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ECE Advancement Exam Guidelines
for
EE 151 Circuits I, EE 153 Circuits II, EE 121 Introduction to Electronic Devices, and CpE 111 Introduction to Computer Engineering.

Missouri University of Science and Technology
Version 2011

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Introduction

The required sophomore-level courses and their associated Advancement Examinations in the EE and CpE curricula are

- EE 151 Circuits I and EEAE I
- EE 153 Circuits II and EEAE II
- EE 121 Introduction to Electronic Devices and EEAE III
- CpE 111 Introduction to Computer Engineering and CpEAE

These courses lay the basis for the material presented in subsequent courses. As such they have common finals which serve as separate degree Advancement Examination requirements. Also, the common finals/Advancement Examinations provide measures for the department ABET accreditation process and serve as placement examinations for transfer students. The department chair appoints coordinators which are responsible for the content, format, and retake policy for these common finals/Advancement Examinations. The intent of the appointments is to maintain reasonable consistency as the department meets these functions from semester to semester.

The current coordinators are:

EE 151, EE 153, and EE 121: Steve E. Watkins, Associate Chair for EE UG Studies
CpE 111: R. Joe Stanley, Associate Chair for CpE UG Studies

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2.0 Advancement Exams

Excerpts from the course descriptions used in the 2008 ABET Report of the ECE Department are shown. The catalog description and prerequisites have not changed for the current Missouri S&T Catalog.

2.1 EEAE-I Advancement Exam (Final) for EE 151 Circuits I

Course Catalog Description:
[Lec. 3.0] Circuit elements, signals, Kirchhoff's laws, network transforms, mesh and node analysis, transient and complete response of RL, RC, and RLC circuits. Prerequisites: Math 15 Calculus II with a Grade of "C" or better.

Prerequisites by topic: Differential and integral calculus

Textbooks and other required material: D. R. Cunningham and J. A. Stuller, *Circuit Analysis,* 2nd ed. (John Wiley & Sons, NJ 1995) Chapters 1, 2, 3, 4, 5, 7, 8, and 9.

Topics covered:
1. Units, Charge, Current, Voltage, Work, and Power
2. Kirchhoff's Current and Voltage Laws and Types of Sources
3. Resistance, Capacitance, and Inductance
4. Parallel and Series Circuits, Current Dividers, and Voltage Dividers
5. Review of Simultaneous Equations
6. Network Analysis by Node Voltages and Mesh Currents
7. Linearity, Superposition, Thevenin's Theorem, and Norton's Theorem
8. Signals, Average Values, and RMS Values
9. First-Order Circuits
10. Second-Order Circuits
11. Reviews, Examinations, and Final Examination

EEAE-I Content Guidelines

EE 151 Format: Student work eight of ten problems for a two-hour examination
EE 151 Content Emphasis:
General Concepts, Power Balance, Parallel and Series Equivalents, etc. (1 problem)
Node and/or Mesh Analysis (2 problems)
Thevenin and Norton Circuits, Maximum Power Transfer, and/or Source Transformations (2 problems)
Superposition (1 problem)
Signal Models, Power, Average and Effective (RMS) Values, etc. (1 problem)
Transient Analysis for Source-Free RC and/or Source-Free RL Circuits (1 problem)
Transient Analysis for Driven RC and/or Driven RL Circuits (1 problem)
Transient Analysis for Driven RLC Circuits (1 problem)

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2.2 EEAE-II Advancement Exam (Final) for EE 153 Circuits II

Course Catalog Description:

[Lec. 3.0] Analysis of steady-state AC circuits, phasor notation, polyphase circuits, complex frequency and frequency response, magnetically-coupled circuits.
Prerequisites: Both Math 22 Calculus III and El Eng 151 Circuits I with a grade of "C" or better. Passing grade on EE Advancement Exam I

Prerequisites by topic: Differential and integral calculus, basic circuit analysis and transient circuit analysis

Textbooks and other required material: D. R. Cunningham and J. A. Stuller, *Circuit Analysis,* 2nd ed. (John Wiley & Sons, NJ 1995) Chapters 10, 11, 12, 13, 17, and 18.

Topics covered:

1. Classical solution of circuit equations with differential equations
2. Complex numbers and phasor representation
3. AC Circuit Analysis
4. Single Phase Power
5. Frequency response
6. Mutual Inductance and Transformers
7. Three Phase Power
8. Reviews, Examinations, and Final Examination

EEAE-II Content Guidelines

EE 153 Format: Student work eight of ten problems for a two-hour examination
EE 153 Content Emphasis:
Transfer Functions in jω and/or s-Domain Circuits (2 problems)
Node and/or Mesh Analysis (1 problem)
Thevenin and Norton Circuits, Maximum Power Transfer, and/or Source Transformations (1 problem)
Superposition (1 problem)
Complex Power and/or Power Factor Correction (2 problems)
Mutual Inductance Circuits (1 problem)
Ideal Transformer Circuits (1 problem)
Three-Phase Circuits (1 problem)

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2.3 EEAE-III Advancement Exam (Final) for EE 121 Introduction to Electronic Devices

Course Catalog Description:

[Lec. 3.0] Materials and device structures for applications in analog and digital electronics. Topics include characteristics and basic circuits for diode, FET transistors, BJT transistors, and operational amplifiers. Prerequisites: Physics 24, El Eng 151 Circuits I, and El Eng Circuit Analysis Laboratory I with a Grade of "C" or better.

Prerequisites by topic: Physics basics in matter and energy and basic circuit analysis

Textbooks and other required material: Department Notes

Topics covered:

1. Electrical safety, expectations for written laboratory notebooks and technical memorandum reports
2. Electronic materials and crystal physics
3. Carriers and doping in semiconductors
4. Drift and diffusion currents in semiconductors
5. Diode characteristics and diode circuits
6. Field effect transistor characteristics and biasing circuits
7. Bipolar junction transistor characteristics and biasing circuits
8. Analog and digital applications of transistors
9. Operational Amplifiers and Basic Circuit Configurations
10. Laser diodes and photodiodes
11. Device Fabrication
12. Reviews, Examinations, and Final Examination

EEAE-III Content Guidelines

EE 121 Format: Student work eight of ten problems for a two-hour examination
EE 121 Content Emphasis:
Semiconductor Crystal and Junction Physics (2 problems)
Diode Circuits (1 problem)
Bipolar Junction Transistors (2 problems)
Field Effect Transistors (2 problems)
OpAmp Circuits (2 problems)
Optoelectronics (1 problem)

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2.4 CpEAE Advancement Exam (Final) for CpE 111 Introduction to Computer Engineering

Course Catalog Description:
[Lec. 3.0] Binary arithmetic, Boolean algebra, logic and memory elements, computer organization. Prerequisites: Sophomore Standing

Prerequisites by topic: None

Textbooks and other required material: Donal D. Givone, Digital Principles and Design, McGraw-Hill, 2003.

Topics covered:

1. Introduction to concepts in digital systems
2. Boolean algebra and logic gates
3. Combinational logic design
4. Digital hardware
5. CMOS logic circuits (selected topics)
6. Logic components
7. Memory elements and arrays
8. Sequential logic networks
9. Computer organization
10. First Concepts in VHDL (optional)

CpEAE Content Guidelines

EE 121 Format: Student work eight of ten problems for a two-hour examination

EE 121 Content Emphasis:

Number base conversions (decimal, binary, hexadecimal)

Complement-based number representation and arithmetic (addition, subtraction, Multiplication, division)

Hardware components (multiplexers, demultiplexers, adders, comparators, decoders, encoders, processor components and design)

Logic expression representation (basic logic gates, truth tables, complete logic sets, structured logic, different hardware components, drawing logic circuits)

Logic expression manipulation (complete logic sets, simplification, Karnaugh maps)

Memory elements (latches, flip-flops, timing diagrams, flip-flop transformation)

State machine design and implementation (Mealy machines, Moore machines) (state table, state transition diagram, circuit implementation)

CMOS circuit design (nFET and pFET transistor and switch models)