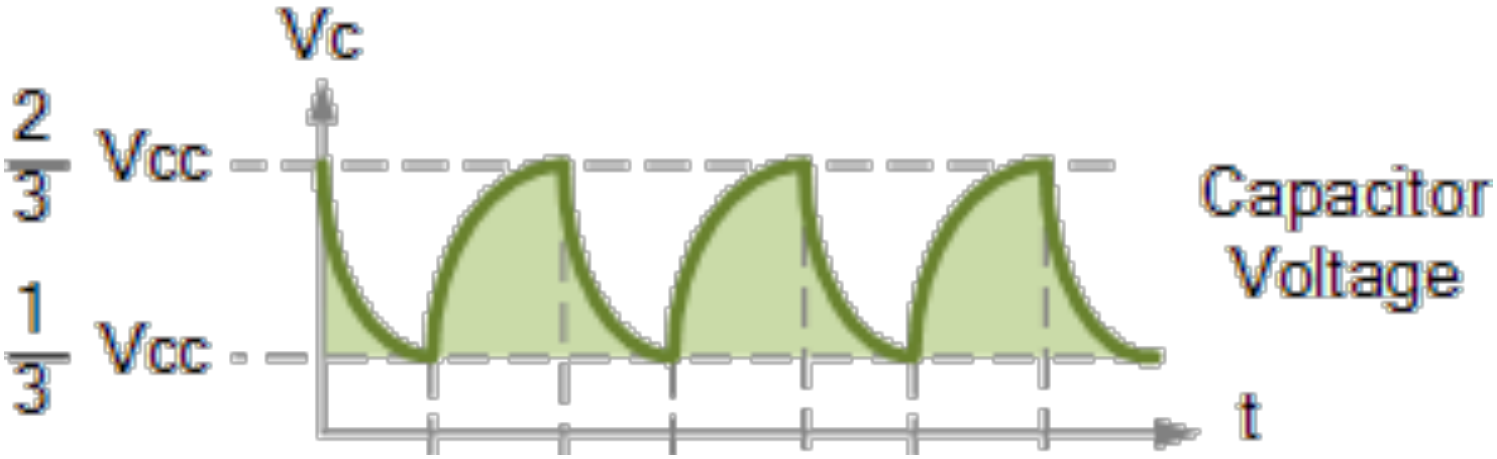
Course Contents

- Learn physical models for some circuit devices
  - "Lumped parameter" paradigm
- Connect these devices into circuits
  - Concerned with electrical interactions
  - Observe interesting (and useful) characteristics
  - Develop analysis tools
- Parallel lab (215) to explore/extend concepts

- Recall the 555 circuit from ELE 202:

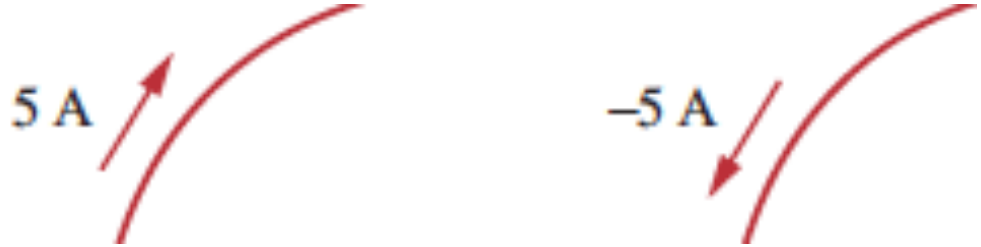


scope here

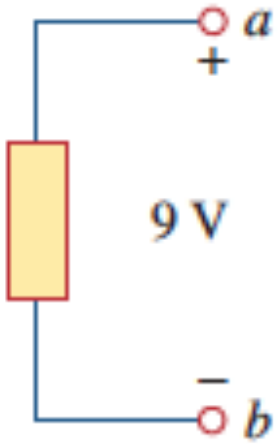


Circuit Variables

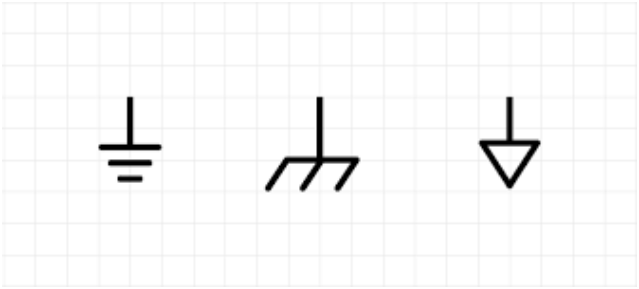
- Charge $q(t)$: unit is coulomb
- **Current** $i(t) = \frac{dq(t)}{dt}$
  - Flow of charge per unit time
  - Measured <u>at a single point</u>
  - Unit is ampere (A, mA, μA) $\sim 6\times10^{18}$ electrons/sec
  - Direction of flow is important (use + or – sign)



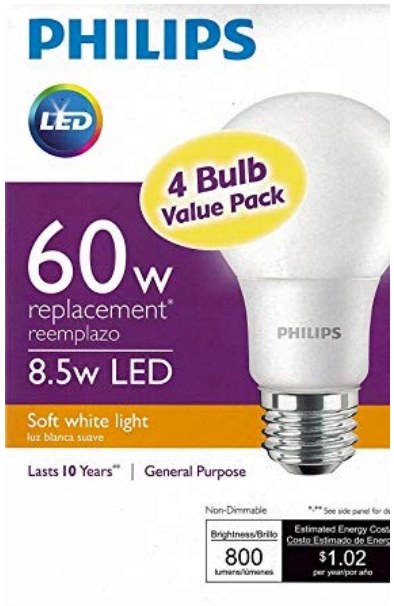
- **Voltage** $v(t) = \frac{dw(t)}{dq}$
  - Potential energy per unit charge
  - Measured between two points (i.e. change in energy); path independent
  - Unit is volt (V, mV, μV)
  - Also has direction or polarity



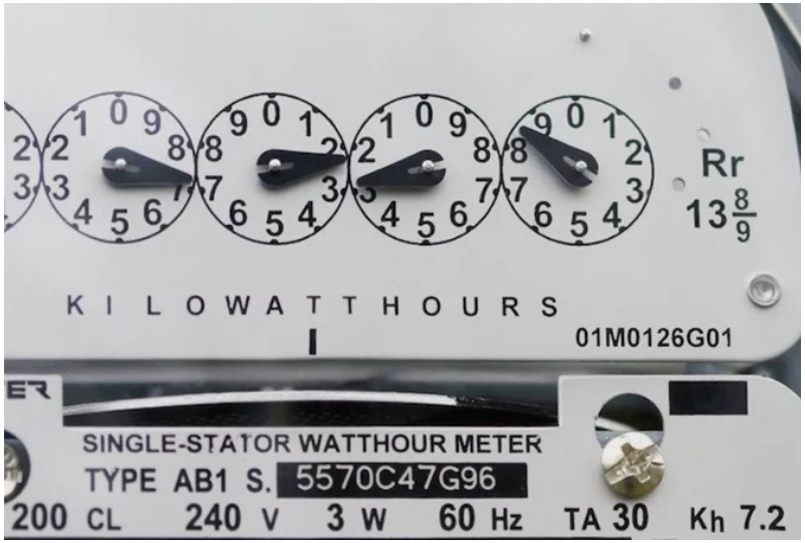
- "Ground" – common reference point for measuring voltage (zero)



- **Power** $p(t) = \frac{dw(t)}{dt} = \frac{dw(t)}{dq}\frac{dq(t)}{dt} = v(t)\ i(t)$
  - Energy per unit time
  - Unit is watt = volt ampere (kW, W, mW, µW)
  - Can be absorbed or delivered
  - Is conserved



- **Energy** $E = \int p(t)dt$
  - Accumulation (integral) of power over time
  - Could be stored, turn into heat, …
  - Unit is joule = watt second



TESLA

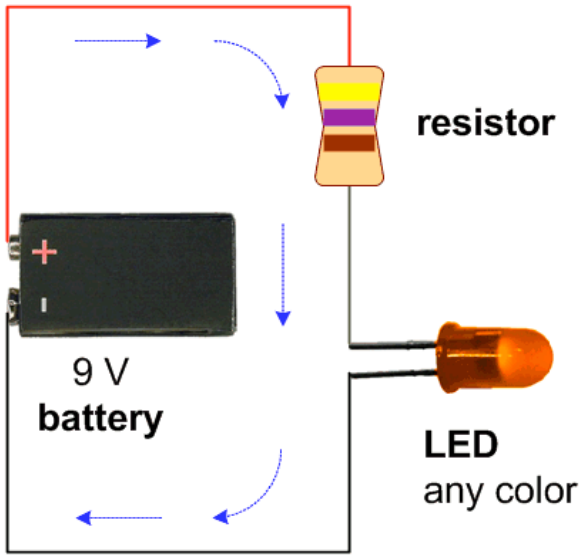
Tesla Model 3 – 50 kWh battery

- **Example:** (recall ELE 202, LED + resistor circuit):
  - Voltage: 9 V battery
  - Current = 10 mA
  - Power

$$p = v\,i = 90 \text{ mW}$$

  - Energy

$$E = \int p(t)dt = \frac{90\ T}{1000} \text{ J}$$



    - For $T = 1$ hour, this is 324 J
    - For a 10 kJ battery, stops after 31 hours