2010

Ohio University

School of Electrical Engineering
& Computer Science

Electrical Engineering
Computer Engineering Options

2010 Senior Electives Fair – May 13, 2010

5:10 – 6:00 PM

Room: Stocker 103

12 - Concentration Areas

33 - Elective Courses (33 EE + 10 CS)
F: 13; W: 15; S: 15

Compiled by Professor Costas Vassiliadis, Ph.D.
Associate Undergraduate Chair, School of EECS
May13th, 2010

EE and CpE Concentration Areas

<u>1. Electromagnetics</u>

<u>2. Optoelectronics and Photonics</u>

<u>3. Controls and Robotics</u>

<u>4. Communications</u>

<u>5. Electric Power and Power Electronics</u>

<u>6. Circuit Design</u>

<u>7. Digital Systems</u>

<u>8. Microprocessors</u>

<u>9. Electronics</u>

<u>10. Industrial Controls</u>

<u>11. Avionics Engineering</u>

<u>12. Computer Software and Hardware Applications</u>

A. Electromagnetics (prerequisite: 395C)

- **EE 441 Antennas** – Winter – Radcliff – Prerequisite EE 395C

This course is about the Antenna Theory, its Analysis and Design. Topics include: Fundamental concepts and definitions, radiation integrals and potential functions, linear wire antennas, loops, arrays, matching techniques, antenna measurements, personal computer applications, and laboratory demonstrations.

B. Optoelectronics and Photonics (prerequisite: EE 321)

- **EE 431 Optoelectronics and Photonics I –** Fall – Whaley
  Prerequisite: EE 321

- **EE 432 Optoelectronics and Photonics II –** Winter – Jadwisienczak

This course covers the material needed for the understanding of current photonics device fundamentals and technology. Topics to be covered include: wave nature of light, propagation of light in different media, interference and optical resonators, optical tunneling, diffraction principles; dielectric waveguide and optical fibers; semiconductor optical properties, basic junction and advanced heterojunction device concepts, materials and fabrication technologies for light emitting diodes (LED); stimulated emission device lasers, including quantum well devices; photodetectors and photovoltaic devices. A broad overview of engineering applications of optical devices, systems and networks will be given including: lightwave communications, optics in computing, optical storage, optical sensors, and optical signal processing.

C. Controls and Robotics (prerequisite: EE 333)

- **EE 429 Mechanics and Control of Robotic Manipulators** – Fall – Prer: Senior Standing – Williams - (ME professor).

Modeling, simulation, and control of spatial multi-degree-of-freedom robotic manipulators. Kinematics and dynamics of robotic manipulators. Laboratory exercises will be performed to get an appreciation for the practical side of robotics. Use of Matlab as a tool in robot system analysis and simulation. This course provides practice in technical writing (via weekly mini-project memos) and practice in technical presentation (one interesting topic in robotics presented orally to the class). Specific topics include: Introduction and mathematical background for robotics; Mobility (degrees-of-freedom); Motion description including rotation matrices.

- Denavit-Hartenberg parameters.
- Forward and Inverse pose kinematics.
- Rate kinematics, Jacobians, static forces, singularities, resolved rate control.
- Trajectory generation.
- Laboratory exercises to demonstrate applied robotics.

- **EE 490 Feedback Control Theory -** Winter – Lawrence- 4 credit Hours (Prereq: EE 333)

This course provides an introduction to the analysis and design of feedback control systems. Introductory topics include mathematical modeling and computer simulation of physical systems, linear approximations of nonlinear systems, transfer functions and state equations, and feedback control system block diagrams, characteristics, and performance specifications. Also covered are frequency domain methods for stability, sensitivity, robustness, and performance analysis and techniques for compensator design and simulation verification. MATLAB and Simulink will be used extensively in this course.

- **EE 427 Digital Control Theory** – Spring – Mitchell - (Prereq: EE 490)

This course provides an introduction to the analysis and design of feedback control systems in which a digital computer is used to close one or more feedback loops to implement a digital controller. Topics that will be covered include mathematical modeling the effects of sampling data, modeling the analog to digital A/D and the digital to analog D/A processes, linear difference equations and z-transforms, linear sampled data systems, stability analysis of linear sampled data systems, root locus and frequency response analyses of linear feedback sampled data systems, and classical root locus and frequency response design techniques for linear sampled data control systems. MATLAB and Simulink will be used extensively.

D. Communications (prerequisites: EE 333 or EE 371)

- **EE 470 Communications Engineering** –Fall– Pelgrum - Prereq: EE 333

Signal representation, Review of Fourier Series and Transforms analysis of linear systems, Frequency-time analysis, **Digital Communications:** Filtering, Sampling and quntization, Time multiplexing, Applications and design of PCM (Pulse Code Communication) systems, Linear and adaptive delta modulation, DPCM (Differential Pulse Code Modulation), Bandpass signals. Detection, Pulse Amplitude Modulation, Pulse Duration Modulation, Pulse Position Modulation. **Analog Communication Systems:** AM double sideband large carrier, AM double sideband suppressed carrier, Vestigal sideband, I-Q modulation, Narrowband FM-PM, Windband FM-PM, Detection, Cellular telephone (mobile) system, Case studies of emerging technologies.

- **EE 471 Stochastic Processes –** Winter – Dill **-** Prereq: EE 371

This course presents an introduction to the analysis of random noise processes in electrical systems, particularly in communications, signal processing, and control systems. The prerequisite is EE 371, Probability and Statistics, or equivalent. Topics covered include multivariate probability distributions, discrete time and continuous time stochastic processes, autocorrelation and power spectral density, additive white Gaussian noise, linear transformations on stochastic processes, estimation, and detection.

- **EE 472 Intro to Digital Communication Systems** - Spring – Matolak - Prereq: EE 470 & EE 471

The goals of the course are to introduce the fundamentals of digital communication systems, almost exclusively at the physical layer. We will begin with a brief review of deterministic and random signals and their transmission through linear systems. From there, we will review the sampling theorem and PCM. Next we will cover some popular baseband transmission schemes, after introducing the concept of signal spaces. This will include reception with the matched filter in AWGN, and analysis of error probability performance. We will also cover intersymbol interference. Subsequently, we will address representations for bandpass signals and systems and their performance. Finally, we will cover link budget analysis and connect the link parameters to the performance evaluations previously obtained. At the completion of this course, students should understand some fundamental principles of digital communications at the physical layer, including the following:

- basic operations required to convey information digitally across a channel,
- how to judge/evaluate digital communication systems performance,
- basic characteristics of modulation schemes used in digital communications, and their relative performance and merits,
- basic digital transmitter and receiver structures
- basic principles behind link budget analysis.

E. Power and Power Electronics (prereqs: EE 395B or EE 334)

- **EE 490 Electric Power Systems Analysis- Fall** –Giesey- Prereq: EE 395B

Electric power engineering, AC steady-state power concepts and symmetrical components, and power system representation. The power transformer, the synchronous machine, the power flow problem and operating and controlling power systems.

- **EE 490 Energy Conversion / Electric Machines – Winter** – Instructor Pending; Prerequisites: EE 321 or PHYS 253

The goal of this course is to develop an understanding of the basic principles of electromechanical energy conversion. Circuit models and characteristics will be learned for single and three-phase transformers, DC machinery, AC synchronous machines and induction motors.

- **EE 454 Power Electronics –** Spring **–** Curtis; Prerequisites: Permission

    - Review of power electronic switching devices
    - Rectifier circuits
    - DC chopper control of DC motors
    - AC voltage controllers
    - Voltage and/or impedance control of the three-phase induction motor using solid-state switches
    - Three-phase, variable-frequency inverters
    - Variable frequency control of the three-phase induction motor

F. Circuit Design (Prerequisite: 334)

- **EE 418 Micro & Nano Electronics Device Fabrication–Winter –** Kaya- Prereq: 334, 405

This course introduces students to the basic steps of fabrication used in the manufacturing of micro and nanoscale electronic devices. The contents centered on the Si BiCMOS technology, which makes up more than 90% of semiconductor device production, to be relevant to industry applications, while novel fabrication tools and processes used in the nano-scale engineering will be also included to make course useful for student research projects. Topics include:

- Trends in micro and nano technology
- Overview of a BiCMOS process and related devices
- Semiconductor crystals and wafer production
- Lithographic Techniques
- Wet and Dry Etching
- Oxidation and Deposition
- Diffusion and Ion implantation
- Analytical Characterization Techniques
- Nanoscale fabrication

- **EE 420 NanoElectronics & NanoTechnology** – Spring – Kaya **–** Prereq: Chem 151, PHYS 252

This course familiarizes students with advances in nano-scale material science, device and circuit architectures, and fabrication technologies. Provides background material required to follow developments in integrative nano-engineering research that encapsulate electronics, material science, MEMS, biomedical sciences and optics. Foster an appreciatation of the interdisciplinary forces and trends that guide the development of nano-scale science and integration of technology today. Provide students with a critical evaluation of the current status of nanotechnology in general and nanoelectronics in particular. Topics include: General Introduction, Microelectronics to Nanotech Evolution, Policy and Economy Issues , Length Scales and Scientific Background, Nanoelectronics, Nanofabrication, MEMS Examples, Optics and Photonics Primer, Nanophotonics, MEMS and Photonics, Nanotechnology and Bioengineering, Biomedical Engineering, Biomolecular Engineering, MEMS and Bioengineering, Nanotechnology and Computing.

- **EE 414 VHDL Design** + **EE 401 Lab (2) – Winter** – Starzyk – Prereq: none

In recent years, there has been a trend toward using very high speed hardware description languages (VHDL) for circuit specification. Creating a VHDL model has similarity to writing a software program. The conciseness of VHDL models made them preferable to the corresponding flow, state, and logic diagrams. Circuits can be modeled using various abstraction levels. Powerful synthesis methods capable of generating detailed gate level or transistor level schematics using VHDL description of the designed architectures were developed and implemented in CAD tools. Xilinx Foundation software and FPGA chips, ActiveHDL and Mentor Graphics tools, permits our students to use the state of the art design environment. Topics covered include: Design of microelectronic circuits; Behavioral modeling of electronic circuits; Abstract hardware models; Compilation and behavioral optimization; Computer-aided synthesis and optimization; Architectural synthesis; Scheduling algorithms; Modeling of component libraries.

- **EE 415 VLSI Design + EE 401 Lab (2) – Spring –** Starzyk- Prereq: EE 334 or EE 395B

This course aims to convey a knowledge of advanced concepts of circuit design for digital LSI and VLSI components in state of the art MOS and BiCMOS technologies. Emphasis is on the circuit design, optimization, and layout of either very high speed, high density or low power circuits for use in applications such as micro-processors, signal and multimedia processors, memory and periphery. Special attention will be devoted to challenges facing digital circuit designers today and in the coming decade, being the impact of scaling, deep submicron effects, interconnect, signal integrity, power distribution and consumption, and timing. This will reflected in both the lectures and the preferred projects. Topics covered include:

- Progress and impacts of MOS technology
- CMOS logic and circuits, MOS transistors
- Resistance and capacitance estimation
- Scaling and short channel devices
- CMOS inverters, Performance estimation
- Driving large loads, CMOS logic gate design

- Combinational logic, Switch logic
- Latches and flip-flops, Fabrication process
- Layout design rules, CAD tools
- Clocking strategies, Dynamic and domino logic
- Sequential system design, Digital systems and VLSI

G. *Digital Systems (Prerequisite: 352)*

- **EE 461A Digital Systems I** – Fall – Kodi- (required course for CpEs). Prerequisites: EE 352; 4 credit hours.

Computer organization/architecture with emphasis in the design of superscalar processors/advanced architectures; pipelined data-path/control organizations; memory system design; I/O units/interfacing; operating system support; vector/array-processing; shared-memory multiprocessing; distributed/grid computing. Topics include:

- Combinational & Sequential Digital Circuits with Memory
- Computer System Technology & Computer Performance
- Instructions and Addressing; Procedures and Data; Assembly Language Programs
- Instruction Set Variations
- Number Representation; Adders and Simple ALUs; Multipliers and Dividers
- Floating-Point Arithmetic; Instruction Execution Steps
- Control Unit Synthesis;
- Pipelined Data Paths; Pipeline Performance Limits
- Main Memory Concepts; Cache Memory Organization; Mass Memory Concepts
- Virtual Memory and Paging; Input/Output Devices and Input/Output Programming
- Buses, Links, and Interfacing; Context Switching and Interrupts
- Road to Higher Performance; Vector &Array Processing; Shared-Memory Multiprocessing
- Distributed Multi-computing

- **EE 462 Digital Systems II**– Image Processing Applications in Medicine and Biology - Spring – Celenk
  – Prereq: (351 or 333) and (371)

This course along with the selected text "Image Processing with MATLAB®: *Applications in Medicine and Biology"* explains complex, theory-laden topics in image processing through examples and MATLAB® algorithms. It describes classical as well emerging areas in image processing and analysis. Providing many unique MATLAB codes and functions throughout, the text book helps covering the theory of probability and statistics, two-dimensional fast Fourier transform, nonlinear diffusion filtering, and partial differential equation (PDE)-based image denoising techniques. We present intensity-based image segmentation methods, including thresholding techniques as well as K-means and fuzzy C-means clustering techniques. The course explores Markov random field (MRF)-based image segmentation, boundary and curvature analysis methods, and parametric and geometric deformable models. As in the final chapters of the text, we focus on three specific applications of image processing and analysis. Reducing the need for the trial-and-error way of solving problems, this course and the selected book help students understand advanced concepts by applying algorithms to real-world problems in medicine and biology. Topics covered include: Medical Imaging Systems. Fundamental Tools for Image Processing and Analysis. Probability Theory for Stochastic Modeling of Images. Two-Dimensional Fourier Transform. Nonlinear Diffusion Filtering. Intensity-Based Image Segmentation. Image Segmentation by Markov Random Field Modeling. Deformable Models. Image Analysis. Applications.

H. Microprocessors (Prerequisite: EE 395A)

- **EE 467 Advanced Microprocessors – Winter – Kodi**
  (Prerequisite: EE 395A)

Organization of 16-bit and 32-bit Microprocessors. Particular attention is given to the 8086 family (8086/286/386/486/Pentium) and Power PC family of microprocessors regarding instruction Set, assembly language programming, arithmetic operations, Memory hierarchy, I/O interfacing, floating point unit, and various other topics.

- **EE 468 Microcomputers II – Spring – Kodi**
  (Prerequisite: EE 395A)

Intended to provide an in-depth study of microprocessor-based digital systems. It includes a basic knowledge and ability required for understanding and designing computer systems. The important topics covered in this class include pipelining, instruction level parallelism, cache and main memory concepts, virtual memory, multi-level caches, I/O devices, multiprocessor networks, snoopy and directory cache coherence, memory consistency models and multiprocessor based interconnection networks.

I. Electronics (Prerequisite: EE 334)

- **EE 490 Solar Cell Devices – Materials, Operation & Technology –** Fall – Jadwisienczak – Prerequisites: EE334, 432

This course is a comprehensive introduction to the physics and engineering of the photovoltaic cell. It covers: basic scientific and technological aspects relevant to physics of classic and novel nano-structured materials in photovoltaic devices; physical models of solar cell operation; characteristics and design of common types of solar cells; approaches to increasing solar cell efficiency; and engineering of the large-area solar cell modules using single and multi-junction solar cells. The focus will be on the latest knowledge of the mechanisms of solar energy conversion and concepts of solar cell device technology. Examples of recent photovoltaic systems will be presented and analyzed helping students to understand the factors driving conversion efficiency and to stimulating them to apply this knowledge to their own solar cell development ideas.

- **EE 405 Physical Electronics – Fall – Curtis** – Prereq: EE 334

  - Simplified One-Dimensional band theory of solids.
  - Valence and Conduction band occupancy Fermi-Dirac Statistics
  - Hole conduction and Doping.
  - PN junction Volt-Amp temperature characteristics.
  - DC, AC characteristics of junction transistors

- **EE 406 Advanced Analog Circuits – Winter- Curtis** –
  Prereq: EE 334/ Perm

  - The Basic Differential Amplifier.
  - The Classical Feedback Equation. Negative Feedback Properties.
  - Non-ideal Behavior: Drift; Offset Voltage.
  - Non-ideal Behavior: CMRR.
  - Choosing an Op Amp to meet Design Specs.
  - Positive Feedback Circuits. Comparators. Schmitt Trigger.
  - Oscillators: General considerations.
  - More Oscillators. Gain Limiting Circuits.
  - Tuned Circuit Oscillators.

J. Industrial Controls (Prerequisite: EE 395B)

- **EE 490 Introduction to Programmable Logic Controllers**
  (Allen Bradly SLC5550 PLC) – Fall – Prereq: EE 395B.

An introduction to programmable logic controllers (PLC's), I/O interfacing, basic ladder logic and discrete I/O instructions, counters, timers, program development techniques, and troubleshooting. Advanced topics in programmable logic controllers including program control instructions, math operations, sequencers, and data manipulation. Hands-on experience and basic industrial applications will be provided using the Allen Bradley SLC500 and RSLogix 5000 programming software. Topics include:

- Programmable Controllers,
- Interfacing and Ladder-Logic Fundamentals,
- SCL 500 Processor Architecture vs. ControlLogix,
- SCL 500 and ControlLogix Bit Instructions,
- Timer and Counter Instructions,
- Data Collecting, and Program Control Instructions,
- Structured Programming on the PLC.

K. Avionics Engineering (Prerequisite: EE 470)

- **EE 470 Communications Engineering** – Fall – Pelgrum – Prereq: EE 333

Signal representation, Review of Fourier Series and Transforms analysis of linear systems, Frequency-time analysis, **Digital Communications:** Filtering, Sampling and quntization, Time multiplexing, Applications and design of PCM (Pulse Code Communication) systems, Linear and adaptive delta modulation, DPCM (Differential Pulse Code Modulation), Bandpass signals. Detection, Pulse Amplitude Modulation, Pulse Duration Modulation, Pulse Position Modulation. **Analog Communication Systems:** AM double sideband large carrier, AM double sideband suppressed carrier, Vestigal sideband, I-Q modulation, Narrowband FM-PM, Windband FM-PM, Detection, Cellular telephone (mobile) system, Case studies of emerging technologies.

- **EE 485 Electronic Navigation Systems I** – Winter – Pelgrum– Prereq: EE 470 taken in the Fall.

This course provides an introduction to electronic navigation systems with the emphasis on Avionics. Topics covered include an overview of aircraft instrumentation, principles of navigation, descriptions of current and future navigation systems, Radio Beacons, VOR/DME, Inertail, Omega, Loran-C, Landing Systems (ILS, MLS), and Satellite Systems (Transit, GPS).

- **EE 486 Electronic Navigation Systems II** – Spring – Pelgrum- Prereq: EE 485

This course is a continuation of the Electronic Navigation Systems I course. The course provides a detailed description and theory of operation of electronic navigation systems with emphasis on current and future Avionics systems and aircraft electronics, including Satellite Navigation (GPS), Long Range Navigation (LORAN), and Instrument Landing Systems (ILS, MLS). Aircraft instrumentation will be emphasized, focused on the design of a GPS Receiver.

L. Computer Science Related Courses *(Prereq: see specific course)*

- **CS 450 Advanced Object Oriented Design and GUI Techniques (Applications of Java)** – Winter – Kelsey –
  Prereq: CS 240C

An intensive course in Java aimed at students who already have a programming background and are considering doing a senior project or thesis in Java. It covers the language, Object-Oriented design methods, and GUI development. A single large application like a discrete event simulator, a Markov Chain analyzer, or a Perti-net simulator forms the basis of most projects assigned in the class. Although the application can be used in analysis of manufacturing systems, no prior manufacturing background is required to take the course. Topics include: JAVA language syntax, Object Oriented Programming, Classes, Methods, Method overloading, Inheritance, Polymorphism, Interfaces, Data Structures, Vectors, Lists, Trees, Exception Handling, Object Oriented Design, Class Design: Boilerplate, Defining a Class Hierarchy, Abstract Classes, Relations, Inheritance (Is-A), Contains (Part-of), Collaboration (Uses), Swing API, Frames, Labels, Buttons, Events and Callbacks, Layout Managers, Dialogs, Menu and Tool bars, Text Editing, Tables, and Applications.

- **CS 462 Data Base Systems I** – Winter & Spring – Marling –
  Prereq: CS 361

Introduces fundamental concepts in data modeling and relational database systems. Begins with the entity-relationship (ER) modeling technique as a tool for conceptual database design. The relational data model and relational algebra are introduced next, followed by the SQL query language for relational databases. Functional dependencies, normalization, and relational database design algorithms are then discussed.

- **CS 425 Computer Graphics** – Fall – Chelberg – Prereq: CS 361

This course introduces students to modern interactive computer graphics. It emphasizes hands-on learning through the development of several projects throughout the quarter. Topics include: graphical systems and models, graphics programming, input and interaction, geometric objects and transformations, lighting and shading, and discrete techniques.

- **CS 442 Operating Systems & Computer Architecture** – Fall & Winter – Drews – Prereq: CS 361 & EE 395A

In-depth coverage of computer operating systems and related computer architecture issues. Coverage of physical devices, interrrupts, and communication between the computer and external hardware. Interfaces between user programs and the operating system, system calls, software interrupts, and protection issues. Context switching, process address spaces, and process scheduling. Process synchronization, interprocess communications, critical sections, and deadlock detection and recovery. Memory mapping, swapping, paging, and virtual memory.

- **CS 412 Parallel Computing** – Winter – Drews – Prereq: CS 361

Covers fundamental concepts such as: Performance of parallel algorithms; Micro-architectural view of popular state-of-the-art parallel architectures, including simultaneous multi-threading architectures, symmetric (and asymmetric) multiprocessing architectures, multi-core architectures, and Cluster-of-Workstation (COW) architectures; Operating system and middleware support for parallel architectures; Common parallel programming patterns and solutions to common parallel programming problems.

- **CS 444 Data Communications** – Spring – Ostermann – Prereq: CS 442

In-depth coverage of computer-to-computer and program-to-program communication over modern computer networks focusing on the TCP/IP protocol family. Review of data communication issues, physical address binding, bridging, Ethernet, and Token Ring. Internetwork protocols, routing, domains, networks, and subnetworks. Transport protocols, reliability, flow control, retransmission, and acknowledgment. Distributed systems, server and client issues including verification, and authentication. High-level protocols and applications including electronic mail, network news, remote terminal interaction, and the World Wide Web.

- **CS 458 Operating Systems & Computer Architecture II** – Spring – Drews – Prereq: CS 442

This course is a continuation of CS 442. It contains a detailed discussion of virtual memory and backing stores. File system interfaces, implementation, and protection mechanisms. Process scheduling issues, policies, and mechanisms. Interprocess communication between programs on different computers. Distributed systems issues, examples, and implementation.

- **CS 475 Internet Engineering** – Winter – Kruse/Tysko Prereq: CS 361

Understanding internet protocols; network cabling, hubs, and switches; configuring network routers; configuring Unix and Windows workstations; measuring and analyzing network performance; and troubleshooting.

- **CS 480 Artificial Intelligence (5cr) –** Fall – Marling Prereq: CS 300

Definition of heuristic versus algorithmic methods, rationale of heuristic approach, description of cognitive processes, and approaches to mathematical invention. Objectives of work in artificial intelligence, simulation of cognitive behavior, and self-organizing systems. Heuristic programming techniques including use of list processing languages. Survey of examples from representative application areas. Mind-brain problem and nature of intelligence. Class and individual projects to illustrate basic concepts

FALL 2010 - SENIOR ELECTIVE OFFERINGS		
EE 429	**Robotic Manipulators**	**Williams**
EE 431	**Optoelectronics –Photonics I**	**Whaley**
EE 490(4)	**Feedback Control Theory**	**Lawrence**
EE 405	**Physical Electronics**	**Curtis**
EE 490	**Energy Conversion/Electric Machines**	**Pending**
EE 461A (4)	**Digital Systems – I (CpE-required)**	**Kodi**
EE 470	**Communications Engineering**	**Pelgrum**
EE 490	**Solar Cells**	**Jadwisienczak**
EE 490	**Introduction to Programmable Logic Controllers**	**Pending**
CS 425	**Computer Graphics**	**Chelberg**
CS 442	**Operating Systems and Computer Architecture**	**Drews**
CS 490	**Virtual Worlds**	**Liu**

WINTER 2011 - SENIOR ELECTIVE OFFERINGS		
EE 406	Advanced Analog Circuits	Curtis
EE 418/420	Nano Electronic Fabrication	Kaya
EE 414	VHDL Design	Starzyk
EE 432	Optoelectronics –Photonics II	Jadwisienczak
EE 441	Antennas	Radcliff
EE 455	Introduction to Power - I	Giesey
EE 467	Advanced Microprocessors	Uijt de Haag
EE 471	Stochastic Processes	Dill
EE 485	Electronic Navigation Systems I	Pelgrum
CS 412	Parallel Computing	Drews
CS 450	Applications of Java	Judd
CS 442	Operating Systems & Comp. Archit. I	Drews
CS 462	Data Base Systems I	Marling
CS 475	Internet Engineering	Kruse/Tysko

SPRING 20011 - SENIOR ELECTIVE OFFERINGS		
EE 415	**VLSI Design**	**Starzyk**
EE 427	**Digital Control Theory**	**Mitchel**
EE 454	**Power Electronics**	**Curtis**
EE 462	**Digital Systems – II**	**Celenk**
EE 468	**Microcomputers II**	**Kodi**
EE 472	**Introduction to Digital Communication Systems**	**Matolak**
EE 486	**Electronic Navigation Systems II**	**TBD**
CS 444	**Data Communications**	**Ostermann**
CS 458	**Operating Systems and Computer Architecture II**	**Drews**
CS 462	**Data Base Systems I**	**Marling**