

APPENDIX I

B. Course Syllabi

Core Courses in the Computer Engineering Curriculum

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CENG 244/244L: Introduction to Digital Systems

CATALOG DATA:
CENG 244/244A – Introduction to Digital Systems: (3-1) 4 Credits. Prerequisite: Completion of college algebra or equivalent. This course is designed to provide Computer Engineering, Electrical Engineering, and Computer Science students with an understanding of the basic concepts of digital systems and their hardware implementation. Topics covered include combinational logic circuits, sequential logic circuits, and CPU control.

TEXTBOOK:

COORDINATOR:
Dr. Larry A. Simonson, Professor

GOALS:
The objective of this course is to provide students with an understanding of the basic concepts associated with the analysis and design of combinational circuits and sequential circuits. Combinational circuits include AND, OR, NOT, NAND and NOR logic gates, adders, code converters, and memory devices. Sequential circuits include flip-flops, registers, counters, and programmable logic devices.

CLASS SCHEDULE:
Lecture: 3 hours per week.
Laboratory: 2 hours per week (1 credit hour).

Topics:
1. Binary Systems:
2. Boolean Algebra:
3. Boolean Function Simplification:
4. Combinational Logic:
5. Sequential Logic:
6. Algorithmic State Machines:

COMPUTER USAGE: Students use Protei 99 SE to program EPROMS and PALs. They also use Protei 99 SE and IsoPro to design circuits for Printed Circuit Board implementation.

OUTCOMES:
Upon completion of this course, students should demonstrate the ability to:

1. Convert numbers between binary and decimal, binary and hexadecimal, and decimal and binary coded decimal notation.
2. Perform the mathematical operations of addition, subtraction, multiplication, and division using signed and unsigned binary numbers.
3. Analyze combinational logic circuits using AND, NOT, OR, NOR, NAND, and XOR logic gates.
4. Design combinational logic circuits using truth tables and Karnaugh maps.
5. Program EPROMs and PALs using Protei software.
6. Analyze sequential logic circuits and prepare timing diagrams using Flip-Flop Characteristic Tables.
7. Design sequential logic circuits using state diagrams, state tables, and Flip-Flop Excitation Tables.
8. Construct logic circuits in the laboratory using student trainer boards.
9. Design and construct digital control and data processing circuits using ASM charts to define digital hardware algorithms.
10. Implement the design of a digital circuit onto a printed circuit board using Protel 99 SE and IsoPro software.

RELATION OF COURSE TO PROGRAM OBJECTIVES:
These course outcomes fulfill the following program objectives:
• (a) An ability to apply knowledge of mathematics, science, and engineering.
• (b) An ability to design and conduct experiments, as well as to analyze and interpret data.
• (c) An ability to design a system, component, or process to meet desired needs.
• (e) An ability to identify, formulate, and solve engineering problems.
• (k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

The following table indicates the relative strengths of each course outcome in addressing the program objectives listed above (on a scale of 1 to 4 where 4 indicates a strong emphasis)

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LABORATORY:
A one credit hour laboratory CENG 244A accompanies this course. The laboratory meets for two hours every week. For the first twelve weeks of the semester, students work on a different assignment each week. After that, students work on a 2-week project. The following laboratories are performed:
1. Logic Gates I
2. Logic Gates II
3. Logic Gates III
4. Adder Circuit
5. Binary Adder/Subtractor Circuit
6. Multiplexers
7. Counter Circuit
8. EPROM Programming
9. Shift Registers
10. PAL Programming
11. Control Implementation
12. Printed Circuit Board Project

PREPARED BY:
Larry A. Simonson, Date: October 31, 2001 (Modified 11/1/2001 and 11/27/01)-

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CENG 342 - DIGITAL SYSTEMS  
Spring Semester 2003

Catalog Data:  CENG 342/342L Digital Systems (3-1) 4 Credits.
Prerequisite: CENG 244. Presents the basic concepts and mathematical tools that are 
applicable to the analysis and design of digital systems, particularly state machines and 
digital processing systems. The VHDL hardware description language is also introduced as a 
design tool.

Coordinator: Brian T. Hemmelman, Asst. Professor of Electrical and Computer Engineering
Room EP 314, Phone 394-1219.
Office Hours are 1:00-2:00 Mon/Wed/Fri and by appointment.

Lecture: Monday/Wednesday/Friday 3:00-3:50 a.m. EP 253
Lab: Tuesday 10:00-11:50 a.m. EP 307
Thursday 10:00-11:50 a.m. EP 307

Objectives:  The primary objective of this course is to educate students on how to design 
digital systems in a timely manner as an individual or member of a team to meet 
specific needs using modern design techniques. Secondary objectives of this 
course are to have students learn to communicate their work effectively, to learn 
how to stay current in a rapidly changing field, and to understand the ethical and 
moral ramifications of their design work.

Topics:  
(1) Programmable Logic Devices
(2) VHDL Syntax
(3) VHDL Implementation Of Combinational Building Blocks
(4) VHDL Implementation Of Sequential Circuits
(5) Tri-State Logic
(6) Review of State Machine Operation and Design
(7) VHDL Implementation Of State Machines
(8) Functions
(9) Procedures
(10) Overloading
(11) Arithmetic Circuits
(12) VHDL Implementation Of Arithmetic Circuits
(13) Design Hierarchy
(14) Introduction To Microcontrollers And Microprocessors
(15) VHDL Implementation of Microcontrollers And Microprocessors
(16) Assembly Language

Computer Use:  Simulation and Synthesis of VHDL Code with Xilinx ISE and/or ModelSim 
Microcoding and Assembly Language Programming for Microcontrollers.

Outcomes:  Upon completion of this course, students should demonstrate the ability to:
1. Fully understand the fundamental combinational building blocks and how to design 
and implement them with VHDL.
2. Fully understand the fundamental sequential building blocks and how to design and 
implement them with VHDL.
3. Understand the internal structure of PALs, CPLDs, and FPGAs and how the internal 
architectures of the various chip families affect design performance.
4. Understand the difference between Moore and Mealy machine performance and be 
able to design and implement any state machine manually or with VHDL using 
binary-encoding or one-hot encoding.
5. Understand how various arithmetic circuits work and how to design and implement 
them with VHDL.
6. Understand how to link various digital building blocks to create a larger hierarchical design.
7. Understand the core pieces of a digital processor and how to design and implement them with VHDL.
8. Understand at a system level how a digital processor works and how to design and implement a processor with VHDL.
9. Understand the link between hardware architecture, instruction sets, and software languages.
10. Understand how to debug a discrete design or debug a VHDL design.
11. Document and effectively communicate the details of their work in written lab reports.

Relation of Course to Program Outcomes:
These course outcomes fulfill the following program objectives:

(a) An ability to apply knowledge of mathematics, science, and engineering.
(b) An ability to design and conduct experiments, as well as to analyze and interpret data.
(c) An ability to design a system, component, or process to meet desired needs.
(d) An ability to function on multi-disciplinary teams.
(e) An ability to identify, formulate, and solve engineering problems.
(f) An understanding of professional and ethical responsibility.
(g) An ability to communicate effectively.
(h) The broad education necessary to understand the impact of engineering solutions in a global and societal context.
(i) A recognition of the need for, and an ability to engage in life-long learning.
(j) A knowledge of contemporary issues.
(k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

The following table indicates the relative strengths of each course outcome in addressing the program objectives listed above (on a scale of 1 to 4 where 4 indicates a strong emphasis).

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Lab Projects: A number of VHDL design projects will be assigned as laboratory projects emphasizing the topics covered in class. Lab reports will be required for all laboratory projects.

Contribution of Course to Professional Component: Course content address approximately 50% engineering science and 50% engineering design.

1. **CENG 464 Computer Engineering Design I**
2. Required
3. **CENG 464 COMPUTER ENGINEERING DESIGN I**
   (2-0) 2 credit. Prerequisites: CENG 342, EE 320. Prerequisite or corequisite: EE 311, EE 312, CSC 470, and ENGL 289. This course will focus on the design process and culminate with the faculty approval of design projects (including schematics and parts list) for CENG 465. Typical topics included are the development of a product mission statement, identification of the customer and customer needs, development of target specifications, consideration of alternate designs using a decision matrix, project management techniques, legal and ethical issues, FCC verification and certification, use of probability and statistics for reliable design, interpretation of data sheets, and component selection. (Design content - two (2) credits)
4. Prerequisites: CENG 342, EE 320. Prerequisite or corequisite: EE 311, EE 312, CSC 470, and ENGL 289
5. No Textbook
6. The goal of this course is to provide students with the working knowledge of practical design issues, project management, issues of professionalism, and prototype development.
7. Discussion of course goals, class logistics, and use of logbook
   Discussion of project possibilities and presentations by project sponsors
   Design Background
   Teaming
   Data Sheets
   Project Management Tools
   PCB Layout, using the circuit board prototyping machine
   Professionalism and Ethics
   Standards and Certification
   Intellectual Property: patents
   Product Liability
   Design Resources
8. One hour per week lecture with an open lab to work on the project.
9. Engineering Design
10. Upon completion of this course, students should demonstrate the ability to:
    1. Begin a design project by writing a mission statement, developing an objectives tree, consider alternative solutions, and choose a solution using a matrix comparison technique.
    2. Use data sheets- understanding the types (product review, advance information, preliminary information, and definitive), terms (e.g. typical, min, max, absolute max), and issues of probability and statistics for reliable design.
    3. Use project management tools such as Gantt Charts created with MS Project.
    4. Work effectively in teams.
    5. Use appropriate prototyping techniques such as breadboards, wirewrap, protoboards, surface mount, programmable chips, and PCB layout and fabrication.
    6. Understand concepts of professionalism and ethics.
    7. Include issues of standards and certification in project design.
    8. Include issues of intellectual property in project design.
    9. Include issues of product liability and social responsibility in project design.
   10. Use design resources such as professional journals, trade journals, catalogs, and the internet in project design.
11. Communicate the project design effectively.
12. Test, debug, and verify that the design meets the desired specifications.

**RELATION OF COURSE TO PROGRAM OBJECTIVES:**
These course outcomes fulfill the following program objectives:
(a) An ability to apply knowledge of mathematics, science, and engineering.
(b) An ability to design and conduct experiments, as well as to analyze and interpret data.
(c) An ability to design a system, component, or process to meet desired needs.
(d) An ability to function on multi-disciplinary teams.
(e) An ability to identify, formulate, and solve engineering problems.
(f) An understanding of professional and ethical responsibility.
(g) An ability to communicate effectively.
(h) The broad education necessary to understand the impact of engineering solutions in a global and societal context.
(i) A recognition of the need for, and an ability to engage in life-long learning.
(j) A knowledge of contemporary issues.
(k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

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**PREPARED BY:**
Michael J. Batchelder, Date: August 30, 2002  (updated January 12, 2004)
1. **CENG 465 Computer Engineering Design II**

2. Required

3. **CENG 465 COMPUTER ENGINEERING DESIGN II**
   (2-0) 2 credits. Prerequisite: CENG 464. The course requires students to conduct their own design projects in a simulated industrial environment. Requirements include detailed laboratory notebook, periodic written and oral progress reports, and a written and oral presentation of a final project report. (Design content - two (2) credits)

4. Prerequisite: CENG 464

5. No Textbook

6. The goal of this course is to provide students with the working knowledge of practical design issues, project management, issues of professionalism, and prototype development.

7. No new topics are included – students complete their design projects.

8. The class meets every third week for coordination and progress reports. Design teams are expected to meet regularly (typically weekly) with their faculty mentors. A midterm design review and a video taped final presentation are required for each project team.

9. Engineering Design

10. Upon completion of this course, students should demonstrate the ability to:
   1. Begin a design project by writing a mission statement, developing an objectives tree, consider alternative solutions, and choose a solution using a matrix comparison technique.
   2. Use data sheets understanding the types (product review, advance information, preliminary information, and definitive), terms (e.g. typical, min, max, absolute max), and issues of specsmsmanship.
   3. Use project management tools such as Gantt Charts created with MS Project.
   4. Work effectively in teams.
   5. Use appropriate prototyping techniques such as breadboards, wirewrap, protoboards, surface mount, programmable chips, and PCB layout and fabrication.
   6. Understand concepts of professionalism and ethics.
   7. Include issues of standards and certification in project design.
   8. Include issues of intellectual property issues in project design.
   9. Include issues of product liability and social responsibility in project design.
   10. Use design resources such as professional journals, trade journals, catalogs, and the internet in project design.
   11. Communicate the project design effectively.
   12. Test, debug, and verify that the design meets the desired specifications.

**RELATION OF COURSE TO PROGRAM OBJECTIVES:**

These course outcomes fulfill the following program objectives:

a) An ability to apply knowledge of mathematics, science, and engineering.

b) An ability to design and conduct experiments, as well as to analyze and interpret data.
c) An ability to design a system, component, or process to meet desired needs.
d) An ability to function on multi-disciplinary teams.
e) An ability to identify, formulate, and solve engineering problems.
f) An understanding of professional and ethical responsibility.
g) An ability to communicate effectively.
h) The broad education necessary to understand the impact of engineering solutions in a global and societal context.
i) A recognition of the need for, and an ability to engage in life-long learning.
j) A knowledge of contemporary issues.
k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

The following table indicates the relative strengths of each course outcome in addressing the program objectives listed above (on a scale of 1 to 4 where 4 indicates a strong emphasis).

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Prepared By:
Michael J. Batchelder, Date: August 30, 2002 (updated January 7, 2004)
EE 220/220L: Introduction to Electrical Engineering I
(Course is required for both EE and CENG majors.)

CATALOG DATA:
EE 220/220L – Introduction to Electrical Engineering I: (3-1) 4 Credits. Prerequisites: GE 115 or equivalent, MATH 125 completed with a grade of “C” or better, MATH 321 completed or concurrent. This course is designed to provide the electrical engineering student with an understanding of the basic concepts of the profession. Topics covered include resistive circuits, transient circuits, and sinusoidal analysis. Students also investigate essential principles by conducting laboratory experiments related to the topics studied in the classroom. P-Spice is used to analyze electrical circuits using personal computers.

COORDINATOR: Dr. Thomas P. Montoya, Assistant Professor

GOALS: The objective of this course is to provide students with the working knowledge of the fundamentals of electrical engineering. A particular emphasis is made on DC, transient, and AC steady-state circuit analysis.

CLASS SCHEDULE: Lecture: 3 hours per week. Laboratory: 2 hours every week (1 credit hour).

Topics:
- DC Circuits:
- Basic Laws:
- Methods of Analysis:
- Circuit Theorems:
- Operational Amplifiers:
- Capacitors and Inductors:
- First-Order Circuits:
- Second-order Circuits:
- Sinusoids and Phasors:
- Sinusoidal Steady-State Analysis:
- AC Power Analysis:

COMPUTER USAGE:
Students use circuit simulation software (such as PSpice) to analyze simple circuits containing current & voltage sources, resistors, capacitors, inductors, operational amplifiers, and semiconductor devices such as BJTs. Also, students are encouraged to use computer programs for mathematics and graphing (e.g., MS Excel, MathCad, MATLAB).

LABORATORY:
A one credit hour laboratory EE 211L accompanies this course. The laboratory meets for two hours every week for a total of 13 laboratories during the semester. The students use basic measurement equipment in the labs including the power supply, digital multimeter, function generator and oscilloscope. All the circuits are breadboarded. In the pre-laboratory work, the students typically analyze the circuits to familiarize themselves with the upcoming lab and often are asked to verify their solutions using PSpice.

OUTCOMES: Upon completion of this course, students should demonstrate the ability to:
1. Understand, apply, and use the definitions of and the SI units for charge, current, voltage, energy, and power.
2. Apply Ohm’s Law to calculate voltages, currents, and impedances/resistances for AC and DC circuits.
3. Understand and calculate equivalent capacitances, inductances, resistances, and impedances for series, parallel, Wye, and Delta connected resistors, capacitors, and inductors.
4. Understand and apply the voltage and current division rules to AC and DC circuits.
5. Understand and apply Kirchoff's Laws, including Nodal and Mesh analysis, to AC and DC circuits.
6. Understand and apply the principles of linearity and superposition to AC and DC circuits.
7. Understand and calculate the Thevenin and Norton equivalents for AC and DC circuits.
8. Analyze and design simple operational amplifier circuits.
9. Understand the properties of capacitors and inductors and apply the current-voltage relationships of capacitors and inductors.
10. Analyze natural and step response of first order circuits (series RC and RL)
11. Analyze natural and step response of second order circuits (series and parallel RLC)
12. Understand, apply, and use phasors for sinusoidal steady-state AC circuit analysis.
13. Understand and calculate apparent, complex, instantaneous, and average power, effective or RMS voltages and currents, power factor, and power factor correction for AC circuits.
14. Use PSpice to model/simulate simple DC, transient, and AC circuits.
15. Use basic laboratory measurement equipment including the power supplies, digital multimeters, function generators, and oscilloscopes to conduct experiments.
16. Understand and use a laboratory notebook for documenting experiments and writing technical reports.

RELATION OF COURSE TO PROGRAM OBJECTIVES:
These course outcomes fulfill the following program objectives:
(a) An ability to apply knowledge of mathematics, science, and engineering.
(b) An ability to design and conduct experiments, as well as to analyze and interpret data.
(c) An ability to design a system, component, or process to meet desired needs.
(d) An ability to function on multi-disciplinary teams.
(e) An ability to identify, formulate, and solve engineering problems.
(f) An understanding of professional and ethical responsibility.
(g) An ability to communicate effectively.
(h) The broad education necessary to understand the impact of engineering solutions in a global and societal context.
(i) A recognition of the need for, and an ability to engage in life-long learning.
(j) A knowledge of contemporary issues.
(k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

The following table indicates the relative strengths of each course outcome in addressing the program objectives listed above (on a scale of 1 to 4 where 4 indicates a strong emphasis).

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Contribution of Course to Professional Component: Course content address approximately 75% engineering science and 25% engineering design.

PREPARED BY: Thomas P. Montoya, Date: August 25, 2003

110
EE 221/221L: Introduction to Electrical Engineering II
(Course is required for both EE and CENG majors.)

CATALOG DATA:
EE 211/211L – Introduction to Electrical Engineering II: (3-1) 4 Credits. Prerequisites: EE 211 completed with a grade of “C” or better, MATH 321. This course is a continuation of the material covered in EE 211. Topics covered include: balanced three phase circuits, frequency response, two-port networks, Fourier series, Fourier transforms, and Laplace transforms. Students also investigate essential principles by conducting laboratory experiments related to the topics studied in the classroom. PSpice is used to analyze electrical circuits using personal computers and MATLAB will be used in systems analysis.


INSTRUCTOR: Larry Meiners
GOALS: The objective of this course is to provide students with the working knowledge of the fundamentals of electrical engineering. A particular emphasis is placed on Laplace and Fourier transforms.

CLASS SCHEDULE: Lecture: 3 hours per week. Laboratory: 2 hours every week (1 credit hour).

Topics:
- Three-Phase Circuits:
- Magnetically Coupled Circuits:
- Frequency Response:
- Laplace Transforms:
- Fourier Series:
- Fourier Transform:
- Two-Port Networks:

COMPUTER USAGE: Students use circuit simulation software (such as Pspice and MATLAB) to analyze simple circuits.

LABORATORY:
A one credit hour laboratory EE 212L accompanies this course. The laboratory meets for two hours every week for a total of 10 laboratories during the semester. The following laboratories are performed:
1. Single Phase Power Measurement and Power Factor Correction
2. Three Phase Power Measurement and Power Factor Correction
3. Using Laplace Techniques to Solve First Order Circuits
4. Step Response of RLC Series Circuits Using Laplace Techniques
5. Transfer Function and the Sinusoidal Steady-State
6. Frequency Response of an Op-Amp Circuit
7. Frequency Response of an RLC Parallel Circuit
8. Two-Port Networks
9. Parallel Connection of Two-Port Networks
10. Fourier Series – a) Determining the coefficients and b) Verifying with PSpice
11. The students use basic measurement equipment in the labs including the power supply, digital multimeter, function generator, and oscilloscope. All the circuits are breadboarded. In the pre-laboratory work, the students typically analyze the circuits to familiarize themselves with the upcoming lab and often are asked to verify their solutions using PSpice.

OUTCOMES:
Upon completion of this course, students should demonstrate the ability to:
1. Analyze single phase ac circuits and calculate average and rms quantities, apparent power and power factor, and complex power.
2. Analyze balanced 3-phase ac circuits and calculate average and rms quantities, apparent power and power factor, and complex power.
3. Analyze mutually coupled inductors and calculate energy in coupled inductors.
4. Perform mesh and nodal analysis on circuits with coupled inductance.
5. Apply the concept of an ideal transformer to find approximate solutions to transformer problems.
6. Be able to construct approximate Bode plots for amplitude and phase response of linear systems.
7. Be able to calculate the transfer functions and plot the frequency and phase response of passive and active filters.
8. Be able to calculate the Laplace transforms and inverse Laplace transforms of the basic input functions.
9. Be able to apply the Laplace transform technique to circuits, which include initial conditions, and solve for the time domain response.
10. Be able to solve for the transfer function of a system response using Laplace transforms.
11. Be able to calculate the coefficients of the trigonometric Fourier series for periodic functions.
12. Be able to calculate the coefficients of the exponential Fourier series for periodic functions.
13. Be able to calculate the response of a linear system to an input signal, which is a periodic function.
14. Be able to calculate the Fourier transforms and inverse Fourier transforms of non-periodic functions.
15. Be able to calculate the response of a linear system to an input signal, which is a non-periodic pulse.
16. Be able to calculate y-parameters, z-parameters, hybrid parameters, and transmission parameters of two-port networks, and perform transformations between the various representations.

**Relation of Course to Program Objectives:**
These course outcomes fulfill the following program objectives:

(a) An ability to apply knowledge of mathematics, science, and engineering.
(b) An ability to design and conduct experiments, as well as to analyze and interpret data.
(c) An ability to design a system, component, or process to meet desired needs.
(d) An ability to function on multi-disciplinary teams.
(e) An ability to identify, formulate, and solve engineering problems.
(f) An understanding of professional and ethical responsibility.
(g) An ability to communicate effectively.
(k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

The following table indicates the relative strengths of each course outcome in addressing the program objectives listed above (on a scale of 1 to 4 where 4 indicates a strong emphasis).

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**Contribution of Course to Professional Component:** Course content address approximately 75% engineering science and 25% engineering design.

**Prepared By:** Larry Meiners  Date: December 16, 2003
EE 311/311L: Systems

Catalog Data:
EE311 – Systems: (3-0.5) 3.5 Credits
Prerequisite: EE 212 completed with a grade of “C” or better, EM 219 completed or concurrent. Mathematical, topological, and circuit models of electro-systems, such as electromagnetic, electromechanical, electrochemical, etc.
Required for Electrical and Computer Engineers

Textbook:

Coordinator:
Elaine Linde, Instructor

Laboratory:
Laboratory assignments are given to complement the lectures and use Matlab® as the primary simulation tool.

Professional Component:
Engineering Science – 3.5 cr. – 57% Engineering Design – 43%

Topics:
- Modeling of Systems (Frequency Domain):
- Time Response:
- Reduction of Multiple Subsystems:
- Transient Analysis:
- Stability Analysis:
- Steady State Errors:
- Root Locus Techniques
- Frequency Response Techniques
- Modeling of Systems (time domain)

Course Outcomes:
1. Use techniques such as linearization, dynamic response, Laplace transforms to model systems.
2. Understand and use block diagrams to represent systems.
3. Understand and use signal flow graphs to represent systems.
4. Determine the sensitivity of the output to changes in the transfer function.
5. Determine how disturbances affect the output of a system.
6. Analyze the performance of a system in the time domain.
7. Analyze the performance of a system in the frequency domain.
8. Analyze the stability of a linear control system.
10. Understand the principles of a PID (proportional, integral, derivative) controller.
11. Use frequency methods (Frequency response, Bode, Nyquist) to analyze feedback control systems.
12. Understand and use state variable models to represent a system.
13. Be comfortable using Matlab® as an analytical tool.
**RELATION OF COURSE TO PROGRAM OUTCOMES:**

These course outcomes fulfill the following program outcome:

(a) An ability to apply knowledge of mathematics, science, and engineering.
(b) An ability to design and conduct experiments, as well as to analyze and interpret data.
(c) An ability to design a system, component, or process to meet desired needs.
(d) An ability to function on multi-disciplinary teams
(e) An ability to identify, formulate, and solve engineering problems.
(f) An understanding of professional and ethical responsibility
(g) An ability to communicate effectively
(h) The broad education necessary to understand the impact of engineering solutions in a global and societal context
(i) A recognition of the need for, and an ability to engage in life-long learning
(j) A knowledge of contemporary issues
(k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

The following table indicates the relative strengths of each course outcome in addressing the program outcomes listed above (on a scale of 0 to 4 where 4 indicates a strong emphasis).

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**PREPARED BY:**
Elaine Linde, Date: August 20, 2003
Revised for ABET requirement May 13, 2004
EE 312/312A: Signals

CATALOG DATA:
EE 312/312A – Signals: (3-0.5) 3.5 Credits. Prerequisites: EE212 completed with a grade of “C” or better. Characterization of signals; the complex plane as a representative of the transient and frequency responses, continuous and discrete signal processing.

TEXTBOOK:

COORDINATOR:
Dr. Neil Chamberlain, Professor

GOALS:
The objective of this course is to provide students a basic understanding of how to analyze and characterize continuous-time and discrete-time signals and systems in both the time domain (convolution and difference/differential equation representations) and in the frequency domain (Fourier series/transform and analysis, discrete-time Fourier transform (DTFT) and analysis, discrete Fourier transform (DFT) and analysis, and z-transform and analysis).

CLASS SCHEDULE:
Lecture: 3 hours per week.
Laboratory: 1 hour every week (0.5 credit hour).

Topics:
- Fundamental Concepts
- Time-domain Analysis
- Fourier Series (FS) and Fourier Transform (FT)
- Frequency-Domain Analysis
- Applications
- z-Transform and Discrete-Time Systems:

COMPUTER USAGE:
Students heavily use MATLAB to study and implement techniques, analyze signals and systems, and design systems covered in the text.

LABORATORY PROJECTS:
A half credit hour laboratory EE 312A accompanies this course. The laboratory projects have a heavy emphasis on computer analysis and simulation using MATLAB. Some laboratory projects involve the use of basic measurement equipment (e.g., power supplies, digital multimeters, function generators, and oscilloscopes). There are no scheduled laboratories.

OUTCOMES:
Upon completion of this course, students should demonstrate the ability to:
1. Understand the basic classification of signals, such as deterministic / random, discrete-time (DT) / continuous-time (CT), periodicity, even / oddness, real / complex, etc.
2. Calculate and compute basic parameters of signals, such as energy, power, mean, rms value, peak value, rise-time, bandwidth, and be able to classify signals based on the parameters.
3. Understand and apply various operations on the dependent variables of signals (amplitude scaling, addition, differentiation, integration) and on the independent variables of signals (time scaling, time shifting, time reversing).
4. Understand elementary signals, such as sinusoids, exponentials, unit steps, impulses, and be able to mathematically manipulate them and represent them in a computer program.
5. Understand the properties of linear time invariant (LTI) systems and their relation to CT and DT signals.
6. Understand and apply the concept of impulse response. Be able to calculate and compute the output of an LTI system by convolution for both CT and DT signals.
7. Calculate the Fourier series for a continuous-time periodic signal, identify harmonics, calculate the power spectral density of a period signal, and calculate harmonic distortion.
8. Use the Fourier transform to calculate the frequency response of various signals and systems and calculate the output of a linear system, understand and apply various Fourier transform properties, compute the discrete Fourier transform and apply the fast Fourier transform.
9. Understand and apply the properties of ideal filters to find the output of the filter to input signals, design active analog filters and simple digital filters.
10. Understand and be to apply the principles of sampling and resulting consequences in the frequency domain.
11. Calculate and compute the output of linear difference equations by recursion.
12. Calculate both the forward and inverse z-transforms of DT signals and systems, including the use of the various properties of the z-transform.
13. Use MATLAB as a computational tool to analyze, manipulate, and display DT signals and to simulate CT signals. Use MATLAB as a tool to simulate CT and DT systems as they relate to signal processing. Be able to use specific tools (filter design) and write functions and scripts.

**Relation of Course to Program Outcomes**

The following table indicates the relative strengths of each course outcome in addressing the program objectives listed above (on a scale of 1 to 4 where 4 indicates a strong emphasis).

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**Contribution of Course to Professional Component:**

Course content address approximately 57% engineering science and 43% engineering design.

**Prepared By:** Neil F. Chamberlain, Date: April 30, 2003
EE 320/321L: Electronics I
(Course is required for both EE and CENG majors)

CATALOG DATA:
EE 320/320L – Electronics I: (3-1) 4 Credits Pre- or co-requisite: EE 220. Presents concepts of electronic devices and circuits including modeling of semiconductor devices, analysis and design of transistor biasing circuits, and analysis and design of linear amplifiers. Use of computer simulation tools and breadboarding as part of the circuit design process is emphasized. Students are introduced to methods of designing circuits, which still meet specifications even when there are statistical variations in the component values.

TEXTBOOK:

INSTRUCTOR: Larry Meiners

GOALS: The objective of this course is to provide students with the working knowledge required to analyze and design basic diode and transistor circuits. Diode circuits include DC and small signal, voltage rectification and limiting and clamping circuits. Transistor circuits include BJT (bipolar junction transistors) and MOSFET (metal oxide semiconductor field effect transistor) technologies. Large signal and small signal analysis is covered as well as the frequency response of selected transistor amplifier circuits.

CLASS SCHEDULE:
Lecture: 3 hours per week.
Laboratory: 3 hours every two weeks (1 credit hour).

Topics:
• Diodes
• Bipolar Junction Transistors
• Field Effect Transistors
• Frequency Response of Amplifiers.
• Multiple Transistor Circuits: current mirrors, logic gates.

COMPUTER USAGE:
Students use their favorite circuit simulation software (such as B2Spice or PSPICE) to analyze circuits containing semiconductor devices such as diodes, BJTs and FETs.

OUTCOMES:
Upon completion of this course, students should demonstrate the ability to:
1. Draw the characteristic curves for the diode, BJT and MOSFET, to identify regions of operation, and to construct linear circuit approximations for each.
2. Complete simple load line analyses for diode and transistor circuits.
3. Design and analyze common rectifier circuits such as half cycle, full cycle and bridge rectifiers and compute the diode currents and peak inverse voltage (PIV) for the circuit with a resistive load.
4. Bias a diode, BJT or MOSFET device to achieve a desired quiescent operating point.
5. Linearize non-linear devices (diodes and transistors) and apply small signal models where appropriate.
6. Design and analyze common transistor amplifier configurations for BJTs (such as common emitter, common base and common collector) and for FETs (such as common source and source follower).
7. Know advantages and disadvantages of common transistor amplifier configurations.
8. Design and analyze simple digital circuits using diodes, BJTs or MOSFETs.
9. Compute the frequency response of basic transistor amplifier circuits.
10. Use SPICE to analyze circuits that include semiconductor devices such as diodes, BJTs and FETs.
11. Construct basic diode circuits in the laboratory (such as rectifiers) and make AC and DC voltage and current measurements.
12. Construct basic BJT transistor circuits in the laboratory (such as small signal amplifiers) and make AC and DC voltage and current measurements.
13. Construct basic FET transistor circuits in the laboratory (such as small signal amplifiers) and make AC and DC voltage and current measurements.

**RELATION OF COURSE OUTCOMES TO PROGRAM OBJECTIVES:**

These course outcomes fulfill the following program objectives:

- (a) An ability to apply knowledge of mathematics, science, and engineering.
- (b) An ability to design and conduct experiments, as well as to analyze and interpret data.
- (c) An ability to design a system, component, or process to meet desired needs.
- (e) An ability to identify, formulate, and solve engineering problems.
- (k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

The following table indicates the relative strengths of each course outcome in addressing the program objectives listed above (on a scale of 1 to 4 where 4 indicates a strong emphasis):

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**LABORATORY:**

A one credit hour laboratory EE 320L accompanies this course. The laboratory meets for three hours every other week for a total of six laboratories during the semester. The following six laboratories are performed:

1) PN Diodes
   a) Diode measurement with an ohmmeter.
   b) Characterization of a silicon diode.
   c) Ideal rectification.
2) Diode Circuits
   a) Zener diode.
   b) Full-cycle bridge rectifier with LEDs.
   c) Half-cycle peak rectification
3) Bipolar Junction Transistor Bias Circuits
   a) An npn BJT circuit.
   b) A BJT inverter.
   c) A pnp BJT inverter
4) Common Emitter Amplifier
5) Emitter-Follower Amplifier
6) MOSFETs

The students use basic measurement equipment in the labs including the power supply, digital multimeter, function generator and oscilloscope. All the circuits are breadboarded. In the pre-laboratory work, the students typically analyze the circuits to familiarize themselves with the upcoming lab and often are asked to verify their solutions using SPICE.

**CONTRIBUTION OF COURSE TO PROFESSIONAL COMPONENT:** Course content address approximately 50% engineering science and 50% engineering design.

**PREPARED BY:** Larry Meiners, Date: Aug. 26, 2003
ME/EE 351/351L: Mechatronics and Measurement Systems

CATALOG DATA:
ME/EE351 – Mechatronic and Measurement Systems: (3-1) 4 Credits
Co-requisites: EE 220 (formerly EE211) and CSC 150. This course will encompass general measurement techniques found in Mechanical and Electrical Engineering. These include measurement of force, strain, frequency, pressure, flow rates, and temperatures. Elements of signal conditioning and data acquisition will be introduced. In addition, the course will have a Mechatronics approach reflected in the combined applications of electronic, mechanical, and control systems. EE 351 and ME 351 are cross-listed.
Required for all Electrical, Computer and Mechanical Engineers.

TEXTBOOK AND MATERIALS:
Project Management and Teamwork. Karl A. Smith, 2000
PEL4, Experimental Circuit Board, 1 per team, sold in bookstore

COORDINATORS:
Dr. Kalanovic, Associate Professor
Elaine Linde, Instructor

PROFESSIONAL COMPONENT:
Engineering Design, (60%) Laboratory Experience (30%), Oral and Written Communications (10%)

TOPICS:
• Introduction to Mechatronics:
• Measurement Fundamentals:
• Electrical Circuits and Components:
• Semiconductor Electronics:
• System Response:
• Analog Signal Processing Using Operational Amplifiers
• Digital Circuits and Systems
• Data Acquisition
• Sensors
• Actuators

LABORATORY:
1. Analog Inputs
2. Temperature Sensor
3. First Order Response
4. Brainstorming on Free Project and Robot Design
5. DC Motor Control
6. Frequency Domain Analysis
7. Robot Sensor and Switch Implementation
8. DC Robot Motor Modification and H-bridge Implementation
9. Sensors
10. Actuators
11. Projects and Robot

COURSE OUTCOMES:
(a) Apply the basic methodology of electronic measurements.
(b) Apply the basics of signal conditioning.
(c) Perform basic computer interfacing for measurements and control.
(d) Select a transducer for standard measurements (temperature, flow, pressure, strain, displacement, velocity and acceleration etc.)
(e) Select an electronically controlled actuator.
(f) Apply the process of design of a mechatronic system.
(g) Implement a mechatronic system.
(h) Present a project via a creative video.
(i) Demonstrate the fundamentals of working in a team.
(j) Deal with issues that arise within a team such as conflict resolution, communication, trust development, and mutual accountability.

RELATION OF COURSE TO PROGRAM OUTCOMES: (ELECTRICAL AND COMPUTER ENG.)

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RELATION OF COURSE OUTCOMES TO PROGRAM OUTCOMES: (MECHANICAL ENG.)

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* (For a list of Program Objectives and Program Outcomes, please go to http://www.hpcnet.org/assessment)

PREPARED BY: Elaine Linde and Dr. Vojislav Kalanovic, Date: August 20, 2003
REVISED: Elaine Linde and Dr. Vojislav Kalanovic, Date: January 5, 2004
Revised for ABET requirement May 13, 2004

120
CSC 150 COMPUTER SCIENCE I
(Required Course)

CATALOG DATA:
CSC 150/150L COMPUTER SCIENCE I
(2-1) 3 credits. Prerequisite and corequisite: MATH 123. An introduction to computer programming. Focus on problem solving, algorithm development, design, and programming concepts. Topics include sequence, selection, repetition, functions, and arrays.

TEXTBOOK:
C++ Programming: From Problem Analysis to Program Design., D.S. Malik, Course Technology, 2002. Additional support material at:

INSTRUCTORS:
Val Manes McLaury 309 394-6079 val.manes@sdsmt.edu
Roger Schrader McLaury 214 394-1210 roger.schrader@sdsmt.edu
Mike Waldron McLaury 311A 355-3624 michael.waldron@gold.sdsmt.edu

TOPICS:
1. Problem solving
2. Algorithm development
3. Basic language syntax
4. Data Types
5. Control structures
6. Procedures and functions

OBJECTIVES: The primary objective of this course is to introduce students to the fundamentals of computer programming, emphasizing logical development of solutions and correct use of a programming language (C++). The material provides a foundation for all programming-oriented courses, covering such topics as algorithm development, data types, control structures and syntax of a programming language. The principles taught are applicable to most programming languages, including the macro facilities of office and design software.

PROFESSIONAL COMPONENT:
Basic Science: 3 credits or 100%

COURSE OUTCOMES: To successfully complete the course, the student will be able to:
1. Identify the differences between C++ basic data types and select types appropriate to a purpose.
2. Select correct and appropriate C++ identifier names.
3. Write syntactically correct C++ statements.
4. Use correct input/output methods appropriate to data type and format.
5. Properly use if...else and switch constructs. Understand and use explicit Boolean values, as well as the implied Boolean evaluation of any value or expression.
6. Use relational expressions to arrive at a Boolean value. Use Boolean operators to construct complex relational expressions.
7. Understand and implement the three types of looping mechanisms: for, while, do...while.
8. Understand and use functions. Identify when arguments are passed by value and by reference; understand the uses and effects of each method. Differentiate between valued and non-valued functions. Identify the lifetime and scope of automatic, static and global variables. Write correct function prototypes, definitions, and calls to the functions.
9. Declare, initialize, and manipulate one-dimensional and two-dimensional arrays. Use arrays as function parameters. Understand the effects of accessing memory beyond an array's allocated memory.
10. Declare, initialize and manipulate C-style strings. Use string functions. Correctly use strings as function arguments.
11. Implement simple search algorithms. Understand the limitations and efficiency of binary search.
12. Implement simple sorting algorithms.
13. Correctly access text files for reading and writing operations. Be able to test for successful file opening, handle errors and test for end of file. Read/write formatted data.
14. Use command line arguments to control program operation.
15. Understand and implement structures. Correctly access member data from an instance of a structure. Use an array of structures to store complex data.
16. Be familiar with the concept of classes. Explain how classes are distinguished from and are similar to structures.

RELATIONSHIP OF COURSE TO PROGRAM OUTCOMES:
CSC 150, Computer Science I, meets part of ABET Criterion 3, outcome (a):
(a) Ability to apply knowledge of mathematics, science, and engineering.

Prepared by: Val Manes May, 2004
CSC 250 COMPUTER SCIENCE II

CATALOG DATA:
CSC 250 COMPUTER SCIENCE II
(4-0) 4 credits. Prerequisite: CSC 150. Problem solving, algorithm design, standards of program style, debugging and testing. Extension of the control structures and data structures of the high-level language introduced in CSC 150. Elementary data structures and basic algorithms that include sorting and searching. Topics include more advanced treatment of functions, data types such as arrays and structures, and files.

TEXTBOOK:

INSTRUCTOR:
Roger Schrader, M 214 (394-1210)
Email: roger.schrader@sdsmt.edu

TOPICS:
- recursion
- algorithms & sorting
- dynamic memory allocation
- linked lists
- trees
- queues

OBJECTIVES:
The primary objective of this course is to further enhance a student’s ability to program in a high level language (C++). This course builds on the foundation that was introduced in CSC 150. The material provides the essential background for all upper level programming-oriented courses, covering such topics as problem solving, recursion, algorithm design, data storage, and developing reusable code in a high level language (C摄影).

PROFESSIONAL COMPONENT:
Basic Science: 4 credits or 100%

COURSE OUTCOMES:
A student who successfully completes this course should, at a minimum, be able to:
1) Write syntactically correct C++ statements.
2) Use both text and binary files.
3) Dynamically allocate and use arrays.
4) Use pointers to access data types.
5) Understand function, scope, parameter passing mechanisms, and modularity.
6) Understand the use of classes and structures.
7) Understand the software development cycle.
8) Understand and use recursion to solve complex problems.
9) Develop and use an Abstract Data Type (ADT).
10) Develop and use linked lists using a variety of implementation methods.
    Methods discussed include: singular, circular, doubly linked, and threaded.
11) Develop and use a stack using a variety of implementation methods.
12) Develop and use a queue using a variety of implementation methods.
13) Understand class inheritance.
14) Understand how to compute the efficiency of an algorithm.

RELATIONSHIP OF COURSE TO PROGRAM OUTCOMES:
CSC 250, Computer Science II, meets part of ABET Criterion 3, outcome (a):
   (a) Ability to apply knowledge of mathematics, science, and engineering.

Prepared by:  Roger Schrader       May, 2004
CSC 251 FINITE STRUCTURES
(Required Course)

CATALOG DATA:
CSC 251 FINITE STRUCTURES
(4-0) 4 credits. Prerequisite: Completion of college algebra or Math 115 completed with a grade of "C-" or better or an acceptable score on the Algebra Placement Examination or permission of instructor. Selected topics from Boolean algebra, set theory, congruences, equivalence relations, complexity, graph theory, combinatorics, induction, difference equations, and logic.

TEXTBOOK:

INSTRUCTOR:
Dr. Logar
Office: McLaury 308
Office phone: 394-2471 (main office)
Office hours: Fonnally, 2:00 - 3:00 MWF and other hours by appointment. Whenever my door is open, however, you are welcome to come in for help.
Email: antonette.logar@sdsmt.edu WWW: http://www.hpcnet.org/sdsmt search for Logar, Select CSC 251 Spring 04 from the listing.

TOPICS:
- Boolean algebra
- Set theory
- Congruences
- Equivalence relations
- Complexity
- Graph theory
- Combinatorics
- Induction
- Difference equations
- Logic

OBJECTIVES:
The primary objective of this course is to introduce students to the mathematical foundations of computer science. The material will provide the necessary preparation for successful study of upper level computer science topics such as data structures and analysis of algorithms. The course also facilitates life-long learning in computer science by providing the student with foundational material that continues to be applicable even as the discipline rapidly evolves.

PROFESSIONAL COMPONENT:
Basic Science: 4 credits or 100%

COURSE OUTCOMES: A student who successfully completes this course should, at a minimum, be able to:
1. be able to translate between symbolic logic and English, including quantifiers
2. be able to determine if two logical expressions are equivalent
3. be able to design a minimized combinational Boolean circuit from a description
4. know the fundamental definitions of sets, set operators, and set identities
5. know the properties of functions
6. be able to evaluate single and double summations
7. know the formal definition of Big O and how to apply it to analyze algorithms
8. know the definitions and formulas needed for public key encryption
9. be able to perform fundamental matrix operations such as addition, subtraction, and know the basic properties of matrices (commutative, distributive, associative)
10. be able to construct a direct proof, an indirect proof, a proof by contradiction, and a proof by induction
11. know how to apply basic counting techniques: the sum and product rules, inclusion-exclusion, and the pigeonhole principle
12. be able to apply advanced counting techniques such as computing combinations and permutations
13. be able to compute discrete probabilities
14. be able to solve recurrence relations with various techniques
15. know the fundamental graph and tree definitions and theorems
16. know how to represent a tree and a graph in a computer
17. be able to apply graph search and analysis algorithms
18. be able to apply tree traversal and search algorithms
19. be able to create a Huffman tree for code compression
20. be able to build a minimal spanning tree

RELATIONSHIP OF COURSE TO PROGRAM OUTCOMES:
CSC 251, Finite Structures, meets part of ABET Criterion 3, outcome (a):
(a) Ability to apply knowledge of mathematics, science, and engineering.

Prepared by: Dr. Logar May, 2004
CSC 300 DATA STRUCTURES
(Required Course)

CATALOG DATA:
CSC 300 DATA STRUCTURES
(4-0) 4 credits. Prerequisite: CSC 250 and CSC 251. A systematic study of data structures and the accompanying algorithms used in computing problems; structure and use of storage; methods of representing data; techniques for implementing data structures; linear lists; stacks; queues; trees and tree traversal; linked lists; and other structures.

TEXTBOOK:
Data Structures and Algorithm Analysis in C++, Second Edition
(Mark Weiss, Addison-Wesley, 1999)

INSTRUCTOR:
Dr. Weiss
Office: McLaury 315
Phone: 394-6145
Email: john.weiss@sdsmt.edu
Office Hours: MWF 11:00-11:50AM, or by appointment
Grader: TBA

TOPICS:
1) Introduction to algorithm analysis
2) Simple data structures (linked lists, stacks, queues, binary trees)
3) Advanced data structures (height-balanced trees, heaps, graphs)
4) Related algorithms (searching and sorting, hashing, graph algorithms)
5) Advanced topics (greedy methods, dynamic programming, NP-completeness)
6) Advanced C++ topics (templates, inheritance)

OBJECTIVES:
CSC 300 is the third course in a four-semester sequence designed to teach students the fundamentals of problem solving on the computer. This sequence provides students with skills required for computer programming, algorithm development, algorithm analysis, and software development, as well as proficiency in a high-level programming language (C++).

The primary objective of this course is to introduce students to a wide variety of fundamental data structures and associated algorithms. The course material provides a foundation for virtually all upper-level computer science courses.

PROFESSIONAL COMPONENT:
Basic Science: 4 credits or 100%
COURSE OUTCOMES: Upon completion of this course, students will obtain the following outcomes:

- intermediate-level problem solving and algorithm development skills on the computer
- ability to analyze algorithms using big-Oh notation
- understanding of fundamental data structures such as lists, trees, heaps, and graphs
- understanding of fundamental algorithms such as searching, sorting, and hashing
- increased fluency in the high-level programming language C++
- ability to write programs using both procedural and object-oriented paradigms
- ability to use the Linux operating system for software development
- greater understanding of the software development process
- experience working in teams

RELATIONSHIP OF COURSE TO PROGRAM OUTCOMES:
CSC 300, Data Structures, meets part of ABET Criterion 3, outcome (a):
(a) Ability to apply knowledge of mathematics, science, and engineering.

Prepared by: John Weiss May, 2004
CSC 314/314L ASSEMBLY LANGUAGE
(Required Course)

CATALOG DATA:
CSC 314/314L ASSEMBLY LANGUAGE
(2-2) 4 credits. Prerequisite: CSC 250. A thorough introduction to assembly language
programming and processor architecture. A study of low-level programming techniques,
and the layout of a typical computer. The student will gain insight into the memory
layout, registers, run-time stack, and global data segment of a running program. This
course is cross listed with CENG 314/314L. Graduation credit will not be allowed for
both this course and CENG 314/314L.

TEXTBOOK:
“Linux Assembly Language Programming” by Bob Neveln

INSTRUCTOR:
Roger Opp
Office: McLaury 314C
Office hours: 2:30-3:30 MWF
Office phone: 394-6119
e-mail address: roger.opp@sdsmt.edu

TOPICS:
- PC architecture
- input/output
- addressing modes
- branching
- modularity
- bit manipulations
- arrays
- string operations
- interrupts
- mixed-language programs
- macros
- recursion

OBJECTIVES:
- To learn how numerical values are internally represented
- To learn how the PC architecture expedites its performance
- To learn how information enters and exits the PC
- To learn how branching is implemented
- To learn how subprograms are implemented
- To learn about Boolean operations
- To learn how arrays are implemented
- To learn about the special-purpose string operations
- To learn how interrupts are implemented
- To learn how assembly functions can be called from C
• Learn the macro mechanism
• Learn how recursion works

PROFESSIONAL COMPONENT:
Basic Science: 4 credits or 100%

COURSE OUTCOMES
• Be able to specifically answer objective questions regarding two's complement
• Be able to use and explain the various special registers, both in program fragments and in objective questions
• Be able to convert a string of keystrokes into a single value and be able to convert a single value into a string of ASCII codes
• Be able to write code fragments that use branching for high-level loops
• Be able to write and invoke functions
• Be able to use bit-wise logical operations in a program fragment or objective question
• Be able to write code that manipulates an array, such as sorting or searching
• Be able to write code or to answer an objective question concerning string moves, compares, inserts, deletes
• Be able to write code or answer a question about TSR programming
• Be able to write an assembly function in one file and call it from a C function in another file
• Be able to write code that defines and uses a macro
• Be able to write and use a recursive function

RELATIONSHIP OF COURSE TO PROGRAM OUTCOMES:
CSC 314/314L Assembly Language, meets part of ABET Criterion 3, outcome (a):
(a) Ability to apply knowledge of mathematics, science, and engineering.

Prepared by: Roger Opp, May, 2004
CSC 456/456L OPERATING SYSTEMS
(Required Course)

CATALOG DATA:
CSC 456/456L OPERATING SYSTEMS
(3-1) 4 credits. Prerequisites: CSC 314 and CSC 300. A study of the functions and
structures associated with operating systems with respect to process management,
memory management, auxiliary storage management, and processor management. Topics
include concurrent and distributed computing, deadlock, real and virtual memory, job and
processor scheduling, security and protection. Graduation credit will not be allowed for
both this course and CENG 472.

TEXTBOOK:
Wesley, 2002
Optional: Advanced Linux Programming, Mitchell, Oldham and Samuel, New Riders,
2001
Optional: Kernel Projects, Nutt, Addison Wesley, 2001

INSTRUCTOR:
Jeff McGough
Office: M 203A
Phone: 355-3455
Email: jeff.mcgough@sdsmt.edu
Math Dept: M 308
Messages: 394-2471
Home Page: http://www.mcs.sdsmt.edu/mcgough
Teaching Schedule: http://www.mcs.sdsmt.edu/mcgough/teaching/schedule.html
Lecture Hours: 2:00pm-2:50pm, MWF
Lab Hours: 2:00pm-2:50pm, TTh
Office Hours: 10:00am-10:50am MWThF
Room: M310
Course URL: http://www.mcs.sdsmt.edu/mcgough/teaching/fall03/456/index.html
Course Schedule:
http://www.mcs.sdsmt.edu/mcgough/teaching/fall03/456/schedule.html
Course Homework:
http://www.mcs.sdsmt.edu/mcgough/teaching/fall03/456/homework.html

TOPICS:
• concurrent and distributed computing
• deadlock
• real and virtual memory
• job and processor scheduling
• security and protection
OBJECTIVES:
The first objective is to gain an understanding of what an operating system does, how it is designed and how it is implemented. The main concepts of the process abstraction, virtual memory, file systems will be treated in detail. This course describes the critical layer between the underlying hardware and the user applications; for which a thorough understanding is required for software design. A typical student in this class will be graduating at the end of the academic year and entering the job market soon after. This course also aims at transitioning students to the profession. Students will be treated somewhat like students and somewhat like junior employees of a corporation. This means that not all assignments will be as detailed as they are in lower-level classes. You will be expected to ask questions and give your input in the projects; expected to do independent research and resolve incomplete specifications.

PROFESSIONAL COMPONENT:
Basic Science: 4 credits or 100%

COURSE OUTCOMES: A student who successfully completes this course should, at a minimum, be able to:
1. describe what an OS does
2. describe the historical development of OSs and list examples of OSs with particular features
3. describe the OS components, OS services, system calls and the standard system design
4. describe the process abstraction and list the contents of the task structure
5. write code for process creation and control
6. write code for interprocess communication
7. describe threads and their differences from processes
8. describe scheduling concepts, criterion and algorithms
9. define the critical section problem and race conditions
10. describe synchronization hardware and software
11. write code using semaphores
12. define and characterize deadlocks
13. discuss methods for deadlock detection, prevention and avoidance
14. discuss swapping and memory allocation
15. describe paging and segmentation
16. define virtual memory
17. describe demand paging, page replacement and frame allocation
18. describe the file system interface and virtual file system concept
19. discuss directory structures and implementation
20. discuss allocation methods and space management

RELATIONSHIP OF COURSE TO PROGRAM OUTCOMES:
CSC 456, Operating Systems, meets part of ABET Criterion 3, outcome (a):
(a) Ability to apply knowledge of mathematics, science, and engineering.

Prepared by: Jeff McGough May, 2004
CSC 470 SOFTWARE ENGINEERING
(Required Course)

CATALOG DATA:
CSC 470 SOFTWARE ENGINEERING
(3-0) 3 credits. Prerequisites: CSC 300. An introduction to the software engineering
process, including lifecycle phases, problem analysis, specification, project estimation
and resource estimation, design, implementation, testing/maintenance, and project
management. In particular, software validation and verification as well as scheduling and
schedule assessment techniques will be discussed. This course together with CSC 465
form a two-course sequence.

TEXTBOOK:
References:
   5th edition.
3. Joseph Schmuller. SAMS Teach Yourself UML in 24 Hours. SAMS Publishing,

INSTRUCTOR:
Dr. Manuel L. Penaloza
Office: McLaury 312, 394-6077
Office hours: W 9-11am, TR 2-3pm, or by appointment.
e-mail: Manuel.Penaloza@sdsmt.edu
URL: http://www.hpccnet.org/cgi-bin/global/a_bus_card.cgi?SiteID=75239
Class Schedule: Lecture: MWF 3 – 4 PM [McLaury 310]

TOPICS:
- Lifecycle phases
- Problem analysis
- Specification
- Project estimation and resource estimation
- Design
- Implementation
- Testing/Maintenance
- Project management

OBJECTIVES:
1. Understand what software engineering is and why it is important.
2. Understand process models for software requirements engineering, software
development, testing and evolution.
3. Understand a number of testing techniques that are used to discover program
faults
4. Identify the important phases of software development
5. Analyze and model complex software application(s) utilizing OOA/OOD or structural methodologies

PROFESSIONAL COMPONENT:
Basic Science: 3 credits or 100%

COURSE OUTCOMES
Upon completion of this course, students should, at a minimum, will be able to:
1. Determine the important features and activities of the software engineering process.
2. Determine the importance of people, product, project, and process during the development of a software product.
3. Identify and apply quality features to software applications such as reliability, performance, safety, and security.
4. Formulate model representation utilizing Unified Modeling Language = UML.
5. Create and deliver the different documents produced during a software life cycle.
6. Evaluate the various styles of information presentation and know when graphical representation of information is appropriate.
7. Apply the tools that are commonly used in software development.
8. Design and implement software applications utilizing object-oriented and structured or functional methodologies in software development.
9. Determine how to measure software process quality.
10. Implement the strategies, techniques, and tools used in software testing.
11. Determine how to estimate cost and schedule of a software product.
12. Evaluate the importance of software risk analysis and management.
13. Determine how to evaluate the “maturity” of a software process.
14. Determine how to develop software as part of a software team.

RELATIONSHIP OF COURSE TO PROGRAM OUTCOMES:
CSC 470, Software Engineering, meets part of ABET Criterion 3, outcome (a):
(a) Ability to apply knowledge of mathematics, science, and engineering.

Prepared by:
Manuel Penaloza May, 2004
EM 216-Engineering Mechanics – Statics & Dynamics
Spring 2003

Course Description:
Prerequisite: MATH 125 completed with a grade of “C” or better. STATICS: The study of effects of external forces acting on stationary rigid bodies in equilibrium. Frames and machines, friction, centroids and moments of inertia of areas and mass are discussed. DYNAMICS: Newton’s laws of motion are applied to particles and rigid bodies. Topics considered are absolute and relative motion; force, mass, and acceleration (of particles and rigid bodies); work and energy; and impulse and momentum (of particles).

Textbook:

Instructor:
Lois Arneson-Meyer, CM 121
Office Hours: open door

Teaching Assistants:    Homework Grader

Expectations:
Students should know all trigonometric functions associated with right angles, sine and cosine law, algebra skills: solving linear equations, exponents, factoring, solving systems of equations, similar triangles and fundamental calculus skills (integration, differentiation)

Course Objectives:
This course is designed to provide students with the basic knowledge for the analysis of the effects of external forces acting on stationary rigid bodies in equilibrium and the study of particles and rigid bodies in motion.

Course Outcomes:
The students successfully completing this course will have the ability to:
1. Determine the components of a force in rectangular coordinates.
2. Draw complete and correct free-body diagrams and write appropriate equilibrium equations from the free-body diagrams
3. Evaluate forces acting on static bodies including determining resultants and 3D components.
4. Calculate moments in 2D and 3D about a point utilizing cross products.
5. Determine the support reactions on a structure.
6. Determine the connection forces in trusses and in general frame structures.
7. Given standard shapes and corresponding centroids and or moment of inertia be able to compute centroids and or moment of inertia for composite bodies.
8. Determine forces required to overcome initial friction and calculate friction losses for bodies in motion.
9. List the principles of rectilinear and curvilinear kinematics and apply them to problems of particle motion.
10. List the principles of rectilinear and curvilinear kinematics and apply them to problems of rigid bodies in motion.
11. Explain and apply Newton’s Second Law of Motion, linear and angular momentum and motion under a central force for particles.
12. Explain and apply equation of motion for rigid bodies: forces and accelerations using D’Alembert’s Principle.

**Topics:**
- Review fundamental concepts
- Statics of particles
- Rigid bodies: equivalent systems of forces
- Equilibrium of rigid bodies.
- Distributed forces: centroids and centers of gravity.
- Analysis of structures
- Analysis of structures.
- Friction
- Kinematics of Particles
- Kinematics of Rigid bodies
- Kinetics of Particles
- Kinetic of rigid bodies
- Plane motion of rigid bodies: forces and accelerations
- Semester review

**Laboratory Projects:** None

**Professional Component:** None

**Relationship Between Program Objectives and Course Objectives:**

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<th>Course Outcomes</th>
<th>ABET Program Outcomes</th>
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**Assessment and Evaluation:**
- Independent Course Assessment (homework, exams, quizzes)
- FE Exam Topical Results
- Student Self Assessment Survey
- Institutional Student Course Evaluation

**Prepared by:** Lois Arneson-Meyer
GE 115: Professionalism in Engineering and Science I

CATALOG DATA:
GE 115 – Professionalism in Engineering and Science I: (1-1) 2 Credits
A course based upon professional issues pertinent to engineers and scientists along with an overview of the various engineering and science disciplines. Case studies based upon actual technical problems will be presented by practicing engineers and scientists. These case studies will involve both societal and professional questions. The format for a particular case study will involve an overview of a particular engineering or science discipline, and introduction to an actual technical problem, and a discussion of the societal implications of decisions that result.

DESIGNATION: Required

TEXTBOOK:
Student Manual (CD available at the Tech Bookstore. Supplements online)

INSTRUCTORS:
Dr’s. Stetler, Kellar, Dixon, Kellogg, Stone, Simonson, and Hladysz, Mr. Ash, Ms. Sieverding

PREREQUISITE KNOWLEDGE:
This is a freshman course with no specific incoming expectations except a commitment to pursue a degree in engineering.

COURSE OBJECTIVES:
To make the most of this course, it is recommended that students adopt the following five learning objectives to guide their priorities and actions during this term.
1. Be able to use technology tools (World Wide Web, Excel, PowerPoint, analysis software) to analyze, solve, and present solutions to engineering problems.
2. Become an effective team member.
3. Develop the communication skills necessary to package acquired technical and professional abilities that are required to succeed in engineering practice.
4. Understand the engineering profession enough to commit to a major and create an education/career plan.

CLASS SCHEDULE:
Lecture/Lab: 3 hours per week, 11:00PM-11:50PM, MWF (Section 9), 1:00PM-1:50PM, MWF (Section 1).

ENGINEERING COMPONENT:
Engineering Topics – 1 credit, Other – 1 credits (significant design)

TOPICS:
The course will cover the following engineering related topics
• Technical Library Orientation
• Teams and Teaming
• Webpage Development and Publishing
• Professional Engineering Ethics
• Dimensions, Units, and Significant Figures
• Technical Writing Overview
• Analytical Methods for Engineering
• Problem Solving and Chart Creation Using Excel
• Experimental Lab and Data Analysis
• Final Teaming Project

COMPUTER USAGE:
Microsoft FrontPage – web development
Microsoft Excel - engineering problem solving
Microsoft Word – for writing memos/technical reports
Microsoft PowerPoint – final team presentation
Logger Pro – data acquisition software used for experimental lab
Course Outcomes:
Upon completion of this course, students will have demonstrated the ability to:
1. Document a rational for selection in their chosen major.
2. Author a web page and post to the Internet.
3. Incorporate the rules of significant digits when solving problems and check for dimensional consistency.
4. Incorporate the 7-step approach to solving engineering problems.
5. Utilize Excel to solve fundamental problems in engineering.
6. Use a data acquisition system to collect experimental data.
7. Utilize Excel to analyze data and conduct a trend analysis on experimental data.
8. Utilize the fundamental principles of engineering design and team problem solving to design a rudimentary engineering system.
9. Utilize fundamental principles of technical writing to prepare a technical report, resume, and technical memorandum.
10. Utilize ethical principles in professional engineering decision making.

Relation of Course Outcomes to Program Outcomes:
The following table indicates the relative strength of each course outcome in addressing the program outcomes (on a scale of 1 to 4, 4 indicating strong emphasis).

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<th>GE 115 Course Outcomes</th>
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Laboratory:
The students will utilize the Lab Pro data acquisition devices to measure the temperature in a coffee pot as a function of time from when the coffee pot is turned on. This data will be collected and analyzed by the students and then placed into a technical report. In addition, extensive lab work is used during the final team project.

Assessment and Evaluation:
- Homework
- Laboratory Project
- Writing, reports, presentation
- Professionalism/presentation
- Portfolio
- FE Exam
- Exit Exam

Prepared By:
S. Kellogg, Date: April 20, 2004
IENG 301: Basic Engineering Economics

CATALOG DATA:
IENG 301 – Basic Engineering Economics: (2-0) 2 credits
Prerequisite: Junior or higher standing preferred. Introduces the concepts of economic
evaluation regarding capital investments, including the time value of money and income tax
effects. Graduation credit cannot be given for both IENG 301 and IENG 302

DESIGNATION: N/A for IE

TEXTBOOK:

INSTRUCTOR:
Jennifer Karlin
Office hours: M, W: 10-11 AM; M, F 1-2 PM,
or by appointment

PREREQUISITE KNOWLEDGE:

CLASS SCHEDULE:
Lecture: 3 hours per week, M, W, F 12 - 12:50 PM, CB 204W

ENGINEERING COMPONENT:
Engineering Topics – 1 credit, Other – 2 credits

TOPICS:
1. Time Value of Money
2. Nominal and Effective Interest Rates
3. Present Worth Analysis
4. Annual Worth Analysis
5. Rate of Return Analysis
6. Benefit / Cost Analysis
7. Replacement and Retention Decisions

COMPUTER USAGE:
Application of Microsoft Excel to spreadsheet based problems.

LABORATORY:
No laboratory component is included in this course.

COURSE OBJECTIVES:
After completing this course, students should be able to:
1. Identify how time and interest affect cash flows.
2. Identify the best engineering economy tool for evaluating alternatives.
3. Utilize present worth analysis, annual worth analysis, rate of return analysis, and
   benefit/cost analysis for evaluating alternatives.
4. Utilize replacement analysis and economic service life for evaluating asset
   replacement.
COURSE OUTCOMES:

Engineering Economy Fundamentals
1. Be able to move various cash flows across time while accounting for discrete or continuous compound interest, e.g., single payment factors, uniform-series factors, and arithmetic and geometric gradient factors.
2. Apply the concept of minimum attractive rate of return in economic decision-making.

Tools for Evaluating Alternatives
3. Be able to identify the best engineering economy tool for evaluating alternatives.
4. Be able to evaluate asset alternatives using present worth analysis, annual worth analysis, rate of return analysis, benefit/cost analysis.
5. Be able to utilize computer spreadsheets and their functions to solve engineering economy problems.

Making Decisions on Real-World Projects
6. Be able to determine the economic service life of an asset that minimizes the total annual worth of costs.
7. Be able to perform an asset replacement study between the defender and the best challenger.

Relation of Course Outcomes to Program Outcomes

The following table indicates the relative strengths of each course outcome in addressing the program objectives (on a scale of 1 to 4 where 4 indicates a strong emphasis):

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ASSESSMENT AND EVALUATION:
Course assessment will involve embedded assessments. Sample problems from student exams will be collected and scored by the instructor against a proficiency rubric. Problems will be saved for IE faculty review. Course results will be compared to weighted average results on FE in engineering economy.

PREPARED BY:
Jennifer Karlin, Date: November 6, 2003.
CENG 420/420A: Design of Digital Signal Processing Systems

CATALOG DATA: (4-1) 4.0 credits. Prerequisite: EE312. An introduction to the design of digital signal processing systems. Topics include discrete-time signals and systems, the Z-transform, infinite impulse response digital filters, finite impulse response digital filters, discrete Fourier transforms, fast Fourier transforms.

TEXTBOOK:
The Scientist and Engineer's Guide to Digital Signal Processing (Second Edition),
Steven W. Smith, California Technical Publishing San Diego, California

COORDINATOR:
Dr. Neil Chamberlain, Professor

GOALS:
To enable students to analyze, design, build, and evaluate digital signal processing functions in both software (primarily MATLAB) and hardware (primarily DSP ICs). Heavy emphasis on filter design and FFT techniques.

CLASS SCHEDULE:
Lecture: 3 hours per week.
Laboratory: 1 hour every week (1 credit hour).

TOPICS:
1. Statistics, Probability and Noise
2. ADC and DAC
3. DSP Software
4. Convolution
5. The Discrete Fourier Transform (DFT)
6. Filter Design
7. Image Signal Processing

COMPUTER USAGE:
Students use Analog Devices Visual DSP (VDSP) , MATLAB , and Visual C++ to solve laboratory and homework problems. Computer usage is heavy.

LABORATORY PROJECTS:
A full credit hour of laboratory, CENG 420A accompanies this course. The laboratory projects have a heavy emphasis on computer analysis and simulation using MATLAB, and real-time digital signal processing using VDSP. Some laboratory projects involve the use of basic measurement equipment (e.g., function generators, and oscilloscopes), There are no scheduled laboratories.

OUTCOMES:
By the end of CENG 420, students will:
1. Have a comprehensive understanding of the underlying theory of digital signal processing, including sampling, aliasing, the relationship between digital and analog frequency, impulse response and frequency response, Fourier and z-transforms.
2. Be able to specify a digital signal processing function in terms of a block diagram, difference equation (including recursive difference equations), and (for linear operations) a z-transform.
3. Be able to implement various linear and non-linear digital signal processing operations and synthesize various digital signals, in both MATLAB and C.
4. Be able to design a variety of linear digital filters with both finite and infinite impulse responses, starting from a digital impulse response (kernel), an analog s-domain transfer function, or a digital frequency response.
5. Be able to perform spectral analysis and fast convolution using the discrete Fourier transform, and have an understanding of the issues of sample size, sample interval, windowing, frequency resolution, and computational efficiency (FFT).
6. Have experience with real-time signal processing in hardware, and be able to develop and debug programs in an integrated developer environment.
7. Have knowledge of the practical limitations in DSP, including quantization, computational accuracy and speed, dynamic range, input and output (A/D and D/A) signal conditioning.

**RELATION OF COURSE TO PROGRAM OBJECTIVES:**

These course outcomes fulfill the following program objectives:

(a) An ability to apply knowledge of mathematics, science, and engineering.
(b) An ability to design and conduct experiments, as well as to analyze and interpret data.
(c) An ability to design a system, component, or process to meet desired needs.
(d) An ability to function on multi-disciplinary teams.
(e) An ability to identify, formulate, and solve engineering problems.
(f) An understanding of professional and ethical responsibility.
(g) An ability to communicate effectively.
(h) The broad education necessary to understand the impact of engineering solutions in a global and societal context.
(i) A recognition of the need for, and an ability to engage in life-long learning.
(j) A knowledge of contemporary issues.
(k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

The following table indicates the relative strengths of each course outcome in addressing the program objectives listed above (on a scale of 1 to 4 where 4 indicates a strong emphasis).

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**PREPARED BY:** Dr Neil Chamberlain, Date: April 30, 2003
CENG 440 – VLSI DESIGN

Catalog Data: VLSI Design. (3-1) 4 credits. Prerequisite EE 321.
Provides an introduction to the technology and design of VLSI integrated circuits. Topics include MOS transistors, switch and gate level logic, scalable design rules, speed and power considerations, floorplanning, layout techniques, and design tools.


Coordinator: Brian T. Hemmelman, Assistant Professor of Electrical and Computer Engineering
Room EP 314, Phone 394-1219.
Office Hours are 1:00-2:00 Mon/Wed/Fri and by appointment.

Lecture: Monday/Wednesday/Friday 8:00-8:50 a.m. EP 254
Lab: Tuesday 10:00-11:50 a.m. EP 340
Thursday 10:00-11:50 a.m. EP 340

Objectives: The primary objective of this course is to educate students on how to design and layout digital VLSI circuits in a timely manner as an individual or member of a team to meet specific needs using modern design techniques. Secondary objectives of this course are to have students learn to communicate their work effectively, to learn how to stay current in a rapidly changing field, and to understand the ethical and moral ramifications of their design work.

Topics: Fabrication technology of VLSI integrated circuits.
- pn junction diodes.
- MOS transistor structure and properties.
- Inverter circuits.
- Parasitic resistances and capacitances
- Speed considerations (propagation delays, rise & fall times, interconnections).
- Power considerations (transistor voltages, currents, and power).
- Optimization techniques.
- Static combinational VLSI logic design techniques.
- Static sequential VLSI logic design techniques.
- Dynamic combinational VLSI logic design techniques.
- Dynamic sequential VLSI logic design techniques.
- Arithmetic logic circuitry.
- Low power design.
- Design tools.
- Layout optimization.
- Floorplanning.
- Clock skew.
- Timing issues.

Computer Use: The lab assignments will require the use of the SUN workstations and Mentor Graphics.

Outcomes: Upon completion of this course, students should demonstrate the ability to:
1. Understand the physical structure (source, gate, drain) and the electrical operation of MOSFET transistors.
2. Understand where, how, and why parasitic resistances and capacitances arise in MOSFET transistors.
3. Determine the static characteristics of various VLSI logic families.
4. Compute the rise times, fall times, and propagation delays in VLSI circuits.
5. Design combinational logic circuits with static VLSI design techniques.
6. Design sequential logic circuits with static VLSI design techniques.
7. Design combinational logic circuits with dynamic VLSI design techniques.
8. Design sequential logic circuits with dynamic VLSI design techniques.
9. Optimize VLSI circuits for either speed or power consumption.
11. Document and effectively communicate the details of their work in written lab reports.

Relation of Course to Program Outcomes:
These course outcomes fulfill the following program objectives:
(a) An ability to apply knowledge of mathematics, science, and engineering.
(b) An ability to design and conduct experiments, as well as to analyze and interpret data.
(c) An ability to design a system, component, or process to meet desired needs.
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Lab Projects: Several lab projects will be conducted throughout the semester covering basic VLSI design issues leading into more complicated circuits and layouts involving combinational and sequential circuits, clock and timing issues. This will culminate in a larger final design project. Lab reports are required. Lab reports will be required for all laboratory projects. Lab reports must be "complete". Complete means that another instructor or student in another semester could completely reconstruct the lab and duplicate your results based solely on the information contained in your report.

1. **CENG 442 Micro-Based System Design**

2. **Elective**

3. **CENG 442 Micro-Based System Design** (3-1) 4 credits. Prerequisite CENG 342. Presents the concepts required for the design of microprocessor-based systems. Emphasis is given to the problems of system specification, choice of architecture, design trade-off, and the use of development tools in the design process. Design projects will be implemented in the laboratory. (Design content - 2 credits)

4. Prerequisite CENG 342

5. **Textbooks:** PIC Datasheets from Microchip:
   - [http://www.microchip.com/download/lit/pline/picmicro/families/16f87x/30292c.pdf](http://www.microchip.com/download/lit/pline/picmicro/families/16f87x/30292c.pdf)

6. The student completing the course should be able to apply hardware and software design concepts to embedded micro-based systems for different applications. Students should be able to design systems based on the PIC single-chip microcontroller using assembly language and C-language cross-compilers and debuggers.

7. **Topics**
   - PIC microcontroller family
     - CPU Architecture and Instruction set.
     - MPLAB Development Software
     - C Compiler
     - Timers and interrupts
     - I/O: Parallel, Serial, A/D, D/A

8. Three lecture hours per week with an open lab that assumes an average of three hours per week.

9. Half engineering science and half engineering design

10. Upon completion of this course, students should demonstrate the ability to:
    1. Use development tools including assembler, compiler, debugger, and Revision Control System (RCS) for implementing micro-based systems.
    2. Understand the basics of CPU architectures and instruction sets.
    3. Develop programs in assembly and C, understanding what is appropriate for a given situation.
    4. Interface sensors, actuators, and networks to micro-based hardware.
    5. Test, debug, and verify that the design meets the desired specifications.
    6. Work effectively in design and development teams to implement micro-based systems.
7. Use appropriate prototyping techniques for implementing micro-based systems.
8. Understand concepts of professionalism, ethics, product liability, social responsibility, and intellectual property in the context of micro-based design.
9. Use design resources such as professional journals, trade journals, catalogs, and the web in project design.
10. Communicate the project design effectively.

**RELATION OF COURSE TO PROGRAM OBJECTIVES:**

These course outcomes fulfill the following program objectives:
(a) An ability to apply knowledge of mathematics, science, and engineering.
(b) An ability to design and conduct experiments, as well as to analyze and interpret data.
(c) An ability to design a system, component, or process to meet desired needs.
(d) An ability to function on multi-disciplinary teams.
(e) An ability to identify, formulate, and solve engineering problems.
(f) An understanding of professional and ethical responsibility.
(g) An ability to communicate effectively.
(h) The broad education necessary to understand the impact of engineering solutions in a global and societal context.
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**PREPARED BY:**
Swamy D. Ponpandi, Date: January 20, 2004
1. CENG 444 Computer Networks  
2. Elective  
3. CENG 444 COMPUTER NETWORKS  
   (3-1) 4 credits. Prerequisite: CENG 244, Math 381 or 333 or 481. This course presents the basic principles of computer networks design and analysis. Topics covered include the layers of the OSI reference model, current and proposed implementations of local, metropolitan, and wide area networks; inter-networking is discussed. The different implementations are compared and their performance evaluated. Graduation credit will not be allowed for both this course and CSC 441. (Design content – 2 credits)  
4. Prerequisite: CENG 244, Math 381 or 333 or 481  
6. I. Data Transmission  
   A. Transmission Media  
   B. Local Asynchronous Communication  
   C. Long-Distance Communication (Carriers, Modulation, and Modems)  
II. Packet Transmission  
   A. Packets, Frames, and Error Detection  
   B. LAN Technologies and Network Topology  
   C. Hardware Addressing and Frame Type Identification  
   D. LAN Wiring, Physical Topology, and Interface Hardware  
   E. Extending the LANs: Fiber Moderns, Repeaters, Bridges, and Switches  
   F. Long-Distance Digital Connection Technologies  
   G. WAN Technologies and Routing  
   H. Network Ownership, Service Paradigm, and Performance  
   I. Protocols and Layering  
III. Internetworking  
   A. Internetworking: concepts, architecture, and protocols  
   B. IP: Internet Protocol Addresses  
   C. Binding Protocol Addresses (ARP)  
   D. IP Datagrams and Datagram Forwarding  
   E. IP Encapsulation, Fragmentation, and Reassembly  
   F. The Future IP (IPV6)  
   G. An Error Reporting Mechanism (ICMP)  
   H. TCP: Reliable Transport Service  
IV. Network Applications  
   A. Client-Server Interaction  
   B. The Socket Interface  
   C. An Example of a Client and a Server  
   D. Naming with the Domain Name System  
   E. Electronic Mail Representation and Transfer  
   F. File Transfer and Remote File Access  
   G. World Wide Web and Browsing  
   H. CGI Technology for Dynamic Web Documents  
   I. Java Technology for Active Web Documents  
   J. RPC and Middleware  
   K. Network Management (SNMP)  
   L. Network Security  
   M. Initialization (Configuration)  
7. Three hours per week lecture with an open lab that assumes an average of three hours per week.  
8. Half engineering science and half engineering design
9. Upon completion of this course, students should demonstrate the ability to:
   1. Define specialized networking terms and TLAs.
   2. Explain the operation of the hardware level of networks.
   3. Explain
   4. Use development tools such as compiler, debugger, Revision Control System (RCS), and network analyzer for implementing networking systems.
   6. Test, debug, and verify that the design meets the desired specifications
   7. Work effectively in design and development teams to implement networking systems.
   8. Understand concepts of professionalism, ethics, product liability, social responsibility, and intellectual property in the context of network design.
   9. Use design resources such as professional journals, trade journals, and the web in a network system design.
10. Communicate the project design effectively.

**RELATION OF COURSE TO PROGRAM OBJECTIVES:**

These course outcomes fulfill the following program objectives:

(a) An ability to apply knowledge of mathematics, science, and engineering.
(b) An ability to design and conduct experiments, as well as to analyze and interpret data.
(c) An ability to design a system, component, or process to meet desired needs.
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(h) The broad education necessary to understand the impact of engineering solutions in a global and societal context.
(i) A recognition of the need for, and an ability to engage in life-long learning.
(j) A knowledge of contemporary issues.
(k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

The following table indicates the relative strengths of each course outcome in addressing the program objectives listed above (on a scale of 1 to 4 where 4 indicates a strong emphasis).

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**PREPARED BY:**
Michael J. Batchelder, Date: August 25, 2003
1. CENG 447 Embedded/Real-Time Computer Systems
2. Elective
3. CENG 447 Embedded/Real-Time Computer Systems
   (3-1) 4 credits. Prerequisite EE 351, CSC 150. This course provides an introduction to
   programming embedded and real-time computer systems. It includes design of
   embedded interrupt driven systems and the use of commercial (for example QNX) or
   open-source (for example Linux RT) RTOS operating systems. (Design content 2
   credits).
4. Prerequisites EE 351, CSC 150
6. The goal of this course is to provide students with the working knowledge of practical
   design and implementation of embedded systems and real-time operating systems.
7. Topics
   I. Introduction to Embedded Systems
   II. The Real-Time Kernel
   III. MicroC/OS-II: x86, ARM, PIC 18Fxx
   IV. WinCE
8. Three lecture hours per week with an open lab that assumes an average of three hours per
   week.
9. Half engineering science and half engineering design
10. Upon completion of this course, students should demonstrate the ability to:
    1. Use development tools including assembler, compiler, debugger, and Revision
       Control System (RCS) for implementing embedded systems.
    2. Understand the basics of CPU architectures and instruction sets.
    3. Develop programs in assembly and C, understanding what is appropriate for a
       given situation.
    4. Interface sensors, actuators, and networks in embedded systems.
    5. Use a Real-Time Operating System to implement an embedded system design.
    6. Test, debug, and verify that the design meets the desired specifications
    7. Work effectively in design and development teams to implement embedded
       systems.
    8. Understand concepts of professionalism, ethics, product liability, social
       responsibility, and intellectual property in the context of embedded system
       design.
    9. Use design resources such as professional journals, trade journals, catalogs, and
       the web in an embedded system design.
   10. Communicate the project design effectively.

RELATION OF COURSE TO PROGRAM OBJECTIVES:
These course outcomes fulfill the following program objectives:
(a) An ability to apply knowledge of mathematics, science, and engineering.
(b) An ability to design and conduct experiments, as well as to analyze and interpret
    data.
(c) An ability to design a system, component, or process to meet desired needs.
(d) An ability to function on multi-disciplinary teams.
(e) An ability to identify, formulate, and solve engineering problems.
(f) An understanding of professional and ethical responsibility.
(g) An ability to communicate effectively.
(h) The broad education necessary to understand the impact of engineering solutions in a
    global and societal context.
(i) A recognition of the need for, and an ability to engage in life-long learning.
(j) A knowledge of contemporary issues.
(k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

The following table indicates the relative strengths of each course outcome in addressing the program objectives listed above (on a scale of 1 to 4 where 4 indicates a strong emphasis).

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**PREPARED BY:** Michael J. Batchelder, Date: January 13, 2004
CSC 433 COMPUTER GRAPHICS

CATALOG DATA:
CSC 433 COMPUTER GRAPHICS
(3-0) 3 credits. Prerequisites CSC 300 and MATH 225. Graphical programming concepts.
Display media and device characteristics. Point, line, and circle plotting. Coordinate
systems and transformations. Polygon clipping and filling. Spline methods, hidden
surface elimination, and shading.

TEXTBOOK:

INSTRUCTOR:
Dr. Weiss
Office: McLaury 315
Phone: 394-6145
Email: John.Weiss@sdsmt.edu
Office Hours: MWF 10:00-10:50 AM and T 11:00-11:50 AM, or by appointment

TOPICS:
1. Introduction to computer graphics hardware and software
2. Graphics primitives: points, lines, polygons, simple curves
3. Region fill algorithms
4. 2-D viewing: coordinate systems, geometric transformations, clipping
5. Complex curves: splines, Bezier curves, fractals
6. 3-D viewing: object representations, geometric transformations, projections
7. Hidden-line and hidden-surface algorithms
8. Light sources, shading, ray tracing
9. Color models
10. Animation

OBJECTIVES:
The primary objective of this course is to give the student an introduction to the theory
and practice of computer graphics. The basics of computer graphics hardware and
software will be presented, along with a survey of advanced methods.

PROFESSIONAL COMPONENT:
Basic Science: 3 credits or 100%

COURSE OUTCOMES:
Upon completion of this course, students will obtain the following outcomes:
• gain understanding of computer graphics hardware
• gain working knowledge of fundamental computer graphics software
• understand and implement simple parametric curves (points, lines, polygons, ellipses)
• understand and implement more complex curves (splines, Bezier curves, fractals)
• understand and implement region fill techniques (flood fill, scanline fill, polygon fill)
• understand and implement the 2-D viewing pipeline (geometric transformations, windows, viewpoints, clipping)
• understand 3-D viewing pipeline (hidden lines and surfaces, transformations, projections, clipping)
• understand color models, lighting models, shading, ray tracing
• understand the fundamentals of animation
• gain experience writing OpenGL programs
• gain greater understanding of the software development process
• gain experience working in teams

RELATIONSHIP OF COURSE TO PROGRAM OUTCOMES:
CSC 433, Computer Graphics, meets part of ABET Criterion 3, outcome (a):
   (a) Ability to apply knowledge of mathematics, science, and engineering.

Prepared by:  John Weiss      May, 2004
CSC 463/463L/563/563L DATA COMMUNICATIONS

CATALOG DATA:
CSC 463/463L/563/563L DATA COMMUNICATIONS
(3-1) 4 credits. Prerequisite: CSC 250. A study of the principles of data communications, computer networks, and open systems, following the outline provided by the ISO/OSI model. Students enrolled in CSC 563/563L will be held to a higher standard than those enrolling in CSC 463/463L.

TEXTBOOK:
DATA COMMUNICATIONS AND NETWORKING 3rd Edition by Forouzan

INSTRUCTOR:
Harold Carda McLaury 311 - phone 394-2470
MEETING ROOM AND TIME: McLaury 313 – 9 AM MWTF (class will meet all four days – the lab is an open lab and will be integrated into the four days)

TOPICS:
- Communication devices
- Computer networks
- Open systems
- Optic fiber
- Frequency hopping
- Data link Layaeer
- LANs

OBJECTIVES:
Be able to analyze, design and incorporate data communications concepts.

PROFESSIONAL COMPONENT:
Basic Science: 4 credits or 100%

COURSE OUTCOMES:
A student who successfully completes this course should, at a minimum, be able to:

1. understand limiting factors in communications
2. understand the OSI model and describe the layer’s functionality
3. choose a communications system that best fits an application
4. choose the best means of connections and transfer mechanism
5. implement standard error detection and compression
6. choose and implement an appropriate communications protocol
7. understand and implement standard local area networks
8. understand and implement internets
9. understand and implement network sharing using multiplexing and multiple access
RELATIONSHIP OF COURSE TO PROGRAM OUTCOMES:
CSC 463/563, Data Communications, meets part of ABET Criterion 3, outcome (a):
(a) Ability to apply knowledge of mathematics, science, and engineering.

Prepared by: Harold Carda May, 2004
CSC 464 INTRODUCTION TO DIGITAL IMAGE PROCESSING AND
COMPUTER VISION

CATALOG DATA:
CSC 464 INTRODUCTION TO DIGITAL IMAGE PROCESSING AND
COMPUTER VISION
(3-0) 3 credits. Prerequisites: CSC 300 and MATH 125. Introduction to digital image
processing and computer vision, including image digitization and display, image
enhancement and restoration, frequency domain techniques using the Fourier transform,
image encoding, segmentation, and feature detection.

TEXTBOOK:
Recommended:  C/C++ and Linux reference books

INSTRUCTOR:
Dr. Weiss
Office: McLaury 315
Phone: 394-6145
Email: john.weiss@sdsmt.edu
Office Hours: MWRF 11:00-11:50AM, or by appointment

TOPICS:
1) image digitization and display
2) image enhancement and restoration
3) image encoding
4) image segmentation and feature detection

OBJECTIVES:
CSC 464 is an upper-level elective course in the computer science major, designed to
teach students the fundamentals of digital image processing on the computer. The
primary objective of this course is to introduce students to basic principles of digital
images, image data structures, and image processing algorithms.

PROFESSIONAL COMPONENT:
Basic Science: 3 credits or 100%
COURSE OUTCOMES
Upon completion of this course, students will obtain the following outcomes:
• understanding of digital image fundamentals
• understanding of image digitization
• understanding of image display hardware and software
• ability to understand and apply image enhancement and restoration techniques
• understanding of image encoding techniques
• understanding of image segmentation approaches
• introduction to pattern recognition and feature detection approaches
• ability to apply image processing techniques in both the spatial and frequency (Fourier) domains
• ability to write image processing programs in a high-level language such as C
• ability to use the Linux operating system for software development
• experience working in teams
• experience in technical communication

RELATIONSHIP OF COURSE TO PROGRAM OUTCOMES:
CSC 464, Introduction to Digital Image Processing and Computer Vision, meets part of
ABET Criterion 3, outcome (a):
   (a) Ability to apply knowledge of mathematics, science, and engineering.

Prepared by:  John Weiss  May, 2004
CSC 476 THEORY OF COMPILERS

CATALOG DATA:
CSC 476 THEORY OF COMPILERS
(3-0) 3 credits. Prerequisites: CSC 314 and CSC 461 or permission of instructor. Course covers formal languages, parsing, design of compilers, assemblers, and translators.

TEXTBOOK:

INSTRUCTOR:
Dr. Gregg T. Stubbendieck
Office: M-203C
Office hours: MW 1-2; Tu 9-10
Office Phone: 394-2474
email: Gregg.Stubbendieck "at" sdsmt.edu
URL: http://www.mcs.sdsmt.edu/gstubben
Class Schedule: Lecture: MWF 10:00 – 10:50 AM [CB 106]

TOPICS:
- Compiler phases
- Compiler construction tools
- Syntax definition
- Syntax directed translation
- Lexical analysis and parsing
- Symbol tables
- Regular expressions and finite automata
- Context-free grammars
- Parsing techniques
- Parser types
- Syntax trees
- Semantic analysis
- Type checking and type conversions
- Overloading functions and operators
- Runtime issues
- Intermediate code
- Code generation
- Optimization
OBJECTIVES:
The primary objective of this course is to introduce students to the theory of compilers and the practice of implementing them. Course lecture material focuses on the function of the main components and phases of compilers, programming language design, and implementation issues. The project provides experience that cannot be gained in a lecture format. In the project, students use a combination of general purpose programming languages and compiler generation tools to implement a compiler component.

PROFESSIONAL COMPONENT:
Basic Science: 3 credits or 100%

COURSE OUTCOMES:

Upon completion of this course, students should, at a minimum, demonstrate the ability to:

- Describe the major phases of a compiler
- Specify lexical tokens with regular expressions
- Specify context free grammars
- Use general purpose programming languages and/or compiler construction tools to create programming language recognizers and translators.
- Perform semantic checking of programming languages
- Create syntax trees from program source code
- Generate intermediate code
- Generate executable code for a target machine
- Construct and manipulate flow graphs
- Optimize generated code

RELATIONSHIP OF COURSE TO PROGRAM OUTCOMES:
CSC 476, Theory of Compliers, meets part of ABET Criterion 3, outcome (a):

(a) Ability to apply knowledge of mathematics, science, and engineering.

Prepared by: Gregg Stubbendieck May, 2004
EE 322/322L: Electronics II – Wireless Communication Electronics

CATALOG DATA: Required for electrical engineering students.
EE 322/322L Electronics II: (3-1) 4 Credits. Prerequisite: EE212 and EE321. A continuation of EE 321 with emphasis on design applications of linear and nonlinear integrated circuits.

TEXTBOOK:

COORDINATOR:
Dr. Keith W. Whites, Professor and Steven P. Miller Endowed Chair

CLASS SCHEDULE:
Lecture: 3 hours per week.
Laboratory: A majority of the 36 homework problems assigned in this course involves laboratory work, which is performed during open lab hours from 7:30 AM to 10:00 PM.

TOPICS:
- Introduction and review.
- Filters.
- Transformers.
- Bipolar junction transistors.
- Field effect transistors.
- Power amplifiers.
- Oscillators.
- Mixers.
- Audio amplifiers.
- Automatic gain control.
- Receiver performance.

COMPUTER USAGE:
Circuit simulation is performed using both Puff and Agilent Technology’s Advanced Design System (ADS). Approximately 20% of the 36 problems assigned during the semester involve circuit simulation.

OUTCOMES:
Upon completion of this course, students should possess an ability to:

1. Understand the operation of a superheterodyne receiver and its advantages over a direct conversion receiver.
2. Use an automatic waveform generator, and account for the effects of this device – as well as an oscilloscope – on a circuit under test.
3. Properly solder and desolder electrical components to a printed circuit board in an RF circuit.
4. Design an L.C ladder filter to meet passband and rejection specifications.
5. Tune a transformer and understand how to use it as an impedance matching device.
6. Design and implement npn and pnp BJTs as electronic switches.
7. Design and analyze BJT common emitter amplifiers, both with impedance loads and with transformer-coupled loads.
8. Design and analyze BJT emitter follower amplifiers.
9. Recognize BJT differential amplifier circuits and recall their uses.
10. Design and implement JFET source follower amplifiers.
11. Understand the operation and design of class C power amplifiers.
12. Recall the efficiencies of class A and class C amplifiers.
13. Construct and analyze a simple thermal circuit for a transistor and heat sink combination.
14. Recall the basic operation of feedback oscillators.
15. Use a frequency counter to make precise frequency measurements.
16. Understand the operation of Gilbert cell mixers.
17. Understand the sources of spurious responses in receivers and their limiting effects on performance.
18. Design and construct a simple audio amplifier circuit using an LM386 IC.
19. Recall the basic operation of receiver automatic gain control using JFETs as variable resistors.
20. Understand the limiting role of noise in communications circuits.
21. Calculate signal to noise ratio (SNR), minimum detectable signal (MDS), noise power density and noise equivalent power (NEP) from measured data.
22. Understand the effect of cascading noisy electrical components.
23. Understand the source of receiver intermodulation and its effects on receiver performance.
24. Make proper measurements and then calculate the dynamic range of a receiver.
25. Use power splitter/combiner devices and adjustable attenuators.

**RELATION OF COURSE OUTCOMES TO PROGRAM OBJECTIVES:**
The table indicates the relative strengths of each course outcome in addressing the program objectives (on a scale of 1 to 4 where 4 indicates a strong emphasis):

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**LABORATORY:**
As mentioned earlier, this course is centered both on the detailed theoretical analysis of a CW transceiver as well as its construction. Nearly all of the laboratory work is centered on the construction of the NorCal 40A, which is a 40-m, 2-W CW transceiver. Once the radio has been constructed, the last two weeks of the course are devoted to measuring and characterizing the performance of the radio.

Equipment that is used in this course includes:
- Agilent 4396B 2 Hz-1.8 GHz RF Network/Spectrum/Impedance analyzers,
- Agilent 33120A 15-MHz function/arbitrary waveform generators,
- HP 54645 digital oscilloscopes,
- Tenma 72-4095 175-MHz universal counters,
- Kay 839 DC-2 GHz adjustable signal attenuators,
- Mini-Circuits ZFSC-2-4 power splitters/combiners.

**CONTRIBUTION OF COURSE TO PROFESSIONAL COMPONENT:**
Course content address approximately 50% engineering science and 50% engineering design. **PREPARED BY:** Dr. Keith Whites
EE 421/421A: Communication Systems
(Elective for EE majors)

CATALOG DATA:
EE 421/421A – Communication Systems: (3-1) 4 Credits. Prerequisites: EE 312. Fundamentals of analog and digital signal transmission. Performance characteristics such as channel loss, distortion, bandwidth requirements, signal-to-noise ratios, and error probability. (Design content - 2 credits)

TEXTBOOK:

COORDINATOR:
Neil F. Chamberlain, Professor of Electrical Engineering.

GOALS:
The goals of the course are as follows: Provide fundamental background for the design, analysis, and evaluation of digital and analog communications systems. Provide an understanding of the practices and trends in the modern communications industry. Prepare undergraduate students for a successful career in the communications and communications-related industries.

CLASS SCHEDULE:
Lecture: 3 hours per week
Laboratory: 1 hour per week

Topics:
1. Introduction to Communication Systems and review of Linear Systems
2. Analog to Digital Conversion
3. Data Encoding Techniques
4. Baseband Communication System performance
5. Case Study: T1 Physical Transport
6. Passband Communication Electronics
7. Analog Passband Modulation
8. Digital Passband Modulation

COMPUTER USAGE:
Students use MATLAB, SIMULINK (Communications Toolbox), and PSPICE to simulate and analyze various communication systems.

LABORATORY:
A one credit hour laboratory EE 421A accompanies this course. The laboratory meets for one hour each week for a total of six laboratories during the semester. The following six laboratories are performed:
1. RF Measurements
2. Evaluation of G.711 mu-law CODEC
3. M-ary baseband communication system (SIMULINK)
4. Varactor Diode VCO (PSPICE)
5. Phase-lock loop (LM565)

This is a ‘systems’ course, but the laboratory work is a mixture of simulation, measurement, and electronic design. Digital communications topics rely heavily on simulation techniques.

OUTCOMES:
Upon completion of this course, students should demonstrate the ability to:
1. Calculate, compute, and measure signal power and noise power of a variety of analog and digital communications systems and signals (sine waves, square waves, pulses).
2. Calculate, compute, and measure signal bandwidth and noise bandwidth of a variety of analog and digital communications systems and signals.
3. Apply Fourier spectral analysis to communication systems (through Fourier series, Fourier transform, and power spectral density).
4. Determine fundamental limits on communication through Shannon and Nyquist theory, and analyze and design systems with optimal performance (e.g. matched filterers, pulse shaping, coding for error protection).
5. Analyze the bit error performance and relative merits of various digital communication systems, and analyze the signal-to-noise-ratio performance and relative merits of various analog communication systems.
6. Demonstrate specific knowledge of key communication systems (Modems, T1, AM, FM, NTSC TV) and their relevant system parameters.
7. Elaborate on specific circuits and techniques that are used to perform signal processing functions in communications systems (e.g., envelope detectors, digital-to-analog converters, voltage-controlled oscillators, filters, mixers)
8. Be proficient with tools that are commonly utilized in communication system analysis, design, and measurement (e.g., spectrum analyzer, power meter, oscilloscope, eye-diagram, MATLAB, SIMULINK, SPICE)
9. Articulate a broad knowledge of the nomenclature, metrics, and terminology of communication systems.
10. Appreciate the role that standards play in modern communication systems (e.g., ITU).

**RELATION OF COURSE OUTCOMES TO PROGRAM OBJECTIVES:**

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**CONTRIBUTION OF COURSE TO PROFESSIONAL COMPONENT:**

Course content address approximately 50% engineering science and 50% engineering design.

**PREPARED BY:** Neil F. Chamberlain, Date: March 7th 2001
EE 451/451L: Control Systems

Catalog Data:
(3-1) 4 credits. Prerequisite: EE 311 Analysis and design of automatic control and
process systems by techniques encountered in modern engineering practice, including
both linear and nonlinear system with either continuous or discrete signals. (Design
content – two credits)

Elective for Electrical and Computer Engineering

Textbook:

Coordinator:
Elaine Linde, Instructor

Laboratory:
Laboratory assignments are given to complement the lectures and use Matlab® as
the primary simulation tool. Additional laboratories will use hardware for system
identification and controller design.

Professional Component:
Engineering Design 4 Cr. – 100%

Topics:
• Time Response:
• Reduction of Multiple Subsystems:
• Transient Analysis:
• Stability Analysis:
• Steady State Errors:
• Root Locus Techniques
• Design of Controllers Via Root Locus
• Frequency Response Techniques
• Design of Controllers Via Frequency Domain Techniques
• Modeling of Systems (time domain)

Course Outcomes:
Upon completion of this course, students should demonstrate the ability to:
1. Use block diagrams and signal flow diagrams to represent systems.
2. Analyze the performance of a system in the time and frequency domains.
4. Use root locus to design PD and lead controllers to improve the transient
   performance of a system.
5. Use root locus to design PI and lag controllers to improve the steady state error of a
   system.
6. Use root locus to design PID and lead/lag controllers to improve both the transient
   and steady state error of a system.
7. Use frequency domain techniques to design cascade compensation (lead, lag,
   lead/lag) to improve the transient and/or steady state error of a system.
8. Use state space representations to design a state-feedback controller using pole placement to meet transient response specifications.
9. Design a state observer for systems where the states are not available to the controller.
10. Use Matlab® as an analytical and design tool.

**Relation of Course to Program Outcomes:**
These course outcomes fulfill the following program outcome:

(a) An ability to apply knowledge of mathematics, science, and engineering.
(b) An ability to design and conduct experiments, as well as to analyze and interpret data.
(c) An ability to design a system, component, or process to meet desired needs.
(d) An ability to function on multi-disciplinary teams
(e) An ability to identify, formulate, and solve engineering problems.
(f) An understanding of professional and ethical responsibility
(g) An ability to communicate effectively
(h) The broad education necessary to understand the impact of engineering solutions in a global and societal context
(i) A recognition of the need for, and an ability to engage in life-long learning
(j) A knowledge of contemporary issues
(k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

The following table indicates the relative strengths of each course outcome in addressing the program outcomes listed above (on a scale of 0 to 4 where 4 indicates a strong emphasis)

<table>
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**Prepared By:** Elaine Linde, Date: January 6, 2004  Revised for ABET May 13, 2004

164
CHEM 112 GENERAL CHEMISTRY I
(Required Course)

CATALOG DATA:
CHEM 112 GENERAL CHEMISTRY I
(3-0) 3 credits. Prerequisites Prerequisite or corequisite MATH 102. An introduction to the basic principles of chemistry for students needing an extensive background in chemistry (including chemistry majors, science majors, and pre-professional students). Completion of a high school course in chemistry is recommended. Duplicate credit for CHEM 106 and 112 not allowed.

TEXTBOOK:
2. Arrington, D. E., "General Chemistry I CD." This CD contains self-tests for this course. You will need an IBM-compatible computer, equipped with a CD-ROM drive, and Windows 9x or NT variants as the operating system.

INSTRUCTOR:
Dr. Dale Arrington, C-313 (394-1236)
E-mail: dale.arrington@sdsmt.edu
Office Hours: 10 a.m. MWF

EXPECTATIONS:
Students are expected to have a fundamental understanding of:
• Algebra
• Prior course in chemistry

COURSE OBJECTIVES:
Students will obtain a foundation in the fundamental principles and models of chemistry necessary for an understanding of the composition, structure, and properties of matter and the changes that matter undergoes.

CLASS SCHEDULE:
C-228 (sec. 1) Monday-Wednesday-Friday; 8:00 – 8:50 a.m.
C-228 (sec. 2) Monday-Wednesday-Friday; 9:00-9:50 a.m.

PROFESSIONAL COMPONENT:
Basic Science: 3 credits or 100%

TOPICS:
• Properties of matter
• Atomic structure
• Stoichiometry
• Reactions in aqueous solution
• Thermochemistry
• Electronic structure
• Periodic properties
• Bonding
• States of matter
• Intermolecular forces
• Properties of solutions
COMPUTER USAGE:
None

COURSE OUTCOMES:
Each student successfully completing Chem112 is expected to have the following abilities:

- Understand, and use correctly, the symbolic representations, chemical notation, formulas, and systematic rules of nomenclature that characterize the language of chemistry.
- Understand and apply the mole concept in a variety of chemical calculations, including calculating the number of particles in a given mass of substance (and vice versa), and the quantitative relationships between reactants and products in a chemical reaction.
- Recognize the different types of chemical transformations: acid-base, precipitation, combination, decomposition, single-replacement, oxidation-reduction, double replacement, and combustion.
- Understand the basic principles of energy transfer involving chemical systems, including the transfer of heat and work between system and surroundings, the qualitative and quantitative interpretation of thermochemical equations, and the application of Hess’s Law.
- Understand the various models of atomic structure, the basic principles of quantum theory, and the experiments that led to those principles.
- Write ground-state electron configurations for atoms and ions of any representative element and the 3d transition series elements.
- Understand the fundamental aspects of chemical bonding, including writing Lewis structures, describing the bonding in molecules by simple valence-bond theory, and using Valence Shell Electron Pair Repulsion Theory to predict the geometries of molecules and ions.
- Use modern atomic theory to understand and predict the properties of different elements.
- Recognize, and account for, in terms of the underlying electronic factors involved, the characteristic properties of the different groups in the periodic table.
- Understand the properties of the different states of matter.
- Qualitatively and quantitatively describe the properties of the gaseous state and the fundamental laws governing the behavior of gases.
- Understand, qualitatively and quantitatively, the behavior of solutions and their colligative properties.
- Understand how fundamental intermolecular interactions among particles determine the physical and chemical properties of a system.
- Understand the fundamental postulates of kinetic-molecular theory and use them to explain the physical behavior of the three states of matter.

RELATIONSHIP OF COURSE TO PROGRAM OUTCOMES:
CHEM 112, General Chemistry I, meets part of ABET Criterion 3, outcome (a):

(a) Ability to apply knowledge of mathematics, science, and engineering.

LABORATORY:
None

ASSESSMENT AND EVALUATION:
Cumulative percent average on the five hour exams is the sole determinant of the grade in this course.

PREPARED BY:
Dale Arrington, Fall 2003
CHEM 112L GENERAL CHEMISTRY I LAB
(Required Course)

CATALOG DATA:
CHEM 112L GENERAL CHEMISTRY I LAB
(0-1) 1 credit. Prerequisite or corequisite: CHEM 112. Laboratory designed to accompany CHEM 112.

TEXTBOOK:
1. Prepackaged set of experiments from the Modular Laboratory Program in Chemistry (Chemical Education Resources, Palmyra, PA). A complete set consists of the following numbered experiments: 368, 387, 388, 389, 394, 395, 399, 451, 455, 460, 484, and 498.
2. Approved safety goggles, which must be worn at all times while in the laboratory. Goggles may be purchased in the bookstore or at the first and second lab meetings.
3. Roll of paper towels. A roll of paper towels should be purchased by you and kept in your lab locker. Any brand will do.

INSTRUCTOR:
Dr. Dale Arrington, C-313 (394-1236)
E-mail: dale.arrington@sdsmt.edu
Office Hours: 10 a.m. MWF

EXPECTATIONS:
Students are expected to have a fundamental understanding of:
- Algebra
- Prior course in chemistry

COURSE OBJECTIVES:
Students will gain familiarity with common chemical laboratory safety practices and the apparatus and experimental methods used in analyzing and investigating the properties and behavior of matter.

CLASS SCHEDULE:
C-204/201 (sec. 51 & 52) Tuesday; 8:00 – 9:50 a.m.
C-201/204 (sec 55 & 56) Thursday; 8:00 – 9:50 a.m.
C-204/201 (sec. 53 & 54) Tuesday 1:00-3:50 p.m.
C-201/204 (sec. 57 & 58) Thursday 1:00-3:50 p.m.

TOPICS:
- Safety Video. Locker check-out.
- Relating Mass and Volume (bring a metric ruler to lab).
- Detecting Signs of Chemical Change.
- Separating and Isolating the Components of a Binary Mixture of Solids.
- Empirical Formula of an Oxide.
- Single Replacement Reactions and Relative Reactivity.
- Percent Water in a Hydrate.
- Heat of Neutralization (partners; bring a watch with a second hand).
- Paper Chromatography of Selected Transition-metal Cations (bring a ruler to lab).
- Separating and Determining the Mass of Calcium Ion in a Calcium-Enriched Tablet.
- Paper Chromatography of Selected Transition-metal Cations (bring a ruler to lab).
- Determining the Molar Concentration of a Sodium Hydroxide Solution.
- Titrating Vinegar and locker check-in.

COMPUTER USAGE:
None
COURSE OUTCOMES:
Each student successfully completing Chem112L is expected to have the following abilities:

- Understand the distinction between qualitative and quantitative chemical analysis.
- Understand the fundamental and operational principles upon which common methods of separation and purification of chemical substances are based.
- Identify sources of error in chemical experiments.
- Interpret experimental results and draw reasonable conclusions.
- Analyze data in terms of the precision and accuracy of results.
- Learn and understand laboratory safety procedures.
- Anticipate, recognize, and respond to hazards of chemical materials and manipulations.
- Learn the importance of performing accurate and precise quantitative measurements.
- Keep legible and complete experimental records.
- Collaborate with peers in obtaining and interpreting data.
- Understand the concept of standardization.

LABORATORY:
100%

ASSESSMENT AND EVALUATION:
Pre-lab questions
Lab Reports

PREPARED BY:
Dale Arrington, Fall 2003
ENG 101 COMPOSITION I
(Required Course)

CATALOG DATA:
ENGL 101 COMPOSITION I
(3-0) 3 credits. Appropriate student placement based on entry level assessment or completion of (or concurrent enrollment in) ENGL 031, 032, or 033. Practice in the skills, research, and documentation needed for effective academic writing. Analysis of a variety of academic and non-academic texts, rhetorical structures, critical thinking, and audience will be included.

TEXTBOOK:
Mims and Nollen, Mirror on America: Short Essays and Images, 2nd Edition
Raimes, Keys for Writers, third edition.

INSTRUCTOR:
Palmer, Morgan, Antonen, and Neumann
Humanities office phone: 394-1243. Leave a message if no one answers.

EXPECTATIONS:
None

COURSE OBJECTIVES:
At the conclusion of English 101, students should be able to:
- understand the basic principles of organization and development necessary to write an essay
- understanding writing as a process that requires analysis, interpretation, drafting and revision
- master basics of expository prose and use of rhetorical strategies to write effectively and critically for a variety of audiences
- know techniques of basic research in order to communicate knowledge and ideas professionally and ethically of the composition, structure, and properties of matter and the changes that matter undergoes.

PROFESSIONAL COMPONENT:
English: 3 credits or 100%

TOPICS:
- Critical Reading
- Argumentation
- Logical Fallacies
- Peer Review
- Brainstorming, Freewriting
- Titles, Topic Sentences, Thesis Statements
- Using & Citing Sources
- Textural Analysis
- Using the Library
- Research Writing, MLA Style
- Documentation
- Sentences, Punctuation, Analyzing Texts
- Portfolio Consultations

COMPUTER USAGE:
Word Processing
COURSE OUTCOMES:
In English 101 students will demonstrate effective communication by:

- designing and producing writing adapted to various audiences and purposes
- composing clear, effective sentences and combining them into focused, coherent paragraphs that support the purpose of their essays
- using basic research skills and appropriate documentation of sources
- exhibiting awareness of ethical standards by accurately using sources and formulating text
- practicing a prose style based on conciseness, clarity, and fluency
- using standard English grammar, punctuation, and other mechanical aspects

RELATIONSHIP OF COURSE TO PROGRAM OUTCOMES:
ENGL 101, Composition I, meets part of ABET Criterion 3, outcome (g):
(g) Ability to communicate effectively.

LABORATORY:
None

ASSESSMENT AND EVALUATION:
- Papers
- Quizzes & Assignments
- Oral Presentation
- Portfolio

PREPARED BY:
Sally Palmer, Spring 2004
ENG 279 TECHNICAL COMMUNICATIONS I
(Required Course)

CATALOG DATA:
ENGL 279 TECHNICAL COMMUNICATIONS I
(3-0) 3 credits. Prerequisites: ENGL 101 or equivalent and sophomore standing. Introductory written and oral technical communications with emphasis on research and explanations of scientific and engineering topics.

TEXTBOOK:
Companion Website to text: http://www.ablongman.com/lannontechcomm

Class WebCT Site: http://webct.sdsmt.edu:8900/
Other Materials: Computer disk for storing writing & videotape for recording speeches

INSTRUCTORS:
Sneller, Hudgens, Palmer, and Boysen,
Humanities office phone: 394-1243. Leave a message if no one answers.

EXPECTATIONS:
Students will have completed English 101, or equivalency.

COURSE OBJECTIVES:
At the conclusion of English 279, students should be able to
• understand the principles of organization and development that are required to produce a variety of short, basic technical documents,
• understand technical writing as a process requiring analysis, interpretation of data, drafting and revision;
• understand the basic components of planning and preparing effective oral presentation of technical and professional material;
• conduct basic technical research using both traditional and electronic methods to communicate in an ethical manner; and
• improve communication and problem solving skills by working on speaking and writing projects in teams.

PROFESSIONAL COMPONENT:
English: 3 credits or 100%

TOPICS:
• What is “technical communication” and what does it entail?
• Audience Analysis
• The “How To’s” of speaking in public
• “Students Take Charge” presentations
• Peer Review
• Summary Writing
• Research / Identifying Sources
• Ethics and/in technical communication
• Visual Aids
• Job Search
• Resumes
• Definitions & Descriptions
• Persuasive Speaking
COMPUTER USAGE:
- Word Processing
- PowerPoint

COURSE OUTCOMES:
Students will demonstrate effective technical communication by
- producing well organized and effectively designed short, basic technical documents;
- employing drafting, revision, and analytical skills to take a document from initial conception to final product;
- producing individual and collaborative documents and oral presentations for a variety of technical, professional, and general audiences;
- recognizing and using appropriate conventional formats and visuals for a variety of basic technical/professional documents;
- the basic research skills and documentation techniques necessary to produce effective written and oral technical communications;
- exhibiting awareness of ethical standards by accurately using sources and formulating text; and
- practicing a technical communication style based on conciseness, clarity, fluency; and using standard English grammar, punctuation, and other mechanical aspects.

RELATIONSHIP OF COURSE TO PROGRAM OUTCOMES:
ENGL 279, Technical Communication I, meets part of ABET Criterion 3, outcome (d), (f), (g):
(d) Ability to function on multi-disciplinary teams
(f) Understanding of professional and ethical responsibility
(g) Ability to communicate effectively

LABORATORY:
None

ASSESSMENT AND EVALUATION:
- Formal writing assignments
- Formal speeches
- Quizzes
- Attendance & participation

PREPARED BY:
Judy Sneller, Spring 2004
ENG 289/289L TECHNICAL COMMUNICATIONS II
(Required Course)

CATALOG DATA:
ENGL 289/289L TECHNICAL COMMUNICATIONS II
(2-1) 3 credits. Prerequisites: ENGL 279 or equivalent and sophomore standing. Advanced written and oral
technical communications with emphasis on the research, preparation, and delivery of complex technical
documents.

TEXTBOOK:
Savage, Gerald J. and Dale L. Sullivan. Writing a Professional Life: Stories of Technical Communicators
On and Off the Job.

INSTRUCTORS:
Rice, Boysen, Lee, Westergaard, and Antonen
Humanities office phone: 394-1243. Leave a message if no one answers.

EXPECTATIONS:
Students will have completed ENGL 279 or equivalent.

COURSE OBJECTIVES:
At the conclusion of English 289, students should be able to
• Understand the advanced principles of organization and development that are required to produce
different types of complex technical documents,
• Understand technical writing as a process requiring analysis, interpretation of data, drafting and
revision;
• Understand the advanced principles of planning and preparing effective oral presentations of
technical and professional material;
• Conduct advanced technical research using a variety of traditional and electronic methods to
communicate in an ethical manner;
• Improve communication and problem solving skills by working on speaking and writing projects
in teams; and
• Use writing, speaking, researching, and networking skills to compete effectively in the job market.

PROFESSIONAL COMPONENT:
English: 3 credits or 100%

TOPICS:
• Elements of the proposal
• Formal reports: preliminary guidelines
• Style review
• Style: clarity
• Style: conciseness
• Summaries and abstracts
• Writing evaluations
• Proposal briefing
• Communication issues in professional writing
• Communication issues workshop
• Team communication problems
• Peer review
• Oral presentations
COMPUTER USAGE:
- Word Processing
- PowerPoint

COURSE OUTCOMES:
In English 289 students will demonstrate effective technical communication by:
- Producing well organized and effectively designed complex technical documents;
- Producing well organized and effectively designed resumes and other job application documents;
- Employing drafting, revision, and analytical skills to take a document from initial conception to final product;
- Producing individual and collaborative documents and oral presentations for a variety of technical, professional, and general audiences;
- Recognizing and using appropriate formats and elements of document design applicable to a variety of complex technical documents;
- Using appropriate, effective graphics in speaking and writing projects;
- Using the advanced research skills and documentation techniques necessary to produce effective written and oral technical communications;
- Exhibiting awareness of ethical standards by accurately using sources and formulating text;
- Adopting a technical communication style based on conciseness, clarity, fluency, and consistency;
- Using standard English grammar, punctuation, and other mechanical aspects.

RELATIONSHIP OF COURSE TO PROGRAM OUTCOMES:
ENGL 289289L, Technical Communication II, meets part of ABET Criterion 3, outcome (d), (f), (g):
(d) Ability to function on multi-disciplinary teams
(f) Understanding of professional and ethical responsibility
(g) Ability to communicate effectively

LABORATORY:
None

ASSESSMENT AND EVALUATION:
- Written Assignments
- Presentations
- Attendance & Participation

PREPARED BY:
Rodney Rice, Spring 2004
MATH 123 Calculus I
(Required Course)

CATALOG DATA:
MATH 123 CALCULUS I
(4-0) 4 credits. Prerequisite: MATH 115 or appropriate mathematics placement or permission of instructor. Prerequisite: MATH 115 completed with a minimum grade of "C.” The study of limits, continuity, derivatives, applications of the derivative, antiderivatives, the definite and indefinite integral, and the fundamental theorem of calculus.

Prerequisite: Pre-calculus.

INSTRUCTORS:
Math office phone: 394-2471. Leave a message if no one answers.

TEXT:
Calculus 2nd edition Smith and Minton.

TOPICS:
1) Functions
2) Limits and continuity
3) Derivatives of polynomial and trigonometric functions
4) Derivatives of logarithmic and exponential functions
5) Applications of derivatives
   i) Curve sketching
   ii) Related rates
   iii) Newton’s method
   iv) Velocity and acceleration
6) Applications of derivatives
   i) Optimization
7) Antiderivatives
8) Integration using u-substitution
9) Topics for Exam 4
10) Definite integrals
11) Applications of integration
   i) Area
   ii) Volume using disks, shells, and washers

COURSE OBJECTIVE:
This course is intended for students majoring in mathematics, physics, chemistry, engineering and related fields. Students will apply the concepts of limits, derivatives and integrals in solving problems in their respective disciplines. They will be able to identify, graph, integrate, and differentiate polynomial, trigonometric, logarithmic, exponential and algebraic functions.
PROFESSIONAL COMPONENT:
Mathematics 4 credits or 100%

OUTCOMES.
A student who successfully completes this should, at a minimum, be able to:

1. Understand functions.
2. Be able to use functional notation in manipulating mathematical expressions.
3. Understand the concept of a limit and how it applies to calculus.
4. Be able to compute limits using various methods.
5. Be able to determine where a function is continuous.
6. Understand the concept of the derivative.
7. Be able to compute derivatives using the power rule, product rule, quotient rule and chain rule.
8. Be able to use the concept of the derivatives in applications such as related rates, linear approximations, Newton’s Method, curve sketching, optimization, velocity and acceleration.
9. Understand the concept of an antiderivative.
10. Be able to manipulate expressions using sigma notation.
11. Be able to integrate using substitution and the power rule.
12. Understand and be able to apply the Fundamental Theorem of Calculus.
13. Be able to use the concept of the integral in applications such as area, volume, velocity and acceleration.
14. Understand the use of numerical integration techniques such as Trapezoidal and Simpson’s rules.

RELATIONSHIP OF COURSE TO PROGRAM OUTCOMES:
MATH 123, Calculus I, meets part of ABET Criterion 3, outcome (a):
   (a) Ability to apply knowledge of mathematics, science, and engineering.

PREPARED BY: Laura Geary and Arden Davis May, 2004
MATH 125 Calculus II
(Required Course)

CATALOG DATA:
MATH 125 CALCULUS II
(4-0) 4 credits. Prerequisite: MATH 120 completed with a minimum grade of "C" or appropriate score on departmental Trigonometry Placement Examination and MATH 123 completed with a minimum grade of "C." A continuation of the study of calculus, including the study of sequences, series, polar coordinates, parametric equations, techniques of integration, applications of integration, indeterminate forms, and improper integrals.

Prerequisite: Calculus I.

INSTRUCTORS:
Math office phone: 394-2471. Leave a message if no one answers.

TEXT:
Calculus (Smith, Minton 2nd ed.) We will cover Chapters 5-9.

OBJECTIVES:
1) The student will continue to learn differentiation and integration techniques, building on the skills learned in Calculus I.
2) The student will learn basic concepts dealing with infinite sequences and series.
3) The student will learn how to work with parametric equations and polar coordinates.

TOPICS:
1. Further applications of the definite integral
   a. Arc length
   b. Surface area
   c. Work
   d. Moments and center of mass
2. Properties of logarithms, exponentials, trig and inverse trig functions Derivatives and antiderivatives
   of exponential, logarithms, trig and inverse trig functions.
3. Evaluation of antiderivatives using:
   a. Trig integrals
   b. Trig substitutions
   c. Parts
   d. Partial fractions
4. L’Hospital’s rule and improper integrals
5. Infinite series and convergence using:
   a. Definition
   b. Integral test
   c. Ratio test
   d. Comparison test
   e. n^th term test
   f. Alternating series, conditional and absolute convergence

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6. Interval of convergence of power series
7. Taylor series expansions
8. Fourier series expansions
9. Parametric and polar graphs and equations, derivatives and integrals

PROFESSIONAL COMPONENT:
Mathematics 4 credits or 100%

OUTCOMES:
A student who successfully completes this course should, at a minimum:
1. Know how to differentiate exponential and logarithmic functions and integrate the corresponding functions.
2. Know how to differentiate inverse trigonometric functions and integrate the corresponding functions.
3. Know how and when to use various integration techniques, including integration by parts and partial fractions.
4. Know how to evaluate limits of infinite sequences, including how and when to use L’Hopital’s Rule.
5. Know how to evaluate improper integrals.
6. Recognize common infinite series, including the geometric and harmonic series.
7. Know how and when to use various tests for convergence of infinite series, including the Ratio Test, the Alternating Series Test, and Comparison Tests.
8. Know how to determine the interval of convergence for a power series.
9. Know how to use infinite series such as the Taylor Series or Fourier Series to approximate functions.
10. Know how to convert between rectangular and parametric form, graph parametric curves, find derivatives, and do other calculus applications using parametric functions.
11. Know how to convert between rectangular and polar coordinates, graph polar curves, and do calculus applications using polar coordinates.

RELATIONSHIP OF COURSE TO PROGRAM OUTCOMES:
MATH 125, Calculus II, meets part of ABET Criterion 3, outcome (a):
(a) Ability to apply knowledge of mathematics, science, and engineering.

PREPARED BY:  Don Teets, Harold Carda, and Arden Davis  May, 2004
MATH 225 Calculus III
(Required Course)

CATALOG DATA:
MATH 225 CALCULUS III
(4-0) 4 credits. Prerequisite: MATH 125 completed with a grade of “C.” A continuation of the study of calculus, including an introduction to vectors, vector calculus, partial derivatives, and multiple integrals.

Prerequisite: Calculus II.

INSTRUCTORS:
Teets, Burgoyne, Carda, Dahl, and Riley.
Math office phone: 394-2471. Leave a message if no one answers.

TEXT:
Calculus (Smith, Minton 2nd ed.) We will cover Chapters 10-14 with some omissions.

TOPICS:
• Vector and vector functions.
• Functions of several variables.
• Partial derivatives.
• Multiple and line integrals.
• Vector analysis.

OBJECTIVES:
1) The student will learn the basic tools and methods of multivariate calculus.
2) The student will understand applications of multivariate calculus.

PROFESSIONAL COMPONENT:
Mathematics: 4 credits or 100%

OUTCOMES:
A student who successfully completes this course should, at a minimum:
1. Know basic vector operations.
2. Know how to work with lines and planes in space.
4. Be able to compute position, velocity, and acceleration vectors.
5. Understand functions of several variables.
6. Be able to compute partial derivatives and gradients using multivariate chain rules.
7. Be able to find extremals of constrained and unconstrained functions.
8. Understand iterated integrals.
9. Be able to set up and evaluate double and triple integrals in various coordinate systems.
10. Understand field vectors.

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11. Be able to compute line integrals.
12. Understand the basic integral theorems of vector analysis.

RELATIONSHIP OF COURSE TO PROGRAM OUTCOMES:
MATH 225, Calculus III, meets part of ABET Criterion 3, outcome (a):
(a) Ability to apply knowledge of mathematics, science, and engineering.

PREPARED BY: Don Teets, Kyle Riley, and Arden Davis        May, 2004
MATH 321 DIFFERENTIAL EQUATIONS
(Required Course)

CATALOG DATA:
MATH 321 DIFFERENTIAL EQUATIONS
(4-0) 4 credits! Prerequisites: MATH 125 with a minimum grade of “C.” Selected
topics from ordinary differential equations including development and applications of
first order, higher order linear and systems of linear equations, general solutions and
solutions to initial-value problems using matrices. Additional topics may include Laplace
transforms and power series solutions. MATH 225 and 321 may be taken concurrently or
in either order. In addition to analytical methods this course will also provide an
introduction to numerical solution techniques.

Prerequisite: Calculus II.

INSTRUCTORS:
Geary, Burgoyne, Carda, and Dahl
Math office phone: 394-2471. Leave a message if no one answers.

TEXT:

TOPICS:
1) Basic definitions and terminology
2) Direction fields and solution curves
3) First order differential equations and their applications
   a) Separable
   b) Linear
   c) Exact
   d) Bernoulli
   e) Numerical Methods
4) Higher order differential equations...homogeneous and nonhomogeneous
5) Method of undetermined coefficients
6) Method of variation of parameters
7) Applications of higher order differential equations
   a) Simple harmonic motion
   b) Damped motion
   c) Forced motion
   d) Electric circuits and analogous systems
8) Basic LaPlace transforms and their inverses
9) Laplace transforms
10) Inverse Laplace transforms
11) Operational Properties
12) Applications
13) Systems of linear first order equations
14) Matrices
15) Gauss elimination
16) Systems of ordinary differential equations
17) Eigenvalues
18) Variation of parameters
PROFESSIONAL COMPONENT:
Mathematics 4 credits or 100%

COURSE OBJECTIVES:
1) The student will learn how to apply basic techniques to solve ordinary differential equations.
2) The student will understand how to determine whether a function is a solution to a given ordinary differential equation or initial value problem.

STUDENT OUTCOMES:
A student who successfully completes this should, at a minimum, be able to:

1) Know how to use separation of variables.
2) Be able to solve first order ordinary differential equations.
3) Be able to solve second order linear ordinary differential equations.
4) Understand the difference between homogeneous and non-homogeneous linear systems.
5) Be familiar with at least one science or engineering application of differential equations.
6) Be able to compute the Laplace transform and inverse Laplace transform for simple functions.
7) Understand the basic process of how to use the Laplace transform to solve an initial value problem.
8) Be familiar with a numerical technique for solving an initial value problem, such as Euler’s Method or the Runge Kutta method.
9) Be able to carry out basic matrix addition and matrix multiplication.
10) Be able to solve a linear system in matrix form.
11) Be able to use matrices to solve simple linear first order systems of ordinary differential equations.

RELATIONSHIP OF COURSE TO PROGRAM OUTCOMES:
MATH 321, Differential Equations, meets part of ABET Criterion 3, outcome (a):
(a) Ability to apply knowledge of mathematics, science, and engineering.

PREPARED BY: Laura Geary and Arden Davis May, 2004
IENG/MATH 381  Introduction to Probability and Statistics

CATALOG DATA:
IENG/MATH 381
(3-0) 3 credits. Prerequisite: MATH 225 concurrently. Introduction to probability theory, discrete and continuous distributions, sampling distributions and the Central Limit Theorem with general principles for statistical inference and applications of random sampling to hypothesis testing, confidence limits, correlation, and regression.

Prerequisite: Calculus III (concurrently).

INSTRUCTORS:
Geary, Johnson, Riley, Trimble
Math office phone: 394-2471. Leave a message if no one answers.

TEXT:
*Probability and Statistics for Engineering and the Sciences, 6th edition, Jay L. Devore*

TOPICS:
1) Graphical and numerical summaries of data
2) Counting techniques to compute probabilities in the equally-likely outcome case
3) The addition and multiplication rules for computing probabilities
4) Conditional probability including “Law of Total Probability”, and “Bayes’ Rule”
5) Special discrete (e.g. binomial) and continuous (e.g. normal) random variables
6) Summary measures for random variables
7) Central Limit Theorem and applications to confidence intervals and tests on a single mean in the large sample case
8) Least squares and simple linear regression

COURSE OBJECTIVE: Students will learn fundamental language and notation of probability and statistics, learn how to summarize data, compute probabilities, estimate parameters, and conduct some simple hypothesis tests.

PROFESSIONAL COMPONENT:
Mathematics: 2 credits
Engineering: 1 credit

OUTCOMES:
A student who successfully completes this should, at a minimum, be able to:

1. Produce and interpret a variety of descriptive summaries of data (e.g. numerical summary statistics, boxplots, and histograms).
2. Determine the least-squares line for a bivariate dataset.
3. Compute probabilities . . .
   a. Using elementary counting techniques
   b. Using fundamental rules of probability, including Bayes' Rule and the Law of Total Probability
   c. By recognizing and using standard probability mass functions (e.g. binomial) and density functions (e.g. normal)
d. Approximately, using the Central Limit Theorem

4. Produce and interpret point and interval estimates for a population mean.

5. Understand the fundamental logic behind a formal hypothesis test and be able to carry out such tests on a population mean.

6. Develop some proficiency in the use of a statistical software package.

7. Learn, and correctly use, fundamental probability and statistics language and notation.

RELATIONSHIP OF COURSE TO PROGRAM OUTCOMES:
IEng/Math 381, Introduction to Probability and Statistics, meets part of ABET Criterion 3, outcome (a):

(a) Ability to apply knowledge of mathematics, science, and engineering

PREPARED BY: Roger Johnson May 2004
MATH 441  Engineering Statistics I

CATALOG DATA:
MATH 441
(2-0) 2 credits. Prerequisite: MATH 225. An introduction to the core ideas in probability and statistics. Computation of probabilities using, for instance, counting techniques and Bayes’ rule. Introduction to discrete and continuous random variables, joint and conditional distributions, expectation, variance and correlation, random sampling from populations, hypothesis tests and confidence intervals, and least squares. This course is the first in a sequence of two (2) two-credit mini-courses in probability in statistics offered in a single term, the second being MATH 442.

Prerequisite: Calculus III.

INSTRUCTORS:
Johnson
Math Office Phone: 394-2471. Leave a message if no one answers.

TEXT:

TOPICS:
1) Graphical and numerical summaries of data
2) Counting techniques to compute probabilities in the equally likely outcome case
3) The addition and multiplication rules for computing probabilities
4) Conditional probability including “Law of Total Probability”, and “Bayes’ Rule”
5) Modeling random phenomena using special discrete (e.g. binomial) and continuous (e.g. normal) random variables
6) Summary measures for random variables
7) Central Limit Theorem and applications to confidence intervals and tests on a single mean in the large sample case
8) Least squares and simple linear regression

COURSE OBJECTIVE: Students will learn fundamental language and notation of probability and statistics, learn how to summarize data, compute probabilities, estimate parameters, and conduct some simple hypothesis tests.

PROFESSIONAL COMPONENT:
Mathematics: 2 credits

OUTCOMES:
A student who successfully completes this should, at a minimum, be able to:

1) Produce and interpret a variety of descriptive summaries of data (e.g. numerical summary statistics, boxplots, and histograms).
2) Determine the least-squares line for a bivariate dataset.
3) Compute probabilities . . .
   a) Using elementary counting techniques
   b) Using fundamental rules of probability, including Bayes' Rule and the Law of Total Probability
   c) By recognizing and using standard probability mass functions (e.g. binomial) and density functions (e.g. normal)
   d) Approximately, using the Central Limit Theorem
4) Produce and interpret point and interval estimates for a population mean.
5) Understand the fundamental logic behind a formal hypothesis test and be able to carry out such tests on a population mean.
6) Develop some proficiency in the use of a statistical software package.
7) Learn, and correctly use, fundamental probability and statistics language and notation.

RELATIONSHIP OF COURSE TO PROGRAM OUTCOMES:
Math 441, Engineering Statistics I, meets part of ABET Criterion 3, outcome (a):
   (a) Ability to apply knowledge of mathematics, science, and engineering

PREPARED BY: Roger Johnson       June 2004
MATH 442 Engineering Statistics II

CATALOG DATA:
MATH 442
(2-0) 2 credits. Prerequisite: MATH 441. In part, covers topics from MATH 441 in more
depth including additional standard distributions used to model real-world phenomena,
additional standard hypothesis tests and confidence intervals. Other topics include
building multiple regression models, parameter estimation, and reliability. Selected
nonparametric and computer-intensive methods may also be covered. This course is the
second in a sequence of two (2) two-credit courses in probability and statistics offered in
a single term, the first being MATH 441.

Prerequisite: Engineering Statistics I

INSTRUCTORS:
Johnson
Math Office Phone: 394-2471. Leave a message if no one answers.

TEXT:

TOPICS:
1) Modeling real-world phenomena using special discrete (e.g. Poisson) and continuous
(e.g. gamma) random variables
2) One-sample hypothesis tests on a mean (small- and large-sample cases) and on a
   proportion (large-sample case)
3) Verifying distributional assumptions (e.g. using normal probability plots)
4) Comparing performance of competing estimators (e.g. using mean-squared error)
5) Least squares/regression models with several predictor variables

COURSE OBJECTIVE: Students will learn how to model real-world random
phenomena using standard distributions, will be able to carry out one-sample tests on a
mean and on a proportion, build least-squares/regression models in several predictor
variables. They will also be able to check whether the assumptions (e.g. normality)
necessary for a procedure (e.g. hypothesis test, multiple regression) are reasonably
satisfied.

PROFESSIONAL COMPONENT:
Mathematics: 2 credits

OUTCOMES:
A student who successfully completes this should, at a minimum, be able to:

1. Recognize and then fit standard distributions to real-world random phenomena.
2. Conduct one-sample tests on a mean (small- and large-sample cases) and on a
   proportion (large-sample case).
3. Be able to reasonably verify normality using a variety of techniques, including normal probability plots.
4. Efficiently build least squares/regression models using a variety of predictor variables.
5. Develop some proficiency in the use of a statistical software package.
6. Learn, and correctly use, fundamental probability and statistics language and notation.

RELATIONSHIP OF COURSE TO PROGRAM OUTCOMES:
Math 442, Engineering Statistics II, meets part of ABET Criterion 3, outcome (a):
   (a) Ability to apply knowledge of mathematics, science, and engineering

PREPARED BY: Roger Johnson June 2004
PHYS 211/211A UNIVERSITY PHYSICS I
(Required Course)

CATALOG DATA:
PHYS 211/211A UNIVERSITY PHYSICS I
(3-0) 3 credits. Prerequisite: MATH 123 or permission of instructor. This is the first course in a two (2)
semester calculus-level sequence, covering fundamental concepts of physics. This is the preferred sequence
for students majoring in physical science or engineering. Topics include classical mechanics and
thermodynamics. Credit will not be allowed in both Phys 111-113 and Phys 211-213

TEXTBOOK:
University Physics by Halliday and Resnick

INSTRUCTOR:
Dr. M. Foygel, EEP 219 (394-1227)
E-mail: michael.foygel@sdsmt.edu
Office Hours: 2:00 – 4:00 p.m. MW

EXPECTATIONS:
Students are expected to have a fundamental understanding of:
• Areas and volumes of simple geometric figures (example: circle, triangle, cylinder and sphere).
• Pythagorean Theorem.
• Solution of quadratic equations.
• Solution of simultaneous linear equations.
• Finding x and y components of a given vector.
• Find the magnitude and direction of a vector from the x and y component.
• Vector addition and subtraction.
• Scalar and vector products of two vectors.
• Integration and differentiation of linear equations.
Generally, most material from algebra, geometry, trigonometry, and calculus should be known thoroughly.

COURSE OBJECTIVES:
1. To present the basic concepts and principles of mechanics;
2. To strengthen an understanding of the concepts and principles through a broad range of interesting
applications in the real world.

To meet these objectives, emphasis is placed on sound physical arguments and problem-solving
methodology.

CLASS SCHEDULE:
C-228 Monday & Wednesday, 11:00 – 11:50 a.m.

PROFESSIONAL COMPONENT:
Basic Science: 3 credits or 100%

TOPICS:
The basic physical principles of Newton’s laws of motion.
The conservation laws concerning momentum, energy and angular momentum are applied to the linear and
curvilinear motion of particles, simple harmonic motion and the rotation of rigid bodies.

COMPUTER USAGE:
None
COURSE OUTCOMES:
Upon completion of this course, students should demonstrate the ability to:
1. Use SI units and convert units from one system to another.
2. Perform basic operations on vectors such as adding and subtracting vectors geometrically and by components in the unit-vector notation; converting components into polar coordinates; multiplying a vector by a scalar and performing the dot and cross multiplication of vectors.
3. Given a position vector of a particle calculate its displacement, average and instantaneous velocity and acceleration; describe projectile motion and uniform circular motion; relate velocities in different frames of reference.
4. Use the free-body diagrams in solving dynamics problems; apply Newton’s laws to a system of several interacting bodies in order to find their accelerations.
5. Calculate work done by a constant or general variable force; calculate power given the force and instant velocity; use the work-energy theorem to relate a change in kinetic energy to the net work done on a system.
6. Calculate gravitational and elastic potential energy; apply energy conservation principle to systems involving gravity, springs, and friction.
7. Find the center of mass of a system of several particles; apply Newton’s second law to a system of particles in order to relate the net external force and the acceleration of the system’s center of mass.
8. Use conservation of linear momentum and of energy to relate velocities of colliding bodies before and after collision for the cases of elastic and purely inelastic collisions in one and two dimensions.
9. Calculate angular displacement, velocity and acceleration; relate angular and linear variables; calculate rotational kinetic energy; use the parallel-axis theorem to find the rotational inertia of a body; calculate torque; apply the Newton’s second law in angular form to relate the net torque and the angular acceleration

RELATIONSHIP OF COURSE TO PROGRAM OUTCOMES:
PHYS 211/211A University Physics I, meets part of ABET Criterion 3, outcome (a):
(a) Ability to apply knowledge of mathematics, science, and engineering.

LABORATORY:
None

ASSESSMENT AND EVALUATION:
Quizzes
Homework
Special Projects
Exams

PREPARED BY:
Michael Foygel, Fall 2003
PHYS 213/213A UNIVERSITY PHYSICS II
(Required Course)

CATALOG DATA:
PHYS 213/213A UNIVERSITY PHYSICS II
(3-0) 3 credits. Prerequisite: PHYS 211. This course is the second course in a two (2) semester calculus-level sequence, covering fundamental concepts of physics. This is the preferred sequence for students majoring in physical science or engineering. Topics include electricity and magnetism, sound, light, and optics.

TEXTBOOK:

INSTRUCTOR:
Dr. Vladimir Sobolev, EEP 220 (394-1225)
E-mail: vladimir.sobolev@sdsmt.edu
Office Hours: open

EXPECTATIONS:
Students are expected to have a fundamental understanding of:
- Areas and volumes of simple geometric figures (example: circle, triangle, cylinder and sphere).
- Pythagorean Theorem.
- Solution of quadratic equations.
- Solution of simultaneous linear equations.
- Finding x and y components of a given vector.
- Find the magnitude and direction of a vector from the x and y component.
- Vector addition and subtraction.
- Scalar and vector products of two vectors.
- Integration and differentiation of linear equations.
- Knowledge of polar coordinate systems and its relation to Cartesian coordinate system.
- Ability to calculate indefinite and definite integrals of power and rational functions, and ability to use table of integrals.

Generally, most material from algebra, geometry, trigonometry, and calculus should be known thoroughly.

COURSE OBJECTIVES:
As a result of this course students will be familiar with basic terminology, processes and fundamental laws in electricity and magnetism. Students will have an understanding of how the mathematical techniques of complex numbers, vector analysis, differentiation and integration can assist in formulating and solving physical problems and will then be able to use these techniques when studying other more-advanced courses in Physics. Student will have also further developed generic problem-solving skills, and scientific world-view.

CLASS SCHEDULE:
EP 252 Monday & Wednesday, 11:00 – 11:50 a.m.

PROFESSIONAL COMPONENT:
Basic Science: 3 credits or 100%

TOPICS:
- Electric Charge
- Electric Fields
- Gauss’ Law
- Electric Potential
- Capacitance
- Current and Resistance
• Circuits
• Magnetic Fields
• Magnetic Fields Due to Currents
• Induction and Inductance
• Magnetism of Matter; Maxwell’s Equations
• Electromagnetic Oscillations and Alternating Current

**COMPUTER USAGE:**
None

**COURSE OUTCOMES:**
Upon completion of this course, students should demonstrate the ability to:
• use SI units for electric and magnetic physical quantities; know non-system units used in electricity and magnetism;
• understand the basic concepts and laws of classical electrostatics and electrodynamics;
• quantitatively describe the forces between point charges; know major application of electrostatics and electrodynamics in modern technology;
• calculate the electric fields and electric potentials due to point charges and simple continuous charge distributions;
• understand the notions of capacitance and resistance, to find equivalent capacitances and resistances for capacitors and resistors connected in series and in parallel; know major application of capacitors and resistors in electric circuits;
• to apply the Kirchhoff’s laws for calculations of multi-loop circuits;
• understand the phenomena taking place in circuits contain resistor and capacitor and how these phenomena are described by corresponding equations;
• calculate magnetic fields due to electric currents;
• understand the laws of motion of charged particles in uniform electric and magnetic fields or combined electric and magnetic fields and applications of these phenomena in modern science and technology;
• understand the laws of electromagnetic induction and their role in modern technology;
• improve ability to use mathematics and problem solving skills

**RELATIONSHIP OF COURSE TO PROGRAM OUTCOMES:**
PHYS 213/213A University Physics II, meets part of ABET Criterion 3, outcome (a):
   (a) Ability to apply knowledge of mathematics, science, and engineering.

**LABORATORY:**
None

**ASSESSMENT AND EVALUATION:**
Quizzes
Homework
Exams

**PREPARED BY:**
Vladimir Sobolev, Fall 2003
PHYS 213L UNIVERSITY PHYSICS II LABORATORY
(Required Course)

CATALOG DATA:
PHYS 213L UNIVERSITY PHYSICS II LABORATORY
(0-1) 1 credit. Corequisite: PHYS 213. This laboratory accompanies PHYS 213. Introduction to physical phenomena and measurements. Recording and processing data, determining uncertainties, reporting results. The experiments supplement the work in PHYS 211 and PHYS 213.

TEXTBOOK:
Experimentation, Third Edition, by D. C. Baird

INSTRUCTOR:
Dr. Vladimir Sobolev with TA’s, EEP 220 (394-1225)
E-mail: robert.corey@sdsmt.edu
Office Hours: posted on EEP 218

EXPECTATIONS:
Students are expected to have a fundamental understanding of:
- Algebra
- Trigonometry
- Differential and integral calculus
- Calculus based classical mechanics (PHYS 211)

COURSE OBJECTIVES:
The broad objective of this laboratory course is to reinforce student’s understanding of the fundamental physical laws in classical mechanics, electricity, and magnetism.

CLASS SCHEDULE:
Tuesday/Thursday, 8-10:50 a.m. or 1-3:50 p.m.

PROFESSIONAL COMPONENT:
Basic Science: 1 credit or 100%

TOPICS:
- Introduction to Motion Detectors
- Human Reaction Time
- Simple Pendulum
- Kinematics
- Ballistic Pendulum
- Newton’s Laws #1
- Hooke’s Law
- Work Energy Theorem
- Motion of Inertia
- Collisions #1
- Kirchhoff’s Rules
- Wheatstone Bridge
- RC Circuits: Intro to Oscilloscope

RELATIONSHIP OF COURSE TO PROGRAM OUTCOMES:
PHYS 213L University Physics II Laboratory, meets part of ABET Criterion 3, outcome (a):
(a) Ability to apply knowledge of mathematics, science, and engineering.

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**Computer Usage:**
Microsoft Word
Excel
Data Studio

**Course Outcomes:**
Upon completion of this course, students should demonstrate the ability to:
- gather experimental data both manually and with various computer controlled detectors;
- graphically represent the data both manually and using standard data manipulation software;
- evaluate and interpret the data in the context of physical laws and theory and draw reasonable conclusions from the data.

**Laboratory:**
100%

**Assessment and Evaluation:**
- Lab Notebooks
- Experiments
- Pre-Labs

**Prepared By:**
Robert Corey, May 2004