**ELC 383 (1.0 CU)**

**Electronics II**

**Course Information Professor: Larry Pearlstein**

**Fall 2014:**

**MR 12:30 PM – 1:50 PM/AR144 (Lecture)**

**W 4:00 PM – 4:50 PM/AR144 (Design hour)**

**Course**

**Description:**

**Instructor**

**Information:**

**Office Hours:**

**Textbook:**

**Prerequisite:**

**Grading Policy:**

**Tips for Success:**

**College Level Policies:**

The continuation of ELC 251 covering the analysis and design of electronic circuits and systems: MOSFET IC Stages, BJT IC Stages, Current Mirrors, Cascode Stages & Frequency Response. Power Amplifier Stages. CMOS Digital Logic. Sinusoidal Oscillators, Tuned Circuits, Active Filters, Crystal Oscillators and Monostable/Astable Multivibrators.

Office Location: AR 130B

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Mondays 4:00 PM - 5:20 PM

Tuesdays 10:00 AM - 11:20 AM

By appointment (send me email)

And whenever my office door is open

*Microelectronic Circuits*, 6th Edition by Adel S. Sedra and Kenneth C. Smith, Oxford University Press, 2010.

ISBN 978-0-19-532303-0

Electronics I (ELC 251)

Homework 25%

Midterm Exam 1 20%

Midterm Exam 2 25%

Final Exam 30%

Read the book sections prior to their discussion in class.

Do as much homework as possible.

Do not be shy about asking questions, either during class or outside of the class.

Attendance Policy: <http://www.tcnj.edu/~recreg/policies/attendance.html>

Academic Integrity Policy: <http://www.tcnj.edu/~academic/policy/integrity.html>

Americans with Disabilities Act (ADA) Policy: <http://www.tcnj.edu/~affirm/ada.html>

**Tentative Agenda:**

| **Week** | **Monday Lecture** | **Design Hour** | **Thursday Lecture** |
| --- | --- | --- | --- |
| 1  Week of 8/25  (short week) | No class | Review of MOSFET and BJT characteristics  Chapters 5 & 6 | Basic gain cell  (Sections 7.1-7.2) |
| 2  Week of 9/1  (Follow Monday schedule on Tuesday) | Cascode amplifier  (Sections 7.3.1-7.3.2) | TBD | Cascode variations (folded, BJT)  (Sections 7.3.3-7.3.9) |
| 3  Week of 9/8 | Current sources and current mirrors  (Sections 7.4-7.5) | Multistage amplifiers  (Section 7.6) | MOS differential pair  (Sections 8.1-8.2) |
| 4  Week of 9/15 | BJT differential pair  Non-ideal characteristics of diff. amps.  (Section 8.3) | Non-ideal characteristics of diff. amps.  (Section 8.4) | Diff. amp. with active load  (Section 8.5) |
| 5  Week of 9/22 | 2-stage amplifiers  (Section 8.6) | Simulate or build long-tailed pair. | Review |
| 6  Week of 9/29 | **Midterm Exam 1 (Chapters 7 & 8)** | Low frequency response of CS and CE amps  (Section 9.1) | Internal capacitive effects, high-frequency model and HF response of MOSFET and BJT  (Sections 9.2-9.3) |
| 7  Week of 10/6 | Miller’s Theorem and HF response  (Sections 9.4-9.5) | TBD | Class A, B, AB power amps.  (Sections 11.1-11.4) |
| 8  Week of 10/13  (short week) | No class | Audio power amp design example. | Biasing AB, power BJTs, IC power amps.  (Sections 11.5, 11.7, 11.9) |
| 9  Week of 10/20 | Digital logic inverters  (Section 13.1) | Survey of interoperation of different logic families. | CMOS inverter, dynamics,  (Sections 13.2-13.3) |
| 10  Week of 10/27 | CMOS dynamics,  (Sections 13.4) | Review | **Midterm 2 (Chapters 11 & 13)** |
| 11  Week of 11/3 | Filter types; incl. Butterworth and Chebyshev  1st and 2nd order filter functions  (Sections 16.1-16.4) | AM radio design. | (Sections 16.5-16.6)  2nd order LCR resonator  Active filters |
| 12  Week of 11/10 | (Sections 16.7-16.8)  Active filters  Biquad | TBD | (Sections 16.9-16-10)  Sensitivity  Switched capacitor filters |
| 13  Week of 11/17 | (Sections 17.1-17.2)  Sinusoidal oscillators  Op-amp RC oscillators | TBD | (Sections 17.3-17.4)  LC and crystal oscillators  Multivibrators |
| 14  Week of 11/24  (short week) | (Sections 17.5-17.7)  Waveform generation  555 timer | No class | No class |
| 15  Week of 12/1 | (Sections 17.8-17.9)  Nonlinear waveform-shaping  Precision rectifiers | Astable multivibrator design and waveforms | Review |
| 16  Week of 12/8 | **Comprehensive Final Exam** |  |  |

**Educational Objectives**

*(What TCNJ ECE engineers should be able to accomplish during the first few years after graduation)*

* To contribute to the economic development of New Jersey and the nation through the ethical practice of engineering;
* To become successful in their chosen career path, whether it is in the practice of engineering, in advanced studies in engineering or science, or in other complementary disciplines;
* To assume leadership roles in industry or public service through engineering ability;
* To maintain career skills through life-long learning.

**Electrical and Computer Engineering Student Outcomes**

*(What TCNJ Electrical and Computer Engineering students are expected to know and be able to do at graduation. What knowledge, abilities, tools and skills the program gives the graduates to enable them to accomplish the Educational Objectives)*

The Student Outcomes listed below are expected of all graduates of the Electrical or Computer Engineering Program.

**ECE graduates will have:**

1. **an ability to apply knowledge of mathematics, science and engineering;**

**Math used extensively in homework problems and exams.**

1. an ability to design and conduct experiments, as well as to analyze and interpret data.
2. **an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability;**

**Students do design in homework problems.**

1. an ability to function in multidisciplinary teams;
2. **an ability to identify, formulate and solve engineering problems;**

**Students do homework problems.**

1. an understanding of professional and ethical responsibility;
2. an ability to communicate effectively;
3. the broad education necessary to understand the impact of engineering solutions in a global and societal context;
4. a recognition of the need for and an ability to engage in life-long learning;
5. a knowledge of contemporary issues;
6. **an ability to use the techniques, skills and modern engineering tools necessary for engineering practice;**

**p-Spice tools are discussed throughout the course.**

**Course Objectives\*:**

Objective 1: To analyze and design IC amplifier stages using field-effect transistor (FET) and bipolar junction transistor (BJT) technology. [a, b, c, e, k]

Objective 2: To examine the foundations of CMOS digital logic circuit design.

Objective 3: To analyze and design tuned circuits and active filters.

Objective 4: To analyze and design sinusoidal and square-wave oscillator circuits

**Topics Covered:**

1. MOSFET and BJT IC amplifier stages
2. CMOS digital logic circuits
3. Tuned circuits and active filters
4. Oscillators

**Evaluation:**

1. Midterm Examination 1
2. Midterm Examination 2

C. Final Examination

D. Homework assignments

**Performance Criteria\*\*:**

Objective 1:

An understanding of the design and analysis of MOS and BJT IC amplifier stages. (A, B, D)

Objective 2

A basic understanding of the design of CMOS digital logic gates (B, D)

Objective 3:

An understanding of the design and analysis of tuned circuits and active filters. (C, D)

Objective 4:

An understanding of the design and analysis of sinusoidal and square-wave oscillators. (C, D)

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\* Small letters in brackets refer to the Student Outcomes

\*\* Capital letters in brackets refer to the evaluation methods used to assess student performance

**ELC 383: ADDITIONAL INFORMATION**

# DESCRIPTION OF DESIGN ACTIVITY

Students will design, analyze, simulate and evaluate linear circuits.

# ENGINEERING STANDARDS

N/A.

# REALISTIC CONSTRAINTS

**Economic:** The cost reduction impact of linear and digital Very Large Scale Integration (VLSI) semiconductor circuits is covered in this course.

**Environmental:** Techniques for lower power design are examined, that require less energy usage.

**Sustainability:** N/A.

**Ethical:** N/A.

**Social Impact:N/A**.

# MODERN AND PROFESSIONAL ENGINEERING TOOLS USAGE

PSpice is used extensively throughout the course.

# COMPUTER USAGE

Students use computers for circuit simulation.

# FEEDBACK MECHANISMS

**Examinations:** Students are given two midterm and one final examinations.

**Reports: N/A**.

**Homework:** Homework problems are assigned and graded. These problems are a mixture of analysis and design problems.