Department of Electrical and Computer Engineering
ECE 372: Electronic Circuits II

ECE 372 - Electronic Circuits II (3-0-3)

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Textbook: R. C. Jaeger – T. N. Blalock, Microelectronic Circuit Design, ISBN 978-0-07-338045-2 (main text)
Reference Book: Sergio Franco, Design with Operational Amplifiers and Analog Integrated Circuits, ISBN 0-07-232084-2

Course Description:
Principles of FET and BJT small signal amplifiers: Q point design, input and output impedance, gain, and signal range limitations for the six different single stage configurations. Design of analog integrated circuits including current sources, differential amplifiers, noise sources, active loads, and CMOS circuits. Transistor high frequency models, Miller effect, and frequency response of multistage amplifiers. Feedback with multistage amplifiers and two-port network theory.

Prerequisites: ECE 232, ECE 271 **Corequisite**: none

Computer Usage in course:
Multisim, Excel, Matlab

Specific Course Learning Outcomes (CLO): The student will be able to

1. analyze and obtain relevant characteristics of the most popular single stage configurations involving BJTs and MOSFETs
2. learn to design these single stage amplifiers, select the appropriate configuration that would fit the specifications of a more complex circuit
3. evaluate the effect that capacitors (coupling and bypass capacitors at low frequencies, and internal capacitances affecting the response at high frequencies) have on the frequency responses of these amplifiers
4. analyze and design differential pairs, and understand the importance of this configuration not only in the case of simple amplifiers but also as a basic block in the design of operational amplifiers
5. determine the characteristics of multistage amplifiers, current sources, active loads, and the blocks that form the backbone of an operational amplifier
6. understand and evaluate the effect of feedback on the characteristics of amplifiers
7. investigate and design comparator-based circuits including schmitt triggers, sine wave generators, and timers
8. reverse engineer a design, reconfigure it based on different specifications, and present it in front of peers

Relevant Student Outcomes:

1. An ability to identify, formulate, and solve engineering problems by applying principles of engineering, science, and mathematics (CLOs 1-8).
2. An ability to apply both analysis and synthesis in the engineering design process, resulting in designs that meet desired needs (CLOs 1-8).
6. An ability to recognize the ongoing need for additional knowledge and locate, evaluate, integrate, and apply this knowledge appropriately. (CLOs 2, 4, 5, 7, 8)
7. An ability to function effectively on teams that establish goals, plan tasks, meet deadlines, and analyze risk and uncertainty. (CLOs 7, 8).

Topics:

Topic	Week
Analog systems • Two-port networks • Ideal operational amplifiers • Operational amplifier-based circuits	1-2
Small-signal modeling • BJT amplifiers • MOSFET amplifiers	2-3
Single and multistage amplifiers • Common emitter, common source • Common collector, common drain • Coupling and bypass capacitor design • Multistage AC-coupled amplifiers	4-5
Nonlinear Circuits • Transistor feedback amplifiers • Comparators • Applications: ON-OFF Control, Window Detectors, Schmitt Triggers	5-6
Midterm exam #1	
Filters and Signal Generators • Active filters • Oscillators • multivibrators	6-7
Differential amplifier • DC and AC analyses • Differential-mode gain, common-mode gain, common-mode rejection ratio • Input and output resistances • Transition to operational amplifiers • Output stages	8-9
Current Sources and Feedback • MOSFET Current Sources • BJT Current Sources • Buffered Current Sources	10

• Widlar Current Sources • Feedback	
Midterm exam #2	11
Amplifier frequency response • Estimation of ω_L using the short-circuit-time-constant method • Transistor models at high frequencies • Estimation of ω_H using the Open-circuit-time-constant method	11-12
Group project presentation, review	12-14
Final exam	15

Grading: Class participation, Homework, quizzes 10%; Group project including simulation, hardware implementation (unless explicitly waived) 10%; Mid-term examinations 2 x 25%; Final examination 30%.

Homework Problems:

Chapter	**Problems**
10	14, 17, 54, 66,
13	11, 22, 30, 34, 65, 66, 68
14	1, 20, 28, 74, 95, 114
15	4, 24, 51, 58, 71, 116, 122
17	9, 18, 40, 45, 58, 60

Date of submission will be announced in class. The topics of the class project will be selected by groups of students and approved by the instructor no later than 4 weeks after the beginning of the semester. The project topic should be about mastering an existing design, then manipulating the design to fit the specifications related to another application that the group will select. Each group should elect a project manager to interact with the instructor, and manage the project.

Honor Code: The NJIT Honor Code will be upheld, and any violations will be brought to the immediate attention of the Dean of Students.

Office: ECEC 311

Office hours: T 1:00 PM – 1:45 PM
T 3:00 PM – 3:45 PM
R 12:00 PM – 12:45 PM

Other times can be arranged through appointments;
Set up appointment for any office hour (regular or extraordinary) meeting through email stating the suitable meeting day and time

Prepared by: M. Feknous