

Electronic Devices – ENGR 355 (3 credit hours)

Abilene Christian University

Spring 2016

Course Description (from the ACU Course Catalog)

Basic physics of semiconductors, pn junctions, diode circuits, bipolar junction transistors, field effect transistors, small-signal and power amplifiers, ideal and non-ideal op amps, oscillators. Must be taken concurrently with ENGR 356 (Electronic Devices Laboratory) Prerequisites: MATH 286 (Calculus II), ENGR 135 (Introduction to Electric Circuits); Recommended: PHYS 330 (Modern Physics)

Class Meeting Times and Location

This class meets Tuesday and Thursday in Foster Science Building Room 330 from 1:30 pm to 2:50 pm.

Intended Audience: Any General Engineering student (BSE) or Physics student (BS) with an interest in electronic circuit design and an exposure to introductory circuit analysis through ENGR 135 and calculus up to MATH 286

Required Text and Software

Microelectronics Circuit Analysis and Design (4th Edition) by Donald A. Neamen, McGraw-Hill Higher Education, 2010, ISBN-13: 9780073380643.

Contact Information

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Office Hours: MWF (10:00 am to 11:00 am) MT (3:00 pm to 5:00 pm). Additional office hours can be arranged as needed.

Teaching Philosophy

Engineering is a well-respected profession. The public entrusts engineers to be honest, competent, and ethical. Many codes of ethics for these fields indicate that the commitment to protecting the health, safety, and welfare of the public is of paramount importance. These values are in harmony with Christian principles and ideals. Christian engineers should be honest (Matthew 5:37), work hard to ensure competency (Colossians 3:23), and put the public's interest ahead of his or her own (Luke 6:31). In light of these principles, this course will be taught such that you will gain an appreciation for the professional nature of engineering. It will be taught so as to give you every opportunity to begin to develop competency in these fields. This will require homework, quizzes, tests, and group discussion. The instructor especially encourages the discussion of topics that would bear on integrating faith and professional responsibilities (cheating on licensure exams, weapons design and manufacture, environmental laws and employment opportunities in developing nations, etc.)

Class Sessions

Classes will consist of traditional lectures, as well as individual and group problem solving sessions.

Learning Objectives and Competencies

ABET Learning Objectives	Course Competencies	Measurement
3(c) 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	Design DC power supplies to meet certain specifications	Homework, Test 1, Final Exam
	Design small-signal and power amplifiers using traditional biasing techniques with op-amps and transistors	Homework, Tests 1 and 2, Final Exam
	Design constant current sources for biasing amplifiers with active loads	Homework, Test 2, Final Exam
	Design electronic oscillator circuits	Homework, Test 2, Final Exam
3(e) an ability to identify, formulate, and solve engineering problems	Describe the physical properties of pn junctions under equilibrium, forward-bias, and reverse-bias conditions	Homework, Tests 1, Final Exam
	Differentiate between MOSFETs, JFETs and BJTs based on their device structures	Homework, Test 1, Final Exam
	Compare characteristics of basic amplifier configurations based on multiple transistor types	Homework, Tests 1 and 2, Final Exam
	Model amplifier behavior schematically using voltage-controlled sources	Homework, Tests 1 and 2, Final Exam
	Analyze frequency response in amplifiers	Homework, Test 2, Final Exam

Student Conduct

Academic integrity is defined as academic work completed as assigned for each class by the individual or group responsible for the work. Violations of academic integrity and other forms of cheating involve the intention to deceive, mislead, or misrepresent and therefore, are a form of lying. Such actions are contrary to behavioral norms that flow from the nature of God. Academic misconduct includes, but is not limited to, the following: 1) Failure to give credit to sources used in a work in an attempt to present the work as one's own, 2) Submission of papers or projects obtained from another

source (e.g., research service or club paper file) as one's own, and 3) Falsifying information orally or in writing. Academic misconduct may result in, but is not limited to, a zero on the assignment and/or an F in the course. Additionally, the department chair, Dean of the College of Arts and Sciences, and the Dean of Student Life will be notified. See the full university policy, including how to appeal a decision, by following this link:

<http://www.acu.edu/campusoffices/studentlife/judicialDocuments/AcademicIntegrityPolicy.pdf>.

Attendance

Attendance is expected at all class sessions. It is also expected that you will arrive promptly.

Grading Policy

Homework –

I encourage you to work together in small groups to solve homework problems, but ***do not copy your classmates' work***. I expect homework to be turned in on time. It will typically be due a week after it is assigned, and will be assigned almost every week. ***No late homework will be accepted***. If you simply cannot finish by the deadline, turn in what you have done on time to receive partial credit. I will drop your lowest homework grade.

Midterm Tests -

Two midterm tests will be given during the semester. The dates are tentatively shown in the schedule, but may be subject to change. You will have at least one week notice before tests. Make-up tests will only be given for university approved absences with my approval and ***you must talk to me about it before the scheduled exam time***. Approved make-up tests will be given at an assigned time at my discretion. Make-up tests will be far more difficult than the in-class test and may be written or oral.

Final Exam -

The final exam will be given at the time scheduled by the university. It will be a cumulative survey of the material presented throughout the entire semester.

Calculation of Final Course Grade-

Homework.....	33 %
Midterm Tests (2).....	33 %
Final Exam.....	34 %

90% and above	A
80% - 89%	B
70% - 79%	C
60% - 69%	D
59% and below	F

ADA Compliance Statement

"Abilene Christian University is dedicated to removing barriers and opening access for students with disabilities in compliance with ADA and Section 504 of the Rehabilitation Act. The Alpha Scholars Program facilitates disability accommodations in cooperation with instructors. In order to receive accommodations, you must be registered with Alpha Scholars Program, and you must complete a specific request for each class in which you need accommodations. If you have a documented disability and wish to discuss academic accommodations, please call our office directly at 325-674-2667."

Disclaimer: This syllabus is complete and correct to my knowledge at the present time; however, this syllabus may be modified at any time if I determine that it is in the best interest of the class to do so.

The mission of the Engineering and Physics Department:

The ACU engineering program strongly supports the university's mission of educating students for Christian service and leadership throughout the world. In support of this mission, ACU engineering graduates will attain:

- A deep and broad understanding of engineering principles and practices as evidenced by professional employment, continued professional development, and graduate study in engineering or other professional fields.
- An extensive knowledge of the innovative design processes unique to engineering professionals as demonstrated by using critical thinking skills to contribute to the scientific and technical literature, patents and intellectual property, professional societies, and creative designs.
- A thorough understanding of Christian service and leadership as shown in their commitments to professionalism, ethics, and service and leadership within the engineering profession, the church, and society.

The mission of the College of Arts and Sciences:

To educate students for worldwide Christian service and leadership through programs of study and other learning experiences that blend a liberal arts education with professional and career education.

The mission of ACU:

To educate students for Christian service and leadership throughout the world.

Electronic Devices Course Schedule

Week, Day (excluding holidays)	Chapter(s)	Topics
1, T	9	(Syllabus overview), Ideal op-amp review (Homework 1 assigned)
1, R	9	Small-signal equivalent amplifier circuits, voltage to current converters
2, T	9	Integrators, differentiators, design of reference voltage sources (Homework 1 due, Homework 2 assigned)
2, R	9	Non-ideal op-amp characteristics and considerations
3, T	1, 2	Semiconductor materials, pn junctions, rectifier diodes (Homework 2 due, Homework 3 assigned)
3, R	2	Specialized diodes, Diode circuits
4, T	3	nnp/pnp bipolar junction transistors, electron/hole currents, device structure (Homework 3 due, Homework 4 assigned)
4, R	3	DC analysis of common collector and common base configurations, load line analysis
5, T	3, 4	BJT biasing, BJT linear amplifiers, small-signal voltage gain, small-signal equivalent circuits for BJT amplifiers (Homework 4 due, Homework 5 assigned)
5, R	4	Input and output impedance, AC load line analysis, multistage BJT amplifiers
6, T	5	Field effect transistors (FETs), metal-oxide-semiconductor FET (MOSFET) device structure, ideal MOSFET I-V characteristics (Homework 5 due.

		Homework 6 assigned)
6, R	5	complimentary nature of NMOS and PMOS transistors, non-ideal I-V characteristics of MOSFETs, DC MOSFET circuit analysis, common MOSFET configurations
7, T	5, 6	Basic MOSFET applications, small-signal FET amplifier equivalent circuit, FET amplifier configurations (Homework 6 due, Homework 7 assigned)
7, R	6	Summary and comparison of the three basic amplifier configurations, basic JFET amplifiers
8, T	1-6, 9	Test 1 review (Homework 7 due)
8, R	1-6, 9	TEST 1
9, T	7	frequency response analysis, system transfer functions(Homework 8 assigned)
9, R	7	More on transfer functions, frequency response of transistor amplifiers with capacitors, BJT frequency response, FET frequency response
10, T	7, 8	High frequency amplifier design, output stages, power amplifier considerations(Homework 8 due, Homework 9 assigned)
10, R	8	Class A and Class AB power amplifiers, power transistors
11, T	10	Introduction to biasing with active loads, BJT current sources, FET current sources(Homework 9 due, Homework 10 assigned)
11, R	10	DC analysis of circuits with active loads, gain in circuits with active loads
12, T	10, 11	Small-signal analysis of circuits with active loads, differential amplifiers (Homework 10 due, Homework 11 assigned)
12, R	11, 12	Building a simple op-amp, feedback and stability in amplifier circuits
13, T	13	Op-amp design case study – BJT-based op-amp (741), Op-amp design case study – CMOS-based op-amp (MC14573) (Homework 11 due, Homework 12 assigned)
13, R	14, 15	non-ideal characteristics of op-amps, op-amp applications: active filters
14, T	15	Op-amp applications: oscillator circuits, Review for Test 2 (Homework 12 due)
14, R	7-8,10-15	TEST 2 (bonus Final Review assigned)
15, T	15, 16	Selected topics: voltage regulators, CMOS logic circuits, RAM and ROM
15, R		Review for Final (bonus Final Review due)