No: ECE 3570

Title: Electronics I.

Credits: 4 (LCT:3, Lab:1)

WSU Catalog Description: Prereq. or coreq: ECE3300 and ECE 3330. DC and small signal analysis of diodes, MOSFETs, and BJTs circuits; operational amplifiers, single-stage amplifiers, differential pair, gain, input resistance, output resistance, and bandwidth of amplifiers. (T)

Prerequisites and co-requisites are checked automatically at the time of registration. However, it is ultimately a student's responsibility to make certain that they have the prerequisites and co-requisites for a course. Students must remain registered for a co-requisite course throughout the semester. Advisors will check course prerequisites and co-requisites during the 5th and 6th week of the semester. Any student found to be registered for a course without meeting these requirements, and without an official waiver on file, will be administratively withdrawn from the course.

Coordinator: Yong Xu, Associate Professor of Electrical and Computer Engineering

Instructor: Yong Xu
Office Hours: T 1:30pm-3:20pm (or by appointment) Office Location: 3131 Engineering
Phone: 313-577-3850 Email: yxu@ece.eng.wayne.edu
Course Meeting Time: T Th 3:30 PM – 5:20 PM
Course Meeting Location: 0237 Mano

Goals: To provide students with basic analytical and laboratory skills in the analysis and design of fundamental analog circuits. To prepare students for more advanced courses in circuit design/analysis.

Learning Objectives: At the end of this course, students will be able to:

1. Understand the terminal characteristics of operational amplifiers, and design/analyze fundamental circuits based on operational amplifiers.
2. Understand the operation principle and characteristics of diodes, and design/analyze fundamental circuits based on diodes.
3. Understand the operation principle and characteristics of BJTs, and design/analyze fundamental amplifiers based on BJTs.
4. Understand the operation principle and characteristics of MOSFETs, and design/analyze fundamental amplifiers (including differential pair) based on MOSFETs.
5. Construct and study fundamental circuits based on operational amplifiers, diodes, BJTs, and MOSFETs experimentally (lab skills).


Reference Texts: none
Prerequisites by Topic:  (ECE 3300 Introduction to electrical circuits and ECE 3330 Electrical circuits II) Electrical quantities, waveforms, Ohm’s law, Kirchhoff’s laws, nodal and mesh analysis, Thevenin’s theorem, Norton’s theorem, and other network theorems, independent current source and voltage source, dependent current source and voltage source, principle of superposition, complex frequency concepts, frequency response.

Topics:
1. Chapter 1: introduction (1 lecture)
2. Chapter 2: Operational amplifiers (3 lectures)
   a. terminal characteristics of ideal op amp.
   b. inverting configuration
   c. non-inverting configuration
   d. difference amplifier
   e. large signal operation: output voltage saturation and output current limits
3. Chapter 3: Diodes (5 lectures)
   a. ideal diode
   b. terminal characteristics and models of real diodes (pn junctions)
   c. small signal analysis
   d. zener diode
   e. diode rectifiers and other diode circuits
   f. basic semiconductor physics behind pn junctions
4. Chapter 4: Bipolar junction transistors (BJTs) (7 lectures)
   a. physical structure and modes of operation.
   b. DC analysis of BJT circuits
   e. small signal analysis
   d. single-stage configurations
5. Chapter 5: Metal-oxide-semiconductor field-effect transistors (MOSFETs) (6 lectures)
   a. physical structure and modes of operation
   b. DC analysis of MOSFETs circuits
   c. small-signal analysis.
   d. single-stage configurations.
   e. frequency response of amplifiers
6. Chapter 6: Differential amplifiers (2 lectures)
   a. large signal operation
   b. small signal operation, equivalent half circuit

Course Structure: The class meets twice a week, 1.5 hours each for total 3 credit hours. The lab session meets once a week.

Computer Resources: Multisim or Altium will be used for the circuit simulation.

Laboratory Resources: Please refer to the syllabus of Lab session.

Laboratory Policy: Please refer to the syllabus of Lab session.

Distribution of Points:
Final score: 75% Lecture + 25% Lab
Lecture: Homework (5%), Midterm I (25%), Midterm II (30%) and Final (40%).
Grading Scale: A: 90.0~100; A-: 85.0~89.9; B+: 80.0~84.9; B: 75.0~79.9; B-: 70.0~74.9; C: 60.0~70.0; F: <60

Attendance: Students are expected to attend all lectures

Tentative Schedule:
1. Chapter 1 Introduction (9/1/11)
2. Chapter 2 Operational amplifiers (9/6/11-9/13/11)
3. Chapter 3 Diodes (9/15/11 – 9/29/11)
4. Midterm I (10/6/11)
5. Chapter 4 Bipolar Junction transistors (10/11/11 – 11/1/11)
6. Midterm II (11/8/11)
7. Chapter 5 Field-effect transistors (FETs) (11/10/11-12/1/11)
9. Final (TBD)

Withdraw policy:
- Weeks 1 and 2: Student may withdraw on Pipeline and receive a full tuition refund. No notation of the course is made on the transcript.
- Weeks 3 and 4: Students may withdraw on Pipeline; however, no tuition refund is given. No notation of the course is made on the transcript.
- Weeks 5 through 15: Student requires instructor’s permission to withdraw from a course. At the time permission is granted, the instructor will submit one of the following three notations:
  WP: Withdrawal/Pass – student passing course at time of withdrawal
  WF: Withdrawal/Fail – student failing course at time of withdrawal
  WN: Withdrawal/No Basis for Grade – student did not submit any work in the course; therefore, there is no basis for assessment at the time of the withdrawal.

Makeup Exam and Makeup Assignment Policy: No makeup exams. No late assignments.

Outcome Coverage:
(a) an ability to apply math, science and engineering knowledge. The lectures, homework, lab projects and exams all require direct application of mathematics, scientific, and engineering knowledge, such as equation solving, circuit analysis, semiconductor physics, and hands-on lab skills.
(b) an ability to design and conduct experiments, as well as to analyze and interpret data. Students conduct fundamental circuit experiments and process raw data to verify electronic theories.
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice. The students are expected to use the techniques and skills learned in this course, such as DC/small signal analysis and miller’s theorem, to solve practical electronic problems and software for assistance of the circuit analysis/design.

Cheating Policy and Penalty for Cheating: Cheating is defined by the University as “intentionally using or attempting to use, or intentionally providing or attempting to provide, unauthorized materials, information, or assistance in any academic exercise.” This includes any
group efforts on assignments or exams unless specifically approved by the professor for that assignment/exam. Evidence of fabrication or plagiarism, as defined by the University in its brochure Academic Integrity, will also result in downgrading for the course. STUDENTS WHO CHEAT ON ANY ASSIGNMENT OR DURING ANY EXAMINATION WILL BE ASSIGNED A FAILING GRADE FOR THE COURSE.

Student Disability Services: If you have a documented disability that requires accommodations, you will need to register with Student Disability Services for coordination of your academic accommodations. The Student Disability Services (SDS) office is located at 1600 David Adamany Undergraduate Library in the Student Academic Success Services department. SDS telephone number is 313-577-1851 or 313-577-3365 (TTY: telecommunication device for the deaf; phone for hearing impaired students only). Once you have your accommodations in place, I will be glad to meet with you privately during my office hours to discuss your special needs. Student Disability Services’ mission is to assist the university in creating an accessible community where students with disabilities have an equal opportunity to fully participate in their educational experience at Wayne State University.

Prepared By: Yong Xu, Associate Professor of Electrical and Computer Engineering

Last Revised: Aug. 31, 2011