

MSE COURSE SYLLABI

August 19, 2009

ENGR 5003 Foundations of Engineering Ethics and Values

Catalog Data: Theories of engineering ethics and values. Ethical theory from a Christian viewpoint. Impact of technology on society. Individual options and obligations for action. Case studies will be used to study a range of issues including environment, safety, honesty, organizational communication, quality control and product liability.

Textbook: TBD

Coordinator: Robert Mitchell

Course Topics:

1. An Ethics Foundation
 - a. Ethical Theories
 - i. Utilitarianism
 - ii. Duty Ethics
 - iii. Rights Ethics
 - iv. Virtue Ethics
 - v. Game Theory and Ethics
 - b. Engineering Ethics Codes
 - c. Professional Responsibility
 - d. Ethical Dilemmas
 - e. Ethical Theory from a Christian Viewpoint
 - i. The Biblical Roots of Christian Morality
 - ii. The Hermeneutics of Biblical Ethics
 - iii. The Role of the Christian Community in Engineering Ethics
2. The Impact of Technology on Society
 - a. Impact on the Middle class
 - b. Impact on the Underclass
 - c. Ethical Questions Regarding Cross-Cultural Technological Advancement
 - i. Motivations and Values
 - ii. Socio-Cultural Impact
 - d. The Environment and Sustainability
 - e. Race and Gender issues
3. Options for Action
 - a. Acknowledging Mistakes
 - b. Conflicts of Interest
 - c. Dissent, Whistle Blowing, Departure
 - d. Employee Protection
 - e. Observer (non-employee) Actions
4. Environmental and Safety Concerns
5. Honesty and Truthfulness
6. Organizational Communication
7. Quality Control and Product Liability
8. Responsibility Arising from What Others Do
9. Public Service

ENGR 5103 Innovation and Invention

Catalog Data: Innovation and invention and their relation to engineering in the workplace. Study of sources of innovative ideas such as surroundings. Understanding the patent process and managing intellectual property.

Text David Pressman, *Patent it Yourself*, 13th Edition, 2007

Coordinator: Jay Martin (adjunct faculty)

Course Topics:

1. Understanding innovation and invention
What are the differences between the two, and how do they relate to engineering in the workplace? Is innovation and invention nature or nurture? Can it be taught or is it innate? What makes an invention successful? How does our world around us influence innovation?
2. Sources of innovative ideas
Just as an artist or painter find inspiration from the external environment, inventors are often inspired by their surroundings. How can we create an environment to inspire great ideas? How do our surroundings in the workplace inhibit or promote new ideas? In what ways can we pursue God's wisdom and creation to stir new ideas? How does Bionics influence engineering design?
3. Managing Intellectual Property
Whether bringing outside ideas in, or enabling internal ideas to flourish, managing intellectual property is a critical function in innovation. We will examine how IP figures prominently in companies' business models. We will also discover hands on how to perform patent searches, write patents, create patent drawings, and the patenting process.

ENGR 5113 Random Variables and Stochastic Processes

Catalog Data: Provides a fundamental understanding of probabilistic methods in engineering and the essential mathematical methods for handling random processes. Includes the statistical properties of random variables, probabilistic transformations, and stationary and non-stationary random processes. Applications to estimation, hypothesis testing, response of systems to random inputs, estimation theory, decision theory, and queueing theory.

Texts:

Probability, Random Variables, and Stochastic Processes, Athanasios Papoulis and S. U. Pillia, McGraw-Hill, 4th Ed, 2002.

Schaum's Outline of Probability, Random Variables, and Random Processes, Hwei Hsu, McGraw-Hill, 1996.

Coordinator: Robert Mitchell

Topics:

1. Probability
2. Repeated Trials
3. Random Variables
4. Multiple Random Variables
5. Functions of Random Variables, Expectation, Moments
6. Sequences of Random Variables
7. Statistics – Estimation and Hypothesis Testing
8. Random Processes – Markov Chains, Poisson Processes, Wiener Processes
9. Analysis and Processing of Random Processes – Power Spectral Densities, Noise, Response of Linear Systems to Random Inputs
10. Estimation Theory – Parameter Estimation, Maximum Likelihood, Bayes, Mean-Square
11. Decision Theory
12. Queueing Theory

ENGR 5203 Systems Engineering

Catalog Data: Principles and applications for design and engineering of complex technical systems: material will be a mix of lectures, case studies, and application to current industry systems. Topics include engineering systems terminology and methodology; creating innovative technical solutions; managing program requirements; resolving integration issues; effective communication; and, effective team, project, and program management.

Textbook: Kossiakof, Alexander and Sweet, William N.; Systems Engineering, Principles and Practice; John Wiley and Sons, Inc., 2003.
Laboratory Notebook

Coordinators: Steve Maher

Course Outcomes: Following this course, the student will be able to:

Math, Science, and Engineering Principles:

- Incorporate new technical knowledge gained in research and learning from experts in engineering topics.

Design:

- Apply engineering processes to complex open-ended problems.
- Develop multiple solutions to complex engineering design problems.
- Consider the downstream impact of all decisions made in the design process.
- Understand and use tools such as QFD (House of Quality), Functional Decomposition, Morphological Charts, and Gantt Charts in the design process.

Project Management:

- Manage a complex project that is ill-defined and requires multiple activities happening concurrently.

Teams:

- Be an effective member of a problem solving team.

Communication:

- Demonstrate the ability to express oneself orally and in writing.

Life-Long Learning:

- Creating the desired culture for an engineering team.

Course Topics:

1. What is Systems Engineering?
2. Team and Group Charters; Mission and Problem Statements; Objectives
3. Team Roles and Team Dynamics
4. Determining Customers, Customer Needs and Priorities
5. Engineering Specifications; Interface Control
6. Integration: hardware/software; multiple systems; systems within systems; interdisciplinary systems
7. Effective Research
8. Managing Technical and Technology Issues
9. Holistic Approaches – Other factors such as Safety; Environmental
10. Work Breakdown and Defining Tasks
11. Determining and Managing Project Resources – Personnel, Time, Budget

ELEC 5003 Foundations in Electrical Engineering

Catalog Data: An overview of the discipline of electrical engineering. Topics include signal processing, electronics and electromagnetic fields. This course is designed for graduate students with a bachelor's degree in an area outside electrical engineering, and would prepare the student for any graduate course with an ELEC prefix.

Coordinators: Jeff Bigelow, Richard Miller, David Waldo

Course Topics:

1. Signal Processing
2. Electronics
3. Electromagnetic Fields

ELEC 5123 Digital Communications

Prerequisite: ENGR 5xx3 Random Variables and Stochastic Processes

Course Data: Characterization of communication signals and systems, source coding, optimum receivers, channel capacity and coding, band pass modulation and demodulation, detection in the presence of noise, broadband signaling techniques, spread spectrum techniques, multipath channels, multiuser communications. Applications in satellite, wireless, and computer communication networks.

Textbook: Digital Communications, John Proakis, and Masoud Salehi, McGraw-Hill, 2007.

Coordinator: Robert Mitchell

Topics:

1. Source Coding
2. Characterization of Communication Signals and Systems
3. Optimum Receivers for Additive White Gaussian Noise Channel
4. Carrier and Symbol Synchronization
5. Channel Capacity and Coding
6. Signal Design
7. Communication Through Band-Limited Channels
8. Adaptive Equalization
9. Multichannel and Multicarrier Systems
10. Spread Spectrum Signals
11. Digital Communications through Fading Multipath Channels
12. Multiuser Communications

ELEC 5323 Electronic Devices

Catalog Data: Introduction to physics of semiconductor devices. The three electronic devices from Electronics are brought from basic physics to current-voltage characteristics and circuit models. Students cannot get credit for both ELEC 4323 and 5323.

Textbook: Kanaan Kano, *Semiconductor Devices*. New York: Prentice Hall, 1998.

Coordinators: Jeff Bigelow

Course Outcomes: Following this course, the student will be able to:

Math, Science and Engineering Principles:

- Use semiconductor physics to describe the operation of fundamental electronic devices
- Use semiconductor physics to predict current-voltage relationships
- Linearize current-voltage relationships of these devices to create linear models

Course Topics:

1. Semiconductor Physics
2. Pn-junction
3. Bipolar Junction Transistor
4. Metal-Oxide-Semiconductor Field-Effect Transistor

ELEC 5333 Power Electronics

Catalog Data: Application of electronics to energy conversion and control. Modeling, analysis and application of power semiconductor devices and passive components in various commonly used circuit topologies for AC-DC, DC-DC and DC-AC conversion. Role of power electronics for advanced renewable power sources and hybrid and electric vehicles is examined.

Textbook: TBD

References: Kassakian, John G., Martin F. Schlecht, and George C. Verghese. *Principles of Power Electronics*. Reading, MA: Addison-Wesley, 1991. ISBN: 0-201-09689-7.

Erickson, Robert W. *Fundamentals of Power Electronic, 2nd Edition*. New York, ;NY: Springer, 2001. ISBN-10: 0-7923-7270-0.

Krein, Philip T. *Elements of Power Electronic*. New York, NY: Oxford University Press, 1998. ISBN: 0-19-511701-8.

Mohan, Ned, Tore Undeland, and William Robbins. *Power Electronics, 3rd Edition*. New York, NY: John Wiley and Sons, 2003. ISBN: 978-0-471-22693-2.

Coordinator: W. Joe Watson

Course Outcomes: The student who successfully fulfills the course requirements will have demonstrated:

- An understanding of the basic operation of various power semiconductor devices and passive components.
- An understanding of the basic principles of power switching circuits.
- An ability to analyze and design AC/DC rectifier circuits.
- An ability to analyze and design DC/DC converter circuits.
- An ability to analyze DC/AC inverter circuits
- An ability to understand the role of power electronics in improving energy usage efficiency and in developing practical renewable energy technologies.

Course Topics:

- Circuit layout considerations
- Power semiconductors and passive components
- Half bridge, full bridge rectifiers
- Buck, boost, buck-boost, boost-buck, flyback and cuk converters
- Modeling, analysis and simulation of power circuits
- Solar, wind, hydro and hybrid renewable power sources
- Hybrid and electric vehicles

ELEC-5383: Power System Analysis

Catalog Data: An introduction to basic power system topics. Major focus is on the steady-state modeling, analysis, and design of single and 3 phase power systems.

Prerequisites: ELEC 3303 Introduction to Electronics

Textbook: J.D. Glover and M. Sarma, *Power System Analysis and Design with Personal Computer Applications*, 4th Edition, Books/Cole, Pacific Grove, CA, 2007.

Coordinator: Grant Cochenour (adjunct faculty)

Course Outcomes:

- Understand complex power
- Analyze & model power system components
- Analyze & model an interconnected power system
- Design an interconnected power system

Course Topics:

1. Complex Power
2. Single and 3-Phase Circuit Analysis
3. Power System Load Characteristics
4. Power System Economics and Optimal Fuel Mix
5. Transformers and Transformer Connections
6. Per-Unit System
7. Transmission Lines Constants and Operation
8. Load Flow

ELEC-5393 Power System Protection

Catalog Data: An introduction to basic power system protection. Major focus is on the steady-state modeling, analysis of balanced and unbalanced faults. The course will also focus on the systems and principles used to detect and interrupt faults on the power system.

Prerequisites: ELEC 3303 Introduction to Electronics

Textbook: J.D. Glover and M. Sarma, *Power System Analysis and Design with Personal Computer Applications*, Third Edition, Books/Cole, Pacific Grove, CA, 2002.

References: J.L. Blackburn, *Protective Relaying Principles and Applications*, Marcel Dekker, New York, 1987.

Coordinator: Grant Cochenour (adjunct faculty)

Course Outcomes:

- Model and analyze balanced faults with traditional circuit techniques.
- Model and analyze unbalanced faults with symmetrical components.
- Know the properties and operation behavior of different protective devices.
- Understand and apply the principles of over-voltage and over-current protection.
- Design an effectively coordinated protection system.

Course Topics:

1. Symmetrical Faults
2. Symmetrical Components
3. Analysis of Unbalanced Systems
4. Unsymmetrical Faults
5. Protective Relaying and Coordination
6. Power System Overvoltages
7. Transient stability

ELEC 5523 Real-time Signal Processing

Catalog Data: Design and implementation of real-time embedded digital signal processing systems. DSP programming, real-time operating systems, parallel processing, host computer interfacing. Students cannot get credit for both ELEC 4523 and ELEC 5523.

Textbook: Gomaa, Hassan, *Designing Concurrent, Distributed, and Real-Time Applications with UML* Addison-Wesley, 2000.

Coordinator: David J. Waldo

Course Outcomes: Following this course, the student will be able to:

Math, Science and Engineering Principles:

- Implement real-time DSP systems on target boards by programming the DSP device and using a real-time operating system.

Design:

- Design real-time embedded DSP systems

Course Topics:

1. Processor architectures
2. Host server/DSP interface
3. Real-time design issues
4. Programming techniques
5. Real-time operating systems
6. Optimization and debugging

ELEC 5533 Image Processing and Computer Vision

Catalog Data: Topics include image properties and human perception, edge detection, morphological operations, image transforms, image data compression, image restoration, segmentation, shape recognition, pattern recognition, 3-D vision, texture, motion, and image intelligence.

Textbook: Sonka, Hlavac, Boyle, *Image Processing, Analysis, and Machine Vision*, 3rd Edition, 2007.

Coordinator: Robert Mitchell

Course Topics:

1. Overview of Image Types and Image Acquisition, and Image Processing
2. The Human Visual System and Visual Perception
3. Image Digitization – sampling and quantization
4. Digital image properties
5. Image data representation
6. Frequency domain representation
7. Image restoration
8. Brightness transformations
9. Geometric transformations
10. Edge detection and use of edge information
11. Segmentation
12. Image morphological operations
13. Shape representation and description
14. Pattern recognition in images
15. 3-D vision
16. Texture
17. Motion analysis
18. Image data compression

ELEC 5613 Radio Frequency Engineering

Catalog Data: Analysis and design of Radio Frequency circuits and systems. Network analysis parameters for system level RF design will be used to bridge earlier field theory analysis to modern RF circuit design techniques and software. Students cannot get credit for both ELEC 4613 and 5613.

Co requisites: None

Textbook: David M. Pozar, *Microwave Engineering*, 3rd Ed., John Wiley & Sons, 2005.

Coordinator: Richard Miller

Course Outcomes: Following this course, the student will be able to:

Math, Science and Engineering Principles:

- Analyze microwave networks, components and active devices.

State-of-the-art Tools:

- Use Ansoft Designer for circuit simulation and analysis
- Introduction to Microwave Network Measurement

Design:

- System design considerations and methods

Course Topics:

1. Waveguiding Components
2. Microwave Networks
3. Power Dividers and Couplers
4. Microwave Filters
5. Microwave Active Devices
6. Microwave Systems

CENG 5003 Foundations in Computer Engineering

Catalog Data: An overview of the discipline of computer engineering. Topics include integrated circuits, computer systems and data communication. This course is designed for graduate students with a bachelor's degree in an area outside computer engineering, and would prepare the student for any graduate course with a CENG prefix.

Coordinators: Steve Maher, Joe Watson and Pat Smith

Course Topics:

1. Integrated Circuits
2. Computer Systems
3. Data Communications

CENG 5013 Integrated Circuit Design (2 hr lec, 3 hr lab)

Catalog Data: Design of modern integrated circuits with emphasis on design and development of custom digital circuits using Hardware Description Languages (HDL) (e.g. VHDL/Verilog). Projects requiring both hardware and software architecture elements will be developed. A complete application-specific microprocessor will be designed, implemented, and tested in the Lab.

Prerequisites: CENG 3203 Introduction to Microprocessors or equivalent

Textbook: Botros, Nazeih M., *HDL Programming Fundamentals: VHDL and Verilog*, Da Vinci Engineering Press, 2006.

Instructor: Steve Maher

Course Outcomes: Following this course, the student will be able to:

Math, Science, and Engineering Principles (P):

- Select and use micro-architecture elements appropriate for processor applications

State-of-the-Art Tools (P, A):

- Use combinations of high-level and low-level programming languages suitable for processor applications
- Use an integrated development environment for designing application-specific (ASIC) processor solutions

Design:

- Design application-specific solutions using microprocessor technology
- Implement, debug, and validate an ASIC processor design in FPGA technology

Perform Experiments (P):

- Design experiments to test specifications given for an ASIC processor
- Verify and troubleshoot the design simulation and physical implementation of an ASIC processor.

Course Topics:

1. High-level design for processor applications
2. Processor interface requirements and implications
3. Verilog HDL and how to use it for device design
4. Using an integrated development environment
5. FPGA programming
6. Developing a test, debug, and validation plan
7. Delivering a proven design

CENG 5023 Advanced Hardware Description Language (HDL) Design
(2 hr lec, 3 hr lab)

Catalog Data: Design of advanced systems-on-a-chip using Hardware Description Languages (HDL) (e.g. VHDL/Verilog). Projects requiring both hardware and software architecture elements will be developed. Emphasis will be on designs that can be implemented on single integrated circuits, such as high-end, multi-element FPGA's.

Prerequisites: CENG 5013 Integrated Circuit Design or equivalent

Textbook: Varies according to the project

Coordinators: Steve Maher

Course Outcomes: Following this course, the student will be able to:

Math, Science, and Engineering Principles:

- Select and use micro-architecture elements appropriate for systems applications

State-of-the-Art Tools:

- Use combinations of high-level and low-level programming languages suitable for systems applications, especially systems-on-a-chip
- Use an integrated development environment for designing application-specific embedded processor solutions

Design:

- Design advanced application-specific system-on-a-chip solutions using microprocessor technology

Course Topics:

8. High-level design for systems-on-a-chip applications
9. Processor interface requirements and implications
10. Interface requirements, both external and internal to the chip
11. Verilog HDL and how to use it for device design
12. Using an integrated development environment
13. FPGA programming
14. Introduction to formal verification
15. Delivering a proven design

CENG 5113 Network System Design

Catalog Data: A study of advanced computer network systems design issues. Examination of the prominent protocols and standards for wired and wireless local area networks and the wireless Internet.

Prerequisites: CENG 3113 Data Communications
- **Or** – adequate experience and permission of professor.

Textbook: Comer, Network Systems Design, Pearson, 2006 (see instructor, text is currently out of print)

Coordinator: Pat Smith

Course Outcomes: Following this course, the student will be able to:

Math, Science and Engineering Principles:

- Understand advanced routing protocol topics including BGP and IGP protocols.
- Understand MPLS networks, how they are implemented, and what their purpose and uses are.
- Understand large scale network implementation issues for protocols, router and switch design, and memory models.
- Understand various techniques and solutions for dealing with communications congestion.

Design:

- Be able to use mathematical models to design, analyze, optimize, and simulate wireless and wired computer networks
- Be able to understand and design communications protocols.
- Be able to design applications for distributed use across unique network compute servers.

Course Topics:

1. Advanced Routing Topics
2. Network management
3. MPLS network design issues
4. Large scale network design considerations
5. Queuing theory, congestion management and control techniques
6. Security topics including impact on throughput, support, and usability
7. Network management
8. Protocol design topics
9. Distributed network application issues including memory management, coherency, and appropriate applications.

CENG 5223 Design of Embedded Systems (2 hr lec, 3 hr lab)

Catalog Data: Embedded microcontroller system design using an integrated development environment (IDE). Reduction of development cycle time through the use of contemporary tools, blending high-level and assembly-level code, conservation of memory resources, performance improvement, conservation of power, serial interfaces, internal peripherals, flash memory, in-system programmability.

Prerequisites: CENG 3213 Computer Systems

Textbook: Nagy, Chris, *Embedded Systems Design using the TI MSP430 Series*, Boston, Newnes Elsevier Series, 2003.

Coordinator: Steve Maher

Course Outcomes: Following this course the student will be able to:

Design:

Efficiently solve embedded application problems using contemporary microcontrollers

Use of Tools:

Use an integrated software development environment (IDE) in developing embedded application solutions

Course Topics:

- Embedded microcontroller design using an integrated development environment
- Reduction of development cycle time
- Blending high-level and assembly-level code
- Conserving memory resources
- Improving performance
- Conserving power
- Serial interfaces
- Internal peripherals
- Flash memory
- In-system programmability

CENG 5233 Advanced Computer Architecture

Catalog Data: Computer organization and design. Fundamentals of computer design, instruction set architectures, instruction-level parallelism, pipelining principles, speculation, thread-level parallelism, memory hierarchies, cache principles, virtual memory, multiprocessors, storage systems, clusters, historical perspectives.

Textbooks: Hennessy, John L. and Patterson, David A., *Computer Architecture, A Quantitative Approach*, Morgan Kaufman Publishers, San Francisco, 2007.

Coordinator: W. Joe Watson

Course Outcomes: Following this course the student will be able to:

Math, Science and Engineering Principles:

- Understand computer architecture from a historical perspective
- Understand computer cost/performance design tradeoffs
- Understand instruction set architectures
- Understand performance enhancement features employed by state-of-the-art computers

Course Topics:

1. Fundamentals of computer design
2. Instruction set architectures
3. Instruction-level parallelism
4. Pipelining principles
5. Speculation
6. Thread-level parallelism
7. Memory hierarchies
8. Cache principles
9. Virtual memory
10. Multiprocessors
11. Storage systems
12. Clusters
13. Historical perspectives

CENG 5613 Object-Oriented Software Engineering

Catalog Data: An introductory software engineering course for seniors and first year graduate students who can program in either C++ or Java. Since the tools and techniques now widely available are for Java the course would begin by teaching C++ programmers the simplifications that led to Java (no multiple inheritances, no manual storage management, and no operator overloading.) The goal of the course would be to prepare the programmer to be a software engineer and to begin the study of software architecture.

Textbook: **Object-Oriented Software Engineering; Practical Software Development using UML and Java**, Timothy Lethbridge and Robert Laganier, McGraw-Hill Europe, 2nd Ed, 2005, ISBN 0072834951 (currently out of print, instructor will provide access)

Coordinator: Peter Patton

Course Topics:

1. What is software engineering?
2. Object-oriented software engineering.
3. Reusable software technology.
4. Developing requirements
5. Modeling with classes.
6. Using design patterns.
7. Software usability and user centered design.
8. Modeling interactions and behaviors.
9. Architecting and designing software.
10. Testing and inspecting to insure high quality
11. Managing the software process

CENG 5623 Software Engineering for Trustworthy Software

Catalog Data: This course explores the technologies and methodology underlying a new robust software design model (RSDM) for software development based on successful methods used in hardware design and development. These include cost of software quality (CoSQ), the analytic hierarchy process (AHP), inventive problem solving (TRIZ), failure mode effects analysis (FMEA), quality function deployment (QFD), and Taguchi Methods, including orthogonal matrix methods. The overall design approach is to eliminate software problems as far upstream in the development process as possible, rather than finding and fixing bugs downstream. The course is intended for the software architect or software engineer or the programmer or student wishing to progress into software design.

Textbook: Design for Trustworthy Software, by Jayaswal and Patton, Prentice-Hall, 2006

Coordinator: Peter Patton

Course Topics:

1. Software Development Methodology Today (Chapter One, pp. 3-32)
2. The Challenge of Trustworthy Software Design (Chapter Two, pp. 37-67)
3. Software Quality Metrics (Chapter Three, pp. 69-92)
4. Financial Perspectives on Trustworthy Software (Chapter Four, pp. 95-138)
5. The Analytic Hierarchy Process (Chapter Eight, pp. 253-300)
6. Complexity, Mistakes, and Poka Yoke (Chapter Nine, pp. 303-329)
7. Understanding customer Needs (Chapter Eleven, pp. 345-400)
8. Creativity and Innovation in Software Design (Chapter Twelve, pp. 405-429)
9. Risk Assessment And Failure Modes Effects (Chapter Thirteen, pp. 431-448)
10. Object and Component Technologies (Chapter Fourteen, pp. 449-473)
11. Designing for Trustworthy Software (Chapters 15,16, pp. 479-510)
12. Taguchi Methods and Applications (Chapters 17-19, pp. 511-586)
13. Review of Selected Case Studies (From Chapters 22-27)

MECH 5003 Foundations of Mechanical Engineering

Catalog Data: This course provides an overview of the discipline of mechanical engineering. The material covered encompasses the primary structural and thermal topics included within the BSME degree at an accelerated pace. Emphasis will be placed on breadth of knowledge rather than specialized topics.

Prerequisites: B.S. degree in any engineering field except civil, mechanical or aerospace engineering.

Textbook: *TBD*

Coordinator: Bill Ryan

Course Topics: The course will cover the following topics ...

1. Foundations of Force Analysis (2 weeks)
 - a. Free-body diagrams
 - b. Equilibrium
 - c. Forces and Moments
2. Foundations of Dynamics (4 weeks)
 - a. Particle Dynamics
 - b. 2D Rigid-body Dynamics
 - c. Energy and Momentum
3. Foundations of Fluid Mechanics (3 weeks)
 - a. Hydrostatics
 - b. Internal and external flow
4. Foundations of Heat Transfer (5 weeks)
 - a. Conduction
 - b. Forced and free convection
 - c. Radiation heat transfer

MECH 5123 Machine Dynamics

Catalog Data: A study of kinematics and dynamics of machines and machine parts. Analysis of the kinematics of planar linkages, dynamics of cam mechanisms, gear trains, governors, flywheels and gyroscopes.

Prerequisites: ENGR 2523 Dynamics

Textbook: Course Notes

Coordinator: Wayne Whaley

Course Outcomes: Students who successfully complete the course should be able to:

1. Calculate three-dimensional velocity and acceleration of systems of rigid bodies.
2. Calculate three-dimensional forces and moments acting on rotating and/or translating rigid bodies.
3. Design a dynamic balance scheme for a rotating rigid body.
4. Design vibration isolation mounts for noisy machines.
5. Calculate velocity and acceleration of slider-crank and crank-rocker mechanisms.
6. Calculate pin forces in slider-crank and crank-rocker mechanisms.

Course Topics:

1. Particle Kinematics in Three Dimensions
2. Rigid Body Kinematics in Three Dimensions
3. Rigid Body Kinetics in Three Dimensions
4. Coordinate Transformations of Vectors and Tensors
5. Dynamic Balancing
6. Vibration of Machines
7. Plane Linkage Motion
8. Plane Linkage Forces
9. Cam-follower Motion

MECH 5233 Heating Ventilation and Air Conditioning

Catalog Data: An introduction to analysis and design methods used in HVAC equipment and systems. Emphasis on comfort, safety, economy and energy conservation in load calculations, room air distribution, piping and duct design, and equipment selection.

Co requisites: MECH-4243 Heat Transfer or equivalent

Textbook: McQuiston, Parker, and Spitler, HEATING, VENTILATING, AND AIR CONDITIONING, Analysis and Design, 6th Edition, Wiley & Sons, New York, 2005.

Coordinator: David Cassel

Course Topics: The course will cover the following topics ...

1. Air Conditioning Equipment and Systems
2. Psychrometrics
3. Space Conditioning and Indoor Air Quality
4. Heat Transmission
5. Solar Radiation Effects
6. Heating and Cooling Loads
7. Energy Calculations
8. Pumps, Piping, and Hydronic Systems
9. Fans, Ducts, Diffusers, and Room Air Distribution

MECH 5513 Advanced Mechanics of Materials

Catalog Data: Stress, strain and torsion analysis; deflections of statically indeterminate structural systems and failure analysis; design criteria. Three-dimensional and unsymmetrical stress analysis, and buckling.

Prerequisites: MECH-4213 Machine Design or equivalent

Textbook: A. P. Boresi and R. J. Schmidt, *Advanced Mechanics of Materials*, John Wiley & Sons, 6th Edition, 2003.

Coordinator: Wayne Whaley

Course Topics: The course will cover the following topics ...

1. theories of stress and strain
2. linear stress-strain relations
3. inelastic material behavior
4. torsion
5. asymmetric bending of beams
6. the thick-wall cylinder
7. stability of columns
8. Shear center for thin-wall beam sections
9. Flat plates

MECH 5523 Finite Element Analysis

Catalog Data: An introduction to the use of finite element methods for the analysis and design of mechanical systems. Emphasis will be placed on both structural and thermal scenarios. The course will start with an overview of 1 and 2-dimensional finite element theory and then progress to the use of commercial software for 3-dimensional analysis. Significant attention will be placed on the proper use of commercial finite element software in solving real-world applications.

Prerequisites: MECH-4213 Machine Design or equivalent

Textbooks: Fish, First Course in Finite elements w/CD, Wiley, 2008
Cook, Visual FEA/CBT Software CD, Wiley

Coordinator(s): Byron Newberry

Course Topics: The course will cover the following topics ...

1. Background and History of Finite Element Methods
3. The Stiffness (Displacement) Method
4. Development of Truss and Beam Element Equations
5. Development of Conduction Element Equations
6. Finite Element Modeling Limitations and Pitfalls
7. 3-Dimensional Stress Analysis
8. 3-Dimensional Thermal Analysis
9. Coupled Thermal Stress Analysis

MECH 5533 Vibration Theory & Application

Catalog Data: A study of free and forced vibration of both single and multiple degree-of-freedom structural systems with and without damping. Design of vibration isolators/absorbers and shock spectrum analysis.

Prerequisite(s): MATH-3013 Differential Equations and ENGR-2523 Dynamics or equivalent

Co-requisites: none.

Textbook: Engineering Vibration, 2nd Edition by Daniel J. Inman, Prentice Hall, 2000.

Coordinator: Byron L. Newberry

Course Topics: The course will cover the following topics ...

1. modeling of dynamic systems
2. stability considerations
3. free and harmonic response of damped and undamped systems
4. impulse response and response to arbitrary excitation
5. design of vibration isolation
6. free and forced response of multiple degree-of-freedom systems
7. design of vibration absorbers

MECH 5543 Radiation Heat Transfer

Catalog Data: This course covers the fundamentals of blackbody radiation, surface characteristics, solar and infrared sources, gray-body exchange in enclosures, and combined mode heat transfer. Included is an introduction to the methods of analysis used for radiation heat transfer.

Prerequisites: MECH-4243 Heat Transfer or equivalent

Textbook: M. F. Modest, Radiative Heat Transfer, Elsevier, 2nd Edition, 2003.

Coordinator: s. David Cassel

Course Topics: The course will cover the following topics:

1. Fundamentals of Thermal Radiation
2. Radiative Property Predictions from Electromagnetic Wave Theory
3. Radiative Properties of Real Surfaces
4. Geometric View Factors
5. Radiative Exchange Between Gray, Diffuse Surfaces
6. Radiative Exchange Between Partially-Specular Gray Surfaces
7. Surface Radiative Exchange in the Presence of Conduction and Convection

MECH 5553 Data Measurement and Analysis

Catalog Data: Applications of computer technology to measurement systems. Dynamic performance characteristics of measurement systems. Digital data collection using labview. Signal conditioning, amplification and filtering.

Prerequisites: Graduate standing.

Textbook: Beckwith, Mechanical Measurements, Pearson, 6th Ed, 2007.

Coordinator: Wayne Whaley

Course Topics: The course will cover the following topics:

1. Static and Dynamic characteristics of measurement systems
2. Motion measurements
3. Force measurements
4. Temperature measurements
5. Fluid Flow measurements
6. Amplifiers
7. Filters
8. Digital data collection using Labview

MECH 5613 Tools and Management of Quality

Catalog Data: An introduction to problem solving methods and statistical tools used by engineers for improving product quality; includes Six-Sigma, Design of Experiments, Statistical Process Control, Taguchi Experiments, and Toyota Production System (Lean Manufacturing).

Prerequisites: ENGR 3023 Engineering Math or equivalent

Coordinator: Jim Elkins

Course Topics: The course will cover the following topics ...

1. Problem Solving Tools – Deming’s PDCA cycle and others
2. Six-Sigma goal for engineering specifications
3. Statistical Process Control: theory and application
4. Design of Experiments: ANOVA theory; experiment types; analysis
5. Taguchi’s experimental method of setting engineering specifications
6. Overview of the Toyota Production System
7. Lean Manufacturing Methods

CMSC 5303 Foundations of Computer Science

Prerequisites

The prerequisite for this course is demonstrated competence in at least one high level programming language.

Note:

Current upper level CS courses assume the student is "fluent" in the C++ programming language. Thus, code examples and programming assignments in these courses tend to be C++ based.

One of the objectives of the CS leveling course will give students some familiarity with C++, but no attempt will be made to teach C++ from scratch. Students will be pointed to resources to help them learn C++ syntax, and examples in this leveling course will use a mixture of pseudo-code and C++. By the end of the course, non C++-speaking students should be able to read and understand C/C++ code to the extent necessary to understand examples in the senior CS courses. In the CS courses, students will be given the option of using the programming language of their choice (provided the language allows the objectives of the exercise to be satisfied).

Course Topics

The course content is designed to give the student an overview of the field of software engineering, including current trends in the field. In addition, the course provides students with the fundamentals of prerequisite concepts for the following CS courses: Artificial Intelligence, Programming Languages, Database Processing, and Operating Systems.

Course Topic	Estimated Time
Software Engineering Fundamentals	1 week
Introduction to Object Oriented Concepts	2 weeks
Data Structures & Algorithms	4 weeks
File Structures	4 weeks
Relational Database Concepts	1 week
Basic Computer Organization and Architecture	2 weeks

CMSC 5323 Database Processing

Objectives

By the end of this course, the student should be able to do the following:

- Discuss the advantages of a DBMS over file system data management.
- Demonstrate the ability to analyze problem specifications and create a relational database design that satisfies the problem requirements.
- Use fundamental database design techniques (e.g. normalization), and analyze various design options in terms of their impact on storage space, performance, and maintenance considerations.
- Demonstrate the ability to document results of analysis/design using Entity-Relationship diagrams.
- Demonstrate the ability to use SQL to define, manipulate, and query database tables.
- Demonstrate understanding of the issues that must be addressed when writing application software that interfaces with a database.
- Discuss the major issues related to implementation of a relational database management system. These topics include storage, file structure, indexing mechanisms, and query processing.
- Discuss trends in databases, including the role of tools such as XML as well as object oriented databases and distributed databases.

Course Content

This course provides you with a broad introduction to database concepts, with an emphasis on relational databases. We will explore the relational database model in detail. We will also learn to use Entity-Relationship diagrams to analyze specifications and develop designs that can be implemented using a relational database. Tradeoffs and design issues faced by a database designer will be addressed. We will learn SQL (Structure Query Language) for defining, manipulating, and querying relational tables. We will also discuss how a relational database management system may be implemented. In addition, the concept of transactions and their implementation is discussed.

Text

Database System Concepts, 5th edition, by Abraham Silberschatz, McGraw-Hill, 2006. ISBN 0-07-295886-3.

Bibliography

Connolly, Thomans (2002) *Database Systems*. Addison Wesley.

O'Neal, Patrick (2001) *Database Principles, Programming, Performance*. Morgan Kaufmann

CMSC 5413 Operating Systems

Objectives

By the end of this course, the student should be able to do the following:

- Demonstrate understanding of the fundamental issues that must be addressed by operating systems designers when constructing the components responsible for process management, storage management, and I/O management. You should also be able to describe the major data structures and algorithms used by LINUX/UNIX specifically to address these needs, as well as discuss the responsibilities of both hardware and software in providing the required functionality.
- Demonstrate understanding of the classical algorithms for CPU scheduling, process synchronization, deadlock handling, real/virtual memory management, and file system management.
- Write programs in C/C++ that make use of synchronization primitives and inter-process communication mechanisms to support multi-threaded and multi-process applications.
- Write programs that make use of major POSIX API's for process and file manipulation. Demonstrate interaction of caching mechanisms used by standard I/O libraries and the operating system.
- Demonstrate detailed understanding of at least one contemporary file system structure and its manipulation.

Text

Avi Silberschatz, Peter Galvin, and Greg Gagne, *Operating System Concepts*, Seventh Edition, John Wiley and Sons, New York (2005).

Course Content

This course provides both a practical and a theoretical introduction to operating systems. We will look at operating systems from both an application viewpoint (e.g., what does it do for me?) and an internal design/implementation viewpoint (e.g., how does it do it?). Although we will discuss algorithms and concepts typical of all operating systems, we will use programming/lab experiences to investigate UNIX design and implementation in some detail. Investigating UNIX provides a concrete example of how theory is implemented in an actual operating system.

Course Prerequisites

In addition to the prerequisites described in the catalog, familiarity with the 'C/C++' programming language is expected, since programming assignments and examples will be based on C/C++. Some Java examples will also be used for illustration, but you will be able to quickly pick up the subset of Java syntax that you need. You will also be expected to come up to speed on basic UNIX commands, since much of your programming work will be done on a UNIX platform. Although I will not spend significant lecture time on C++ and UNIX commands, I will be available to help you with both of these topics.

CMSC 5513 Programming Languages

Objectives

By the end of this course, the student should be able to do the following:

- Discuss the historical roots of modern programming languages
- Describe terms and concepts important in language translation and runtime support of language features.
- Read and construct BNF notation. Demonstrate understanding of formal models for syntax description and translation, including regular grammars, BNF grammar, parse trees, and finite state automata
- Demonstrate understanding of parsing concepts and be able to construct lexer and parser for a small language.
- Describe the issues associated with handling variables and data types in a language, and be able to describe the most common rules for binding times and scoping.
- Describe implementation strategies used by languages to implement features such as subprograms, classes, sequence control, aggregate data structures, polymorphism, exceptions, concurrency, and garbage collection.
- Discuss the unique features of functional and logic programming languages.

Course Content

This course provides an introduction to fundamental concepts of programming language design and implementation. We will study issues relating to syntax and the translation of high-level languages into lower level representations. We will examine ways in which common constructs such as subprograms and recursion are implemented, as well as study implementation techniques for additional language features like polymorphism, exception handling, and garbage collection. Several popular languages, including C++, Java, and C# will be used to illustrate concepts throughout the course but we will also examine unique language features such as those found in LISP and Prolog.

Text

Programming Languages, 2nd ed., Allen Tucker, Robert Noonan, McGraw Hill, 2007.

CMSC 5713 Artificial Intelligence

Objectives

By the time you complete this course, you should be able to do the following:

- Use Lisp to write small programs which illustrate fundamental techniques of Artificial Intelligence (AI) to solve problems.
- List and briefly discuss the traditional areas of research and application of AI.
- Demonstrate understanding of techniques for knowledge representation, including propositional and predicate logic, frames, and semantic networks.
- Demonstrate understanding of data structures and algorithms used for state space search, including those used for production/expert systems.
- Be able to explain the applications and limitations of basic stochastic methods for reasoning

Course Content

This course provides an introduction to fundamental concepts in Artificial Intelligence. Knowledge representation and search techniques are emphasized, since these are building blocks for many areas of AI. To reinforce these concepts, we will learn elements of the Lisp language to allow implementation of relevant algorithms. You will write at least one game-playing program to help you understand the application of search algorithms. We will also discuss the difficulties confronting AI researchers, as well as the possibilities and promises of AI.

Text

Artificial Intelligence, 5th ed, George Luger. Addison Wesley, 2005.

Bibliography

Brownson, L., Farrell, R., Kant, E., *Programming Expert Systems in OPS5*, Addison-Wesley Publishing, Reading, MA, 1986.

Winston, Patrick, *Artificial Intelligence*, 3rd ed., Addison Wesley, Reading, MA 1993.

Nilsson, Nils, *Principles of Artificial Intelligence*, Morgan Kaufman Publishers, Los Altos, CA, 1980.

Steele, Guy L., *Common Lisp*, Digital Press, 1984.

MA 5113 Probability and Statistics I

Text: John E. Freund's Mathematical Statistics, 7th Edition, Miller and Miller

Course Description:(As described in the college catalog) Sampling, presentation of data, testing statistical hypotheses, estimating and testing variability and comparisons of populations.

Intellectual Objectives:

1. Increase the student's ability to analyze, model and solve problems.
2. Communicate mathematical ideas and concepts to others in a more effective way.
3. Be provided with tools that will enable him or her to explore new areas related to mathematics and engineering.

Functional Objectives:

1. Learn about several different statistical and probabilistic models and how to relate them to real life situations.
2. Become familiar with sampling techniques and sampling distributions.
3. Learn about the fundamental aspects of decision theory.
4. Be able to use estimation techniques and perform hypothesis testing.
5. Understand the use of regression and correlation in analyzing data.
6. Understand how analysis of variance is used to compare populations.

MATH 5213 Probability and Statistics II

Text: John E. Freund's Mathematical Statistics, 7th Edition, Miller and Miller

Course Description:(As described in the college catalog) Sampling, presentation of data, testing statistical hypotheses, estimating and testing variability and comparisons of populations.

Intellectual Objectives:

1. Increase the student's ability to analyze, model and solve problems. (NCTM 1.5.12)
2. Communicate mathematical ideas and concepts to others in a more effective way. (NCTM 1.2)
3. Be provided with tools that will enable him or her to explore new areas related to mathematics and engineering (NCTM 1.5.12)

Functional Objectives:

1. Learn about several different statistical and probabilistic models and how to relate them to real life situations. (NCTM 1.5.6)
2. Become familiar with sampling techniques and sampling distributions. (NCTM 1.5.7)
3. Learn about the fundamental aspects of decision theory.
4. Be able to use estimation techniques and perform hypothesis testing.
5. Understand the use of regression and correlation in analyzing data.
6. Understand how analysis of variance is used to compare populations.

Math 5313 Complex Variables

Text: Complex Variables and Applications by Brown and Churchill, 7th edition, McGraw-Hill Publishing Co.

Course Description: Complex numbers, analytic functions, integration, series, contour integration, analytic continuation, and multi-valued problems, conformal mapping, boundary value problems and integral transforms.

Objectives: (1) To develop those parts of the theory which are prominent in applications of the subject; and (2) to acquaint the student with the basic knowledge which would be expected of a beginning graduate student.

Course Outline:

1. Algebra of complex numbers;
2. Analytic Functions;
3. Elementary functions (exponential, logarithmic, complex exponents, trig functions, hyperbolic and inverse trig functions);
4. Integrals (Contour integrals, Cauchy-Goursat Theorem, Cauchy Integral Formula, Liouville's Theorem and the Fundamental Theorem of Algebra);
5. Maximum Modulus Principle;
6. Series
7. Residues and Poles;
8. Applications of Residues;
9. Mappings by elementary functions;
10. Conformal mappings