EEE 102 Analog/Digital Electronics

Service Course

2004 – 2006 Catalog Data: EEE 102. Analog/Digital Electronics. Introduction to analog/digital electronics, diodes, FET's, BJT's, DC biasing, VI characteristics, single-stage amplifiers, power supplies and voltage regulators, power electronic devices, OP-amps, active filters, A/D and D/A converters. PSPICE used extensively. **Note:** Cannot be taken for credit by E&EE Majors. **Prerequisite:** ENGR 017. **Corequisite:** EEE 102L. 3 units.

Text: Jaeger, R.C., Microelectronic Circuit Design, 2nd Edition, McGraw-Hill, 1997, ISBN 0-07-232099-0

Support Software: Herniter, M.E., Schematic Capture with Cadence PSpice, Prentice-Hall, 2nd Edition, 2003, ISBN 0-13-048400-8

Course Goals:

1. To build upon the mathematical and engineering analysis background provided by the prerequisite course, and provide the student with fundamental engineering knowledge about analog and digital electronic circuit design and analysis.
2. To provide the student with the capability to use LabVIEW and PSpice software as tools in electronic circuit analysis and design, and in future courses, design projects, and professional work assignments.

Prerequisites by Topic:

1. General knowledge of a structured programming language (i.e. C++).
2. Basic physical concepts of electricity and magnetism.
3. Basic circuit analysis concepts and procedures.

Topics Covered/Course Outline/Evaluation:

Topics

1. Introduction to Electronics: The Focus of the Course; Analog-to-Digital and Digital-Analog-Conversion; Digital Sampling and Aliasing Principles; Review of Circuit Theory Concepts including Thevenin/Norton Equivalent Circuits and Sinusoidal Steady-state Analysis; Frequency Spectrum of Electronic Signals; Amplifiers/Filters
2. Introduction to Digital Electronics: Ideal/Real Logic Gates; Logic Level Definitions and Noise Margins; Analysis of the Dynamic Response of Logic Gates; Power-Delay Product
3. Solid State Diodes and Diode Circuits: The pn Junction Diode; The i-v Characteristics of the Diode; The Diode Equation; Diode Characteristics Under Reverse, Zero, and Forward Bias; Diode Temperature Coefficient; Diode Breakdown Under Reverse Bias; pn Junction Capacitance; Diode Circuit Analysis; Multiple Diode Circuits; Diodes Operating in the "Breakdown" Region; Half-Wave & Full-Wave Rectification and Power Supply Design; Wave Shaping Circuits; Dynamic Switching Behavior of Diodes
4. Field Effect Transistors: Characteristics and Structure of MOS Devices; Operating Regions and Characteristics of NMOS and PMOS Devices; Body Effect; Biasing MOSFETs; MOSFET Capacitance.
5. Bipolar Junction Transistors: Physical Structure of the BJT; The Transport Model; NPN and PNP Transistors; Operating Regions and Characteristics of the BJT; Forward-Active Region Analysis and Design; The Early Effect; Biasing BJT Circuits; BJT Current Mirrors
6. Small-Signal Modeling and Linear Amplification: The Transistor as an Amplifier; BJT and FET Amplifier Characteristics; Coupling and Bypass Capacitors; Circuit Analysis Using dc and ac Equivalent Circuits; Small-Signal Models for the BJT; The BJT Common-Emitter Amplifier
7. Operational Amplifiers: The Differential Amplifier; Ideal Operational Amplifiers (Op-Amps); Non-ideal Op-Amps; Frequency Response; Input/Output Impedance; Instrumentation Amplifiers; Common Mode Signal Analysis; Active Filters; Non-linear Circuit Applications
8. Analog Integrated Circuits: Digital-to-Analog Converter Circuits; Analog-to-Digital Converter Circuits

Course Outline

Week	*Topic*	*Text Chapter*	*Homework (H) or Exam (E)*
1	Introduction to Electronics	1	
2	Electronics Fundamentals	1	
3	Introduction to Digital Electronics	6.1 – 6.3	H
4	Diode Characteristics	3	
5	Simple Diode Circuit Analysis	3	H
6	Diode Circuit Applications	3	
7	Field Effect Transistor Characteristics	4	E
8	FET Circuit Analysis	4	
9	FET Bias Circuit Analysis and Design	4	H
10	Bipolar Junction Transistor Characteristics	5	
11	BJT Bias Circuits Analysis and Design	5	H
12	Small-Signal Modeling and Linear Amps	13.1 – 13.5	
13	C-E Amplifiers	13.6	E
14	Operational Amplifier Basics	11.1 – 11.2	H
15	Linear Op-Amp Circuits; A/D&D/A	11.3 – 11.4	
Exam Week	Final Exam		E

Note: This course includes applications of PSpice and LabVIEW software for both analysis and design.

Evaluation

Three examinations (including the "Final") -- 200 pts.
(Note: Examinations will be "open book" problems similar to examples done in class and homework assignments. The first two "midterms" will count 60 points each; the "final" will count 80 points. Exams will cover material in each outline "block".
Graded homework assignments -- 100 pts.
(Note: Specific due dates for homework will be specified. No late homework will be accepted.)

Science and Design Content Distribution

Science – 2 units or 67%; Design – 1 unit or 33%

Contribution of Course to the Professional Education Component:

1. Homework assignments include practical electronic circuit design and analysis problems with realistic source and load constraints.
2. LabVIEW and PSpice analysis and design applications introduce students to major professional engineering software tools.

Relationship of Course to Program Outcomes:

1. #4 Knowledge of Engineering core: This course adds electronic circuit analysis and design applications to fundamental concepts of circuit analysis, and computer programming.
2. #7 Use of contemporary tools for analysis and design: This course applies computer methods using PSpice and LabVIEW software tools to electronic circuit analysis and design.

Course Coordinator: John Oldenburg, EEE

Date: January 19, 2005

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