AME 263 COMP MODELS OF MUSIC

We will explore various computational approaches to musical problems (rule-based approaches, connectionism, dynamic systems, and probabilistic models), focusing on two main areas: 1) models of musical processing and information retrieval; 2) models of musical styles. Our focus will be on the symbolic level of music representation rather than on the signal level (there will be no signal processing in this course). Most assignments will consist of reading articles and answering questions about them. There will be some programming assignments, with other options for students without programming ability.

Offered: Spring

AME 271 COMP MODELS OF MUSIC Processes

This course is designed for engineering and science students to learn the basic elements of music theory and analysis, but employing concepts and tools from digital signal processing, pattern classification, machine learning and data mining. Class requirements include weekly readings and programming assignments, and a final project in which students complete an analysis of a large-scale symphonic work combining their subjective aesthetic response to the piece with the computational analysis using the tools developed throughout the course

Offered: Spring

AME 471 COMP MODELS OF MUSIC PROC

This course is designed for engineering and science students to learn the basic elements of music theory and analysis, but employing concepts and tools from digital signal processing, pattern classification, machine learning and data mining. Class requirements include weekly readings and programming assignments, and a final project in which students complete an analysis of a large-scale symphonic work combining their subjective aesthetic response to the piece with the computational analysis using the tools developed throughout the course. A knowledge of the rudiments of musical notation is helpful, but not a prerequisite.

Offered: Spring

BME 276 BIOMEDICAL OPTICS

See OPT 276

BME 393 SENIOR PROJECT

BME 404 COMPUTATIONAL METHODS APPLIED TO BIOLOGICAL SYSTEMS

The aim of this class is to gain experience solving analytically intractable research problems using computational methods. At the beginning of the course, general numerical analysis topics are reviewed. The rest of the course is oriented toward projects. Examples will be drawn from problems of biological systems.

BME 445 BIOMATERIALS SCIENCE AND ENGINEERING

This course provides a background in biomaterials: basic material properties, specifics on ceramics, polymers and metals used in the body, and special topics related to biomaterials including tissue engineering, biological responses to implanted materials, and drug delivery.

Offered: Spring

BME 448 CONTROLLED RELEASE SYSTEMS

This course will cover the principles, strategies, and materials used in controlled drug delivery systems.

BME 458 HUMAN ANATOMY

The course analyzes the structural composition of the human body from cellular to organ levels. The goes is to provide a foundation in human anatomy appropriate for students interested in the bioscience and health care professions (e.g., nursing, physical therapy, medicine, bioengineering). Learning objective will be achieved through a combination of lecture and hands-on (laboratory) approaches, reinforced by clinical examples. Graduate students (BME458) will participate in small group discussions of clinical case studies, topic appropriate biomedical devices, and prepare a term paper on the subject of their choice from the topics listed at the end of the syllabus.

BME 470 BIOMEDICAL MICROSCOPY

This course covers the principles and practice of light microscopy as applied to biological and medical questions. Topics include basic light microscopy, epifluorescence, confocal and multiphoton laser-scanning microscopy, and selected methods such as CARS, FRET, FRAP, FCS, etc.

Offered: Fall

BME 487 NONLINEAR FINITE ELEMENT

The theory and application of nonlinear FE methods in solid and structural mechanics, and biomechanics. Topics: review and generalization of linear FE concepts, review of solid mechanics, nonlinear incremental analysis, FE formulations for large displacements and large strains, nonlinear constitutive relations, incompressibility and contact conditions, hyperelastic materials, damage plasticity formulation, solution methods, explicit dynamic formulation.

BME 492 SP TOP:MEDICAL DEVICE DESIGN

BME 502 ANALYTIC FOUNDATIONS IN BME

The goal of this course is to introduce students to a select range of key concepts and methods from engineering and applied mathematics that are common across most subdisciplines of BME and to illustrate by example how these concepts and methods can be applied directly in the study of biological systems and/or for the solving of biological problems. We expect that students completing the course will have acquired basic practical skills to develop novel analytic approaches to biological problems and will be well prepared for subsequent coursework in their chosen discipline.

Offered: Fall

BME 513 INTRODUCTION TO fMRI: IMAGING, COMPUTATIONAL ANALYSIS AND NEURAL REPRESENTATIONS

The core focus of the course will be on how fMRI can be used to ask questions about neural representations and cognitive and perceptual information processing. Some of the questions that the course will address include: 1) The basic fMRI signal just shows activation in different parts of the brain. How can we get from that to addressing questions about neural representations and neural information processing? 2) Ways of relating neural activation to behavioural performance. Can fMRI provide information over and above what can be obtained from behaviour alone? 3) Standard fMRI analysis using the General Linear Model, including preprocessing steps. 4) Multivariate fMRI analysis using machine learning approaches. There will also be a component, about 20% of the class, on the big-picture aspects of MRI physics and physiology which make fMRI possible.

Offered: Fall

BME 890 SUMMER IN RESIDENCE - MA

BME 990 SUMMER IN RESIDENCE

CHE 213 ENGINEERING OF SOFT MATTER

This course will provide an overview of several contemporary research topics pertaining to structured organic materials. Lectures will focus on intermolecular interactions and the thermodynamics of self-assembly. Additional lectures will introduce molecular crystals, polymer crystallinity, liquid crystals, self-assembled monolayers, surfactants, block copolymers, and biomimetic materials. Homework assignments and a brief technical presentation will be required. Advanced undergraduate students are welcome. OFFERED EVEN YEARS

Offered: Spring

CHE 292 BIOINTERFACES

The course will focus on interfacial phenomena in hybrid bio-inorganic systems. The goal of the course is to increase the understanding of interactions between biomolecules and surfaces. The course will aim at investigating the behavior of complex macromolecular systems at material interfaces and the importance of such systems in the fields of biology, biotechnology, diagnostics, and medicine. The first part of the course will focus on mechanisms of interactions between biomolecules and surfaces. The second part will focus on the characterization of physical, chemical, and morphological properties of biointerfaces. OFFERED EVEN YEARS

Offered: Spring

CHE 413 ENGINEERING OF SOFT MATTER

This course will provide an overview of several contemporary research topics pertaining to structured organic materials. Lectures will focus on intermolecular interactions and the thermodynamics of self-assembly. Additional lectures will introduce molecular crystals, polymer crystallinity, liquid crystals, self-assembled monolayers, surfactants, block copolymers, and biomimetic materials. Homework assignments and a brief technical presentation will be required. Advanced undergraduate students are welcome. OFFERED EVEN YEARS

Offered: Spring

CHE 430 ORGANIC ELECTRONICS

Basic optical and electronic processes of organic molecules and polymers. Charge transport and luminescent properties of organic solids. Metal/organic contacts and charge injection. Applications in thin-film organic electronic devices including organic light emitting diodes, solar cells, photoconductors, and transistors. Review of selected papers.

CHE 432 CONTROLLED RELEASE SYSTEMS

See BME 432 for course description

CHE 448 CONTROLLED RELEASE SYSTEMS

See BME 448 for course description

CHE 454 INTERFACIAL ENGINEERING

Lectures on the fundamentals of colloids and interfaces, systems with high interfacial area, and their role in modern processes and products. Topics include interfacial tension, contact angle, adsorption, surfactants, miscelles, microemulsions, and colloidal dispersions. Techniques for formation and characterization of interfaces and colloids will be reviewed.

Offered: Spring

CHE 492 BIOINTERFACES

The course will focus on interfacial phenomena in hybrid bio-inorganic systems. The goal of the course is to increase the understanding of interactions between biomolecules and surfaces. The course will aim at investigating the behavior of complex macromolecular systems at material interfaces and the importance of such systems in the fields of biology, biotechnology, diagnostics, and medicine. The first part of the course will focus on mechanisms of interactions between biomolecules and surfaces. The second part will focus on the characterization of physical, chemical, and morphological properties of biointerfaces. OFFERED EVEN YEARS

CHE 589 TEACH, RESEARCH, WORK AFRICA

CHE 890 SUMMER IN RESIDENCE - MA

CHE 990 SUMMER IN RESIDENCE

CSC 112D INTRO TO HUMAN/COMP INTERACT

This course was last offered in Spring 2013. There are no plans to offer it in the future.

CSC 132 RECREATIONAL GRAPHICS II

A hands on project based instruction of 3D computer graphics and animation techniques taught from a user point of view using the BLENDER modeling system. Topics include fluid animation, storyboarding, sound, character rigging, and computer game design. Assessment based on projects. No written exams.

CSC 160 ENGINEERING COMPUTING

Introduction to programming and computational approaches to engineering problems and their solution. Matlab language illustrates principles such as data representation, mathematical operations, looping and decisions, functions and subroutines, display and user interaction. Projects from several different engineering domains have subjects like linear algebra, differential equations, fitting data to models, signal processing, and the practical use of analog-digital converters in an experimental setting.

CSC 169 WEB DESIGN

Students will learn principles of web page design using HTML5 and CSS. Students will create web pages without programming. No prereq.

CSC 170D INTRO TO WEB PROGRAMMING

Students learn the technological components of programming for the worldwide web. They will also study the historical, aesthetic and social components of computer code.

CSC 172H SCI OF DATA STRUCT. HONORS

Abstract data types (e.g., sets, mappings, and graphs) and their implementation as concrete data structures in Java. Analysis of the running times of programs operating on such data structures, and basic techniques for program design, analysis, and proof of correctness (e.g., induction and recursion). Students in the Honors version of 172 will have additional projects and assignments.

CSC 194 NETWORK PHENOMENA

We will examine and relate ``connectedness" phenomena in a broad spectrum of social, economic, and technological settings. Students taking course at graduate level will have additional readings and assignments. Prerequisites: senior standing or permission of instructor.

CSC 199 CREATIVE COMPUTING

Rotating topics in computer science that do not require prior computing experience. This course may be repeated for credit for different topics. See term for details.

CSC 200 UNDERGRAD PROBLEM SEMINAR

Intensive seminar on cooperative problem solving. Overview of the subdisciplines and the research of the University of Rochester’s computer science faculty. 200H required for the Honors B.S. in Computer Science; 200 required for the B.S. Students taking CSC 200H may have additional reading, assignments or projects.

CSC 209 ADV FRONT END WEB DEVELOPMNT

"Front-end" is an industry term that refers to the focus on HTML, CSS and JavaScript, which differentiates this course from the formal programming courses. - Topics in CSC 209 will include Information Architecture, visual design, use of client libraries (mostly JS), and asset management strategies; we will also cover Content Management Systems and introduce web databases using PHP and MySQL.

CSC 211 Principles of Human Computer Interaction

In this course, you will learn how to design technology that bring people joy, rather than frustration. We will cover the fundamentals of HCI, including principles of design, cognition, and user experience. You will learn about rapid prototyping techniques and how to evaluate systems, and why they are essential to the design of interactive systems.

CSC 247 NATURAL LANGUAGE PROCESSING

An introduction to natural language processing: constructing computer programs that understand natural language. Topics include parsing, semantic analysis, and knowledge representation. CSC 447, a graduate-level course, requires additional readings and assignments.

CSC 260 DIALOG SYSTEMS

This course will examine recent research in computational linguistics and artificial intelligence on natural language dialog systems. Students will take turns leading the discussion of current research papers. Undergraduates taking the course for credit will also be required to prepare a written review of one of the papers. Graduates taking the course may have additional readings or assignments. It may be repeated for credit with permission of the instructor.

CSC 263 COMPUTATIONAL MODELS OF MUSIC

We will explore various computational approaches to musical problems (rule-based approaches, connectionism, dynamical systems, and probabilistic models), focusing on two main areas: 1) models of musical processing and information retrieval; 2) models of musical styles. Our focus will be on the symbolic level of music representation rather than on the signal level (there

will be no signal processing in the course). Most assignments will consist of reading articles and answering questions about them. There will be some programming assignments, with other options for students without programming ability.

CSC 267 ADV GPU PROJECT DEV

This course is cross-listed with ECE. In this course, advanced GPU parallel programming techniques are taught that permit extremely compute-intensive applications to be run in real-time on a cloud-based GPU cluster. These applications demand 100x to 1000x more compute power than a single CPU (or even a GPU) can provide, making it necessary to utilize the cloud for computation. An additional layer of complexity is introduced into the computational model when real-time response is required. Students will be exposed not only to the most challenging GPU parallel programming methods, but also the intricacies of running such compute-intensive applications through high-latency (and potentially unpredictable) communications links.

CSC 283 TOPICS IN CRYPTOGRAPHY

This will be a seminar-style course in which students will read and present papers on current research in Cryptography. Potential topics include lattice-based cryptography, concurrency and protocol security, database privacy, cryptographic game theory and interplay of cryptography with other fields.

CSC 285 ALGORITHMS & ELECTIONS

The focus of this course is on using algorithms to manipulate elections and on using complexity to protect elections from such manipulative attacks. Among the attacks we will study are manipulation, bribery and control. Students taking this course at the 400 level may be required to complete additional tests, readings, or assignments.

CSC 292 Topics in Programming Languages

This course covers special topics that are of current interest in the area of Programming Languages. Topics vary by term. Check term detail for information regarding the particular semester.

CSC 293 TOPICS IN Programming Systems

This course covers special topics that are of current interest in the area of Programming Systems. Topics vary by term. Check term detail for information regarding the particular semester

CSC 294 Topics in Theory of Computation

This course covers special topics that are of current interest in the area of Theory of Computation. Topics vary by term. Check term detail for information regarding a particular semester.

CSC 295 Topics in Human Computer Interaction

This course covers special topics that are of current interest in the area of Human Computer Interaction. Topics vary by term. Check term detail for information regarding a particular semester.

CSC 296 Topics in Applications of Computer Science

This course covers special topics that are of current interest in the area of Applications of Computer Science. Topics vary by term. Check term detail for information regarding a particular semester.

CSC 297 Topics in Artificial Intelligence

This course covers special topics that are of current interest in the area of Artificial Intelligence. Topics vary by term. Check term detail for information regarding the particular semester.

CSC 298W VIDEO GAME STUDIES

CSC 396A BLACKOUT GAMES STUDIO

Group Independent Study

CSC 396B BRAILLE TECHNOLOGIES

Group research topic. Varies by term

CSC 396C MATLAB COMP CHEMISTRY
Group research topic. Varies by term

CSC 396D ROBOT SOCCER
Group research topic. Varies by term

CSC 447 NATURAL LANGUAGE PROCESSING
See CSC 247 for description. Cross-listed course.

CSC 460 DIALOG SYSTEMS
Please refer to CSC260 for course description.

CSC 463 COMP MODELS OF MUSIC
Please refer to CSC263 course description.

CSC 467 ADV GPU PROJECT DEV
Please refer to ECE 277 for course description.

CSC 483 TOPICS IN CRYPTOGRAPHY
Please refer to CSC283 for course description.

CSC 485 ALGORITHMS & ELECTIONS
Please refer to CSC285 for course description.

CSC 512 COMP METHODS COG SCI
Please refer to BCS512 for course description.

CSC 513 COGNITV PROCESSING ON BLKBRD
Please refer to BCS 532 for course description.

CSC 572 COMP. SECURITY FOUNDATIONS

CSC 573 MEMORY SYSTEMS

CSC 574 COMP INTRO TO STATISTICS

CSC 579 CACHE MEMORY

CSC 990 SUMMER IN RESIDENCE

EAS 106 THE SCIENCE OF PROGRAMMING
See CSC 171

EAS 120 MICROELECTRONICS FOR THE CEO
NO LONGER OFFERED.

EAS 300 INACTIVE STATUS-ENGINEERING

EAS 448 WIRELESS SENSOR NETWORKS

ECE 120 MICROELECTRONICS FOR THE CEO

This course discusses the fundamentals of silicon - what its material properties are, how a transistor is formed, hoe the transistors are integrated into “microelectronics”, how down-scaling the transistors increase their functionality and speed and what new nano-technology lies ahead as we approach the end of the silicon road. Special “widget deconstruction” will address common pieces of modern technology (e.g., Smart Phone, GPS) Student led discussions will examine the transformational impact of each widget.

Offered: Spring

ECE 207 Advanced GPU Programt Development

In this course, advanced GPU parallel programming techniques are taught that permit extremely compute-intensive applications to be run in real-time on a cloud-based GPU cluster. These applications demand 100x to 1000x more compute power than a single CPU (or even a GPU) can provide, making it necessary to utilize the cloud for computation. An additional layer of complexity is introduced into the computational model when real-time response is required. Students will be exposed not only to the most challenging GPU parallel programming methods, but also the intricacies of running such compute-intensive applications through high-latency (and potentially unpredictable) communications links.

Offered: Spring

ECE 224 INTRO CONDENSED MATTER PHY

SEE PHY 251

Offered: Fall

ECE 227 Electric Power: Conversion, Transmission, and Consumption

We will describe how the principal sources of energy - coal, natural gas, impounded water (hydroelectric), and fissile materials - are exploited to create electric power, how it is transmitted and distributed through the grid and finally the patterns of its consumption. To assure that students gain a proper appreciation for the factors that determine the real cost of electricity per kilowatt-hour, the subject will be treated in a highly quantitative way. The goal will be to provide students with the information and tools they need for informed analysis of the true prospects and technological challenges involved in integration of new energy sources, such as solar, wind, geothermal, and tidal power, with the existing grid. There will be weekly homework and a midterm. Two projects with oral presentations, including a major one at the end of the semester, are required. There is no final exam. Several required field trips to local power facilities occur during the semester.

Offered: Spring

ECE 235 INTRODUCTION TO OPTOELECTRONICS

Introduction to fundamentals of wave propagation in materials, waveguides and fibers, generation, modulation and detection of light using semiconductor devices, and elements of optocommunication systems.

Offered: Spring

ECE 262 ADVANCED CMOS VLSI DESIGN

Senior design course for "Computer Design" or "Integrated Electronics" concentrations. Review of CMOS Subsystem design. Design focus on digital or mixed-signal systems, such as a simple microprocessor, a self-timed multiplier, a digital filter, data converter, or memory. Project design requirements include architectural design, logic and timing verification, layout design, and test pattern generation. Extensive use of CAD tools. The resulting VLSI chips may be fabricated.

Offered: Spring

ECE 266 RF AND MICROWAVE INTEGRATED CURCUITS

This course involves the analysis and design of radio-frequency (RF) and microwave integrated circuits at the transistor level. We begin with a review of electromagnetics and transmission line theory. Several design concepts and techniques are then introduced, including Smith chart, s-parameters, and EM simulation. After the discussion of RLC circuits, high-frequency narrow-band amplifiers are studied, followed by broadband amplifiers. Then we examine the important issue of noise with the design example of low-noise amplifiers (LNA). Nonlinear circuits are studied next with the examples of mixers. A study of oscillators and phase noise follows. Afterwards we introduce phase-locked loops (PLL) and frequency synthesizers. The course concludes with an overview of transceivers architectures. The course emphasizes the development of both circuit design intuition and analytical skills. There are bi-weekly design labs and a term project using industry-standard EDA tools (ADS, Asitic, etc.).

Offered: Spring

ECE 277 COMPUTER AUDITION

Computer audition is the study of how to design a computational system that can analyze and process auditory scenes. Problems in this field include source separation (splitting audio mixtures into individual source tracks), pitch estimation (estimating the pitches played by each instrument), streaming (finding which sounds belong to a single event/source), source localization (finding where the sound comes from) and source identification (labeling a sound source).

ECE 292 SILICON WORLD

This course discusses the fundamentals of silicon - what its material properties are, how a transistor is formed, hoe the transistors are integrated into “microelectronics”, how down-scaling the transistors increase their functionality and speed and what new nano-technology lies ahead as we approach the end of the silicon road. Special “widget deconstruction” will address common pieces of modern technology (e.g., Smart Phone, GPS) Student led discussions will examine the transformational impact of each widget.

Offered: Spring

ECE 386V VISITING STUDENT IN ECE

ECE 391W INDEPENDENT STUDY

ECE 402 MEMORY SYSTEMS

Advanced topics in the organization, architecture, and implementation of modern memory subsystems. Power, performance, reliability, and QoS issues in DRAM memory systems and Flash-based SSDs; high-performance memory controllers and interfaces; memory system design for data centers and enterprise systems.

Offered: Fall

ECE 407 Advanced GPU Project Development

Students develop an advanced project for the GPU platform. A GPU compute-cluster can be employed, as well as a single GPU computer. Students meet with the instructor twice a week to report the progress and the new direction is determined based on the results and the ongoing progress. Project options include: Protein folding (BLAST algorithm), Face recognition (using Open CV), 3D Image reconstruction of biomedical images, and other sophisticated image processing algorithms.

Offered: Spring

ECE 424 INTRO CONDENSED MATTER PHY

An emphasis on the wide variety of phenomena that form the basis for modern solid state devices. Topics include crystals; lattice vibrations; quantum mechanics of electrons in solids; energy band structure; semiconductors; superconductors; dielectrics; and magnets

Offered: Spring

ECE 427 Electric Power: Conversion, Transmission, and Consumption

We will describe how the principal sources of energy - coal, natural gas, impounded water (hydroelectric), and fissile materials - are exploited to create electric power, how it is transmitted and distributed through the grid and finally the patterns of its consumption. To assure that students gain a proper appreciation for the factors that determine the real cost of electricity per kilowatt-hour, the subject will be treated in a highly quantitative way. The goal will be to provide students with the information and tools they need for informed analysis of the true prospects and technological challenges involved in integration of new energy sources, such as solar, wind, geothermal, and tidal power, with the existing grid. There will be weekly homework and a midterm. Two projects with oral presentations, including a major one at the end of the semester, are required. There is no final exam. Several required field trips to local power facilities occur during the semester.

ECE 431 COMPUTATIONAL METHODS

Computational Methods covers basic computational techniques for the numerical solution of these problems on computers. This process involves the conversion of physical problems into mathematical boundary-value problems, the approximation of continuous problems as discrete problems, and numerical inversion of systems of equations. Applications in acoustic and electromagnetic wave propagation and scattering will be presented as motivation. Students are encouraged to adapt the techniques to their own research interests and will be expected to develop basic computer programs implementing the discussed

algorithms. Applications in acoustic and electromagnetic wave propagation and scattering will be presented as motivation for the development of methods. Students are encouraged to adapt the techniques to their own research interests and will be expected to develop basic computer programs implementing the discussed algorithms.

Offered: Spring

ECE 435 INTRODUCTION TO OPTOELECTRONICS

Introduction to fundamentals of wave propagation in materials, waveguides and fibers, generation, modulation and detection of light using semiconductor devices, and elements of optocommunication systems.

Offered: Spring

ECE 441 DETECTION & ESTIMATION THEORY

Loss and utility; Bayesian inference; risk functions, randomized decisions, admissible decisions; empirical Bayes for unknown prior; Neyman-Pearson hypothesis testing, receiver operating characteristic; sufficient and minimal sufficient statistics and Rao-Blackwellization; unbiased estimation; minimum variance unbiased estimation and Cramer-Rao inequality, maximum likelihood estimation; nonparametric estimation of cdfs.

Offered: Spring

ECE 450 INFORMATION THEORY

Entropy, Relative Entropy, mutual information, asymptotic equipartition property, data compression, channel capacity, joint source channel coding theorem, Gaussian channels, rate distortion theory, selected applications.

Offered: Spring

ECE 462 ADVANCED CMOS VLSI DESIGN

Senior design course for "Computer Design" or "Integrated Electronics" concentrations. Review of CMOS Subsystem design. Design focus on digital or mixed-signal systems, such as a simple microprocessor, a self-timed multiplier, a digital filter, data converter, or memory. Project design requirements include architectural design, logic and timing verification, layout design, and test pattern generation. Extensive use of CAD tools. The resulting VLSI chips may be fabricated.

Offered: Spring

ECE 463 VLSI ERROR CONTROL SYSTEMS

This course reviews the reliability challenges introduced by the multi-core billion-transistor integration era, and discusses circuit, architectural, and algorithm level solutions to address these challenges. After a brief review of IC design and layout concepts, students are introduced to the tradeoffs in continued CMOS scaling. Lectures, assigned readings, discussions, student presentations, review reports of the research literature, computer simulations and modeling, design projects of varying complexity.

Offered: Spring

ECE 466 RF AND MICROWAVE INTEGRATED CIRCUITS

This course involves the analysis and design of radio-frequency (RF) and microwave integrated circuits at the transistor level. We begin with a review of electromagnetics and transmission line theory. Several design concepts and techniques are then introduced, including Smith chart, s-parameters, and EM simulation. After the discussion of RLC circuits, high-frequency narrow-band amplifiers are studied, followed by broadband amplifiers. Then we examine the important issue of noise with the design example of low-noise amplifiers (LNA). Nonlinear circuits are studied next with the examples of mixers. A study of oscillators and phase noise follows. Afterwards we introduce phase-locked loops (PLL) and frequency synthesizers. The course concludes with an overview of transceivers architectures. The course emphasizes the development of both circuit design intuition and analytical skills. There are bi-weekly design labs and a term project using industry-standard EDA tools (ADS, Asitic, etc.).

Offered: Spring

ECE 467 ANALOG INTEGRATED CIRCUIT

MOSFET and bipolar device structures and models. Analysis and design of analog CMOS integrated circuits. Modern opamp design with noise, offset and distortion analysis, feedback, frequency compensation, and stability. Current mirrors and bandgap references. Sampling devices and structures. More advanced design projects and use of design aids and CAD tools (including simulation and synthesis) are included.

ECE 471 COMP MODELS OF MUSIC Processes

Fundamentals of computational music including selected topics in modern music theory and music representation, encoding of music information by computers, musical sound representation and compression, automated music transcription, human-computer music interfaces and music informatics.

Offered: Spring

ECE 473 Computational Models of Music

We will explore various computational approaches to musical problems (rule-based approaches, connectionism, dynamic systems, and probabilistic models), focusing on two main areas: 1) models of musical processing and information retrieval; 2) models of musical styles. Our focus will be on the symbolic level of music representation rather than on the signal level (there will be no signal processing in this course). Most assignments will consist of reading articles and answering questions about them. There will be some programming assignments, with other options for students without programming ability.

Offered: Spring

ECE 480 CONVEX OPTIMIZATION

This course will provide students with the tools and training to recognize convex optimization problems that arise in engineering. It will introduce basic convex optimization models (linear programming, second-order cone programming and semi-definite programming), duality theory, modern algorithms for non-smooth optimization, as well as interior point methods and robust optimization techniques. All concepts and theories will be illustrated with numerous applications from signal processing, statistical learning for data analytics, digital communication (e.g., wireless communication system design), control, circuit design, and computational geometry.

Offered: Fall

ECE 565 PERF ISSUES VLS/IC

Primary and recent research in the fields of high performance digital and analog VLSI design and analysis. Provides background and insight into some of the more active performance related research topics of the field such as CMOS deisign techniques, speed/area/power tradeoffs in CMOS circuits, low power design, RLC interconnect, synchronization and clock distribution, pipelining/retiming, and many other areas.

Offered: Spring

ECE 592 ACOUSTIC IMAGING II

ECE 594P PHD RESEARCH INTERNSHP PT

ECE 890 SUMMER IN RESIDENCE - MA

ECE 990 SUMMER IN RESIDENCE

ERG 120 FUN WITH MICROELECTRONICS

ERG 413 ENGINEERING OF SOFT MATTER

ERG 430 ORGANIC ELECTRONICS

Basic optical and electronic processes of organic molecules and polymers. Charge transport and luminescent properties of organic solids. Metal/organic contacts and charge injection. Applications in thin-film organic electronic devices including organic light emitting diodes, solar cells, photoconductors, and transistors. Review of selected papers.

Offered: Spring

ERG 454 INTERFACIAL ENGINEERING

ERG 486 POLYMER SCIENCE & ENGINEERING

Mechanisms and kinetics of polymerization reactions; solution,suspension, and emulsion polymerization processes; thermodynamics of polymer solutions; the Flory-Huggins theory; principles and practice of membrane osmometry, light

scattering, viscometry, and size exclusion chromatography; polymer rheology and mechanical properties; polymer morphology and phase transitions.

Offered: Fall

ERG 890 SUMMER IN RESIDENCE - MA

ME 106 ENGINEERING IN ANTIQUITY

Application of engineering principles and technology to the design and performance of engineering structures from antiquity to the pre-industrial world. Engineering principles (transfer of forces, momentum, and power), study of primary texts (in translation), and examination of existing structures/monuments. Primary texts include selections from Aristotle's Mechanical Problems, Vitruvius' Ten Books on Architecture, Leonardo's Notebooks, Galileo's Dialogues on Two New Sciences. Emphasis on engineering design of engineered structures from the Bronze Age to the 18th century. Topics: Evolution of engineered materials (metals, wood, stone, marble, concrete, composites) and limitations; Bronze Age fortifications; Structural design of Greek temples; Roman aqueducts, siphons, and vaults; Force, power sources and transmission; Failure of materials; Lifting devices; Construction engineering; Columns, beams, vaults, trusses, frames; Instruments of warfare. Open to all undergraduates. No prerequisites.

ME 107 MECHANICS & OPTICS IN ANTIQUITIES

The basic principles of mechanics and optics as they developed in ancient Greece, Rome, China and Europe and the emergence of mechanics and optics prior to the industrial revolution. Examples: Law of the lever (Aristotle and Archimedes); Center of gravity (Archimedes and Galileo); Gears, metalworking, and the Antikythera mechanism; Hellenistic science; Medieval mechanics and optics; Mechanical designs of Leonardo da Vinci; Development of glass-making, eyeglasses, the telescope (Galileo, Kepler, Newton); Lens grinding and polishing; Dynamics and strength of materials (Galileo); The emergence of mechanics (Newton) and optics (Kepler). The course includes basic mechanics and optics; study of texts (in English translation); and study of artifacts and archaeological and historical discoveries. Open to all undergraduates. No prerequisites.

Offered: Spring

ME 107W MECH & OPTICS IN ANTIQUITIES

The basic principles of mechanics and optics as they developed in ancient Greece, Rome, China and Europe and the emergence of mechanics and optics prior to the industrial revolution. Examples: Law of the lever (Aristotle and Archimedes); Center of gravity (Archimedes and Galileo); Gears, metalworking, and the Antikythera mechanism; Hellenistic science; Medieval mechanics and optics; Mechanical designs of Leonardo da Vinci; Development of glass-making, eyeglasses, the telescope (Galileo, Kepler, Newton); Lens grinding and polishing; Dynamics and strength of materials (Galileo); The emergence of mechanics (Newton) and optics (Kepler). The course includes basic mechanics and optics; study of texts (in English translation); and study of artifacts and archaeological and historical discoveries. Upper level witing

ME 108 Engineering and Architectural Heritage

The aim of the course is to present the basics of structural engineering and its application for the preservation of architectural heritage. The course begins with an introduction to basic concepts of structural engineering. Then, the course examines the engineering developments of the main cultures, and states the general guidelines for the intervention and conservation of heritage buildings. Next, the main techniques for inspection, diagnosis and intervention are presented, including data processing tools and possibilities for structural analysis. The concepts presented in the course are finally used for carrying out a field project, which consists in the geometric, material survey, and finally the structural evaluation of a historical building in Rochester. Open to all undergraduates.

Offered: Fall

ME 202 INTRODUCTION TO APPLIED COMPLEX VARIABLES

Complex numbers and the complex plane; analytic functions; elementary functions; complex integration; series expansions; residue theory; multi-valued functions; conformal mapping. Applications: use of complex functions in oscillation theory; solution of Laplaces equation; evaluation of definite integrals by contour integration; series solutions of ordinary differential equations.

ME 206W BUILDING ENGRG TECHNOLOGY

ME 208 Structural Dynamic and Instrumentation on Architectural Heritage Buildings

The course aims at presenting concepts of structural dynamics in the context of architectural heritage buildings applications. The concepts of classical dynamics for single and multi degree of freedom systems are introduced. Then, the topics related to experimental dynamics, and the instrumentation for structural health monitoring of heritage buildings are presented. The concepts studied in the course are finally used for carrying out a field project, which consists on performing experimental tests, and the determination of the response under working conditions of an existing structure in Rochester.

Offered: Fall

ME 251 HEAT POWER APPLICATION

Review of thermodynamics, vapor power systems, gas power systems, refrigeration and heat pumps, internal combustion engines, nozzles and diffusers, compressors and turbines, aircraft propulsion, cost analysis of power production

Offered: Fall

ME 253 INTRODUCTION TO NUCLEAR ENGINEERING

A first course in nuclear engineering with emphasis on the fundamental physics and technology of modern water-cooled power reactors, the nuclear fuel cycle, and the regulatory environment surrounding nuclear power in the United States

Offered: Spring

ME 291 VEHICLE DESIGN AND DYNAMICS

Engineering design aspects of car dynamics, with hands-on workshop for vehicle measurements and data. Tire behavior, center of gravity, vehicle axis systems and SAE tire axis system, stability and control, break system, suspension, steering. Applications to SAE Mini Baja design. Course offered August 30th through October 30th.

ME 311 ENGINEERING COMPUTATION

Engineering computation and algorithms using MatLab. Solution of systems of linear equations, numerical integration, integration of differential equations, boundary value problems. Examples drawn from the mechanical engineering curriculum (statics, dynamics, fluid mechanics, mechanics of materials, heat transfer, mechanical systems.)

Offered: Spring

ME 386V VISITING STUDENT IN MECH ENG

ME 401 MATHEMATICAL METHODS

Mathematical methods for obtaining approximate analytical solutions to differential equations that cannot be solved exactly. Particular attention will be given to the following methods: Boundary Layer Theory, WKB Theory, Multiple-Scale Analysis, Asymptotic Expansion of Integrals (method of stationary phase, method of steepest descents), Renormalization group.

Offered: Spring

ME 402 PARTIAL DIFFERENTIAL EQUATIONS

The course covers first-order equations and the theory of characteristics, classification of second-order linear equations, method of separation of variables, Green’s functions, and some numerical methods.

ME 404 COMPUTATIONAL METHODS APPLIED TO BIOLOGICAL SYSTEMS

The course deals with computational methods to analytically intractable mathematical problems in biological research. For the first half of the course, general numerical analysis topics are reviewed such as linear algebra, ODE and PDE. Through homework assignments, students write their own computer code. Sufficient sample solutions are given to practice various numerical methods within limited time. The rest of the course is comprised of case studies and projects. Examples of computational analyses are drawn from life science problems such as biodynamics of human loco motion, ion channel kinetics, ionic diffusion, and finite element analysis of cells/tissues. For final project, students bring their own research problems, express them in mathematical equations, solve them using custom written computer programs and interpret the solutions.

Offered: Spring

ME 408 PHASE TRANSFORMATION

How and why atomic rearrangements leading to phase transformations occur and how they are associated with kinetic and crystallographic features; liquid-solid and solid-solid transformations, nucleation theory,growth, massive and martensitic transformations.

Offered: Fall

ME 431 COMPUTATIONAL METHODS

ME 440 MECHANICS OF STRUCTURES

Application of energy methods to obtain the governing equations and approximate solutions to problems involving elastic structures. Static models will be developed to determine the maximum displacements and stresses for structures subjected to forces. Dynamic models will be developed to determine approximate natural frequencies and mode shapes. Rayleigh-Ritz and Galerkin approximation methods will be covered.

Offered: Fall

ME 443 APPLIED VIBRATION ANALYSIS

Deformations and the stresses in different types of structural systems subjected to prescribed dynamic loading conditions. Topics include: overview of structural dynamics, matrix structural analysis and Finite Element analysis, single-degree and multi-degree-of-freedom systems, linear and inelastic systems, numerical evaluation of dynamic response, Finite Element methods in dynamic analysis, earthquake response and structural design.

Offered: Spring

ME 451 Characterization Methods in Materials

Crystallography, symmetry elements, space groups, x-ray diffraction from single crystals and powder patterns. Fourier transforms, grain size effects, residual stresses and textures, diffuse and small angle scattering, Bragg and Laue x-ray diffraction topography, thin films and epitaxial layers. Modern x-ray software for diffraction analysis including textures, residual stresses, pattern identification and Rietveld applications.

Offered: Fall

ME 453 INTRO TO NUCLEAR ENGINEERING

A first course in nuclear engineering with emphasis on the fundamental physics and technology of modern water-cooled power reactors, the nuclear fuel cycle, and the regulatory environment surrounding nuclear power in the United States

ME 461 FRACTURE & ADHESION

Stress fields near cracks in linear elasticity. Linear elastic fracture mechanics. Griffith fracture theory. K and J approaches to fracture. Failure analysis and fracture stability; crack tip deformation, crack tip shielding. Crack nucleation. Adhesion. Low cycle fatigue; fatigue crack propagation. Emphasis on the role of microstructure in determining fracture, adhesion and fatigue behavior of materials; improving fracture toughness for advanced materials especially ceramics and polymers. This course is taught at a level that brings the student to the level of current research.

Offered: Fall

ME 463 MICROSTRUCTURES

Point, line, 2-D and 3-D defects. Diffusion of interstitial and substitutional solutes. Random walk and correlation effects. Thermal diffusion. Irreversible thermodynamics. Diffusion-induced stresses. Dislocations. Grain boundaries and interfaces. Nanowires and particles. Precipitates and inclusions. Amorphous materials, polymers, and composite structures.

Offered: Spring

ME 483 BIOSOLID MECHANICS

Application of engineering mechanics to biological tissues with an emphasis on orthopedic biomechanics. Includes an investigation of structure-function relationships in cartilage, bone, soft tissues and blood cells, as well as static analyses of the musculoskeletal system at the joint level. Techniques for modeling complex biological material properties such as composites, poroelasticity, finite elasticity, and viscoelasticity will also be presented.

Offered: Fall

ME 532 MAGNETOHYDRO DYNAMICS

A general introduction to magnetohydrodynamics (MHD), with applications in engineering and astrophysics. The MHD approximation, basic equations, boundary conditions. The induction equation, the magnetic Reynolds number; perfectly conducting fluids, frozen-in magnetic fields; kinematic MHD, combined convection and diffusion of magnetic fields. Magnetic equilibria, magneto-atmospheres, magnetic buoyancy; force-free fields. Alfvén waves, magneto-acoustic waves, magneto-atmospheric waves, MHD shock waves. Magnetic flux tubes: tubes: waves, siphon flows. Viscous flows: MHD channel flows, Hartmann boundary layers, electromagnetic pumps and flow meters; vorticity in MHD flows. Stability of magnetohydrostatic configurations: kink and sausage instabilities, convective instability. Dynamo theory: Cowling's theorem, the mean-field dynamo equations, the alpha effect, solar and stellar dynamos, interface dynamos, nonlinear dynamos.

Offered: Spring

ME 533 INTRO-INERTIAL CONFINEMENT FUSION

Fusion energy. Lawson criterion for thermonuclear ignition. Fundamentals of implosion hydrodynamics, temperature and density in spherical implosions. Laser light absorption. Implosion stability. Thermonuclear energy gain.

Offered: Fall

ME 541 NANOSCALE CRYSTALLINE DEFECT

ME 545 ADV TOPICS IN PLASMA PHYSICS

The course will discuss the physical principles of selected diagnostics used for plasma measurements. This includes measurements of density, temperature, current, magnetic field, refractive index, emitted and scattered electromagnetic radiation, radiation properties etc. The emphasis lays on a systematic presentation from first principles that will help to form the basis for gaining understanding of many applications in plasma physics. We will concentrate on laboratory plasma diagnostics from the perspective of controlled fusion research.

ME 890 SUMMER IN RESIDENCE - MA

ME 987V PART TIME VISITING STUDENT

MSC 401 PHASE TRANSFORMATION

How and why atomic rearrangements leading to phase transformations occur and how they are associated with kinetic and crystallographic features; liquid-solid and solid-solid transformations, nucleation theory, growth, massive and martensitic transformations.

Offered: Fall

MSC 403 Characterization methods in Materials Science- Diffraction

Crystallography, symmetry elements, space groups, x-ray diffraction from single crystals and powder patterns. Fourier transforms, grain size effects, residual stresses and textures, diffuse and small angle scattering, Bragg and Laue x-ray diffraction topography, thin films and epitaxial layers. Modern x-ray software for diffraction analysis including textures, residual stresses, pattern identification and Rietveld applications.(same as ME 451)

Offered: Spring

MSC 404 BIOPHYSICAL CHEMISTRY II

This course explores how fundamental interactions determine the structure, dynamics, and reactivity of proteins and nucleic acids. Examples are taken from the current literature with emphasis on thermodynamic, kinetic, theoretical, and site-directed mutagenesis studies. Paper and presentation. (Spring - odd years).

Offered: Spring

MSC 406 FRACTURE & ADHESION

Stress fields near cracks in linear elasticity. Linear elastic fracture mechanics. Griffith fracture theory. K and J approaches to fracture. Failure analysis and fracture stability; crack tip deformation, crack tip shielding. Crack nucleation. Adhesion. Low cycle fatigue; fatigue crack propagation. Emphasis on the role of microstructure in determining fracture, adhesion and fatigue behavior

of materials; improving fracture toughness for advanced materials especially ceramics and polymers. This course is taught at a level that brings the student to the level of current research.

Offered: Fall

MSC 408 MICROSTRUCTURE

Point, line, 2-D and 3-D defects. Diffusion of interstitial and substitutional solutes. Random walk and correlation effects. Thermal diffusion. Irreversible thermodynamics. Diffusion-induced stresses. Dislocations. Grain boundaries and interfaces. Nanowires and particles. Precipitates and inclusions. Amorphous materials, polymers, and composite structures.(same as ME 463)

MSC 409 MECHANICL BEHAVIOR OF SOLIDS

The mechanical response of crystalline (metals, ceramics, semiconductors)and amorphous solids (glasses, polymers) and their composites in terms of the relationships between stress, strain, damage, fracture, strain-rate, temperature, and microstructure. Topics include: (1) Material structure and property overview. (2) Isotropic and anisotropic elasticity and viscoelasticity. (3) Properties of composites. (4) Plasticity. (5) Point and line defects. (6) Interfacial and volumetric defects. (7) Yield surfaces and flow rules in plasticity of polycrystals and single crystals. (8) Macro and micro aspects of fractures in metals, ceramics and polymers.(9) Creep and superplasticity. (10) Deformation and fracture mechanism maps. (11) Fatigue damage and failure; fracture and failure in composites (If time permits). (same as ME 481)

Offered: Fall

MSC 413 ENGINEERING OF SOFT MATTER

This course will provide an overview of several contemporary research topics pertaining to structured organic materials. Lectures will focus on intermolecular interactions and the thermodynamics of self-assembly. Additional lectures will introduce molecular crystals, polymer crystallinity, liquid crystals, self-assembled monolayers, surfactants, block copolymers, and biomimetic materials. Homework assignments and a brief technical presentation will be required. (same as CHE 413)

Offered: Spring

MSC 420 INTRO CONDENSED MATTER PHY

An emphasis on the wide variety of phenomena that form the basis for modern solid state devices. Topics include crystals; lattice vibrations; quantum mechanics of electrons in solids; energy band structure; semiconductors; superconductors; dielectrics; and magnets.

Offered: Fall

MSC 433 POLYMER SCIENCE& ENGINEERING

Mechanisms and kinetics of polymerization reactions; solution,suspension, and emulsion polymerization processes; thermodynamics of polymer solutions; the Flory-Huggins theory; principles and practice of membrane osmometry, light scattering, viscometry, and size exclusion chromatography; polymer rheology and mechanical properties; polymer morphology and phase transitions.(same as CHE 486)

MSC 445 BIOMATERIALS SCIENCE AND ENGINEERING

This course provides a background in biomaterials: basic material properties, specifics on ceramics, polymers and metals used in the body, and special topics related to biomaterials including tissue engineering, biological responses to implanted materials, and drug delivery. 4 cr Graduate students will do extra assignments

MSC 447 LIQUID-CRYSTAL MATERIALS AND OPTICAL APPLICATIONS

his course will introduce the student to the physical, chemical and optical properties of liquid crystals (LC) that are the basis for their wide and successful exploitation as optical materials for a broad variety of applications in optics, photonics and information display. Topics to be presented include: origins of LC physical properties in thermotropic and lyotropic materials as a function of chemical structure, influence of these structure-property relationships on macroscopic organization in LC mesophases, and the effect of molecular ordering and order parameter on properties of special significance for device applications. Operating principles for LC devices in a wide variety of applications will be described, including passive and tunable/switchable polarizers, wave plates, filters, information displays and electronic addressing, electronic paper, color-shifting polarizing pigments, optical modulators, and applications in photonics and lasers.

MSC 454 INTERFACIAL ENGINEERING

Lectures on the fundamentals of colloids and interfaces, systems with high interfacial area, and their role in modern processes and products. Topics include interfacial tension, contact angle, adsorption, surfactants, miscelles, microemulsions, and colloidal dispersions. Techniques for formation and characterization of interfaces and colloids will be reviewed.

MSC 464 FUNDAMENTALS OF LASERS

Fundamentals and applications of laser systems, including optical amplification, cavity design, beam propagation and modulation. (For non-Optics/Physics graduate students)(same as OPT 424)

MSC 471 FABRICATION AND TESTING

Characteristics and properties of optical glass and the methods for fabricating high quality surfaces and components. Lectures will describe applications of such glass in laser systems and nonlinear optics.

MSC 472 BIOINTERFACES

The course will focus on interfacial phenomena in hybrid bio-inorganic systems. The goal of the course is to increase the understanding of interactions between biomolecules and surfaces. The course will aim at investigating the behavior of complex macromolecular systems at material interfaces and the importance of such systems in the fields of biology, biotechnology, diagnostics, and medicine. The first part of the course will focus on mechanisms of interactions between biomolecules and surfaces. The second part will focus on the characterization of physical, chemical, and morphological properties of biointerfaces.

MSC 473 INTRO TO OPTO-ELECTRONICS

Introduction to fundamentals of wave propagation in materials, waveguides and fibers, generation, modulation, and detection of light using semiconductor devices, and elements of optocommunication systems.

MSC 492 SPECIAL TOPICS

MSC 541 NANOSCALE CRYSTALLINE DEFECT

This course is a thorough study of the means by which defects in crystalline lattices control the observable macroscopic properties of single phase materials. The properties under consideration are mechanical properties, electrical properties, optical properties, and chemical properties. The defects of interest include point, line, and planar defects, including charged defects, that determine internal friction, yield strength, transparency and translucency, chemical potential, stored energy, electrical resistivity, dielectric response. Knowledge of how such defects determine important engineering properties of solids is a fundamental requisite for all areas of materials research.

MSC 890 SUMMER IN RESIDENCE - MA

MSC 990 SUMMER IN RESIDENCE

OPT 000 OPTICS SEMINAR

OPT 197 GEOMETRICAL OPTICS LAB

Students examine, analyze, measure, dismantle and reverse-engineer a variety of new and used optical tools, apparatus and systems. Emphasis on conceptual understanding and intuitive problem-solving.

Offered: Fall

OPT 198 PHYSICAL OPTICS LAB

This lab complements OPT 261. Experiments cover interference and diffraction phenomena, introduction to optical information processing and electronic imaging systems with emphasis on error analysis.

Offered: Spring

OPT 199 INSTRUMENTATION LAB

This laboratory complements OPT 242. Students experience further optical phenomena in the lab setting to better understand equipment that provides measurement and key optical data.

Offered: Fall

OPT 224 FUNDAMENTALS OF LASERS

Fundamentals and applications of laser systems, including optical amplification, cavity design, beam propagation and modulation.

Offered: Fall

OPT 226 OPTOELECTRONICS I:DEVICES

Light propagation in restricted geometries including waveguides and optical fibers. Dispersion and loss in linear and nonlinear pulse propagation. Coupling between passive and between active and passive elements.

Offered: Fall

OPT 256 OPTICS LABORATORY

Students rely on previous learning to create, align, collect data, solve and report on a variety of optical experiments.

Offered: Fall

OPT 257 OPTICS LABORATORY II

A continuation of OPT 256 for those who elect to try additional experimentation.

Offered: Spring

OPT 270 BIOMEDICAL MICROSCOPY

This course covers the principles and practice of light microscopy as applied to biological and medical questions. Topics include basic light microscopy, DIC, phase epifluorescence, confocal and multiphoton laser-scanning microscopy, and selected methods such as CARS, FRET, FRAP, FCS, etc. This course is jointly listed as 470 for graduate students. Some homework problems are “470 only”.

OPT 386V VISITING STUDENT IN OPTICS

OPT 414 DETECTION & ESTIMATION

Loss and utility; Bayesian inference; risk functions, randomized decisions, admissible decisions; empirical Bayes for unknown prior; Neyman-Pearson hypothesis testing, receiver operating characteristic; sufficient and minimal sufficient statistics and Rao-Blackwellization; unbiased estimation; minimum variance unbiased estimation and Cramer-Rao inequality, maximum likelihood estimation; nonparametric estimation of cdfs.

OPT 424 FUNDAMENTALS OF LASERS

Fundamentals and applications of laser systems, including optical amplification, cavity design, beam propagation and modulation. (For all graduate students EXCEPT Optics/Physics Students)

Offered: Fall

OPT 428 OPTICAL COMMUNICATION SYSTEMS

The course is designed to give the student a basic understanding of the optical communication systems while making him aware of the recent technological advances. The following topics are covered: components of an optical communication system, propagation characteristics of optical fibers, lightwave sources such as light-emitting diodes and semiconductor lasers, optical receivers, noise analysis and bit error rate, coherent communication systems, multichannel communication systems, soliton-based communication systems. References: J. C. Palais, Fiber-Optics Communications, Prentice- Hall; E. E. Bert Basch, Optical-Fiber Transmission, Sams; Agrawal and Dutta, Long-Wavelength Semiconductor Lasers, Van- Nostrand Reinhold; Miller and Kaminow, Optical Fiber Telecommunications II, Academic.

Offered: Spring

OPT 449 DES TOL FAB & COAT OPT SYS

OPT 492 SP TOP: THz Phenomenon & Technology

THz technology session provides the fundamentals of free-space THz optoelectronics for sensing, imaging and spectroscopy applications. A free-space THz-ray optoelectronic system, with diffraction-limited spatial resolution, femtosecond temporal resolution, DC-THz spectral bandwidth, and mV/cm field sensitivity, will be central to the course. We will cover the basic concepts of generation, detection and propagation of T-rays, and their applications. Students will learn how up-to-the-minute results in THz laboratories apply to research and development. Students will learn advanced systems with THz time-domain spectroscopy, optical rectification, electro-optic sampling, THz gas laser, Gunn diodes and Schottky diodes, and FTIR. Many newly developed THz systems at Rochester will be the examples used in this course. Ultrafast Phenomena session covers the methods for optical measurement with short laser pulses. Short laser pulse generation, amplification, detection, and characterization will be discussed.

Offered: Spring

OPT 511 ADV MATH METHODS IN OPTICS

This course focuses on advanced numerical and analytical techniques that are likely to be useful for PhD-level Optics students. It will begin with a review of numerical errors and then develop simple algorithms for solving nonlinear algebraic and differential equations. The later half of the course will cover several analytical techniques useful for solving ordinary and partial differential equations encountered in various areas of optics and photonics. Students will be given weekly homework problems based on the material covered each week. Course Textbook: S. Chapra, Applied Numerical Methods with MATLAB, 3rd edition (McGraw-Hill, 2011).

OPT 544 ADVANCED LENS DESIGN

Complex zoom lenses and multi-mirror reflective systems are discussed detail starting with first principles. Other topics include materials for other wavelength bands, tolerancing, sensitivity analysis, monte carlo analysis, ghost and stray light analysis. Students required to complete two complex group design projects.

Offered: Fall

OPT 564 THRY OF ELECTRONC IMAG'G SYS

With a definite systems orientation, we will study topics in diffraction theory, coherence, signal processing, detection theory, digital image processing, spatial and frequency domain filtering, and statistical optics as they apply to systems for imaging, digital cameras and remote sensing. Regular problem sets will be assigned together with request-for-proposal (RFP) topics, so that the advanced graduate student will obtain experience in the technical aspects of preparing systems proposals. Students will prepare a final oral presentation (no other final examination) to brief the class on a topic related to the course material. Lecture topics will be advanced diffraction theory & photomixing, ICIS - digital camera systems, coherence Theory, synthetic aperture systems, laser radar systems, digital image processing fundamentals, computer tomography systems, Speckle and remote sensing, holography & diffractive optics.

Offered: Fall

OPT 592 MODERN COHERENCE THEORY

Theory of random processes, stationary erogdicity, the auto-correlation function and the cross-correlation function of random processes. Spectrum of a stationary random process and the Wiener-Khintchine theorem, second-order coherence theory in the space-time domain, the mutual coherence function, the degree of coherence. Second-order coherence theory in the space-frequency domain, the cross spectral density, mode representation, propagation problems, inverse radiation problems, effects of source correlations and scattering of partially coherent light from deterministic and from random media.

OPT 890 M.S. CO-OP PROGRAM IN OPT

OPT 990 SUMMER IN RESIDENCE

TCS 447 NATURAL LANGUAGE PROCESSING

An introduction to natural language processing: constructing computer programs that understand natural language. Topics include parsing, semantic analysis, and knowledge representation.

TCS 473 COMP MODELS OF MUSIC

We will explore various computational approaches to musical problems (rule-based approaches, connectionism, dynamical systems, and probabilistic models), focusing on two main areas: 1) models of musical processing and information retrieval; 2)

models of musical styles. Our main focus will be on the symbolic level of music representation, though some attention will be given to signal-level processing. Most assignments will consist of reading articles and answering questions about them. There will be some programming assignments, with other options for students without programming ability.

TCS 481 INTRO TO CRYPTOGRAPHY

The modern study of cryptography investigates techniques for facilitating interactions between distrustful entities. In this course we introduce some of the fundamental concepts of this study. Emphasis will be placed on the foundations of cryptography and in particular on precise definitions and proof techniques.

TCS 483 TOPICS IN CRYPTOGRAPHY

This will be a seminar-style course in which students will read and present papers on current research in Cryptography. Potential topics include lattice-based cryptography, concurrency and protocol security, database privacy, cryptographic game theory and interplay of cryptography with other fields. The course will build on material covered in the introductory course (281/481) but is not a required prerequisite.

TCS 485 ALGORITHMS & ELECTIONS

The focus of this course is on using algorithms to manipulate elections and on using complexity to protect elections from such manipulative attacks. Among the attacks we will study are manipulation, bribery and control. Students taking this course at the 400 level may be required to complete additional tests, readings, or assignments.

TEB 470 BIOMEDICAL MICROSCOPY

This course covers the principles and practice of light microscopy as applied to biological and medical questions. Topics include basic light microscopy, DIC, phase epifluorescence, confocal and multiphoton laser-scanning microscopy, and selected methods such as CARS, FRET, FRAP, FCS, etc.

TEC 413 ENGINEERING OF SOFT MATTER

This course will provide an overview of several contemporary research topics pertaining to structured organic materials. Lectures will focus on intermolecular interactions and the thermodynamics of self-assembly. Additional lectures will introduce molecular crystals, polymer crystallinity, liquid crystals, self-assembled monolayers, surfactants, block copolymers, and biomimetic materials. Homework assignments and a brief technical presentation will be required. Advanced undergraduate students are welcome.

TEC 430 ORGANIC ELECTRONICS

Basic optical and electronic processes of organic molecules and polymers. Charge transport and luminescent properties of organic solids. Metal/organic contacts and charge injection. Applications in thin-film organic electronic devices including organic light emitting diodes, solar cells, photoconductors, and transistors. Review of selected papers.

TEC 454 INTERFACIAL ENGINEERING

Lectures on the fundamentals of colloids and interfaces, systems with high interfacial area, and their role in modern processes and products. Topics include interfacial tension, contact angle, adsorption, surfactants, miscelles, microemulsions, and colloidal dispersions. Techniques for formation and characterization of interfaces and colloids will be reviewed.

TEE 407 ADV GPU PROJECT DEV

Students develop an advanced project for the GPU platform. A GPU compute-cluster can be employed, as well as a single GPU computer. Students meet with the instructor twice a week to report the progress and the new direction is determined based on the results and the ongoing progress. Project options include: Protein folding (BLAST algorithm), Face recognition (using Open CV), 3D Image reconstruction of biomedical images, and other sophisticated image processing algorithms.

TEE 427 Electric Power: Conversion, Transmission, and Consumption

We will describe how the principal sources of energy - coal, natural gas, impounded water (hydroelectric), and fissile materials - are exploited to create electric power, how it is transmitted and distributed through the grid and finally the patterns of its consumption. To assure that students gain a proper appreciation for the factors that determine the real cost of electricity per kilowatt-hour, the subject will be treated in a highly quantitative way. The goal will be to provide students with the information and tools they need for informed analysis of the true prospects and technological challenges involved in integration of new

energy sources, such as solar, wind, geothermal, and tidal power, with the existing grid. There will be weekly homework and a midterm. Two projects with oral presentations, including a major one at the end of the semester, are required. There is no final exam. Several required field trips to local power facilities occur during the semester.

TEE 435 INTRO TO OPTO-ELECTRONICS

Introduction to fundamentals of wave propagation in materials, waveguides and fibers, generation, modulation, and detection of light using semiconductor devices, and elements of optocommunication systems.

TEE 450 INFORMATION THEORY

Entropy, Relative Entropy, mutual information, asymptotic equipartition property, data compression, channel capacity, joint source channel coding theorem, Gaussian channels, rate distortion theory, selected applications.

TEE 462 ADVANCED CMOS VLSI DESIGN

Senior design course for "Computer Design" or "Integrated Electronics" concentrations. Review of CMOS Subsystem design. Design focus on digital or mixed-signal systems, such as a simple microprocessor, a self-timed multiplier, a digital filter, data converter, or memory. Project design requirements include architectural design, logic and timing verification, layout design, and test pattern generation. Extensive use of CAD tools. The resulting VLSI chips may be fabricated.

TEE 463 VLSI ERROR CONTROL SYS

This course reviews the reliability challenges introduced by the multi-core billion-transistor integration era, and discusses circuit, architectural, and algorithm level solutions to address these challenges. After a brief review of IC design and layout concepts, students are introduced to the tradeoffs in continued CMOS scaling. Lectures, assigned readings, discussions, student presentations, review reports of the research literature, computer simulations and modeling, design projects of varying complexity, and a final scholarly paper required.

TEE 465 PERF ISSUES VLS/IC

Primary and recent research in the fields of high performance digital and analog VLSI design and analysis. Provides background and insight into some of the more active performance related research topics of the field such as CMOS deisign techniques, speed/area/power tradeoffs in CMOS circuits, low power design, RLC interconnect, synchronization and clock distribution, pipelining/retiming, and many other areas.

TEE 466 RF AND MICROWAVE INTEGRATED CURCUITS

This course involves the analysis and design of radio-frequency (RF) and microwave integrated circuits at the transistor level. We begin with a review of electromagnetics and transmission line theory. Several design concepts and techniques are then introduced, including Smith chart, s-parameters, and EM simulation. After the discussion of RLC circuits, high-frequency narrow-band amplifiers are studied, followed by broadband amplifiers. Then we examine the important issue of noise with the design example of low-noise amplifiers (LNA). Nonlinear circuits are studied next with the examples of mixers. A study of oscillators and phase noise follows. Afterwards we introduce phase-locked loops (PLL) and frequency synthesizers. The course concludes with an overview of transceivers architectures. The course emphasizes the development of both circuit design intuition and analytical skills. There are bi-weekly design labs and a term project using industry-standard EDA tools (ADS, Asitic, etc.).

TEE 467 ANALOG INTEGRATED CIRCUIT

Analysis and design of analog CMOS integrated circuits. MOS and bipolar device structures and models. Modern opamp design with noise, offset and distortion anaylsis, feedback, frequency compensation, and stability. Current mirrors and bandgap references. Sampling devices and structures. Switched-capacitor filters and other digital and digital-to-analog converters.

TEE 471 COMP MODELS OF MUSIC PROC

This course is designed for engineering and science students to learn the basic elements of music theory and analysis, but employing concepts and tools from digital signal processing, pattern classification, machine learning and data mining. Class requirements include weekly readings and programming assignments, and a final project in which students complete an analysis of a large-scale symphonic work combining their subjective aesthetic response to the piece with the computational analysis using the tools developed throughout the course

TEM 483 BIOSOLID MECHANICS

TEM 494P INTERNSHIP

TEM 890 SUMMER IN RESIDENCE - MA

TEO 424 FUNDAMENTALS OF LASERS

Fundamentals and applications of laser systems, including optical amplification, cavity design, beam propagation and modulation.

TEO 428 OPTICAL COMMUN SYSTEMS

Covers analog and digital signals, multiplexing techniques, modulation formats, dispersive and nonlinear properties in optical fibers, LED's and semiconductor lasers, optical amplifiers and dispersion management with several systems.

TEO 461 FOURIER OPTICS

The principles of physical optics including diffraction and propagation based on Fourier transform theory; integral formulation of electromagnetic propagation; diffraction from apertures and scattering objects; applications to optics of Fourier transform theory, sampling expansions, impulse response, propagation through optical systems, imaging and transforming, optical transfer function, optical filtering; and selected topics of current research interest. Text: Goodman, Introduction of Fourier Optics; Class Notes; References: Born and Wolf, Principles of Optics; Gaskill, Linear Systems, Fourier Transforms and Optics; Papoulis, Systems and Transforms with Applications in Optics; Siegman, Lasers.

TEO 511 ADV MATH METHODS IN OPTICS

TME 408 PHASE TRANSFORMATION

How and why atomic rearrangements leading to phase transformations occur and how they are associated with kinetic and crystallographic features; liquid-solid and solid-solid transformations, nucleation theory,growth, massive and martensitic transformations.

TME 440 MECHANICS OF STRUCTURES

Application of energy methods to obtain the governing equations and approximate solutions to problems involving elastic structures. Static models will be developed to determine the maximum displacements and stresses for structures subjected to forces. Dynamic models will be developed to determine approximate natural frequencies and mode shapes. Rayleigh-Ritz and Galerkin approximation methods will be covered.

TME 443 APPLIED VIBRATION ANALYSIS

Deformations and the stresses in different types of structural systems subjected to prescribed dynamic loading conditions. Topics include: overview of structural dynamics, matrix structural analysis and Finite Element analysis, single-degree and multi-degree-of-freedom systems, linear and inelastic systems, numerical evaluation of dynamic response, Finite Element methods in dynamic analysis, earthquake response and structural design.

TME 453 INTRO TO NUCLEAR ENGINEERING

A first course in nuclear engineering with emphasis on the fundamental physics and technology of modern water-cooled power reactors, the nuclear fuel cycle, and the regulatory environment surrounding nuclear power in the United States

TME 461 FRACTURE & ADHESION

Stress fields near cracks in linear elasticity. Linear elastic fracture mechanics. Griffith fracture theory. K and J approaches to fracture. Failure analysis and fracture stability; crack tip deformation, crack tip shielding. Crack nucleation. Adhesion. Low cycle fatigue; fatigue crack propagation. Emphasis on the role of microstructure in determining fracture, adhesion and fatigue behavior of materials; improving fracture toughness for advanced materials especially ceramics and polymers. This course is taught at a level that brings the student to the level of current research.

TME 463 MICROSTRUCTURE

Point, line, 2-D and 3-D defects. Diffusion of interstitial and substitutional solutes. Random walk and correlation effects. Thermal diffusion. Irreversible thermodynamics. Diffusion-induced stresses. Dislocations. Grain boundaries and interfaces. Nanowires and particles. Precipitates and inclusions. Amorphous materials, polymers, and composite structures.