ECE 4201
Electronic Circuits and Applications

Credits and contact hours: 3 Credits (Two 75-minute lectures per week)

Instructor: Mehdi Anwar

Textbook *Analysis and Design of Analog Integrated Circuits (5th Edition)*
Paul R. Gray, Paul J. Hurst, Stephen H. Lewis and Robert G. Meyer

a. *Other supplemental materials* : *Microelectronic Circuits* by Sedra and Smith
b. *Lecture Notes*

***Specific course information*:**

a. Analysis and design of linear amplifiers. The effects of feedback in tuned, video, and operational amplifiers. Noise, stability, and frequency compensation. Applications encompass active filters, oscillators, phase lock loops and nonlinear operations such as multiplication, modulation, sampling, and analog-to-digital conversion.
b. Prerequisite: ECE 3201; and either ECE 4211 or ECE 4225, which may be taken concurrently; open only to students in the School of Engineering.
c. Recommended preparation: ECE 3111.
d. Required, elective, or selected elective: Selected elective

***Specific goals for the course*:**

a. Specific outcomes of instruction: Students taking this course are expected to

- develop expertise in the design and analysis of discrete component-based analog electronic circuits such as, operational amplifiers, oscillators, comparators and filters,
- apply scientific theory and engineering principles in the design and analysis of analog electronic circuits,
- utilize software platform/CAD (e.g. Spice, Cadence) to analyze and design simple and involved analog circuits,
- recognize functional analog units (e.g. active loads, current mirrors, differential amplifiers) and simplify analysis.
- be able to simplify complicated expressions based upon order-of-magnitude relevance of circuit parameters to understand the functionality of different sub-analog units.

b. ***ABET Criterion 3 Student Outcomes addressed by the course*:**

(1) an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
Electronic circuit and system design requires the application of mathematics, science and engineering knowledge. Problems are studied and solved related to circuit design - requiring the analysis and interpretation of experimental, numerical, and theoretical data.

(2) an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
n/a

(3) an ability to communicate effectively with a range of audiences
Participation in class discussion is a requirement. Students are grouped and assigned challenging problems that they are required to present and discuss with the whole class.

(4) an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
n/a

(5) an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
Students are encouraged to discuss assigned problems with their fellow students, thus sharing a developing knowledge base.

(6) an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
n/a

(7) an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.
The students are encouraged to continuously update and augment their understanding of circuits based upon desired performance requirements. The lectures are also designed and updated continuously to reflect current trends in integrated circuit design and analysis, as an example the implication of the gradual reduction in MOS channel lengths and the technological challenges.

Topics covered:

(a) Analysis and Design of Class A amplifiers
   i. Single transistor (BJT and MOS) amplifiers
   ii. Multiple transistor amplifiers
   iii. Differential pairs
(b) Current Mirrors and Active Loads
(c) Output states
   i. Single transistor output stage
   ii. Class AB output stage
   iii. Class B push-pull stage
(d) Operational Amplifiers
(e) Frequency Response of Analog Circuits
(f) Feedback and noise
(g) Non-linear Analog Circuits