MESABI RANGE COMMUNITY & TECHNICAL COLLEGE – VIRGINIA/EVELETH

Course Outline

Course Title:	**Circuit Analysis and Lab**	**Submitted By:**	**M. Threapleton**
Semester Course Prefix and Number:	**ENGR 2461**	**Approval Date:**	**April 2002**
Old Quarter Course Prefix and Number:	**PHYS 230 and 630**	**Revision Date:**	**April 2002**

Number of Credits: **4**	**Number of Lecture Credits:**	**3**	
Semester(s) Offered:	**Number of Lab Credits:**	**1**	**Number of Lab Hours:** **2**
Negotiated Class Size:	**Number of Studio/Demonstration/Internship Credits:**		

Course Purpose Code:

_____ **0 –** Developmental Courses
_____ **1 –** Non-transferable, General Education
_____ **2 –** Technical course related to career programs
_____ **3 –** College course which has the primary goal of applying certain concepts (e.g. vocal ensemble)
__X__ **4 -** Other college course not considered a part of general education (MNTC) e.g. computer science, health, physical education
_____ **5 –** Course which is intended to fulfill the Minnesota Transfer Curriculum (MNTC) requirements.
_____ **9 –** Continuing Education/Customized Training specialized credit course (not occurring in 0-5)

Catalog Description:
This is the first course in electrical circuits for all engineering majors. Electrical engineering fundamentals are introduced and applied to basic circuit analysis, resistive circuits, independent and dependent current and voltage sources, operational amplifiers, phasors, network theorems, RL,RC, RLC circuits, natural and forced responses.

Prerequisites and/or recommended entry skills/knowledge:

Course Prerequisite(s):	PHYS 1572 and 1582 Engineering physics II and lab
Reading Prerequisite:	None
Composition Prerequisite:	None
Mathematics Prerequisite:	Co-requisite MATH 2564 Differential Equations and Linear Algebra or instructors consent.

Career Programs and Transfer Majors Accessing this Course:
Engineering majors

Minnesota Transfer Curriculum Goal(s) partially met by this course if applicable: Notes: No more than two goals may be met by any one course. (Curriculum Committee review and the Chief Academic Officer's approval are required).

0. **X** None
6. _____ The Humanities and Fine Arts

1. _____ Communications
2. _____ Critical Thinking
3. _____ Natural Sciences
4. _____ Mathematical/Logical Reasoning
5. _____ History and the Social and Behavioral Sciences
7. _____ Human Diversity
8. _____ Global Perspectives
9. _____ Ethical and Civic Responsibility
10. _____ People and the Environment

Learning outcomes, including any relevant competencies listed in the Minnesota Transfer Curriculum:

The student will

1. show proficiency in analyzing DC circuits
2. identify all circuit elements
3. apply Kirchoff's laws
4. use node voltages in circuit analysis
5. use mesh currents in circuit analysis
6. perform source transformations
7. analyze op-amps
8. analyze RC, RL, and RLC circuits
9. analyze AC circuits including applications of phasors
10. perform average, reactive and complex power calculations in AC circuits
11. demonstrate proper use of laboratory equipment
12. prepare professional lab reports
13. investigate, through simulations, the major analysis results from the lecture sessions
14. investigate, through hands-on-training in a laboratory setting, the major analysis results from the lecture sessions
15. design and perform experimental investigations in teams

Student assessment methods:

Several problem-based one hour exams; graded lab reports; design project

Use of instructional technology (includes software, interactive video and other instructional technologies):

PSpice circuit modeling software; use of Excel, Mathcad, Mathematica for problem solutions

Outline of the major course content:

1. Circuit elements
   - 1.1. Voltage and current sources
   - 1.2. Electrical resistance and Ohm's law
   - 1.3. Construction of a circuit model
   - 1.4. Kirchoff's laws
   - 1.5. Analysis of circuits containing dependent sources
2. Simple Resistive Circuits
   - 2.1. Resistors in series and parallel
   - 2.2. Voltage-divider and current-divider circuits
   - 2.3. d'Arsonval meter movement
   - 2.4. ammeter circuit
   - 2.5. voltmeter circuit
   - 2.6. ohmmeter circuit
   - 2.7. Wheatstone bridge
   - 2.8. Delta-to-Wye and Pi-to-Tee equivalent circuits
3. Techniques of Circuit Analysis
   - 3.1. Terminology
   - 3.2. Introduction to node-voltage method
   - 3.3. Node-voltage method and dependent sources
   - 3.4. Introduction to mesh currents
   - 3.5. Mesh-current method and dependent sources

3.6. Source transformations
3.7. Thevenin and Norton equivalents
3.8. Superposition

4. The Operational Amplifier
   4.1. Operational-amplifier terminals
   4.2. Terminal voltages and currents
   4.3. The inverting-amplifier circuit
   4.4. The summing-amplifier circuit
   4.5. The noninverting-amplifier circuit
   4.6. The difference-amplifier circuit
   4.7. An equivalent circuit for the opamp
   4.8. The differential mode
   4.9. The common-mode rejection ratio
5. Inductance and Capacitance
   5.1. Inductors and capacitors
   5.2. Series and parallel combinations of L and C
   5.3. Mutual inductance and dot convention
   5.4. Natural response of RL and RC circuits
   5.5. Sequential switching
   5.6. Unbounded response
   5.7. Step response of RL and RC circuits
   5.8. The integrating amplifier
6. Natural and Step Responses of RLC Circuits
   6.1. Natural responses of a parallel RLC circuit
   6.2. Step response of a parallel RLC circuit
   6.3. Step response of a series RLC circuit
   6.4. A circuit with two integrating amplifiers
7. Sinusoidal Steady-State Analysis
   7.1. Sinusoidal source and response
   7.2. Phasors
   7.3. Passive circuit elements in the frequency domain
   7.4. Kirchoff's laws in the frequency domain
   7.5. Series, parallel and Delta-to-Wye Simplifications
   7.6. Source transformations and Norton/Thevenin equivalents
   7.7. Node-voltage and mesh-current methods
   7.8. Transformers and ideal transformers
8. Sinusoidal Steady-State Power Calculations
   8.1. Instantaneous, average, and reactive power
   8.2. rms values and power calculations
   8.3. Complex power
   8.4. Maximum power transfer

Additional special information (special fees, directives on hazardous materials, etc.)

Transfer Information: (Please list colleges/majors that accept this course in transfer.)
UM, UMD, MSU Mankato, St. Cloud State, Michigan Tech, NDSU, UND.

Approvals:

Body	Representative Signatures	Date
Curriculum Committee	Kim Giermann	
Faculty Association	Georgia Suoja	
	Dr. Jill Peterson	

Meet and Confer		
Chief Academic Officer	Dr. Jill Peterson	

Distribution: Original – Administrative Office, Library, Learning Center, Records, Student Services, Curriculum Committee Chair