Circuits II

Prof. Daniel Costinett

ECE 202 Lecture 1
January 24, 2024

THE UNIVERSITY OF
TENNESSEE
KNOXVILLE

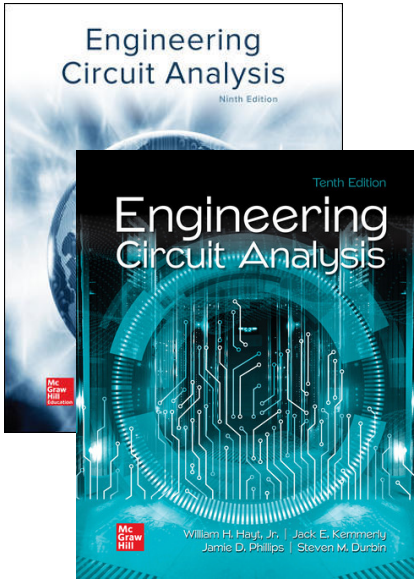
Contact Information

- **Instructor:** Daniel Costinett
  - Office: MK504
  - OH: **W 2:00-3:00 & R 10:00-11:00**, by appointment
  - E-mail: Daniel.Costinett@utk.edu
  - Please use `[ECE 202]` in the subject line
  - Email questions will be answered within 24 hours (excluding weekends)

Textbook and Materials

Textbook

- Hayt, Kemmerly, Phillips, and Durbin, *Engineering Circuit Analysis* 10th Edition
  - ISBN: **1264149913**
  - required
- Course covers Chapters 10-17



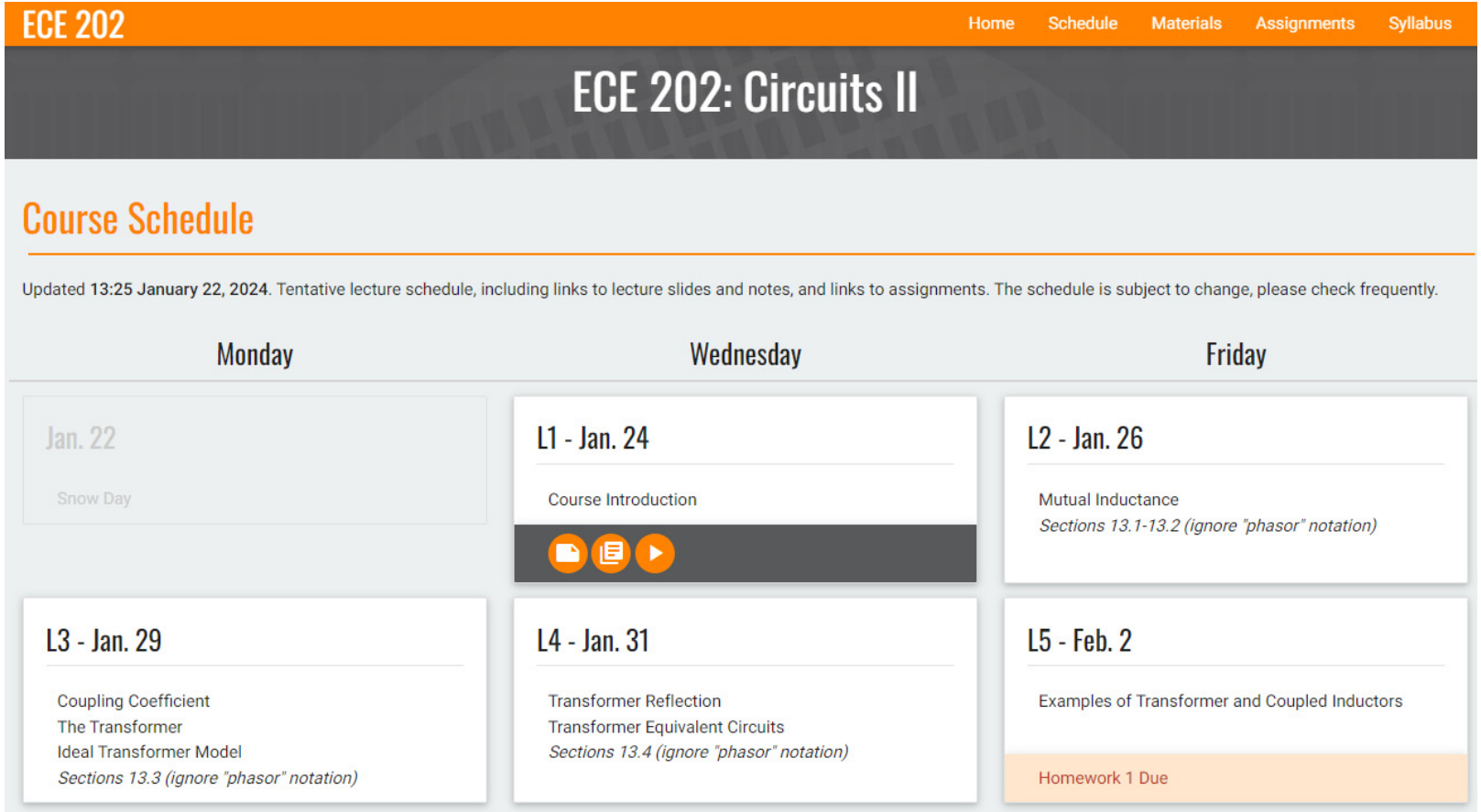
Course Website

- http://web.eecs.utk.edu/~dcostine/ECE202

Software

- MATLAB
- LTSpice

Course Website



Grading

- **Homework: 20%**
  - Weekly, due on Fridays *before* the start of lecture
  - Covers lectures up to and including Monday of the current week
  - The one lowest homework grade will be dropped
- **Quizzes: 10%**
  - In-class, open-book, open-note & calculator
- **Labs: 15%**
  - Completed outside of class
- **Midterms (2): 30%**
- **Final: 25%**
  - All exams open-book, open-note & calculator

Assignments

- Submission
  - Homeworks and Labs should be submitted by uploading a **single pdf** to canvas
    - Physical copy submitted prior to the due date/time loses 5% credit
    - https://www.eecs.utk.edu/resources/it/eecs-it-knowledge-base/using-the-scanner/
    - https://libanswers.utk.edu/faq/103187
    - https://acrobat.adobe.com/us/en/mobile/scanner-app.html : app for Android and iOS

Lab Experiments

- Completed in groups of 2-3
- May be completed using either
  - Analog Discovery Studio
  - Equipment in MK333

Course Policy

- No late work will be accepted except in cases of documented medical emergency
- Collaboration encouraged on Labs and Homework
  - Must submit your own work on all assignments
  - Adhere to Student Code of Conduct
- Attendance is required in all lectures

How to Succeed in ECE202

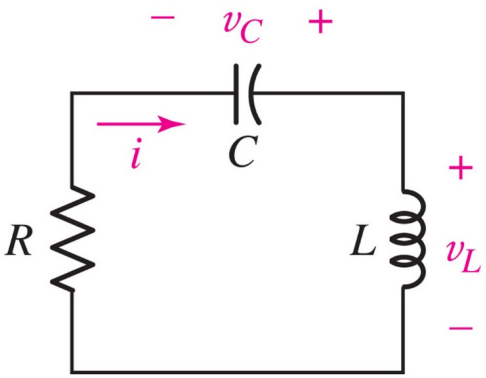
- Attend all lectures
- Read associated sections in the book, as listed on the course schedule
- Work collaboratively (in person or virtually) to understand homework assignments
  - Complete your own work
  - Self-assess solution process
  - Review any incorrect answers
- Actively participate in lab sessions
- Review material in advance of quizzes and tests
- Ask questions in lecture / office hours / e-mail after having made an attempt at the material on your own

INTRODUCTION TO ECE202

ECE 201 Review

- KCL, KVL, Series/Parallel Circuits (Chapter 3)
- Nodal and Mesh Analysis (Chapter 4)
- Linearity/Superposition, Source Transform (Chapter 5)
- Ideal Op-amps (Chapter 6)
- Capacitors and Inductors (Chapter 7)
- RLC Circuits, Resonance, Damping (Chapter 8-9)
  - Differential Equations approach

End of ECE201



$$L\frac{d^2i}{dt^2}+R\frac{di}{dt}+\frac{1}{C}i=0$$

$$v(t)=A_1e^{s_1t}+A_2e^{s_2t}$$

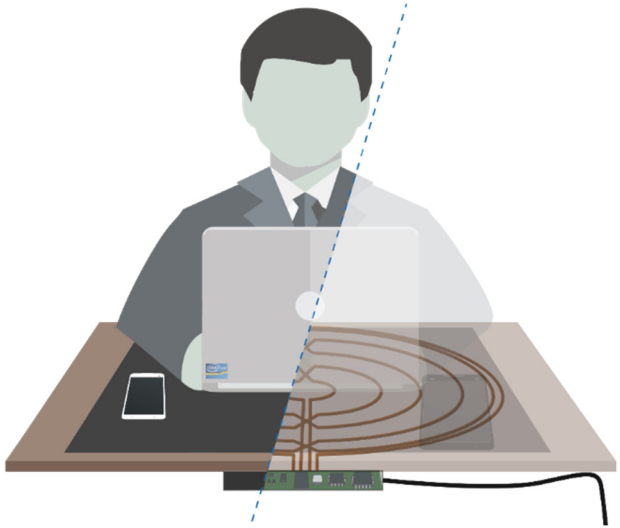
$$s_1,s_2=-\frac{R}{2L}\pm\sqrt{\left(\frac{R}{2L}\right)^2-\frac{1}{LC}}$$

Example Application: Wireless Power Transfer

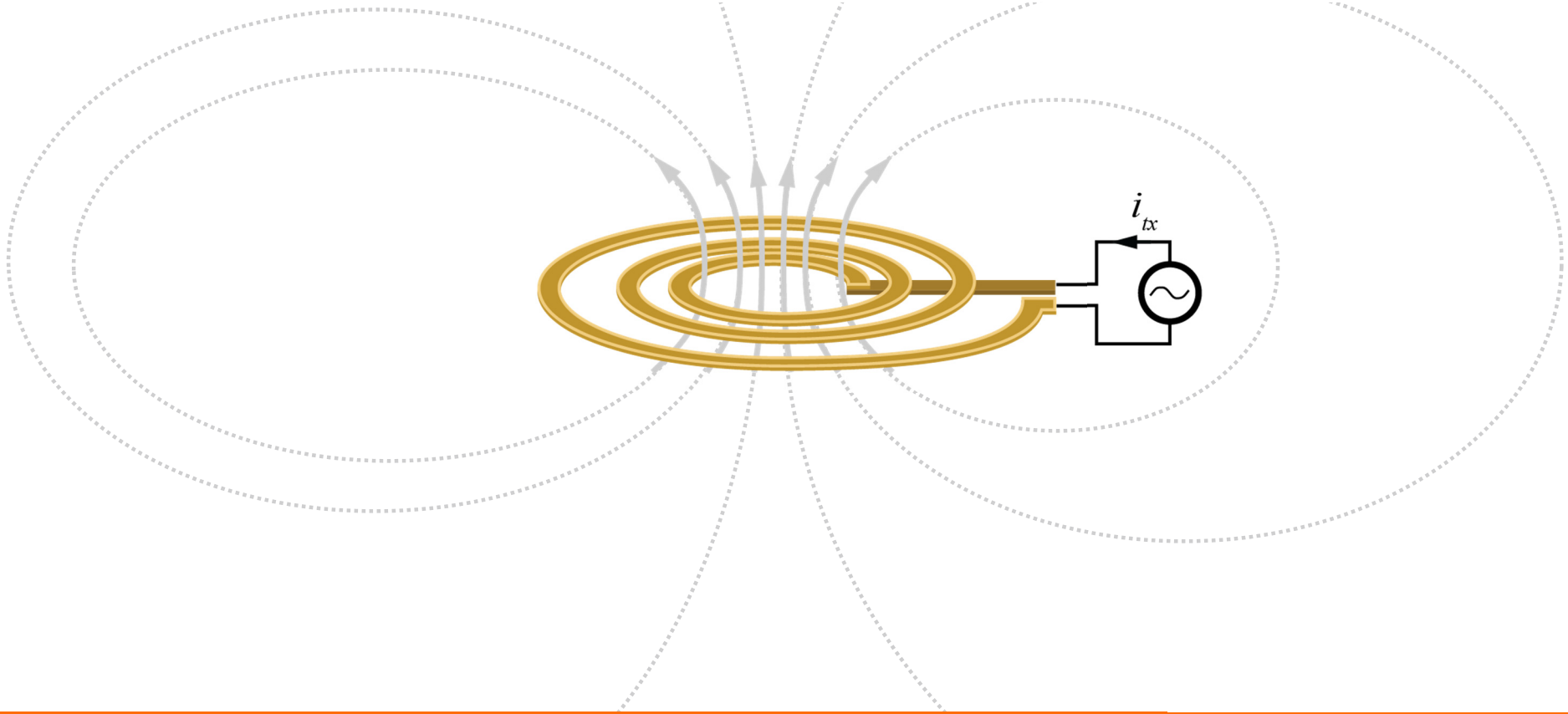
Commercial

Samsung
Fast charging wireless stand 2018
And wireless charger duo

Research



Wireless Power Transfer (WPT)



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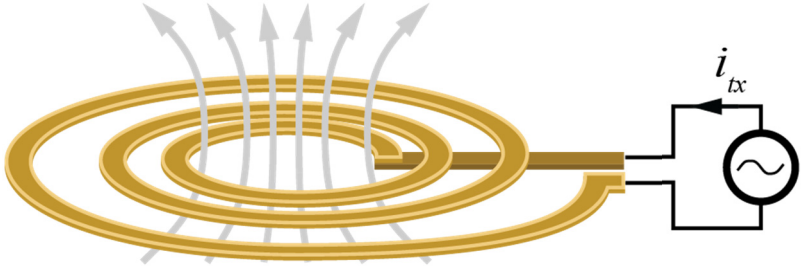

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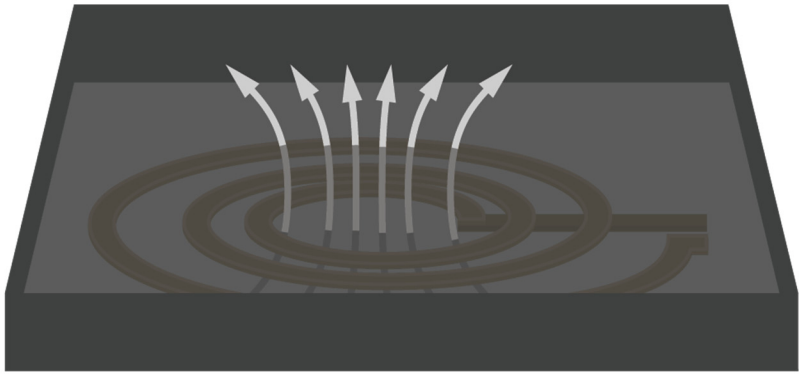

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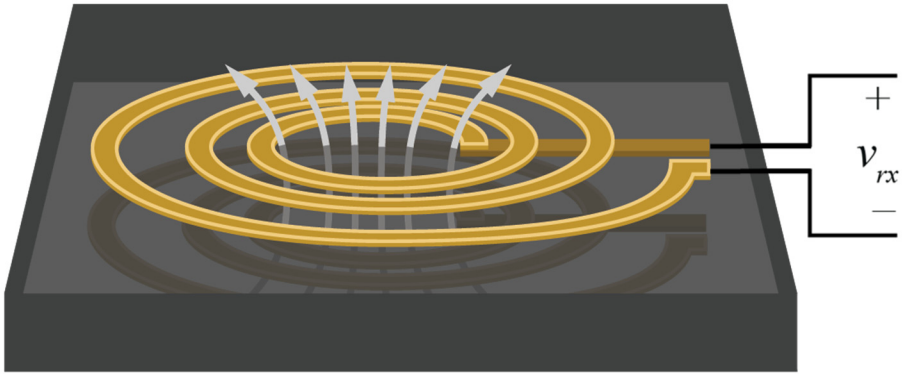
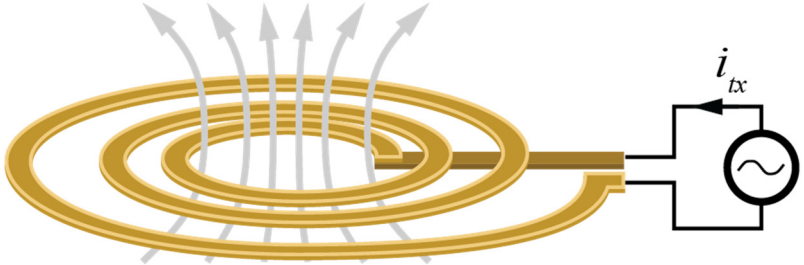
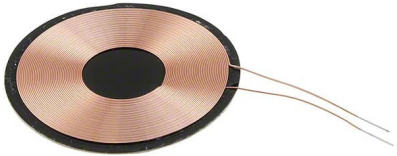


WPT System Design



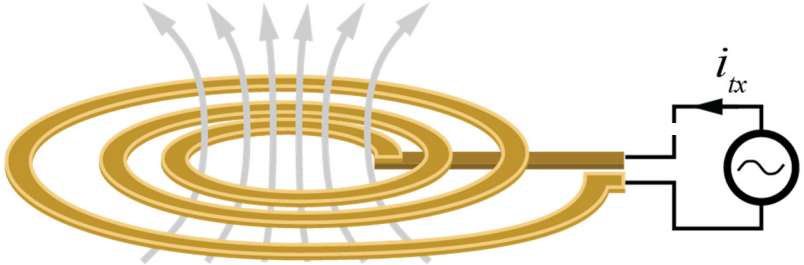


Example Coil

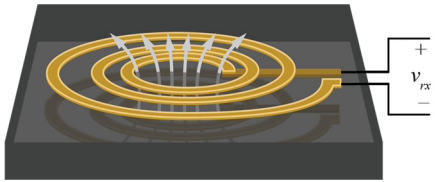
TDK Part Number: WR282840-37K2-LR3

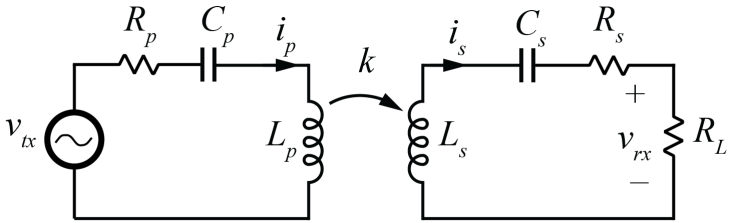
3 x 3 cm, 37 turns, L = 46 µH, f_s = 100 kHz

WPT Compensation

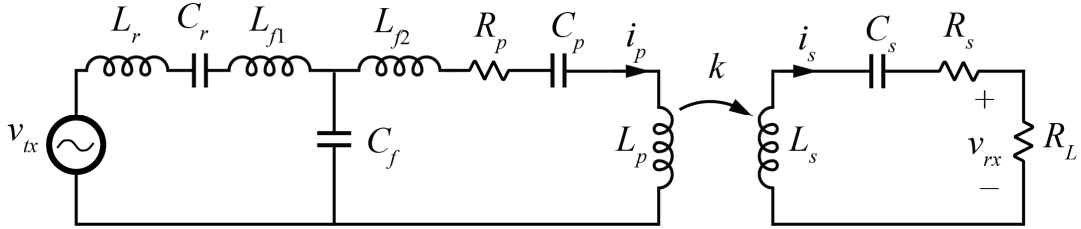


Receiver Side





A Slightly More Complicated System



L. Jiang, F. Tamjid, C. Zhao, D. Costinett, A. Fathy and S. Yang, "A GaN-based 100 W two-stage wireless power transmitter with inherent current source output," *2016 IEEE PELS Workshop on Emerging Technologies: Wireless Power Transfer (WoW)*, Knoxville, TN, 2016, pp. 65-72.

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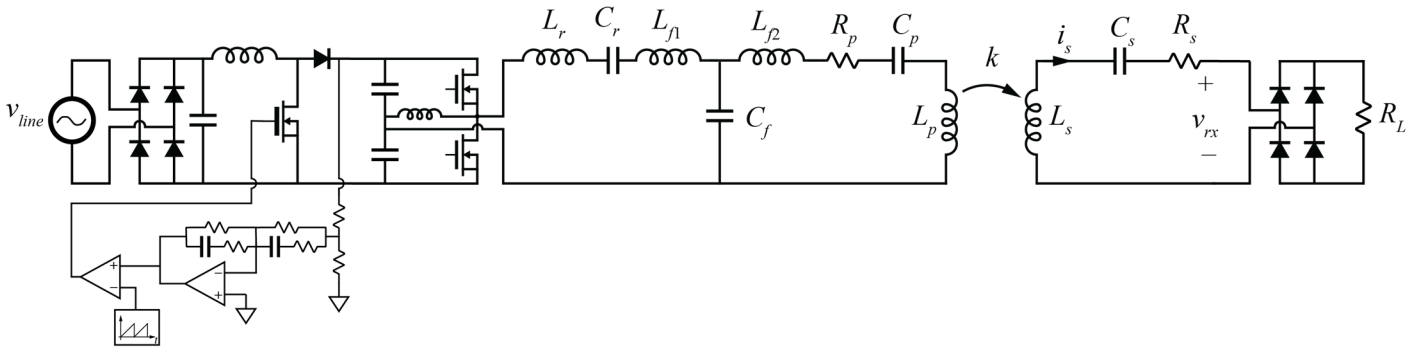

Course Content

- Magnetically Coupled Circuits (Ch 13)
- Sinusoidal Steady-State Analysis (Ch 10)
- AC Circuit Power Analysis (Ch 11)
- Fourier Circuit Analysis (Ch 17)
- Circuit Analysis in the s-Domain (Ch 14)
- Frequency Response (Ch 15)
- Two-Port Networks (Ch 16)
- ~~Polyphase Circuits (Ch 12)~~ [ECE 325]

ECE 202 Core Concepts

- Continued development of fluency with circuit analysis
  - Solving circuits *without* resulting to Nodal/Mesh Analysis
- Linear, Time Invariant (LTI) systems
  - Superposition and shift independence
  - Transformation-based solutions to complex circuits
- Frequency-domain analysis