EE 3444
Electronics II

Spring 2009

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Catalog Course Description:

EE 3444. ELECTRONICS II WITH LAB (3-3). Low and high frequency characteristics and circuit models for diodes, bipolar junction transistors (BJTs), and field effect transistors (FETs). Analysis and design of full spectrum small signal BJT and FET circuits. Analysis and design of active filters, oscillators, feedback configurations, and multistage differential and operational amplifiers. Concurrent laboratory exercises in support of the topics covered in Electronics I and II. Prerequisite: EE 2303, EE 2446. Co-requisite: EE 3317.

Topics:

EE 3444 covers the analysis and design of analog bipolar junction transistor (BJT) and field-effect transistor (JFET and CMOS) amplifier circuits. The first part of the course includes a review of the small-signal models of bipolar devices (diodes, BJT's, and FET's), current sources and current mirrors, single-stage bipolar dc biasing methods, bias sensitivity and stability concepts, principles of small-signal ac amplifiers, a review of immittance and transfer functions, the use of small-signal BJT models in amplifier circuits, the frequency response characteristics of single-stage amplifiers, and the Miller effect and model. The second half of the course is concerned with multiple-stage cascade amplifier designs, cascode amplifier designs, differential amplifier analysis and design, and circuits used in operational amplifiers which include the dc bias and interstage coupling circuits as well as output stage designs. Additional topics include the analysis of feedback amplifiers, oscillators, and single amplifier active filters.

Prerequisite:

EE 2303, EE 2446.

Co-requisite:

EE 3317.

Textbooks:

1. H.T. Russell, Jr., *Analog BJT and FET Circuit Analysis and Design*, $OPAL_{tx}$, Fort Worth, TX, 2009.
2. A.R. Hambley, *Electronics, 2nd Ed.*, Prentice-Hall, Inc., Upper Saddle River, NJ, 2000.

Tools:

Scientific calculator.
Breadboard (mandatory).
Toolbox (mandatory) – containing an assortment of electronics tools consisting of needle nose pliers, diagonal cutters, tweezers, precision knife set, pocket screwdrivers.

Times and Location:

Lecture – Tuesday and Thursday, 9:30am to 10:50am, room 103, GACB.
Lab – TBD.

GTAs:

Lecture – TBD.
Lab – TBD.

Lecture Schedule				
Week/Date		**Tuesday**	**Thursday**	**Reading Assignment**
1	1-19	Semiconductor device models; diode model	Diode large and small-signal models	1. Chapter 1 – all
2	1-26	BJT large and small-signal models	MOS large and small-signal models	Class handout
3	2-2	Active current sources	Current mirrors	1. Chapter 2 – 2.1 2. Chapter 7
4	2-9	DC bias circuits for single stage BJT amplifiers	DC bias sensitivity functions	1. Chapter 3 – 3.1 to 3.2 2. Chapters 4 and 5
5	2-16	Examples of dc bias circuits	Small-signal amplifier principles; applications of small-signal models	1. Chapter 3 – 3.3 2. Chapters 4 and 5
6	2-23	Amplifier driving point and transfer functions	**Mid-Term Exam 1**	1. Chapter 3 – 3.3 2. Chapters 4 and 5
7	3-2	Low and mid-band frequency response characteristics	High-frequency response characteristics of single-stage amplifiers	1. Chapter 3 – 3.4 2. Chapter 8
8	3-9	The Miller effect; calculation of the dominant pole	Derivation of the Miller model and the unilateral (U) model of BJT and CMOS devices	1. Chapter 3 – 3.4 2. Chapter 8
9	3-16	**Spring Break**	**Spring Break**	
10	3-23	Multiple-stage transistor amplifier designs; cascade design; bandwidth shrinkage	Cascode analysis and design	1. Chapter 3 – 3.5 to 3.6
11	3-30	Voltage differential amplifiers (VDA)	Current differential amplifiers (CDA)	1. Chapter 4 – 4.1 to 4.3 2. Chapter 7
12	4-6	**Mid-Term Exam 2**	Op-amp designs; topology and stages	1. Chapter 5 – 5.1
13	4-13	Op-amp parameters	Op-amp testing and measurements	1. Chapter 5 – 5.1; Class handouts
14	4-20	Feedback amplifiers topologies; comparing and sampling	Feedback amplifier analysis – a two-port approach	2. Chapter 9; Class handouts
15	4-27	Feedback amplifier analysis	Oscillator circuits	2. Chapter 9
16	5-4	Active RC filters; positive feedback SAB	Active RC filters; negative feedback SAB	2. Chapter 11; Class handouts
17	5-11	**Final Exam**		

References:

1. P.R. Gray, P.J. Hurst, S.H. Lewis, and R.G. Meyer, *Analysis and Design of Analog Integrated Circuits, Fourth Edition*, John Wiley & Sons, Inc., New York, NY, 2001.
2. S. Franco, *Design with Operational Amplifiers and Analog Integrated Circuits, 3rd Ed.*, The McGraw-Hill Companies, Inc., New York, NY, 2001.
3. A.B. Grebene, *Bipolar and MOS Analog Integrated Circuit Design*, John Wiley and Sons, Inc., New York, NY, 1984.
4. M.S. Ghausi, *Principles of Linear Active Circuits*, McGraw-Hill Book Co., Inc., New York, NY, 1965.
5. J.M. Pettit and M.M. McWhorter, *Electronic Amplifier Circuits; Theory and Design*, McGraw-Hill Book Co., Inc., New York, NY, 1961.
6. P.E. Gray and C.L. Searle, *Electronic Principles; Physics, Models, and Circuits*, John Wiley and Sons, Inc., New York, NY, 1969.
7. P. Antognetti and G. Massobrio, *Semiconductor Device Modeling With SPICE, Second Edition*, McGraw-Hill Book Co., Inc., New York, NY, 1993.
8. *SPICE 2 User's Guide*, University of California Berkeley, Electronics Research Labs, Berkeley, CA.

General Class Information:

1. There are 31 class meetings scheduled for the 17 weeks of the Spring 2009 Semester. Twenty eight of these meetings are devoted to in-class lectures with three devoted to examinations – two mid-terms and one final. The week of March 15 is reserved for the University Spring Break. There will be no class or lab meeting during this week.
2. Mid-term examinations will be given on the 6th and 12th weeks, and will be one hour 20 minute written exercises.
3. The final examination will be given on Tuesday, May 12, 2009 and will be a comprehensive written examination. **NOTICE**: The UTA registrar has demanded a firm, unforgivable final date (**two** calendar days after the last final examination date) for the submission of course grades from all instructors. Because of this rigid schedule, the above date planned for the final examination (Tuesday, May 12, 2009) is fixed and will not be changed for any reason. Therefore, all students, without exception, **must** take the final examination at this time.
4. There will be absolutely no late or make-up mid-term examinations given unless a written request has been submitted to and approved by the instructor at least two weeks prior to the examination date. As a rule, make-up examinations are several orders of magnitude more difficult than examinations given on the scheduled dates. Please be advised that illness or any other absence on the examination date does not constitute a valid reason for a make-up examination.
5. There will be four to five homework assignments, usually given on two-week intervals. Each assignment requires about five to ten hours for completion. These assignments will be graded and will be included as part of your total course grade. Past experience has shown that students who spend the necessary time to work these assignments usually do quite well on the examinations.
6. The total grade for this course is based upon the homework (HW), lab (LA), two mid-term exams (MTE1 and MTE2), and the final exam (FE) grades. The total grade is computed from

   $$\text{Total grade} = 0.1*HW + 0.2*LA + 0.2*(MTE1 + MTE2) + 0.3*FE$$

7. In order to adhere to current privacy law requirements, class grades will not be posted. If you wish to receive your final examination paper and/or your class grade prior to their mailing by the registrar, please give me a large self-addressed and adequately stamped envelope prior to the final examination date so that I may mail your papers and grade to you.
8. Office hours are posted outside my office (NH526). If you have any questions and/or adverse difficulty with the lectures or class material, I strongly suggest that you call or e-mail me (during regular working hours, of course). If necessary, a scheduled office visit can be arranged.

Drop Policy:

Please refer to the University policy for dropping courses.

Americans With Disabilities Act:

The University of Texas at Arlington is on record as being committed to both the spirit and letter of federal equal opportunity legislation; reference Public Law 92-112 - The Rehabilitation Act of 1973 as amended. With the passage of federal legislation entitled *Americans with Disabilities Act (ADA)*, pursuant to section 504 of the Rehabilita-

tion Act, there is renewed focus on providing this population with the same opportunities enjoyed by all citizens. As a faculty member, I am required by law to provide "reasonable accommodations" to students with disabilities, so as not to discriminate on the basis of that disability. Student responsibility primarily rests with informing faculty of their need for accommodation and in providing authorized documentation through designated administrative channels. Information regarding specific diagnostic criteria and policies for obtaining academic accommodations can be found at www.uta.edu/disability. Also, you may visit the Office for Students with Disabilities in room 102 of University Hall or call them at (817) 272-3364.

Student Support Services Available:

The University of Texas at Arlington supports a variety of student success programs to help you connect with the University and achieve academic success. These programs include learning assistance, developmental education, advising and mentoring, admission and transition, and federally funded programs. Students requiring assistance academically, personally, or socially should contact the Office of Student Success Programs at 817-272-6107 for more information and appropriate referrals.

Final Review Week:

A period of five class days prior to the first day of final examinations in the long sessions shall be designated as Final Review Week. The purpose of this week is to allow students sufficient time to prepare for final examinations. During this week, there shall be no scheduled activities such as required field trips or performances; and no instructor shall assign any themes, research problems or exercises of similar scope that have a completion date during or following this week unless specified in the class syllabi. During Final Review Week, an instructor shall not give any examinations constituting 10% or more of the final grade, except makeup tests and laboratory examinations. In addition, no instructor shall give any portion of the final examination during Final Review Week. Classes are held as scheduled during this week and lectures and presentations may be given.

E-Culture Policy:

The University of Texas at Arlington has adopted the University email address as an official means of communication with students. Through the use of email, UT-Arlington is able to provide students with relevant and timely information, designed to facilitate student success. In particular, important information concerning registration, financial aid, payment of bills, and graduation may be sent to students through email. All students are assigned an email account and information about activating and using it is available at www.uta.edu/email. New students (first semester at UTA) are able to activate their email account 24 hours after registering for courses. There is no additional charge to students for using this account, and it remains active as long as a student is enrolled at UT-Arlington. Students are responsible for checking their email regularly.

Ethics:

Student Responsibility

Undergraduate and graduate students assume full responsibility for knowledge of all University rules, regulations and deadlines published in the Undergraduate and Graduate Catalogs and of all departmental and program requirements concerning their degree programs.

Academic Dishonesty

All students are expected to pursue their academic careers with honesty and integrity. Academic dishonesty includes, but is not limited to, cheating on a test or other coursework, plagiarism (offering the work of another as one's own) and unauthorized collaboration with another person. Students found responsible for dishonesty in their academic pursuits are subject to penalties that may range from disciplinary probation, suspension or expulsion from the University. In accordance with the Rules and Regulations of the Board of Regents of The University of Texas System (Part One, Chapter VI), institutional procedures regarding allegations of academic dishonesty are outlined in Part Two, Chapter 2, of the U.T. Arlington Handbook of Operating Procedures. This information may be obtained by accessing the Dean of Students' Web site at www.uta.edu/studentaffairs/dos or the Student Judicial Affairs' Web site at www.uta.edu/studentaffairs/judicial affairs. Copies of each regulation can be obtained in the Dean of Students' Office on the lower level of the University Center.

Definitions (UTA Handbook of Operating Procedures)

F. scholastic dishonesty, including, but not limited to, cheating on an examination or an assignment, plagiarism, and collusion;

1. *cheating on an examination or an assignment* includes:
   a. copying the work of another, engaging in written, oral or any other means of communication with another, or giving aid to or seeking aid from another when not permitted by the instructor;
   b. using material during an examination or when completing an assignment that is not authorized by the person giving the examination or making the work assignment;
   c. taking or attempting to take an examination for another, or allowing another to take or attempt to take an examination for a student;
   d. using, obtaining, or attempting to obtain by any means, the whole or any part of an un-administered examination or work assignment;
   e. any act designed to give unfair advantage to a student or the attempt to commit such an act;
2. *plagiarism* means the unacknowledged incorporation of the work of another in work that is offered for credit;
3. *collusion* means the unauthorized collaboration with another in preparing work that is offered for credit.

The following is an excerpt from the College of Engineering's statement on Ethics, Professionalism, and Conduct of Engineering Students. Read the statement carefully, sign it, and return it to your instructor. You may make a copy for your records. Additional copies of this statement can be obtained from your instructor or the Office of the Dean of Engineering.

STATEMENT ON ETHICS, PROFESSIONALISM, AND CONDUCT FOR ENGINEERING STUDENTS

COLLEGE OF ENGINEERING
THE UNIVERSITY OF TEXAS AT ARLINGTON

The College cannot and will not tolerate any form of academic dishonesty by its students. This includes, but is not limited to cheating on examination, plagiarism, or collusion.

Cheating on an examination includes:

1. Copying from another's paper, any means of communication with another during examination, giving aid to or receiving aid from another during examination;
2. Using any material during examination that is unauthorized by the proctor;
3. Taking or attempting to take an examination for another student or allowing another student to take or attempt to take an examination for oneself.
4. Using, obtaining, or attempting to obtain by any means the whole or any part of an un-administered examination.

Plagiarism is the unacknowledged incorporation of another's work into work which the student offers for credit.

Collusion is the unauthorized collaboration of another in preparing work that a student offers for credit.

I have read and I understand the above statement.

In addition, I understand that, in order to ensure fairness to all students, exams will be proctored and possibly videotaped.

Course and section number: ____EE 3444-001_____

Date: _____

Student's signature: _____

Student's name, printed: _____

Student's ID number: _____

Student's e-mail address: _____
(please print clearly)