Appendix I
Section B. Course Syllabi

Department of Physics ABET Course Syllabi were formatted to conform to the Engineering Physics ABET Program Outcomes.

The Electrical Engineering ABET Course Syllabi were formatted to conform to the EE ABET Program Outcomes.

The Mechanical Engineering ABET Course Syllabi were formatted to conform to the ME ABET Program Outcomes.

The Program Outcomes ***(a)*** thru ***(k)*** are the same for the EP, EE, and ME programs. However, the Educational Objectives for the three programs differ slightly.

Other Course Syllabi are not formatted to the ABET format as they do not measure any of the EP Program Outcomes.

EE 111 Introduction to Electrical and Computer Engineering (DC Circuits)

Required? Yes

Description: Electric component descriptions and equations. Kirchoff's voltage and current laws, formulation and solution of DC network equations.

Corequisites: Math 191

Textbook and other Required Materials:

Engineering Circuit Analysis, W.H. Hayt, J.E. Kemmerly, S.M. Durbin, 6th edition, McGraw Hill, 2002. Web link www.mhhe.com/hayt6e This will give access to chapter outlines, overviews, tutorials, and virtual professor.

The laboratory will require a bread board, 2 protoboards, a Digital Multimeter, and possibly some additional electronic components depending on the project selected. A small screwdriver, wirestrippers, and pliers may be purchased separately if desired. The protoboards, and breadboard can be purchased from the EE office (T&B 106).

Objectives: The objectives of this class are as follows:

1. To use Ohm's Law, Kirchoff's voltage and current laws to analyze circuits.
2. To solve basic circuit problems using nodal and mesh analysis, superposition, and equivalent circuits (using circuit reductions, source transforms and Thevenin equivalence techniques).
3. To apply the basic tools used in electrical engineering, and show how to use these tools consisting of O-scopes, multi-meters, power supplies, function generators, breadboards, soldering irons, and electronic components to make measurements of voltage, current, resistance, and frequency
4. To use Op Amps in a circuit and be able to analyze the circuit using the ideal Op Amp model.
5. To expose students to the code of engineering ethics.
6. To offer the student an opportunity to display his/her competency in both course work, laboratory procedures and problem solving skills by doing in-lab demonstrations and presentations.

Topics: The topics covered in this class are:

- DC Power, Kirchoffs laws, Ohm's law
- Equivalent resistance (series, parallel and delta-wye combinations)
- Voltage and current division
- Nodal and mesh analysis
- Superposition, source transforms, Thevenin and Norton equivalent circuits
- Ideal Op Amps and introduction to capacitors and inductors

Meetings: Monday, Wednesday and Friday 9:30 -10:20 AM, T&B 104

Labs: Register for one Lab section. Labs are held in T&B 102. Labs will begin the week of January 23rd. Laboratory class (150 minutes/week) is required

Sec. 01A	10:20 AM – 12:50 PM	Tuesday
Sec. 01C	1:10 PM - 3:40 PM	Thursday

Contribution to the Professional Component

This course contributes four semester hours of engineering topics.

This course lays the foundation for the electrical engineering curriculum. In this class, students will experience applications of concepts learned in the classroom. They will learn through hands on experience how to build circuits, analyze them, and do basic design. These basic concepts lay the groundwork for more advanced circuit and system analysis techniques that they will explore in later classes and use in their workplace. The basic design problems encountered here help pave the way toward their ultimate design class – the capstone course. By forming teams in the lab, students begin their preparation to work in inter-disciplinary teams

Relationship of Course to Program Outcomes

Course Objective	*Program Outcome*										
	I a	II a	II c	III a	III b	III c	III d	III e	III f	III g	III k
1	x	x	x	x	x			x			
2	x	x	x		x	x		x			
3	x	x		x							x
4	x	x		x		x					
5									x		
6							x			x	

Relevant Program Outcomes

I a. Critical Thinking skills to solve problems in EE
II a. Knowledge of breadth and depth across the range of EE topics.
II c. Knowledge of math through derivatives and integrals.
III a. Ability to apply knowledge of mathematics, science and engineering
III b. Design and conducts experiments, analysis and interpretation of data.
III c. Ability to design a system to meet desired needs.
III d. Ability to function on multidisciplinary teams.
III e. Ability to identify, formulate and solve engineering problems.
III f. Understand professional and ethical responsibility
III g. Ability to communicate effectively
III k. Ability to use the techniques, skills and modern engineering tools necessary to engineering practice.

EE 161 Computer-Aided Problem Solving

Required? Yes

Description: Evolution and application of computers, social and economic implications, introduction to programming using engineering workstations. Extensive practice in writing programs to solve engineering problems. Computer interfaces to real-world systems.

Corequisite: MATH 191

Text: Jeri R. Hanly and Elliot B. Koffman, *Problem Solving and Program Design in C*, 4th ed., Addison-Wesley, 2003

Website: A class web site, consisting of homework assignments, quizzes, laboratory handouts, current grades, the course syllabus, and other helpful handouts, exists at WebCT at http://salsa.nmsu.edu/

Objectives: The objectives of this class are as follows:

1. Understanding ethical and fair computer use
2. Understanding and interpreting problem statements
3. Designing an algorithm to solve a problem
4. Writing a program in C to implement an algorithm
5. Documenting a program with comments
6. Debugging a C program
7. Working and learning in teams
8. Reading from and writing to files
9. Writing if and switch statements
10. Writing for loops
11. Writing while and do while loops
12. Writing and passing arguments to functions
13. Performing operations with 1D and 2D arrays
14. Performing operations with strings

Topics: The topics covered in this class are:

- Overview of Computers
- Overview of the C Programming Language
- Writing Programs with Functions
- Conditions: If and Switch Statements
- Repetition and Loop Statements
- 1-D and 2-D Arrays and Array Processing
- Strings and String Processing

Meetings: Monday, Wednesday, Friday, 12:30 p.m. to 1:20 p.m., T&B 104

Labs: Register for one meeting per week (T&B 202):
Monday, 2:30 p.m. to 5:00 p.m.
Tuesday, 1:10 p.m. to 3:40 p.m.

Contribution to the Professional Component

This course contributes three semester hours of engineering topics and one semester hour of engineering design.

This course helps lay the foundation for the undergraduate electrical engineering curriculum. Working in teams, students learn how to read and interpret problem statements and develop structured software necessary to solve these problems.

Relationship of Course to Program Outcomes

Course Objective	***Program Outcomes***					
	I a	II b	II d	III a	III e	III f
1						X

2	X			X	X	
3	X	X	X	X	X	
4		X	X		X	
5		X				X
6	X	X			X	
7						X
8		X	X			
9		X	X			
10		X	X			
11		X	X			
12		X	X			
13		X	X			
14		X	X			

Relevant Program Outcomes

I a. Apply critical thinking skills to solve engineering problems.
I.b. Apply computers to assist in solving engineering problems.
II d. Knowledge of basic science, including computer science.
III a. Ability to apply knowledge of mathematics, science and engineering.
III e. Ability to identify, formulate and solve engineering problems.
III f. Understanding of professional and ethical responsibilities.

EE 201 Networks I
COURSE SYLLABUS for Spring 2006
The Klipsch School of Electrical and Computer Engineering
College of Engineering
New Mexico State University
Co-requisites: Math 192 Calculus and Analytical Geometry II

Classes:	Tuesdays and Thursdays, 11:45 AM - 1:00 PM, T&B 104
Instructor:	Ram Prasad
Office:	Thomas and Brown, Rm. 222
Office Hours:	Mondays & Wednesdays 10:00 AM - 11:30 AM
Phone:	646-3623
Email:	rprasad@nmsu.edu; ramprasad@msn.com;

EE 201 Instruction begins	Thursday	January 19
Late registration	Tuesday	January 24
Deadline for registration/course addition	Friday	January 27
Deadline for filing degree application (students meeting requirements at end of spring)	Friday	January 27
Last day to drop with "W"	Thursday	March 16
Spring break	Monday-Friday	March 20-24
Spring holiday	Friday	April 14
Last day to withdraw from University	Monday	April 24
EXAM WEEK	Monday-Friday	May 8-12
Last day of classes	Friday	May 12

Textbook: *Fundamentals of Electric Analysis*, Clayton Paul.

Course Objectives:

Provide non-EE majors the fundamental knowledge and skills needed to solve DC and AC electrical circuits with R L C components. Students will understand how electric networks perform, what their performance measures are, and how to calculate the performance characteristics. Students will understand how to develop electrical analogs of mechanical, chemical, and other processes and systems. The course also provides the knowledge and skills required of non-EE majors in order to pass the electrical circuits portion of the engineers in training (EIT) exam.

Grading Policy:

Exams - 80%; *Homework* - 20%

Tentative Exam Dates (See Chapter topics for details)

- Mid - February: Exam #1 on chapter 1; (20%)
- Mid-March: Exam #2 on chapters 2-3; (20%)
- Mid-April: Exam #3 on chapters 4-5; (20%)
- May: Final cumulative exam emphasizing chapters 6-7; (20%)

Policies:

Homework

Homework will be assigned in each class. Homework is due the next class from the time it is assigned except when there is an exam. Homework should be turned in at the beginning of class. Homework will cover the topics discussed in lectures and in the readings. Late homework will not be accepted. If you need to miss a class, please see me in advance so that homework will not be missed. **Homework must be stapled together. Please do neat work, show all work, and box your final answers.**

Exams:

There are four exams including the final. Exams will cover the material given in lectures, the text, and homework. **All exams are closed book and closed notes**. Students missing exams must present a valid excuse in order to make up an exam.

Material Covered in Course:

Chapter 1 – Basic Definitions and Laws
Chapter 2 – Basic Circuit Elements and Analysis Techniques
Chapter 3 – Additional Circuit Analysis Techniques
Chapter 4 – The Operational Amplifier
Chapter 5 – Energy Storage Elements
Chapter 6 - Sinusoidal Excitation of Circuits
Chapter 7 – The General Time-Domain Response of Circuits

EE 211 AC CIRCUITS

Required? Yes

Description: Complete solutions of RLC and switching networks. Sinusoidal steady-state analysis. Three-phase analysis. Mutual coupling. Frequency selective networks.

Corequisites: C or better in EE 111 and Math 192 (Calculus II)

TEXTBOOKS and other REQUIRED MATERIALS

Electric Circuits Introduction to Electrical and Computer Engineering, by JamesW. Nilsson and Susan Riedel, Pearson Custom Publishing, 2002.
Engineering Circuit Analysis, W.H. Hayt, J.E. Kemmerly, S.M. Durbin, 6th edition, McGraw Hill, 2002. Web link www.mhhe.com/hayt6e This will give access to chapter outlines, overviews, tutorials, and virtual professor.

Additional References:
D. Zwillinger, *CRC Standard Mathematical Tables and Formulae*, CRC Press.
M. Navhi and J. A. Edminister, *Schaum's Outline of Theory and Problems of Electric Circuits*, 4th ed., New York; McGraw-Hill, 2003.
M. R. Spiegel, *Schaum's Outline of Theory and Problems of Complex Variables*, New York; McGraw-Hill, 1964.
Laboratory Kit: An EE 211 LABKIT is required which can be purchased from the Klipsch School

Objectives: The objectives of this class are as follows:

1. To use circuit analysis concepts (learned in EE 111) to analyze new types of networks involving switched, DC and steady-state AC circuits.
2. To reinforce mathematical skills in differential equations, vector/phasor analysis, derivative and integral calculus, matrices, and algebra.
3. To apply the basic tools and circuit elements used in electrical engineering, the proper and responsible use of oscilloscopes, digital multimeters, power supplies, function generators, and other electronic testing equipment.
4. To use circuit/problem solving software such as Top Spice, MathCAD, and/or Matlab.
5. To develop competency in the application, analysis and design of ac and dc circuits, and have exposure to basic transfer functions, and variable frequency networks.
6. To offer the student an opportunity to display his/her competency in both course work, laboratory procedures and problem solving skills by doing in-lab demonstrations and presentations.

Topics: The topics covered in this class are:

• Inductance, Capacitance, and Mutual Inductance	Chapter 6	Chapter 7 &13
• Response of First-Order RL and RC Circuits	Chapter 7	Chapter 8
• Natural and Step Responses of RLC Circuits	Chapter 8	Chapter 9
• Sinusoidal Steady-State Analysis	Chapter 9	Chapter 10
• Sinusoidal Steady-State Power Calculations	Chapter 10	Chapter 11
• Introduction to the Laplace Transform	Chapter 12	Chapter 14

Meetings: Monday, Wednesday and Friday 8:30 -9:20 AM, T&B 104

Labs: Register for one Lab section. Labs are held in T&B 102. Labs will begin the week of January 23. Laboratory class (150 minutes/week) is required

Sec. 01A	1:10 PM – 3:40 PM	Tuesday
Sec. 01B	2:30 PM – 5:00 PM	Wednesday

Contribution to the Professional Component

This course contributes four semester hours of engineering topics.
This course reinforces the critical network analysis skills learned in EE 111 with applications to new types of networks. The student learns via the text, class work, handouts, and hands on experience, the theory behind transient networks, single-phase networks, transformers**, Laplace** transforms and variable frequency

networks. This course consists of four (4) credits; three (3) credits of engineering topics and one (1) credit of laboratory.

Relationship of Course to Program Outcomes

Course Objective	*Program Outcome*											
	I a	I b	II a	II c	II d	II e	III a	III b	III c	III d	III e	III g	III k
1	x		x	x			x				x		
2	x		x	x		x	x				x		
3	x		x					x		x			x
4	x	x	x							x	x		x
5	x		x	x	x		x		x				
6	x	x						x		x	x	x	

Relevant Program Outcomes

I a. Critical Thinking skills to solve problems in EE
I b. Apply computers to assist in solving EE problems.
II a. Knowledge of breadth and depth across the range of EE topics
II c. Knowledge of math through derivatives and integrals
II d. Knowledge of basic science
II e. Knowledge of advanced math, differential equations, and vector calculus
III a. Ability to apply knowledge of mathematics, science and engineering
III b. Design and conducts experiments, analysis and interpretation of data.
III c. Ability to design a system to meet desired needs.
III d. Ability to function on multidisciplinary teams.
III e. Ability to identify, formulate and solve engineering problems.
III g. Ability to communicate effectively
III k. Ability to use the techniques, skills and modern engineering tools necessary to engineering practice.

Klipsch School of Electrical and Computer Engineering
College of Engineering
New Mexico State University

EE 302: Random Variable and Signal Analysis, 3.0 Credits
Spring 2006

Class Schedule: MWF 9:30-10:20PM
Class Location: Thomas & Brown, Rm 204
Office hours: M 2:20-3:30, Th 3-4; by appointment (recommended)
Course Description:
The application of probability, random variables and random processes to problems in electrical engineering. Topics include modeling random experiments, discrete probability, random variables, probability density functions, functions of a random variable, computing mean, variance, moments and characteristic functions, joint random variables, confidence intervals, and related topics. Applications to be covered include probabilistic modeling of electrical/electronic systems in general and, in particular, the analysis of simple communications systems.

Prerequisites: EE211
Textbook:
R.D. Yates and D.J. Goodman, *Probability and Stochastic Processes: A friendly introduction for electrical and computer engineers*, 2nd Edition, Wiley, 2005, ISBN 0-471-27214-0
Software: MATLAB , (available in all T&B computer labs). Purchase of MATLAB is optional.
Online Resources: WebCT

Course Objectives:
After completing this course, the student should be comfortable with probability theory, basic statistical estimation, and the application of these to electrical engineering. Specific objectives include:
1. Understanding a set theory approach to probability
2. Understanding discrete and continuous random variables and how they can be used to model and analyze systems
3. Understanding probability density functions, cumulative distribution functions, and probability mass functions and how they can be used to characterize engineering systems
4. Understanding sets of random variable and how they relate to electrical engineering applications
5. Understanding how to estimate random variables and how such estimates can be used to characterize engineering processes
6. Understanding the basics of stochastic processes and their application to signal processing and communications systems
7. Using Matlab to better understand the above-listed concepts and to apply them to selected problems in electrical and computer engineering.

Contributions of EE302 to Meeting the Professional Component
Random Variable and Signal Analysis is the new undergraduate foundation course in probability theory and stochastic processes within the Electrical Engineering curriculum, designed to replace the existing statistics requirement. It is considered an engineering topics course in the Professional Component. In this class, students will learn basic probability and random process theory, applying this theory to electrical engineering problems as they learn it in both an analytical and a computational framework. A particular focus in our applications will be on the stochastic modeling and simulation of both signals and systems.

Relationship of Course to Program Outcomes

Course Objective	*Program Outcome*					
	I b	II b	III a	III b	III e	III k
1		x				
2		x	x		x	

3		x	x			
4		x	x			
5		x	x	x		
6		x	x			
7	x	x	x			x

Relevant Program Outcomes
Ib. Use of computers to assist in solving EE problems.
IIb. Knowledge of probability and statistics and EE applications
IIIa. Ability to apply knowledge of mathematics, science and engineering
IIIb. Ability to design and conduct experiments as well as to analyze and interpret data
IIIe. Ability to identify, formulate, and solve engineering problems
IIIk. Ability to use the techniques, skills, and modern engineering tools necessary to engineering practice

Prepared by: C. Creusere, 01/19/06

EE 315 Applied Electromagnetics – (4 credits; 3 + 3P)
Spring 2005

Klipsch School of Electrical and Computer Engineering
College of Engineering
New Mexico State University

Instructor and Class Information
Day and Time: 1:30 - 2:20 PM MWF; Thomas & Brown Room 204
Instructor: Dr. Russ Jedlicka; Office: Thomas & Brown Room 311
Office Hours: 2:30 – 3:30 MWF.
Phone: NMSU – Las Cruces (505) 646-4821; Fax: (505) 646-1435
E-Mail: rjedlick@nmsu.edu

Course Description from Catalog:
Static and magnetic fields. Maxwell's equations, time-varying electromagnetic fields, generalized plane wave propagation in lossless media, introduction to plane-wave polarization, and microwave transmission line theory. This begins with consideration of charges and current and is followed by study of Coulomb's and Gauss' law. Electric scalar potential is introduced and its relation to electric field is studied. The properties of materials are investigated and then electromagnetic boundary conditions are studied. And finally the concept of capacitance is introduced. Magnetostatics is introduced in terms of the Biot-Savart law and the concept of inductance is introduced. The course concludes with a study of Faraday's law and plane wave propagation.

Course Summary:
The course begins with an introduction to waves and phasors then moves on to a study of transmission line theory and its applications. After a brief review of vector analysis, the topic of electrostatics is studied in detail. This begins with consideration of the fields due to varying charge distributions via the laws of Coulomb and Gauss. Electric scalar potential is introduced and its relation to electric field is studied. The properties of materials are investigated and then electromagnetic boundary conditions are studied. And finally the concept of capacitance is introduced. Magnetostatics is introduced in terms of the Biot-Savart law and the concept of inductance is introduced. The course concludes with a study of Faraday's law and plane wave propagation.

Prerequisite: C or better in EE301.

Textbook: Fundamentals of Applied Electromagnetics – 2001 Media Edition , Fawwaz T. Ulaby, Prentice Hall, Upper Saddle River, NJ, 2001. In addition, reference materials will be posted on the WebCT.

Course Objectives:

Introduce radio frequency (RF) and microwave transmission lines.
Develop an understanding of transmission line circuits and Smith Charts.
Introduce Impedance Matching
Review vector analysis.
Study electrostatics: Potential, Electric Fields, and Capacitance.
Study magnetostatics: Magnetic Fields and Inductance.
Introduce Faraday's law and plane wave propagation
Introduce Wave Reflection/Refraction and Antenna Theory

Contribution of EE 315 to Meeting the Professional Component:
This course is the core electromagnetics course, which is required for depth and breadth electives such as Microwave Engineering (EE453) or Antennas (EE454). It is also a prerequisite for EE458/459 the Wireless Systems capstone sequence. In this class, students will be exposed to the theory of underlying signal propagation on transmission lines as well as through free space. The material presented in this class is the essential basis for microwave circuit and antenna design. This course is four credit hours total.

Relationship of the Course to Program Objectives:

The educational program objectives of the Klipsch School of Electrical and Computer Engineering are to provide students the broad educational background and skills necessary for a successful, fulfilling and life long career in electrical and computer engineering. To assist in supporting these objectives, EE 315 applies differential, integral and vector mathematics, learned in previous courses, to practical transmission lines and electrostatic/magnetostatic configurations.

EE 221 Electronics I

Required? Yes

Description: Introduction to solid-state devices. Diode circuits. Single-transistor BJT and MOS amplifiers. Introduction to digital CMOS circuits.

Corequisite: C or better in EE211

Text: Adel S. Sedra and Kenneth C. Smith, *Microelectronic Circuits*, 5th ed., Oxford University Press, 2004

Website: A class web site, consisting of homework assignments, quizzes, laboratory handouts, current grades, the course syllabus, and other helpful handouts, exists at WebCT at http://salsa.nmsu.edu/

Objectives: The objectives of this class are as follows:

15. Analysis and design of single time-constant circuits
16. Analysis and design of linear opamp circuits
17. Analysis and design of linear AC-to-DC power supplies
18. Describing the physical structure and operation of silicon devices
19. Biasing of single-transistor amplifiers
20. Small-signal analysis of single-transistor amplifiers
21. Analysis and design of CMOS logic gates
22. DC, AC, and transient simulation of circuits using SPICE
23. Developing teamwork skills while working in teams
24. Proto-typing circuits with breadboards
25. Laying out and testing a small printed-circuit board
26. Testing and measuring electronic circuits using power supplies, function generators, multi-meters, and oscilloscopes
27. Documenting laboratory results through written lab summaries
28. Presenting a team laboratory project in front of peers

Topics: The topics covered in this class are:

- Amplifier Models and Single-Time-Constant Circuits
- Operational Amplifiers
- Diodes and Linear Power Supplies
- MOS Field-Effect Transistors
- Bipolar Junction Transistors (BJTs)
- Digital CMOS Logic Circuits

Meetings: Monday, Wednesday, Friday, 11:30 a.m. to 12:20 p.m., T&B 104

Labs: Register for one meeting per week (T&B 309):
Wednesday, 2:30 – 5:00 p.m.
Thursday, 7:40 – 10:10 a.m. or 1:10 – 3:40 p.m.

Contribution to the Professional Component

This course contributes three semester hours of engineering topics and one semester hour of engineering design. This course is the foundational class in electronics, preparing students for electives in discrete electronics (EE482) and/or integrated electronics (EE324). Students apply Ohm's Law, Kirchoff's Voltage and Current Laws, and phasor analysis to design, simulate, and build functional electronics circuits.

Relationship of Course to Program Outcomes

Course Objective	*Program Outcomes*								
	I a	II b	II g	III a	III c	III d	III e	III g	III k
1	X		X	X	X		X		
2	X		X	X	X		X		
3	X		X	X	X		X		

4				X					
5	X		X	X	X		X		
6	X		X	X	X		X		
7	X			X			X		
8		X	X		X				X
9						X		X	
10	X				X				X
11		X							X
12									X
13								X	X
14						X		X	

Relevant Program Outcomes

I a. Apply critical thinking skills to solve engineering problems.
I.b. Apply computers to assist in solving engineering problems.
II g. Ability to analyze and design complex electrical and electronic devices and system that contain hardware and software components.
III a. Ability to apply knowledge of mathematics, science and engineering.
III c. Ability to design a system or component to meet desired needs
III d. Ability to function on multi-disciplinary teams.
III e. Ability to identify, formulate and solve engineering problems.
III g. Ability to communicate effectively.
III k. Ability to use the techniques, skills and modern engineering tools necessary to engineering practice.

EE 261 Digital Design I

Required? Yes

Description: Design of combinational logic circuits. Introduction to state machine design. Implementation using programmable logic devices and microcontrollers.

Prerequisite: C or better in EE 111 Introduction to Electrical and Computer Engineering and EE 161 Computer Aided Problem Solving.

Texts: Fundamentals of Digital Logic with VHDL Design, by Stephen Brown and Zvonko Vranesic, Second Edition, McGraw-Hill, 2000.
THE TTL LOGIC DATA BOOK Standard TTL, Schottky, Low-Power Schottky, Texas Instruments.

Laboratory Kit: An EE 261 LABKIT is required.

Software: Quartus II CAD Software

Objectives: The objectives of this course are as follows:

1. To introduce the student to the principles of combinational logic design, sequential logic design, digital design circuit components, programmable logic devices, and micro-controllers.
2. To introduce the student to the use of modern software toolkits for digital design.
3. To introduce the student to the number systems in digital systems and their use.
4. To learn the use of VHDL hardware description language in computer-based homework designs and downloading these designs into actual hardware.
5. The introduction of basic design, analysis, and simulation concepts, and software tools.

Topics: The topics covered in this course are:

- Boolean algebra
- Truth tables and Karnaugh maps
- Number systems
- Combinational logic circuits
- Mixed logic and IEEE standard symbology
- Multiplexers and decoders
- Adders and subtractors, arithmetic logic units
- Comparators
- Flip-flops, counters, registers
- Programmable logic and memory
- VHDL

Meetings: Monday, Wednesday, Friday, 10:30 – 11:20 AM, T&B 104

Labs: Register for one meeting per week, T&B 305B
Monday, Wednesday, 2:30 – 5:00 PM
Tuesday, Thursday, 1:10 – 3:40 PM

Contribution to the Professional Component

EE 261 contributes four semester hours of engineering topics.

EE 261 EE 261 Digital Design I lays the foundation for digital design in electrical engineering, computer engineering, and software engineering. Students learn basic digital design using classic design, simulation, implementation, and test, as well as through the use of the latest software tools. Students also practice the use of the VHDL hardware description language in computer-based homework designs and download these designs into actual hardware. Introduction of basic design, analysis, and simulation concepts, and software tools, lays the groundwork for more advanced courses in modern digital design, high performance computer design, computer architecture, software engineering, and digital communications networks. The actual hardware design and familiarization with the associated software tools prepares the students for more complex designs in later courses, as well as in co-op and summer job experiences, graduate school, or the profession.

Relationship of Course to Program Outcomes

Course Objective	*Program Outcome*				
	I b	II e	II f	III a	III k
1		X	X	X	
2	X		X	X	X
3		X		X	
4	X		X	X	X
5	X		X	X	X

Relevant Program Outcomes

I b. Use of computers.
II e. Knowledge of advanced mathematics.
II f. Knowledge of engineering sciences.
III a. Ability to apply knowledge of mathematics, science and engineering.
III k. Use of engineering tools.

EE 301 Vector Principles for Electrical Engineers

Required? Yes

Description: Calculus of vector functions through electrostatic and magnetostatic applications. Techniques for finding resistance, capacitance, and inductance. Coulomb's law, gradient, Gauss' divergence theorem, curl, Stoke's theorem, and Green's theorem.

Prerequisites: C or better in MATH 291

Texts: David K. Cheng, *Fundamentals of Engineering Electromagnetics,* Prentice Hall 1993.
Harry M. Schey, *div, grad, curl, and all that*, 4th ed., W.W. Norton & Company 2005.

Software: None

Objectives: The objectives of this class are as follows:

- To use field quantities, e.g., flux and fluid flow velocity to bring physical meaning to abstract vector operations, and to motivate students to learn vector calculus through applications in electromagnetics.
- To learn the mathematics of differential vector opeartors.
- To learn the mathematics of different integrals involving vector functions.
- To learn the vector theorems important for electrical engineering.
- To learn how to use vectors to perform analysis and solve problems with different coordinate systems.
- To learn how to use vector differential operators and integrals to describe static field behavior.
- To apply vector calculus techniques to calculate static field quantities both in free space and in arbitrary materials.
- To apply vector calculus techniques to calculate electric potentials.
- To use vector calculus and static field theory to establish circuit laws and calculate circuit quantities.
- To prepare for upper-level classes, such as Applied Electromagnetics (EE 315), Microwave Engineering (EE 453) and Antennas (EE 454), that make extensive use of vector calculus.

Topics: The topics covered in this class are:

- Vector algebra, orthogonal coordinate systems
- Vector differential operators
- Line integral, surface integral and volume integral
- Vector theorems
- Static field theory
- Vector field calculations in free space and dielectrics
- Electric potential and its evaluation
- Circuit quantities and their calculation

Meetings: Tuesday, Thursday, 11:45 a.m. to 1:00 p.m., T&B 204
Labs: None

Contribution to the Professional Component

This course contributes three semester hours of mathematical science and its applications.
Vector differential operators and multi-dimensional integrals are used together with static field theory to build toward an understanding of vector calculus and its applications in electrical engineering. The concepts learned in this course lay the groundwork for more advanced vector applications. They also provide a bridge between the mathematical concepts learned in algebra, trigonometry and calculus, and the analysis and design of electromagnetic systems as taught in later course work.

Relationship of Course to Program Outcomes

Course Objective	*Program Outcome*	
	II e	III a
2	x	
3	x	
4	x	
5	x	x
6	x	x
7	x	x
8	x	x
9	x	x

Relevant Program Outcomes

II e. Knowledge of advance Math, Diff. Eq. and vector calculus
III a. Apply knowledge of math, science and engineering

<u>EE 311 Signals and Systems</u>

Required? Yes

Description: Transform methods for solution of continuous- and discrete-time systems. Fourier and Laplace transforms. Frequency response and Bode plots. Z transform. Continuous- and discrete-time convolution.

Prerequisites: C or better in EE 161, EE 211

Texts: Simon Haykin and Barry Van Veen, *Signals and Systems,* 2nd ed., Wiley 2003.
John Buck, Michael M. Daniel, and Andrew C. Singer, *Computer Explorations in Signals and Systems using Matlab,* 2nd ed., Prentice Hall 2002.

Software: Matlab, Student Version

Objectives: A student who completes this class should be able to:

- Distinguish between a *signal* and a *system*. Use each to appropriately model the behavior of a circuit or device.
- Classify signals and systems as *continuous time* or *discrete time*. Analyze the behavior of each type using appropriate methods.
- Classify signals according to whether they are *periodic*, or have finite *energy* or *power*. Choose appropriate methods for analyzing each type of signal.
- Classify systems according to whether they are *linear*, *time invariant*, *causal* or *stable*. Choose appropriate methods for analyzing each type of system.
- Model linear circuits and systems as differential and difference equations. Use these to compute the output of the system, and to discover other important system properties.
- Represent signals and systems in the *frequency domain*. Choose between time-domain and frequency-domain techniques to simplify the analysis of specific problems.
- Use graphical and matrix math tools of Matlab to try out and refine solutions to engineering problems.
- Choose appropriate methods to verify that a solution to an engineering problem is correct.

Topics: The topics covered in this class are:

- Signal, system properties
- Differential, difference equations
- Continuous-time and discrete-time convolution
- Fourier representations
- Frequency response
- Laplace transforms

Meetings: Tuesday, Thursday, 8:55 a.m. to 10:10 a.m., T&B 104

Labs: Register for one meeting per week (T&B 304):
Monday, Wednesday, 2:30 p.m. to 5:00 p.m.
Tuesday, 1:10 p.m. to 3:40 p.m.

Contribution to the Professional Component

This course contributes four semester hours of engineering topics.
Linear system theory and Fourier analysis, together with the mathematical modeling of physical systems, build toward an understanding of frequency response, the core concept of the course. This provides a bridge between the mathematical concepts learned in algebra, trigonometry and calculus, and the design of control, signal processing and communication systems as taught in later course work.

Relationship of Course to Program Outcomes

Course Objective	*Program Outcome*				
	I b	II e	II f	III a	III k
1			x	x	
2			x	x	
3			x	x	
4			x	x	
5		x	x	x	
6			x	x	
7	x		x	x	x
8			x	x	

Relevant Program Outcomes

I b. Use of computers.
II e. Knowledge of advanced mathematics.
II f. Knowledge of engineering sciences.
III a. Ability to apply knowledge of mathematics, science and engineering.
III k. Use of engineering tools.

EE 324 Introduction to VLSI

Required? No

Description: Introduction to analog and digital VLSI circuits and MOS technology. Design of differential amplifiers, opamps, CMOS logic, and flip-flops. Introduction to VLSI CAD tools.

Pre-requisites: C or better in EE 221 and EE 261.

Text: John P. Uyemura, *Introduction to VLSI Circuits and Systems*, John Wiley & Sons, 2002

Adel S. Sedra and Kenneth C. Smith, *Microelectronic Circuits*, 5th ed., Oxford University Press, 2004

Website: A class web site, consisting of homework assignments, quizzes, laboratory handouts, current grades, the course syllabus, and other helpful handouts, exists at WebCT at http://salsa.nmsu.edu/

Objectives: The objectives of this class are as follows:

1. Complex CMOS logic design techniques, including standard complementary-CMOS, transmission gate, and pseudo-nMOS
2. Describing integrated circuit (IC) layers and IC fabrication process
3. Applying MOS I-V equations and small-signal models to circuits
4. Designing current sources and analyzing differential amplifiers
5. Analysis and design of CMOS 2-stage and folded-cascode op-amps
6. Design of digital blocks: multiplexer, decoder, latch, flip-flop, adder
7. Analyzing switching characteristics and power of the CMOS inverter
8. Analyzing and designing complex CMOS gates for speed
9. Schematic entry and simulation using Cadence
10. Layout entry and verification using Cadence
11. Proto-typing and testing digital and analog circuits
12. Working and learning in teams
13. Presenting a team project in front of peers
14. Writing an essay in the area of integrated circuits and devices

Topics: The topics covered in this class are:

- Overview and Logic Design with MOSFETs
- Physical Structure and Fabrication of CMOS Integrated Circuits
- Current Sources and Small-Signal Analysis
- Introduction to CMOS OpAamp Analysis and Design
- Digital VLSI System Components
- Analysis of MOSFET Circuits and High-Speed Design

Meetings: Monday – Thursday, 8:00 a.m. to 10:00 a.m., T&B 307

Labs: Tuesday and Thursday, 12:20 – 4:20 p.m. (T&B 308/309)

Contribution to the Professional Component

This course contributes 2.5 semester hours of engineering topics and 1.5 semester hours of engineering design. This course lays the foundation for the design of analog and digital VLSI systems. Students learn to analyze and design circuits, simulate circuits with SPICE, generate layout files, verify layout files, and test MOS circuits. Student teams prepare a final project presentation on the design of a small analog/digital VLSI system.

Relationship of Course to Program Outcomes

Course Objective	*Program Outcomes*													
	I a	II b	II a	II g	III a	III c	III d	III e	III f	III g	III h	III i	III j	III k
1	X			X	X	X		X						
2			X							X		X		

3	X			X	X	X		X						
4	X			X	X	X		X						
5	X			X	X	X		X						
6	X			X	X	X		X						
7	X			X	X	X		X						
8	X			X	X	X		X						
9		X				X		X						X
10		X				X		X						X
11						X		X						X
12							X							
13				X		X	X			X				
14			X						X	X	X	X	X	X

Relevant Program Outcomes

- I a. Apply critical thinking skills to solve engineering problems.
- I.b. Apply computers to assist in solving engineering problems.
- II.a. Breadth and depth across the range of EE topics
- II g. Ability to analyze and design complex electronic systems.
- III a. Ability to apply knowledge of mathematics, science and engineering.
- III c. Ability to design a system or component to meet desired needs
- III d. Ability to function on multi-disciplinary teams.
- III e. Ability to identify, formulate and solve engineering problems.
- III.f. Understanding of professional and ethical responsibilities.
- III g. Ability to communicate effectively.
- III.h. Broad education to understand the impact of engineering solutions.
- III.i. Recognition of the need for and engaging in life-long learning.
- III.j. Knowledge of contemporary issues.
- III k. Ability to use modern techniques, skills and engineering tools.

EE 341 Systems I
COURSE SYLLABUS for Spring 2006
The Klipsch School of Electrical and Computer Engineering
College of Engineering
New Mexico State University
Prerequisite: 311 Signals and Systems.

Classes:	Tuesdays and Thursdays, 10:20 AM - 11:35 AM in T&B 307
Instructor:	Ram Prasad
Office:	Thomas and Brown, Rm. 222
Office Hours:	Mondays & Wednesdays 11:30 AM - 1:00 PM
Phone:	646-3623
Email:	rprasad@nmsu.edu; ramprasad@msn.com;

Textbook: ***Automatic Control Systems*****, Benjamin Kuo and Farid Golnaraghi, Edition**
Course Description: Work in the Systems area provides the student with a strong background in modeling, analysis, design, simulation, and control of complex systems. These systems may be associated with engineering, ecology, economy, transportation, natural resources, environment, or other areas. In this course, you will learn how to model physical systems, analyze and examine the behavior of control systems, test for stability of the control system, and design controllers that will stabilize an otherwise unstable system.
Course Objectives:

To develop a firm understanding of control theory concepts including basic terminology
To understand stability and performance characteristics of control systems
To learn how to design controllers to meet time-domain specifications such as settling time, overshoot, undershoot, and maximum control effort
To gain insight into modeling complex physical systems
To provide the students laboratory exposure for the design and analysis of control systems
To serve as the fundamental background for advanced studies in Systems Science

Grading: Grades will be based upon in-class exams, homework, and Laboratory. 75% of your grade will be based upon coursework and in-class performance. 25% is based upon Laboratory performance. Exams will be graded on a scale of 0-100. Each homework problem will be graded on a scale of 0-10. The weighting is as follows:

Homework	10%
Exam 1	15%
Exam 2	15%
Exam 3	15%
Final Exam	20%
Laboratory	25%

Homework is assigned during each class period, and is due the following class unless otherwise stated. Hand in your homework at the beginning of the class period. Homework grades will be based on how accurate your solutions are, as well as how the solution is communicated. A solution is well-communicated if the problem is clearly stated, the solution steps are explained, and the soundness of the solution is verified. Neatness counts. It is important that you describe your work in a way that others will understand. If your work is not legible, some credit will be lost even if the solution is correct.

Students are expected to come to class on time, be prepared, and are expected to participate in class discussions. Any work missed is the student's responsibility.

Topics covered in EE 341

The topics listed below are general, and are not the title of each chapter in the book. These topics are representative of what we plan to address in this course.

Introduction

Historical background, definitions, some common control systems found in everyday life, need for transform theory (Laplace Transforms)

Writing System Equations

Modeling electrical, mechanical, electro-mechanical systems, hydraulic systems, gear-trains and rotational systems. Use of Lagrange Equation to model systems.

Solution of Differential Equations

Steady-state response, Transient response, Linear Algebra, Eigenvalue and Eigenvector analysis, State-variable concepts, state-variable method of modeling, complete solution of the state equation.

Laplace Transforms

Solution of state-variable models using Laplace transforms, Transfer functions.

System Representation

Block diagrams, combining and reducing block diagrams, Signal flow graphs, Obtaining transfer functions from signal-flow diagrams, Canonical forms of system realization, the Diagonal form.

Control System Characteristics

Stability concepts, Routh's Stability criteria, Analysis of system stability, Determining steady-state error coefficients.

Root Locus

Concept of Root locus, why we need it, how to plot the root locus, how to use root locus to design systems.

Frequency Response

Concept of Frequency Response, why we need it, how to plot the Frequency Response characteristics (Bode Plots), how to use Frequency Response characteristics to design systems.

Closed-Loop Pole-zero Assignment

Controllability and Observability, State-variable feedback design of controllers

Design of Tracking Systems

EE 361 Digital Design II

Required? Yes

Description: Sequential digital logic design technique. Classical and modern design of synchronous and asynchronous machines. Design using SSI and MSI technology

Prerequisites: C or better in E E 261

Texts: Text Book: Fundamentals of Digital Logic with VHDL Design 2nd Ed. Stephen Brown and Zvonko Vranesic, JMcGraw Hill, 2005.

Software: Quartus and/or MaxPlus II VHDL simulation software, student edition from Altera.

Objectives: The objectives of this class are as follows:

1. Compare combinational and sequential logic systems.
2. Describe the components of a FSM.
3. Construct state diagrams and next-state tables.
4. Starting with a sequential circuit, generate the corresponding next-state table and associated state diagram.
5. Starting with a description of a problem, construct the state diagram solution.
6. Design a FSM from a state diagram.
7. Design an Asynchronous sequential systems.
8. Compare Mealy and Moore FSM's.
9. Compare asynchronous and synchronous state machines.
10. Write VHDL code to execute state-diagrams.
11. Connect FSM design principles with real-world engineering products.
12. Understand the connection between FPGA programming and engineering solutions.
13. Research attributes and applications of FPGA's and other programmable devices.
14. Understand the professional and ethical responsibilities of digital design engineers.

Topics: The topics covered in this class are:
1. Short review of combinational digital design,
2. Synchronous and a synchronous digital design
3. FPGA's and VHDL
4. Simulation and Coding

Meetings: Tuesday, Thursday, 10:20 a.m. to 11:35 a.m., T&B 104

Contribution to the Professional Component

This course contributes three semester hours of engineering topics.

The purpose of EE 361 Digital Design II is to develop in-depth and practical knowledge of digital logic design. The course begins with a short review of combinational digital design, proceeds through a thorough treatment of synchronous and a synchronous digital design and concludes with an introduction to modern digital design.

Relationship of Course to Program Outcomes

Course Obj.	**Program Outcomes**											
	I.a	I.b	I.c	II.a	II.f	III.a	III.e	III.f	III.g	III.h	III.i	III.j	III.k
1			x	x									
2			x	x									
3													

4													
5	x						x						
6	x					x							
7	x												
8			x	x									
9			x	x									
10		x					x			x			x
11					x	x	x		x	x		x	x
12						x						x	
13									x		x	x	
14								x					

Relevant Program Outcomes

I.a. Apply critical thinking skills to solve problems in EE
I.b. Apply computers to assist in solving EE problems
I.c. Explore specialties pertinent to their career choices
II.a. Breadth and Depth across the range of EE topics
II.f. Knowledge of engineering science
III.a. Apply knowledge of math, science and engineering
III.e. Ability to identify, formulate and solve engineering problems
III.f. Understand professional and ethical responsibilities
III.g. Ability to communicate effectively
III.h. Broad education necessary to understand the impact of engineering solutions in a global and societal context.
III.i. Recognition of the need for and the ability to engage in life-long learning
III.j. Knowledge of contemporary issues
III.k. Ability to use the techniques, skills and modern engineering tools necessary to engineering practice.

<u>EE/PHYS 370 – Geometrical Optics (Optics I)</u>

Required? No

Description: Covers lenses, prisms, image formation, aberrations, stops and pupils, photometry, optical instrumentation, reflection, and refraction.

Corequisites: PHYS 216, 216L or PHYS 217, 217L

Texts: Modern Geometrical Optics by Richard Ditteon, John Wiley & Sons, Inc. (1998), ISBN: 0-471-16922-6

Software: Rose6 (ray tracing program) and ZEMAX (lens design program)

Objectives: The objectives of this class are as follows:

1. To provide an up-to-date treatment of the introductory aspects of optics and photonics with an emphasis on the analysis and design methods of modern geometrical optics.
2. To help students develop an understanding of optics and photonics that will enable them to keep pace with new technologies and to develop future technologies that utilize photonics systems.
3. To gain hands-on laboratory experience in the design, implementation, and characterization of imaging and nonimaging optical systems.

Topics: The topics covered in this class are:

- The nature of light; notes on optical fibers, plane mirrors and nondispersing prisms, thin lens equation, plane/spherical refracting/reflecting surfaces.
- Thin lens derivation, human eye, microscopes, telescopes
- Paraxial ray tracing and first-order design.
- Third-order optics; notes on aberrations, image quality.

Meetings: Monday, Wednesday, 10:30 a.m. to 11:20 a.m., Gardiner 116.

Labs: Register for one meeting per week (Gardiner 265)
Monday, Tuesday, Wednesday, Thursday, 2:30 p.m. to 5:00 p.m.

Contribution to the Professional Component

This course contains 1 hour of engineering science (basic concepts of geometrical optics and photonics) and 2 hours of engineering design (specific applications of geometrical optics and photonics for which there may be more than one correct answer). It builds on the foundation obtained by the students in their fundamental courses in math, physics, electronics, and computers and teaches them the skills needed to analyze and design a first-order optical system and to recognize the degrading effects of higher-order aberrations in the system. Since many modern photonics systems integrate electronics and computers with optical devices such as cameras, lasers, and optical fibers, examples of these modern systems are discussed in the classroom lectures, and some are demonstrated in the laboratory sessions

Tools such as ray sketching for simple systems and paraxial ray tracing for more complex multiple-lens systems are used in this class to design and analyze the optics needed to collect photons and form images. After performing several ray traces by hand, the students download the Rose6 ray tracing program and use it extensively to analyze and design complex first-order optical systems consisting of many lenses. They are also introduced to the ZEMAX lens design code, and they use ZEMAX in two laboratory workshops toward the end of the semester. Eight laboratory experiments require the students to work in teams to build and test optical systems, many of which they have designed and analyzed in their homework assignments.

Relationship of Course to Program Outcomes

Course Objective	**Program Outcomes**								
	I b	II c	II d	II f	III a	III b	III c	III e	III k
1	x	x	x	x	x	x	x	x	x
2	x	x	x	x	x			x	x
3	x	x	x	x	x	x		x	x

Relevant Program Outcomes

I b. Use of computers.
II c. Knowledge of calculus.
II f. Knowledge of engineering sciences.
III a. Ability to apply knowledge of mathematics, science and engineering.
III b. Ability to design and conduct experiments and analyze data.
III c. Ability to sign a system to meet desired needs.
III e. Ability to identify, formulate,and solve engineering problems.
III k. Use of engineering tools.

EE 442 / EE592 Real-Time Digital Signal Processing

Required? No

Description: Projects-oriented course covering the fundamentals of real-time digital signal processing (DSP) by programming a state-of-the-art digital processor to solve a variety of problems in digital audio and communications engineering.

Prerequisites: A grade of C or better in EE395 Introduction to Digital Signal Processing or EE545 Digital Signal Processing or equivalent.

Texts:
Real-Time Digital Signal Processing using the Motorola DSP5630xEVM by Phillip De Leon
DSP56300 Digital Signal Processor Family Manual
DSP56302 Digital Signal Processor User's Manual
Motorola DSP56302EVM User's Manual
Motorola DSP Assembler Reference
Domain Technologies Debug-56K User's Guide

Hardware:
Personal Computer (PC) with Windows XP
Motorola DSP56302EVM, Texas Instruments TMS320C6416DSK
Test and measurement equipment, speakers, and audio cables

Software:
Motorola DSP56300 Macro Assembler
Domain Technologies Debug-EVM
Code Composer Studio (CCS)
MATLAB 6.5, Signal Processing Toolbox

Objectives: The objective of this course is to gain an understanding of real-time DSP through:
1. Software design for real-time applications
2. Understanding of digital signal processor architecture and programming model
3. Understanding of processor addressing modes, instruction set, and parallel operations
4. Algorithm and code development
5. Debugging and code verification techniques

Topics: The topics covered in this class are:
1. Introduction to real-time DSP
2. Motorola DSP56300 architecture, addressing modes, instruction set, and programming model
3. Motorola DSP56302EVM, development tools
4. Simple assembly programs
5. Applications: sound field simulator, adaptive noise canceler, wavetable synthesizer, modem
6. Texas Instruments TMS320C6416

Contribution to the Professional Component
Real-Time Digital Signal Processing is the depth course in DSP within the Electrical Engineering curriculum and is considered an engineering topics course in the Professional Component. Students in EE442/EE592 will apply techniques learned in class through software development and in-class discussions. Techniques learned in this class will provide students with a deepening of their knowledge base to see applications of mathematics, computer science, and electrical engineering techniques to the real-time processing of signals in the digital domain, provide preparation for capstone design project, and provide a basis for career employment or graduate school. Discussion of design issues relate the class theory to practical societal issues. Class provides 3 credits of engineering science credit.

Relationship of Course to Program Outcomes

Course Objective	*Program Outcomes*								
	I a	I b	I e	II f	II g	III a	III c	III e	III k
1	X	X	X		X	X	X	X	
2				X	X				
3					X				
4	X	X	X		X	X	X	X	X
5	X	X	X		X			X	X

Relevant Program Outcomes
I.a. Apply critical thinking skills to solve problems in EE
I b. Use of computers.
I.e. Obtain meaningful employment or continue with graduate education
II f. Knowledge of engineering sciences.
II.g. Ability to analyze and design complex electrical and electronic devices and system thatcontain hardware and software components.
III a. Ability to apply knowledge of mathematics, science and engineering.
III.c. Ability to design a system, component or process to meet desired needs
III.e. Ability to identify, formulate and solve engineering problems
III k. Use of engineering tools.

Prepared by Phillip De Leon, December 19, 2005.

EE 460 Space Mission Analysis and Design

Required? No

Description: **Course Description:** This practical introduction to Space Mission Analysis and Design provides the student with the overview concepts, methodologies, models and tools needed to understand the satellite from a top-down, integrated, life-cycle perspective, evolving in coverage from the identification of customer requirements to design and development, production/construction, launch, system operations and life cycle support. The purpose of the class is to give the student an overview of satellite and launch systems plus the systems engineering approach involved in a generic, cradle to grave space program. All space program segments will be included: spacecraft system development and fabrication, launch and spacecraft and ground operations.

Prerequisites: Junior or higher engineering student in good standing.

Texts: James R. Wertz and Wiley J. Larson (editors), *Space Mission Analysis and Design,* 3rd ed., Wiley .

Software: STK, Student Version

Course Objectives: Upon successful completion of the course, the student should be able to understand:

1. The process of space mission analysis and design
2. Space mission characterization and evaluation
3. Space mission requirements definition
4. Space mission geometry, orbit selection and launch systems
5. An introduction to astrodynamics, the space environment and mission survivability.
6. Spacecraft subsystem design
7. Spacecraft payloads
8. Spacecraft missions operations and ground systems.
9. Participate in a team environment to design and present an engineering project
10. Use Satellite Tool Kit to solve simple orbital problems.

Topics: The topics covered in this class are:

- Historical perspective of space programs and their contributions.
- System requirements and flow down
- Orbital Mechanics
- Use of Satellite Tool Kit
- Subsystem Design (attitude determination and control, propulsion, structure, power, payloads, communications, and launch systems)
- Space Environments
- Mission analysis and mission constellations
- Integration and Test
- Manufacturing
- Spacecraft operations
- Project presentation techniques

Meetings: Tuesday, Thursday, 4:00 pm to 5:15 pm, T&B 104

Contribution to the Professional Component

This course contributes three semester hours of engineering topics.

Relationship of Course to Program Outcomes

Course Objective	**Program Outcomes**					
	Ia	I b	Ic	IIa	IIId	IIIg
1	x		x	x		
2	x		x	x		
3	x		x	x		
4	x	x	x	x		
5	x		x	x		
6	x		x	x		
7	x		x	x		
8	x		x	x		
9	x	x	x	x	x	x
10		x				

Relevant Program Outcomes

I a. Apply critical skills to integrate course information and apply it to design project.
I b. Use STK to solve practical satellite problems.
I c. Knowledge of spacecraft subsystems, environments and accepted processes.
II a. Ability to apply knowledge of engineering application to several spacecraft functions.
III d. Function in a project team for a complex engineering problem.
III g. Communicate effectively during team meetings and project brief outs.

EE-461 Systems Engineering and Program Management

Required? Yes

Description: The purpose of the course is to give the student an overview of Systems Engineering from a major program perspective including the societal impact of engineering solutions to today's problems. The course demonstrates the systems engineering discipline that is required to establish an effective configuration and size of system hardware, software, facilities, and personnel through an interactive process of analysis and design, satisfying an operational mission need in the most cost effective manner. The course provides a guide for systems engineering functions in program development, fabrication, operations, maintenance and life cycle support The student learns the fundamentals and principles of program management including program structure, cost and schedule control, staffing and subcontract management. They also learn the societal implications of a major program including environmental, health, safety and political impacts. The professional and ethical responsibilities of managing a major program are also addressed. Students are also required to do a design project of a major system.

Prerequisites: Junior or higher engineering student in good standing

Texts: Systems Engineering: Principles and Practices, Alexander Kossiakoff, Wiley, 2003

Software: N/A

Objectives: A student who completes this class should be able to understand:

(1) The fundamentals and "best practices" of systems engineering, as applied to all segments of a typical engineering program

(2) The product development life cycle and sustainability of a program

(3) Systems engineering functions including requirements analysis, functional analysis and allocation, trade studies and criteria, synthesis and design, verification and test planning, and integration and control.

(4) Integration of engineering specialties into systems engineering (reliability, materials and process, manufacturability, maintainability and testing, system safety, human factors, including health and safety, producibility, EMC/EMI, survivability, integrated logistic support, etc)

(5) The fundamentals of successful program management

(6) Professional and ethical responsibilities.

(7) Participate in a team environment to design and present a systems engineering project.

Topics: The topics covered in this class are:

- System Engineering Processes
- Systems Engineering Managment
- Program Life Cycles
- Introduction to Program Management
- Contract Management
- Cost and Schedule Management
- Risk Management
- Ethics and Ethics' Case Studies

Meetings: Tuesday, Thursday, 4:00pm to 5:15pm., T&B 104

Labs: N/A

Contribution to the Professional Component

This course contributes four semester hours of engineering topics.

Systems engineering and program management provide a realistic bridge between the academic and professional world.

Relationship of Course to Program Outcomes

Course Objective	*Program Outcome*				
	I a	I b	I c	II a	III d
1	x	x	x	x	
2	x	x	x	x	
3	x	x	x	x	
4	x	x	x	x	
5	x	x	x	x	
6			x	x	x
7	x	x	x	x	x
8					

Relevant Program Outcomes

I a. Apply critical skills to integrate course information and apply it to design project..
I b. Use course information to solve basic systems engineering problems.
I c. Knowledge of the systems engineering process.
II a. Ability to apply knowledge to specific systems engineering and program management problems and issues.
III d. Ability to apply lessons learned to ethical case studies.

EE 475 Control Systems II

Required? No.
Description: Analysis, design and control of linear systems.
Prerequisites: Senior standing or consent of instructor.
Texts: *Industrial Control Electronics: Devices, Systems and Applications*, 3/e (2006) by T. Bartelt,
Clifton Park, NY: Thomson and Delmar Learning.
Software: MATLAB, Student Version, SIMULINK Student Version
Objectives: The objectives of this class are as follows:

- To understand basic properties for linear, time-invariant systems.
- To understand how to analyze and simulate linear and nonlinear systems.
- To understand performance limitations and tradeoffs in linear feedback systems.
- To learn how to design controllers which may include observers for linear systems.
- To learn the basics of controlling nonlinear systems.
- To provide the students an opportunity to apply the knowledge of the above material in a practical (project) experience. A small project will help the students grow in competence with the elements of motion control.
- To write an essay based on a current article in the area of control systems. This will include how engineering was used to solve a problem and advance the state of the art, how the solution will impact society, and how professional and ethical standards must be applied to obtain an engineering solution.

Topics: The topics covered in this class are:

- Introduction & Background
- Analysis of Linear and Nonlinear Systems
- Observers
- Model Reference Design and The Robust Servomechanism
-

Meetings: Tuesday, Thursday, 8:55 a.m. to 10:10 a.m., T&B 303
Contribution to the Professional Component:
This course provides an in-depth view of linear system analysis, and design. In class, the students will be expected to attain a level of competence in each step of the process of a control design. This progresses from the modeling, to the analysis, to the design, to the testing steps for a particular problem. Attention will be given to understanding and handling problem specifications and constraints. The material and the laboratory experience (projects) provide students with opportunities to apply theories to real problems. The multi-disciplinary material in this course lends itself well to its application in capstone courses, and many industrial settings. This course fills the contribution of three engineering depth or breadth credits.

Relationship of Course to Program Outcomes

		Course Objective						
		1	2	3	4	5	6	7
Program Objective	**I.a**			4	4	4	4	
	I.b		4		4			
	II.a						4	
	II.c	4	4	4				
	II.e	4	4	4				
	II.f	4	4	4	4			
	II.g		4	4	4		4	

	III.a	4	4	4		4		
	III.c				4	4	4	
	III.e	4			4	4		
	III.f							4
	III.g						4	4
	III.h							4
	III.i							4
	III.j							4
	III.k		4		4		4	

Relevant program Outcomes

I.a. Apply critical thinking skills to solve problems in EE
I.b. Apply computers to assist in solving EE problems
II.a. Breadth and Depth across the range of EE topics
II.c. Knowledge of Math through differential and integral calculus
II.e. Knowledge of advanced Math, Diff. Eq. and vector calculus
II.f. Knowledge of engineering science
II.g. Ability to analyze and design complex electrical and electronic devices and system that contain hardware and software components.
III.a. Apply knowledge of math, science and engineering
III.c. Ability to design a system, component or process to meet desired needs
III.e. Ability to identify, formulate and solve engineering problems
III.f. Understand professional and ethical responsibly
III.g. Ability to communicate effectively
III.h. Broad education necessary to understand the impact of engineering solution in a global and societal context.
III.i. Recognition of the need for and the ability to engage in life-long learning
III.j. Knowledge of contemporary issues
III.k. Ability to use the techniques, skills and modern engineering tools necessary to engineering practice.

EE/PHYS 477/527 – Fiber Optics I

Required? No

Description: Covers the fundamental characteristics of individual elements (transmitters, detectors, and fibers) of fiber optic communication systems.

Prerequisites: Grade of C or better in EE 315 or PHYS 461

Texts: Fiber Optic Communications, Fifth edition, by Joseph C. Palais, Pearson Prentice-Hall (2005). ISBN: 0-13-008510-3

Software: Mathcad

Objectives: The objectives of this class are as follows:

1. To introduce class participants to the fundamentals of fiber optics communication systems.
2. To learn mathematical techniques for analyzing and designing optical fiber communications links.
3. To learn mathematical techniques for analyzing optical sources for fiber optics.
4. To learn mathematical techniques for analyzing optical detection systems.
5. To learn mathematical techniques for analyzing optical digital transmission performance (to calculate signal-to-noise ratio, bit error rates, and data rates for a point-to-point system).
6. To learn to design a point-to-point fiber optic communication system.

Topics: The topics covered in this class are:

- Basic properties of fiber optic communication systems
- Optics review and lightwave fundamentals
- Integrated optic waveguides
- Optic fiber waveguides
- Optical Sources and Detectors
- Couplers and connectors
- Noise and detection
- System design

Meetings: Monday, Wednesday, 9:30 a.m. to 10:20 a.m., T&B 303

Labs: Register for one meeting per week (T&B 10C)
Monday, Tuesday, Wednesday, Thursday, 2:30 p.m. to 5:00 p.m.

Contribution to the Professional Component

This course contributes 3 semester hours of engineering topics.
It introduces the students to fiber optic communications. In this class the students learn to design and analyze the subsections of fiber optic systems and to design a point-to-point fiber optic communications system. They will learn by doing both analysis and design problems. The design of a point-to-point fiber optic communications system is required.

Relationship of Course to Program Outcomes

Course Objective	Program Outcomes								
	I b	II b	II c	II f	III a	III b	III c	III e	III k
1			x	x	x	x	x	x	
2	x		x	x	x	x	x	x	x
3			x	x	x	x		x	x
4		x	x	x	x	x		x	x
5	x	x	x	x	x	x	x	x	x

6	x	x	x	x	x	x	x	x	x

Relevant Program Outcomes

I b. Use of computers.
II b. Knowledge of Prob. and Stats. snd EE applications.
II c. Knowledge of calculus.
II f. Knowledge of engineering sciences.
III a. Ability to apply knowledge of mathematics, science and engineering.
III b. Ability to design and conduct experiments and analyze data.
III c. Ability to sign a system to meet desired needs.
III e. Ability to identify, formulate,and solve engineering problems.
III k. Use of engineering tools.

EE 486/524 Digital VLSI Design

Required? No

Description: Digital CMOS system design, including hardware description, circuit simulation, schematic generation, physical layout, design verification using software tools. Introduction to VLSI testing.

Pre-requisites: C or better in EE 324 and EE 361.

Text: R. Jacob Baker and David E. Boyce, *CMOS Circuit Design, Layout, and Simulation*, 2nd ed., IEEE Press, 2005.

Website: A class web site, consisting of homework assignments, quizzes, laboratory handouts, current grades, the course syllabus, and other helpful handouts, exists at WebCT at http://salsa.nmsu.edu/

Objectives: The objectives of this class are as follows:

1. Applying MOS device equations to analyze circuits
2. Identifying CMOS process layers and drawing cross-sectional views
3. Analysis and design of the CMOS inverter and static logic gates
4. Design of dynamic logic gates, transmission gates and flip-flops
5. Floorplan and design of memory circuits
6. Design of digital phase-locked loops
7. Design of arithmetic operators, such as adders and subtractors
8. Design of special-purpose circuits, such as Schmitt triggers and charge pumps
9. Using VLSI CAD tools to simulate, lay out, and verify digital integrated circuits
10. Building and testing small prototype circuits with discrete MOS transistors
11. Writing laboratory reports and project documentation
12. Presenting a team laboratory project in front of peers
13. Writing an essay in the area integrated circuits and devices

Topics: The topics covered in this class are:

- MOSFET Layers, Device Equations, and Models
- Static Logic
- Transmission Gate Logic and Flip-flops
- Dynamic Logic
- High-Speed Adders and Multipliers
- SRAM and DRAM Memory Circuits
- Digital Phase-Locked Loops
- Introduction to Test Methods

Meetings: Monday and Wednesday, 12:30 – 1:30 p.m., T&B 307

Labs: Monday or Wednesday, 2:30 – 5:00 p.m. (T&B 308/208)

Contribution to the Professional Component

This course contributes 1.5 semester hours of engineering topics and 1.5 semester hours of engineering design. Digital VLSI Design challenges students to design digital integrated circuit building blocks with real-world constraints of power supply voltage, power consumption, silicon area, and fabrication technology. Students develop graduate-level skills in VLSI: CMOS logic design and VLSI CAD tools for simulation and layout.

Relationship of Course to Program Outcomes

Course Objective	*Program Outcomes*													
	I a	II b	II a	II g	III a	III c	III d	III e	III f	III g	III h	III i	III j	III k
1	X			X	X	X		X						
2			X											
3	X			X	X	X		X						
4	X			X	X	X		X						

5	X			X	X	X		X						
6	X			X	X	X		X						
7	X			X	X	X		X						
8	X			X	X	X		X						
9		X				X		X						X
10						X		X						X
11										X				
12				X		X	X			X				
13			X						X	X	X	X	X	X

Relevant Program Outcomes

I a. Apply critical thinking skills to solve engineering problems.
I.b. Apply computers to assist in solving engineering problems.
II.a. Breadth and depth across the range of EE topics
II g. Ability to analyze and design complex electronic systems.
III a. Ability to apply knowledge of mathematics, science and engineering.
III c. Ability to design a system or component to meet desired needs
III d. Ability to function on multi-disciplinary teams.
III e. Ability to identify, formulate and solve engineering problems.
III.f. Understanding of professional and ethical responsibilities.
III g. Ability to communicate effectively.
III.h. Broad education to understand the impact of engineering solutions.
III.i. Recognition of the need for and engaging in life-long learning.
III.j. Knowledge of contemporary issues.
III k. Ability to use modern techniques, skills and engineering tools.

EE 493 Power Systems III

Required? No

Description: Analysis of a power system under abnormal operating conditions. Topics include symmetrical three-phase faults, theory of symmetrical components, unsymmetrical faults, system protection, and power system stability.

Prerequisite: C or better in EE 332 - Power Systems I

Text: Power System Analysis and Design, (3rd edition), by J. Duncan Glover and Mulukutla Sarma, PWS Publishing Company

Software: In addition to studying the theory of abnormal system operation, the students will use several software packages to analyze typical problems in electric power system design and operation, and to conduct planning studies.
A solver such as Mathcad will be a very helpful tool for many of the homework problems.

Objectives:

1. To introduce students to the most essential abnormal power-system studies, including short-circuit analysis and stability.
2. To allow the students to use fundamental circuit analysis laws for the solution of power network problems.
3. To introduce the students to the method of symmetrical components and the use of this analysis technique to analyze a variety of unbalanced three-phase problems.
4. To instill in the students a sense of professional ethics.

Topics:

- Course introduction; steady-state ac review
- Review of power-system device models and solution techniques,
- Three-phase circuits, electrical history, etc.
- Symmetrical (balanced) faults (and general fault-analysis concepts)
- Symmetrical components (theory and use)
- Unsymmetrical (unbalanced) faults
- Power system stability
- Special topics (which may include detailed follow-up of previous material, introduction to power-system control and economic operation of power systems, power-quality analysis, etc.)

Meetings: 11:45 AM - 1:00 PM TTh, T&B 307

Contribution of EE 493 to Meeting the Professional Component:

In this course, the students study in detail the design, analysis and operation of an interconnected power system in the steady-state, as well as the analysis of the system in the short-circuit and transient-stability states. Students assemble the component models (for rotating machines, transformers, transmission lines, loads, etc.) studied in previous courses in order to achieve an understanding of how an entire electric power system functions, and in particular, how it can be analyzed in various abnormal states.

Relationship of the Course to Program Outcomes

Course Objective	*Program Outcome*				
	I b	II e	II f	III a	III k
1	X		x	x	x
2			x	x	
3	X	x	x	x	x

4		x		x	

Relevant Program Outcomes

- I b. Use of computers.
- II e. Knowledge of advanced mathematics.
- II f. Knowledge of engineering sciences.
- III a. Ability to apply knowledge of mathematics, science and engineering.
- III k. Use of engineering tools.

EE 498/499 - Senior Capstone – Satellite Design

Required? Yes

Description: Application of engineering principles to a significant design project. Includes teamwork, written and oral communications, and realistic technical, economic, and public safety requirements.

Prerequisite: Senior standing and consent of instructor.

Textbook: *Capstone Design Class Student Handbook*.
Additional References: NASA and Air Force design documents that are available via the WebCT page

Software: Students will also need to know how to access the class Web page via a Web browser.

Objectives:
1. To be able to determine performance requirements for a design
2. To be able to test a design to validate meeting those requirements
3. To make the design meet the constraints imposed by safety, materials, and related factors.
4. To be able to document the design and test.
5. To be able to make the design interface properly with other hardware and software entities.
6. To be able to communicate the design and validation both orally and in writing.

Topics: Topics covered in this class include:
1. Exercises on defining requirements with the customer.
2. Formal requirements definition.
3. System Concept Review and Preliminary Design Review presentations.
4. Developing design concepts to meet customer needs and constraints.
5. Formal reviews with the Air Force customers

Meetings: Formal meeting times are Monday 6:00 - 7:00 pm; Friday 2:30 - 3:20 pm. Students meet outside of class as necessary.

Labs: Students may use the Telemetry Lab facilities as necessary for device prototyping and testing.

Contribution to the Professional Component:
The capstone design experience is intended to give the students an opportunity to learn how to organize and execute an open-ended project that calls on their skills in analysis, critical thinking, and engineering and physical science to produce a specified product. This product must conform to appropriate constraints dictated by the customer or applicable standards. The students will work in an engineering team environment to produce the design and communicate the design concepts through written and oral reports.

Relevant Program Outcomes:

1. Ia – Apply critical thinking
2. IIf – Knowledge of engineering science
3. IIg – Ability to analyze and design complex systems
4. IIIc – Ability to design a system or component
5. IIId – Ability to function on teams
6. IIIe – Ability to formulate and solve problems
7. IIIf – Ability to understand professional ethics
8. IIIg – Ability to communicate effectively
9. IIIk – Ability to use tools and techniques for modern engineering Practice

Relationship of Course to Program Outcomes:

Course Objective	Program Outcome								
	Ia	IIf	IIg	IIIc	IIId	IIIe	IIIf	IIIg	IIIk
1	X		X	X		X			X
2	X		X	X		X			X
3		X	X	X			X		
4								X	
5			X	X					
6					X			X	X

EE 498 - Senior Capstone – Parrot Telemetry

Required? Yes

Description: Application of engineering principles to a significant design project. Includes teamwork, written and oral communications, and realistic technical, economic, and public safety requirements.

Prerequisite: Senior standing and consent of instructor.

Textbook: *Capstone Design Class Student Handbook*.

Software: Students will also need to know how to access the class Web page via a Web browser.

Objectives:
1. To be able to determine performance requirements for a design
2. To be able to test a design to validate meeting those requirements
3. To make the design meet the constraints imposed by safety, materials, and related factors.
4. To be able to document the design and test.
5. To be able to make the design interface properly with other hardware and software entities.
6. To be able to communicate the design and validation both orally and in writing.

Topics: Topics covered in this class include:
1. Exercises on defining requirements with the customer.
2. Formal requirements definition.
3. System Concept Review and Preliminary Design Review presentations.
4. Developing design concepts to meet customer needs and constraints.

Meetings: Formal meeting times are Monday 6:00 - 7:00 pm; Friday 2:30 - 3:20 pm. Students meet outside of class as necessary.

Labs: Students may use the Telemetry Lab facilities as necessary for device prototyping.

Contribution to the Professional Component:

The capstone design experience is intended to give the students an opportunity to learn how to organize and execute an open-ended project that calls on their skills in analysis, critical thinking, and engineering and physical science to produce a specified product. This product must conform to appropriate constraints dictated by the customer or applicable standards. The students will work in an engineering team environment to produce the design and communicate the design concepts through written and oral reports.

Relevant Program Outcomes:
1. Ia – Apply critical thinking
2. IIf – Knowledge of engineering science
3. IIg – Ability to analyze and design complex systems
4. IIIc – Ability to design a system or component
5. IIId – Ability to function on teams
6. IIIe – Ability to formulate and solve problems
7. IIIf – Ability to understand professional ethics
8. IIIg – Ability to communicate effectively
9. IIIk – Ability to use tools and techniques for modern engineering Practice

Relationship of Course to Program Outcomes: