The Department of Electrical Engineering and Computer Science

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Professors

Parviz Rastgoufard, Department Chair, Michigan State University, 1983; Electrical Engineering and Systems Science. Large Scale Power and Control Systems, Compuatational Intelligence in Power Systems, Electrodynamics.

Boumediene Belkhouche, Ph.D., University of Southwestern Louisiana, 1983; Computer Science. Programming Languages, Formal Semantics, Software Engineering, Bioinformatics.

Billy Paul Buckles, Ph.D., University of Alabama, 1981;Operations Research. Petri Nets, Fuzzy Databases, Genetic Algorithms.

Paul Frank Duvoisin, Ph.D., University of Wisconsin, 1969; Electrical Engineering. Electronics, Microprocessors.

Shieh-Tsing Hsieh, D.E., Tulane University, 1974; Electrical Engineering. Electromagnetics, Microwave Devices.

Frederick Eugene Petry, Ph.D., Ohio State University, 1975; Computer Science. Representation of Imprecision via Fuzzy Sets and Rough Sets in Databases, GIS, and other information systems, Genetic Algorithms.

Associate Professors

Mark Benard, Ph.D., Yale University, 1969; Mathematics. Computer Security, Networking, Operating Systems.

Sergey V. Drakunov, Ph.D., Institute of Control Sciences, 1985; Nonlinear Control. Observers and Filters, Systems and Sliding Modes.

Johnette Hassell, Ph.D., Tulane University, 1975; Mathematics, Software Engineering, Computer Forensics.

Cris Koutsougeras, Ph.D., Case Western University, 1988; Computer Science. Neural nets, Theoretical Computer Science, Artificial Intelligence.

Andrew B. Martinez, Ph.D., Princeton University, 1982; Information Sciences and Systems, Communications, Digital Signal Processing, Sonar, and Navigation.

Assistant Professors

Dale Joachim, Ph.D., Michigan State University, 1998; Electrical Engineering. System Identification, Speech Processing, Set-membership Theory.

Jing Peng, Ph.D., Northeastern University, 1994; Computer Science. Machine Learning, Image Retrieval, Pattern Classification.

Uvais Qidwai, Ph.D., University of Massachusetts, 2001; Electrical Engineering. Signal and Image Processing, Robotics.

Marin Simina, Ph.D., Georgia Institute of Technology, 1999; Computer Science. Artificial Intelligence, Web-based Agents, Case-based Reasoning, Cognitive Science.

Brij Singh, Ph.D., Indian Institute of Technology Delhi, 1996; Power Electronics. Power Supplies for Telecommunication Systems, Power Electronics Applications to Power Systems, Machine Control and Solar Power Based Systems.

Computer Engineering (CPEN)

Early computers were large, temperature sensitive, unreliable and thoroughly unsuited to today's problems, problems such as spacecraft control, health care monitoring, nuclear plant regulation, robotics and telephone switching systems. The role of the computer engineer is to design and engineer computers and related hardware systems that are increasingly small, versatile, reliable, and cost effective.

Traditionally, hardware and software have been studied separately, but recent and dramatic developments have blurred distinctions between the two. The field of computing requires engineers to have backgrounds that span both hardware and software issues and the interface between the two as well as be able to interact with engineers and applied scientists from other disciplines.

Tulane's Computer Engineering program meets these needs through an integrated curriculum that includes design, theory, and applications of engineering and computer science. Traditional topics such as electronic circuits, digital logic, computer architecture, and computer systems design and testing are supplemented with studies about the principles of software development and the interaction of computer hardware and software. A senior design sequence allows students to apply their accumulated knowledge to an open-ended problem relevant to the student's personal and career objectives. The open-ended problem chosen by the student will serve as the student's thesis topic required of all Computer Engineering students for their graduation from the department.

Graduates of the Computer Engineering program elect either graduate study or immediate employment in industry, commerce, or government. Typical industrial employers include both manufacturers and users of computer systems, petrochemical industries, government agencies and laboratories, and telecommunications firms. Jobs in these industries may include designing new tools, technologies, or testing mechanisms for computers and computer peripherals, establishing standards for computer hardware and software performance, and applying artificial intelligence techniques to manufacturing or health care.

The Computer Engineering program, being one of the three interrelated programs offered by the department, substantially benefits from both Computer Science and Electrical Engineering programs. For more information, see the Computer Science and Electrical Engineering descriptions and listings.

DEPARTMENTAL MISSION

The mission of the Computer Engineering program of the Department of Electrical Engineering and Computer Science is to train highly qualified undergraduate and graduate students who will contribute to the advancement of information technology in all aspects of our society. The faculty and students of the Computer Engineering program continuously interact with the faculty and students in the Electrical Engineering and Computer Science programs of the department and as a result shall be trained to obtain backgrounds that span both hardware and software issues and the interface between the two as well as be able to interact with engineers and applied scientists from other disciplines.

OBJECTIVES

The educational objectives for the Computer Engineering program of the Department of Electrical Engineering and Computer Science are:

- To prepare our students for today’s and future challenging problems such as information technology, spacecraft control, health care monitoring, nuclear plant regulation, robotics, and telephone switching systems.
- To train our computer engineers to design and engineer computers and related hardware and software systems that are increasingly small, versatile, reliable, and cost effective.
- To strive for state-of-the-art laboratories and facilities that are suitable for experimenting topics such as electronic circuits, digital logic, computer architecture, computer systems design, computer hardware and software interfacing, robotics, and information technology.
- To provide opportunities for our students to use the departmental industrial and governmental alliances to interact with practicing engineers and scientists in industrial, commercial, academic, and government communities.
- To emphasize the importance of verbal, written, and visual communications and requiring all of our seniors to engage in completion of a year long senior thesis in their field of interest. Our students are also encouraged to engage in interdisciplinary projects and international cultural exchange activities.

Curriculum

Freshman Year

Fall Semester		*Credits*
CPSC 101	Software Design and Programming	4
ENGR 100	Introduction to Engineering and Computer Science	1
CHEM 107	General Chemistry I	3
CHEM 117	General Chemistry Lab I	1
MATH 121	Calculus I	4
PHYS 131	General Physics I and Lab	4
	Fall Semester Total:	**17**

Spring Semester		
CPSC 102	Object-oriented Design and Programming	4
ENGR 101	Introduction to Engineering and Computer Science	1
CHEM 108	General Chemistry II	3
CHEM 118	General Chemistry Lab II	1
MATH 122	Calculus II	4
PHYS 132	General Physics II and Lab	4
	Spring Semester Total:	**17**

Sophomore Year

Fall Semester		
CPEN 200	Sophomore Testing Period	0
CPEN 201	Computer Organization	4
ELEN 201	Electric Circuits I	3
MATH 217	Discrete Mathematics	3
MATH 221	Calculus III	4
Elective	Engineering Science	3
	Fall Semester Total:	**17**

Spring Semester

CPEN 200	Sophomore Testing Period	0
CPEN 240	Digital Logic	4
CPSC 118	Data Structures	4
ELEN 202	Electric Circuits II	3
ENGL 101	Writing	4
	or	
**** 119	Writing Seminar	4
MATH 224	Introduction to Applied Mathematics	4
	Spring Semester Total:	**19**

Junior Year

Fall Semester

CPEN 383	Computer Engineering Lab	2
CPSC 355	Operating Systems Design	4
ELEN 303	Electronics	3
ELEN 321	Signals and Systems	3
Elective	Humanities or Social Science	3
	Fall Semester Total:	**15**

Spring Semester

CPEN 341	Microcomputer Interfacing	4
CPSC 305	Software Engineering	4
MATH 301	Probability and Statistics	3
Elective	Humanities or Social Science	3
Elective	Humanities or Social Science	3
	Spring Semester Total:	**17**

Senior Year

Fall Semester

CPEN 444	Computer Architecture	3
CPEN 485	Senior Design Project I	2
Elective	Technical	3
Elective	Technical	3
Elective	Humanities or Social Science	3
	Fall Semester Total:	**14**

Spring Semester

CPEN 486	Senior Design Project II	3
Elective	Technical	3
Elective	Technical	3
Elective	Humanities or Social Science	3
Elective	Humanities or Social Science	3
	Spring Semester Total:	**15**

PLACEMENT IN COMPUTER SCIENCE COURSES

Students who are proficient in C or C++ should contact the Department of Electrical Engineering and Computer Science to determine placement.

Students who have taken the College Board AP examination in computer science should contact the Department of Electrical Engineering and Computer Science to determine college credits and placement.

ENGINEERING SCIENCE ELECTIVE (3 CREDITS REQUIRED)

The student may select this elective from the basic engineering science courses offered outside of computer engineering, computer science, and electrical engineering.

TECHNICAL ELECTIVES (12 CREDITS REQUIRED)

Technical electives permit the student to focus his or her undergraduate program on an area of special interest. As examples, acceptable focus areas include depth in computer science and engineering, depth in electrical engineering, pre-med, pre-law, or cognitive science. Each student is required to meet with his or her department adviser and plan out the full extent of the focus area for the technical electives prior to taking any of these courses. These courses must be at the 300-level or above unless approved by the department.

Students completing an ROTC program receive 6 credits towards this requirement for their ROTC course work.

MINOR IN COMPUTER ENGINEERING

The minor is available only to students in other Engineering departments. The following courses are required:

CPSC 101	(Software Design and Programming)
CPSC 102	(Object-oriented Design and Programming)
CPSC 118	(Data Structures)
CPEN 201	(Computer Organization)
CPEN 240	(Digital Logic)
MATH 217	(Discrete Mathematics)

One (1) additional Computer Engineering (CPEN) course is required at the 300 or 400 level excluding laboratory courses such as 383, 485, or 486 and independent studies courses.

MINORS AND SECOND MAJORS FOR COMPUTER ENGINEERING STUDENTS

There are established minors in business management and in mathematics and an established second major in mathematics. Other minors or majors may be arranged on request by mutual consent of the Department of Electrical Engineering and Computer Science and the department in which the minor or major is to be taken.

COURSE DESCRIPTIONS

CPEN 201 Computer Organization (4) Lecture 3, laboratory 2.
Prerequisite: CPSC 101. An introduction to the logical and physical organization of digital computers. This course provides a general overview of the structure and function of computer systems. Topics covered include data representation, CPU organization and control, memories, input/output devices, communications, and system software. Assembly language programming is introduced to illustrate these topics.

CPEN 240 Digital Logic (4) Lecture 3, laboratory 2.
Prerequisite: CPEN 201. An introduction to the design and analysis of digital logic systems. The use of gates, flip-flops, counters, and other common transistor logic devices is studied. Laboratory work includes the construction and testing of logic circuits.

CPEN 341 Microcomputer Interfacing (4) Lecture 3, laboratory 2.
Prerequisite: CPEN 383 or ELEN 391. The study of the interaction of the components of a computer system and the interfacing of these components to form an operational unit. Laboratory work includes experiments with processors, memory, and I/0 devices.

CPEN 383 Computer Engineering Laboratory (2) Laboratory 3.
Prerequisite: CPEN 240. Experience in using the techniques of Logic Design in the design of large scale systems including digital computing oriented as well as hybrid digital-analog systems. Students are required to implement in hardware and prototype boards a real world engineering application which calls for problem solving skills beyond the standard algorithmic processes of Logic Design.

CPEN 422 Image Processing (3) Lecture 3.
Prerequisite: CPEN 201 and MATH 221. Digital image processing techniques covering image representation, compression, enhancement, restoration, segmentation, and reconstruction. These methods are examined in both the spatial and frequency domains. Students receive hands-on experience in processing images.

CPEN 427 Speech Processing (3) Lecture 3.
Prerequisites: CPEN 201, ELEN 321. A hands-on perspective on the field of speech processing is given using the hidden Markov model (HMM) software HTK. Relevant notions in signal processing, HMMs, clustering and speech modeling are presented.

CPEN 444 Computer Architecture and Design (3) Lecture 3.
Prerequisite: CPEN 240. A presentation of both theoretical and practical aspects of computer architecture. Design methods and languages are introduced and a complete design of a typical small processor and various alternative designs are considered. Approaches to ALU design emphasizing speed trade-offs are given. Topics in multiprocessing and parallel and distributed processing are also considered.

CPEN 449 Neural Nets (3) Lecture 3.
Prerequisites: advanced standing in computer science, or computer engineering, or electrical engineering or a good mathematics background and the permission of the instructor. A study of the sub-symbolic computing paradigm and a basic set of neural network models. The course covers perspectives and applications of neurocomputing to machine learning, pattern recognition, associative memory, and automatic control.

CPEN 461 Graphics and Animation (3) Lecture 3.
Prerequisites: CPEN 201 and department permission. Algorithmic approaches towards making realistic computer graphics with mathematical modeling and simulation. The course is intended to cover the topics such as graphics basics, representation of complex shapes with simple geometrical shapes and their mathematical representation, interpolation of pixel values for the cases of motion, and size changes, output primitives, representations of motion, shadows, and 3D effects, morphing and multi-layered animation.

CPEN 472 Computer Networks (3) Lecture 3.
Prerequisite: CPSC 355. A student of computer network architecture and design. Topics covered include the TCP/IP Internet model and specific protocols which are used at each layer of this model as well as general methods for flow and error control, error detection, encryption, and security.

CPEN 485 CPEN 486 Senior Design Project I, II (2,3) Seminar 2, laboratory 3.
Prerequisite: Senior standing in computer engineering. A two-semester sequence in which students apply their accumulated knowledge in designing and implementing a major project. Students will be graded on the basis of oral and written presentations dealing with their analysis and design as well as the quality of the project.

CPEN 497 CPEN 498 Independent Studies (1-3).
Prerequisite: Approval of the department.

CPEN 627 Speech Processing (3) Lecture 3.
Prerequisites: Graduate standing and department permission. A hands-on perspective on the field of speech processing is given using the hidden Markov model (HMM) software HTK. Relevant notions in signal processing, HMMs, clustering and speech modeling are presented.

CPEN 640 Digital Logic (3) Lecture 3, laboratory 2.
Prerequisite: Graduate standing. An introduction to the design and analysis of digital logic systems. The use of gates, flip-flops, counters, and other common transistor logic devices is studied. Laboratory work includes the construction and testing of logic circuits.

CPEN 641 Microcomputer Interfacing (3) Lecture 3, laboratory 2.
Prerequisite: CPEN 640. The study of the interaction of the components of a computer system and the interfacing of these components to form an operational unit. Laboratory work includes experiments with processors, memory, and I/O devices.

CPEN 644 Computer Architecture and Design (3)
Lecture 3.
Prerequisite: CPEN 640. A presentation of both theoretical and practical aspects of computer architecture. Design methods and languages are introduced and a complete design of a typical small processor and various alternative designs are considered. Approaches to ALU design emphasizing speed trade-offs are given. Topics in multiprocessing and parallel and distributed processing are also considered.

CPEN 649 Neural Nets (3) Lecture 3.
Prerequisite: Graduate standing and department permission. A study of the sub-symbolic computing paradigm and a basic set of neural network models. The course covers perspectives and applications of neurocomputing to machine learning, pattern recognition, associative memory, and automatic control.

CPEN 661 Graphics and Animation (3) Lecture 3.
Prerequisites: Graduate standing and department permission. Algorithmic approaches towards making realistic computer graphics with mathematical modeling and simulation. The course is intended to cover the topics such as graphics basics, representation of complex shapes with simple geometrical shapes and their mathematical representation, interpolation of pixel values for the cases of motion, and size changes, output primitives, representations of motion, shadows, and 3D effects, morphing and multi-layered animation.

CPEN 672 Computer Networks (3) Lecture 3.
Prerequisite: CPSC 655. A student of computer network architecture and design. Topics covered include the TCP/IP Internet model and specific protocols which are used at each layer of this model as well as general methods for flow and error control, error detection, encryption, and security.

Computer Science (CPSC)

In the Computer Science program we offer a flexible curriculum that is constantly updated to reflect and use emerging technologies. The curriculum provides a balance of computer science, basic science and mathematics, breadth requirements, and electives. After a three year core study including software engineering, operating systems, computer organization, and the theory of computation, a student may choose technical electives from courses as varied as artificial intelligence, computer networks, databases, and computer architecture.

The electives portion of the program is particularly flexible and allows students to pursue courses of study which meet their personal and career objectives. Students may develop a self-defined major or minor for virtually any program in the university; predefined options are given under the section on minors and second majors.

As students have gained more access to computers and computer programming in their pre-college education, it is easy to think of computer science as merely programming. While the construction of computer programs is a vital part of computer science, programming alone does not provide a sufficient basis for a lasting professional career. Thus the study of computer science goes far beyond programming and includes developing new problem solving methods, the planning, design, and testing of sophisticated, innovative computing systems, and deriving the conceptual foundations of all computing.

Some graduates go on to graduate studies in computer science or professional studies in business, law, or medicine. Others form their own companies or work for companies as varied as telecommunications, computer manufacturers, consulting firms, and petrochemical companies. Their jobs fall into a range of areas including software design, quality assurance, project management, and customer consulting, and they may serve as representatives to professional societies or international standards organizations.

The Department of Electrical Engineering and Computer Science also offers an undergraduate degree in Computer Engineering for students interested in the design and engineering of computers and related hardware systems. The Computer Engineering curriculum focuses on the design of computers and the hardware/software interface. Details of the computer engineering curriculum are found in the Computer Engineering section of this bulletin.

DEPARTMENTAL MISSION

The mission of the Computer Science program of the Department of Electrical Engineering and Computer Science is to offer a flexible curriculum that is constantly updated to reflect and use emerging technologies. The curriculum provides a balance of computer science, basic science and mathematics, breadth requirements, and electives that ensures the training of highly qualified students for the rapidly growing information technology industry.

OBJECTIVES

The educational objectives for the Computer Science program of the Department of Electrical Engineering and Computer Science are:

To provide quality education for our students for today's and future challenging problems requiring knowledge of software engineering, systems software, computer organization and architecture, intelligent systems, and theory.

To strive for state-of-the-art classrooms, computing facilities, and multimedia equipment that support our students in computer programming, problem solving, planning, design, and testing of sophisticated innovative computing systems, and deriving the conceptual foundations of computing.

To provide a flexible curriculum that allows students to pursue courses of study which meet their personal and career objectives.

To encourage the students to interact with the faculty of the department on research projects that are performed in the department for industry and government.

To emphasize the importance of verbal, written, and visual communications by requiring students to take appropriate courses and engage in interdisciplinary projects and international cultural and scientific activities.

Curriculum

Freshman Year

Fall Semester		*Credits*
CPSC 101	Software Design and Programming	4
ENGR 100	Introduction to Engineering and Computer Science	1
MATH 121	Calculus I	4
	Lab Science I	4
Elective	General	3
	Fall Semester Total:	**16**

Spring Semester

CPSC 102	Object-oriented Design and Programming	4
ENGR 101	Introduction to Engineering and Computer Science	1
MATH 122	Calculus II	4
	Lab Science II	4
ENGL 101	Writing	4
	or	
****119	Writing Seminar	4
	Spring Semester Total:	**17**

Sophomore Year

Fall Semester

CPEN 200	Sophomore Testing Period	0
CPEN 201	Computer Organization	4
MATH 221	Calculus III	4
Elective	Science	3-4
Elective	General	3
Elective	General	3
	Fall Semester Total:	**17-18**

Spring Semester

CPSC 118	Data Structures	4
CPEN 200	Sophomore Testing Period	0
CPEN 240	Digital Logic	4
MATH 217	Discrete Mathematics	3
Elective	Science	3-4
Elective	General	3
	Spring Semester Total:	**17-18**

Junior Year

Fall Semester

CPSC 355	Operating Systems Design	4
CPSC 362	Theory of Computation	3
MATH 301	Probability and Statistics	3
Elective	General	3
Elective	General	3
	Fall Semester Total:	**16**

Spring Semester

CPSC 305	Software Engineering	4
CPSC 350	Programming Language Structures	3
Elective	General	3
Elective	General	3
Elective	General	3
	Spring Semester Total:	**16**

Senior Year

Fall Semester

CPSC or CPEN 400-level courses		6
CPSC 491	Senior Seminar	2
Elective	General	3
Elective	Free	3
	Fall Semester Total:	**14**

Spring Semester

CPSC or CPEN 400-level courses		6
Elective	Free	3
Elective	Free	3
Elective	Free	3
	Spring Semester Total:	**15**

Placement in Computer Science Courses:

- Students who are proficient in C or C++ should contact the Department of Electrical Engineering and Computer Science to, determine placement.
- Students who have taken the College Board AP examination in computer science should contact the Department of Electrical Engineering and Computer Science to determine college credits and placement.

SCIENCE REQUIREMENT

The computer science major requires a two-semester lab science sequence plus two additional courses in the sciences. For the lab science sequence, a student may choose any of the following:

Physics: PHYS 121-122 or 131-132

Chemistry: CHEM 107/117-108/118

Biology: CELL 101/2l1-EEOB 101/111

The remaining two science courses must be chosen from courses intended for science or engineering majors in biology, chemistry, geology, physics, experimental psychology, or the basic engineering sciences. A complete list of acceptable courses can be obtained from the Department of Electrical Engineering and Computer Science.

ELECTIVES

Electives are divided into two categories, general and free.

The 30 credits of general electives must be chosen from courses in humanities, social sciences, arts and other disciplines that serve to broaden the student's background. Specifically, computer science and computer engineering courses may not be used for these electives, although the electives may be used for a second major or a minor in any other department including business management, mathematics, and the other engineering departments.

The 12 credits of free electives need not fall into any special category but must be approved by the student's adviser in the Department of Electrical Engineering and Computer Science. Courses specifically prohibited from being used as electives include mathematics courses below the level of calculus, University College Computer Information Systems (UCIS) courses, Information Services (UINS) courses, Telecommunications (UTEL) Courses, and Business School Information Systems (ISDS) courses.

Students completing an ROTC program receive 6 credits of free electives for their ROTC courses. General and free electives may be taken satisfactory/unsatisfactory, unless being applied to a minor or major. Other courses must be taken for a grade.

MINOR IN COMPUTER SCIENCE

The following courses are required:

CPSC 101 (Software Design & Programming)

CPSC 102 (Object-Oriented Design and Programming)

CPSC 118 (Data Structures)

CPEN 201 (Computer Organization)

MATH 121-122 (Calculus I & II)

MATH 217 (Discrete Mathematics)

Two (2) additional 3 or 4 credit Computer Science (CPSC) courses are required at the 300 or 400 level, excluding independent studies courses (CPSC 497 and 498) and seminars (CPSC 491).

MINORS AND SECOND MAJORS FOR COMPUTER SCIENCE MAJORS

There are established minors in business management and in mathematics and an established second major in mathematics. A coordinate major in cognitive studies involves computer science, philosophy and psychology. Other minors or majors may be arranged on request by mutual consent of the Department of Electrical Engineering and Computer Science and the department in which the minor or major is to be taken.

COURSE DESCRIPTIONS

CPSC 101 Software Design and Programming (4) Lecture 3, laboratory 1.
An introduction to software design and its implementation using a modern programming language such as C. Emphasis is on the design of algorithms using top-down modular design techniques. No previous experience with computers is assumed.

CPSC 102 Object-oriented Design and Programming (4) Lecture 3, laboratory 1.
Prerequisite: CPSC 101. An introduction to object-oriented analysis, design, and programming. Object-oriented methodology, including processes and notations, is covered. Concepts of classes, objects, inheritance, and polymorphism are discussed. Structural and behavioral modeling is emphasized throughout the course. An object-oriented language (e.g., C++) is introduced and used to implement OO designs.

CPSC 103 Introduction to Computing (4) Lecture 3, laboratory 1.
An introduction to software design and its implementation using a programming language such as Pascal. Emphasis is on the design of algorithms using top-down modular design techniques. No previous experience with computers is assumed.

CPSC 118 Data Structures (4) Lecture 3, laboratory 1.
Prerequisite: CPSC 102. An introduction to computer data structures and their manipulation and applications. Structures studied include arrays, queues, stacks, linked lists, and binary trees. Applications covered include methods of searching and sorting. A modern programming language such as C++ is used for programming assignments.

CPSC 300 Principles of Computer Science (3) Lecture 3.
Prerequisites: CPSC 101, MATH 122. An introduction to a broad range of fundamental concepts in computer science. Topics covered includes data structures, discrete mathematics, analysis of algorithms, software engineering, and computer organization. This course is intended for students who are not majoring or minoring in computer science or computer engineering, but wish the background necessary for taking selected advanced computing courses such as artificial intelligence. Not open to computer science or computer engineering majors or minors for credit.

CPSC 305 Software Engineering (4) Lecture 3, laboratory 1.
Prerequisites: CPSC 118, CPEN 201, MATH 217. A study of the techniques of software development, use, and maintenance. Topics discussed include specification and design methods, program testing, program verification, software reliability, user-machine interfaces, and ethical, social, and legal considerations of software engineering. Substantial projects in specification and design are required.

CPSC 350 Programming Language Structures (3) Lecture 3.
Prerequisites: CPSC 118, CPEN 201, MATH 217. A comparative study of issues involved in the design, implementation, and use of programming languages. The study of syntax includes methods for specifying languages using formal grammars and an introduction to parsing techniques. The study of semantics includes the definition of an abstract model of computation and its application to a specific programming language. Features that are treated in-depth include primitive types, abstract data types, control structures, and storage management. Procedural and functional languages are used throughout to illustrate similarities and differences in language design philosophy and implementation.

CPSC 355 Operating Systems Design (4) Lecture 3, laboratory 1.
Prerequisites: CPSC 118, CPEN 201, MATH 217. A study of operating systems, with emphasis on a multi-programming environment. The course concentrates on the general principles involved in the management of resources and on the application of these principles to operating system design. Specific algorithms for functions such as thread scheduling and memory management are also studied along with an evaluation of the trade-offs involved in choosing a particular algorithm as part of a system design.

CPSC 362 Theory of Computation (3) Lecture 3.
Prerequisites: CPSC 118, CPEN 201, MATH 2l7. A study of the formal concepts and notations of theoretical computer science. Topics covered include automata, formal languages and grammars, Turing machines, recursive functions, computability, and undecidability. Emphasis is on developing and presenting rigorous and formal arguments.

CPSC 413 Database Systems (3) Lecture 3.
Prerequisites: CPSC 118, CPEN 201, MATH 217. A study of database design and implementation. Basic database models (hierarchical, network, relational) are compared. Data manipulation languages for querying are studied, and issues of integrity and security are discussed. An overview of distributed databases is given.

CPSC 414 Advanced Database Systems (3) Lecture 3.
Prerequisite: CPSC 413. A study of the issues for the design and implementation of databases for complex data such as spatial and temporal data. Spatio-temporal data indexing and data mining algorithms are presented. Representations of incomplete and uncertain data for advanced databases are considered.

CPSC 420 Design and Analysis of Algorithms (3) Lecture 3.
Prerequisites: CPSC 118, CPEN 201, MATH 217. A study of general approaches for designing computer algorithms and techniques of analyzing their time and space requirements. Numerous specific algorithms are analyzed, chosen from applications including searching, sorting, resource scheduling, and graph theory.

CPSC 452 Compiler Design (3) Lecture 3.
Prerequisite: CPSC 350. A study of the principles and implementation of compilers for high-level languages. The basic components of syntactic and semantic analysis are presented: scanning, parsing, code generation. Issues in optimization and error diagnostics are also considered.

CPSC 464 Data Mining and Pattern Recognition (3) Lecture 3.
Prerequisites: CPEN 201. A study of the process concerned with discovering patterns, associations, anomalies, and statistically significant structures and events in data, with an emphasis on large observational databases. This course covers some of the principal methods used for Data Mining, with the goal of placing them in common perspective and providing a unifying overview.

CPSC 466 Artificial Intelligence (3) Lecture 3.
Prerequisites: CPSC 319 (may be taken concurrently); [CPSC 118, CPEN 201, MATH 217] or CPSC 300; MATH 301. An overview of the field of artificial intelligence studying the basic techniques such as heuristic search, deduction, learning, problem solving, knowledge representation and special languages and systems. Application areas presented may include natural languages, machine vision, automatic programming, and speech systems.

CPSC 469 Machine Learning (3) Lecture 3.
Prerequisites: CPSC 466. A study of computer programs that automatically improve their performance through experience. This course will present the key algorithms and theory, such as concept learning, decision tree learning, statistical learning, PAC learning, instance-based learning, analytical learning, and reinforcement learning.

CPSC 491 Senior Seminar (2) Seminar 3.
A seminar which focuses on ethics and the interaction of computer science and information technology with society. Individual and group presentations, individual written papers, and group discussions are used as a means of improving oral and written communication skills.

CPSC 497, CPSC 498 Independent Studies (1-3)
Prerequisite: Approval of the department.

CPSC 600 Principles of Computer Science (3) Lecture 3.
Prerequisite: Graduate standing. An introduction to a broad range of fundamental concepts in computer science. Topics covered inc jude data structures, discrete mathematics, analysis of algorithms, software engineering, and computer organization. This course is intended for students who are not majoring or minoring in computer science or computer engineering, but wish the background necessary for taking selected advanced computing courses such as artificial intelligence and computer graphics. Not open to computer science or computer engineering majors or minors for credit.

CPSC 605 Software Engineering (3) Lecture 3, laboratory 1.
Prerequisites: Graduate standing and department permission. A study of the techniques of software development, use, and maintenance. Topics discussed include specification and design methods, program testing, program verification, software reliability, user-machine interfaces, and ethical, social, and legal considerations of software engineering. Substantial projects in specification and design are required.

CPSC 613 Database Systems (3) Lecture 3.
Prerequisites: Graduate standing and department permission. A study of database design and implementation. Basic database models (hierarchical, network, relational) are compared. Data manipulation languages for querying are studied, and issues of integrity and security are discussed. An overview of distributed databases is given.

CPSC 614 Advanced Database Systems (3) Lecture 3.
Prerequisite: CPSC 613. A study of the issues for the design and implementation of databases for complex data such as spatial and temporal data. Spatio-temporal data indexing and data mining algorithms are presented. Representations of incomplete and uncertain data for advanced databases are considered.

CPSC 620 Design and Analysis of Algorithms (3) Lecture 3.
Prerequisites: Graduate standing and department permission. A study of general approaches for designing computer algorithms and techniques of analyzing their time and space requirements. Numerous specific algorithms are analyzed, chosen from applications including searching, sorting, resource scheduling, and graph theory.

CPSC 651 Programming Language Structures (3) Lecture 3.
Prerequisites: Graduate standing and department permission. A comparative study of issues involved in the design, implementation, and use of programming languages. The study of syntax includes methods for specifying languages using formal grammars and an introduction to parsing techniques. The study of semantics includes the definition of an abstract model of computation and its application to a specific programming language. Features that are treated in-depth include primitive types, abstract data types, control structures, and storage management. Procedural and functional languages are used throughout to illustrate similarities and differences in language design philosophy and implementation.

CPSC 652 Compiler Design (3) Lecture 3.

Prerequisite: CPSC 651. A study of the principles and implementation of compilers for high-level languages. The basic components of syntactic and semantic analysis are presented: scanning, parsing, code generation. Issues in optimization and error diagnostics are also considered.

CPSC 655 Operating Systems Design (3) Lecture 3, laboratory 1.
Prerequisites: Graduate standing and department permission. A study of operating systems, with emphasis on a multi-programming environment. The course concentrates on the general principles involved in the management of resources and on the application of these principles to operating system design. Specific algorithms for functions such as thread scheduling and memory management are also studied along with an evaluation ofthe trade-offs involved in choosing a particular algorithm as part of a system design.

CPSC 664 Data Mining and Pattern Recognition (3) Lecture 3.
Prerequisites: Graduate standing and department permission. A study of the process concerned with discovering patterns, associations, anomalies, and statistically significant structures and events in data, with an emphasis on large observational databases. This course covers some of the principal methods used for Data Mining, with the goal of placing them in common perspective and providing a unifying overview.

CPSC 666 Artificial Intelligence (3) Lecture 3.
Prerequisites: Graduate standing and department permission. An overview of the field of artificial intelligence studying the basic techniques such as heuristic search, deduction, learning, problem solving, knowledge representation and special languages and systems. Application areas presented may include natural languages, machine vision, automatic programming, and speech systems.

CPSC 669 Machine Learning (3) Lecture 3.
Prerequisites: CPSC 666. A study of computer programs that automatically improve their performance through experience. This course will present key algorithms and theory, such as concept learning, decision three learning, statistical learning, PAC learning, instance-based learning, analytical learning, and reinforcement learning.

CPSC 673 Theory of Computation (3) Lecture 3.
Prerequisites: Graduate standing and department permission. A study of the formal concepts and notations of theoretical computer science. Topics covered include automata, formal languages and grammars, Turing machines, recursive functions, computability, and undecidability. Emphasis is on developing and presenting rigorous and formal arguments.

CPSC 697, CPSC 698 Independent Studies (1-3)
Prerequisites: Graduate standing and department permission.

Electrical Engineering (ELEN)

Electrical engineering is a dynamic field, encompassing a broad range of engineering activities. Developments in electronics, microprocessors, and computers now affect nearly every aspect of human activity. Our society is heavily dependent on technology that demands more efficient electric power generation, transmission, and distribution, improved mobile, point-to-point communications, computer-controlled manufacturing, and computer-automated public services requiring more complex and intelligent software systems. This dependence naturally translates into great demands for highly trained electrical engineers. Many electrical engineering graduates pursue post graduate degrees in business, law, medicine, or engineering. Others find careers in research and development in virtually every type of industry, as well as in manufacturing, marketing, and management.

The Electrical Engineering program of the department is designed to be flexible enough to educate engineers for a rapidly changing future, yet sufficiently structured in the first three years to provide students with a thorough understanding of the scientific and engineering principles that form the foundation of electrical engineering. Concurrently with electrical engineering studies, the student receives training in the physical sciences, mathematics, and the humanities and social sciences. Throughout the program we emphasize the breadth of knowledge and the development of oral and written communication skills essential for a successful professional career.

Professional development is guided by a sequence of courses and project-oriented laboratories. The senior year is highlighted by a capstone design course that culminates in a senior thesis. The importance of communicating ideas effectively is emphasized through extensive written reports in advanced courses. Laboratory work not only develops practical skills and design techniques, but experience in project management is gained through team and individual projects in the junior and senior level laboratories. At the junior level, the student is introduced to team projects, and proposal and report writing in the laboratory. Concurrently, the student builds experience in technical writing and oral presentation in the junior seminar. The senior design course integrates the basic training with the decision-making process, including safety, reliability, economics, aesthetics, ethics, and social impact. Senior Design Projects are carried out in several facilities that support Intelligent & Knowledge-Based Systems, Electronic Instrumentation, Microprocessor Applications and Microcomputer Interfacing, Signal & Image Processing, Electric Power Engineering, and Control Systems.

DEPARTMENTAL MISSION

The mission of the Electrical Engineering Program of the Department of Electrical Engineering and Computer Science is to train highly qualified undergraduate students in fulfilling the electrical engineering research and educational needs of local and national academic, government, and industrial communities.

The Program faculty and undergraduates are committed to continuously work with practicing engineers and scientists in strengthening the departmental industrial, academic, and government alliance by exploring leading-edge technologies in several fields of electrical engineering.

OBJECTIVES

The objectives of the Program are to create the necessary educational foundation for the students to successfully build their careers once they enter the work force. The

Flexibility, Creativity, Independence and *Competency* features of the Program are:

- To prepare students to be *flexible*, high quality professionals by enabling them to successfully formulate and solve challenging problems in the general fields of electrical engineering. To complement their knowledge in the fields of electrical engineering, students shall be able to gain expertise in solving problems in a variety of specialized dynamic technical fields.
- To *enhance students creativity* by familiarizing them with state-of-the-art *techniques*, including laboratory methods and simulation software, in solving *open-ended* problems.
- To emphasize research independence by requiring a year long *individual senior thesis* and *team collaboration* with classmates, the faculty, and their faculty advisor.
- To enhance graduates' *job competency* by emphasizing the importance of project management, ethics, entrepreneurship, life-long learning, and effective verbal, visual, and written technical communication skills.

CURRICULUM

Sophomore Year

Fall Semester		*Credits*
ELEN 201	Electric Circuits I	3
ELEN 297	Sophomore Testing Period	0
CPEN 201	Computer Organization	4
ENGR 247	Statics and Dynamics	4
MATH 221	Calculus III	4
Elective	Humanities or Social Science	3
	Fall Semester Total:	**18**
Spring Semester		
ELEN 202	Electric Circuits II	3
ELEN 204	Electrical Engineering Lab I	2
ELEN 220	Signals and Systems I	3
ELEN 298	Sophomore Testing Period	0
CPEN 240	Digital Logic	4
MATH 224	Introduction to Applied Mathematics	4
Elective	Humanities or Social Science	3
	Spring Semester Total:	**19**

Junior Year

Fall Semester		
ELEN 303	Electronics	3
ELEN 321	Signals and Systems II	3
ELEN 391	Electrical Engineering Lab II	2
Elective	Electrical Engineering Fundamental	3
MATH 301	Probability and Statistics	3
Elective	Humanities or Social Science	3
	Fall Semester Total:	**17**
Spring Semester		
ELEN 312	Electrical Engineering Seminar	3
ELEN 316	Electromagnetic Waves and Techniques	3
ELEN 392	Electrical Engineering Lab III	2
Elective	Electrical Engineering Fundamentals (2)	6
Elective	Humanities or Social Science	3
	Spring Semester Total:	**17**

Senior Year

Fall Semester

ELEN 491	Senior Design Project I	3
Electives	Technical (3)	9
Elective	Humanities or Social Science	3
	Fall Semester Total:	**15**

Spring Semester

ELEN 492	Senior Design Project II	3
ELEN 4XX	Elective	3
ELEN 4XX	Elective	3
ELEN 4XX	Elective	3
Elective	Humanities or Social Science	3
	Spring Semester Total:	**15**

FUNDAMENTAL, TECHNICAL, AND OTHER ELECTIVES

The Electrical Engineering Fundamental Electives are intended as introductions to specific areas of study in electrical engineering, and they are prerequisites for many of the more advanced senior-level electives. Each student must select at least three Electrical Engineering Fundamental Electives from the following list: ELEN 311 Physical Electronics, ELEN 333 Introduction to Modern Power Engineering, ELEN 304 Advanced Electronic Systems, ELEN 332 Introduction to Communication Systems, ELEN 346 Introduction to Control Systems, and CPEN 341 Microcomputer Interfacing.

The Technical Elective requirements are intended to provide depth of study in electrical engineering. The program requires a minimum of three ELEN courses at the 400-level. In addition, three technical electives are required which can be selected from either ELEN 300 or 400-level courses, or from 300 or higher level courses in other branches of engineering, computer science, mathematics, or science. All technical electives outside the School of Engineering must first be approved by the student's advisor.

Students completing an ROTC program receive 6 credits of technical electives for their ROTC coursework.

MINOR IN ELECTRICAL ENGINEERING

The following courses are required:

ELEN 201 (Electric Circuits I)

ELEN 202 (Electric Circuits II)

ELEN 303 (Electronics)

ELEN 321 (Signals & Systems II)

MATH 221 (Calculus III)

MATH 224 (Introduction to Applied Mathematics)

Two (2) additional 3 credit ELEN courses at the 300-level or above are required, with at least of these selected from EE Fundamentals courses.

MINORS AND SECOND MAJORS FOR ELECTRICAL ENGINEERING MAJORS

An Electrical Engineering major wishing to complete a minor in Biomedical Engineering should take the following courses:

BMEN 303 Medical Science for Engineers I, BMEN 304 Medical Science for Engineers II, BMEN 322 Materials Engineering, and BMEN 423 Biomaterials Design Laboratory.

There are established minors in business management and in mathematics and an established second major in mathematics. Other minors may be arranged on request by mutual consent of the Department of Electrical Engineering and Computer Science and the department in which the minor is to be taken.

COURSE DESCRIPTIONS

ELEN 201 Electric Circuits I (3) Lecture 3.
Prerequisite: MATH 122. A fundamental course dealing with electric charge, current, voltage, power, energy, and passive and active circuit elements. Response of linear circuits to steady and time varying signals by use of circuit laws, network topology, differential equations, and phasors. Frequency response, coupled circuits, power and energy in the ac steady state. Operational amplifier applications and three phase circuits.

ELEN 202 Electric Circuits II (3) Lecture 3.
Prerequisite: ELEN 201. Co-requisite: MATH 224. A continuation of the analysis of linear circuits Second-order differential equations, state variables, Fourier series, the Laplace transform, the Fourier Transform, scaling, and two-port networks. Computer applications in circuit analysis.

ELEN 204 Electrical Engineering Laboratory I (2)
Laboratory 3.
Prerequisite: Credit for or registration in ELEN 202. A series of experiments to acquaint the student with the techniques, equipment, and safety procedures for basic electrical measurements. Circuit theorems, transients, frequency responses, op amps, digital Ics, spectral analysis, and Pspice.

ELEN 220 Signals & Systems I: Discrete and Continuous-Time Signals (3) Lecture 3.
Prerequisites: ELEN 201, MATH 221. Fundamental concepts of continuous-time and discrete-time signals with emphasis on discrete-time. Classification of signals and basic properties. Frequency-domain representation of discrete-time and continuous-time signals. The Fourier series and spectra of periodic discrete-time and continuous-time signals. The Fourier transform of discrete-time and continuous-time signals. Continuous and discrete-time filters. Basics of MATLAB. Applications in communications and signal processing.

ELEN 303 Electronics (3) Lecture 3.
Prerequisite: ELEN 202. Introduction to electronic devices (Diode, BJT, FET, MOSFET) and basic applications. Biasing and bias-point stabilization of junction and field-effect transistors. Low frequency and high frequency linear models of transistors. Multistage amplifiers.

ELEN 304 Advanced Electronic Systems (3) Lecture 3.
Prerequisite: ELEN 303. Feedback in amplifiers. Differential amplifiers. Operational amplifiers and applications. Tuned amplifiers. Butterworth and Chebyshev frequency characteristics. Advanced electronic devices, Modulation and detection.

ELEN 311 Physical Electronics (3) Lecture 3.
Prerequisite: Credit for or registration in ELEN 303. Introduction to the physical principles involved in the operation of modern solid state devices including diodes and transistors, circuit models, and introduction to integrated circuits, computer simulation of design and performance of devices.

ELEN 312 Electrical Engineering Seminar (3) Recitation 3.
Prerequisite: Junior standing in electrical engineering. Written and oral presentation of reports on topics of interest to electrical and computer engineers. Emphasis is placed on explanatory, descriptive and letter writing skills and on oral presentation of reports. Societal problems, professional ethics and aesthetic aspects of the engineering profession are discussed.

ELEN 316 Electromagnetic Waves and Techniques (3) Lecture 3.
Prerequisites: PHYS 132, MATH 221, junior standing. Introduction of electromagnetic theory, Maxwell’s equations and electromagnetic waves, Poynting Theorem, microwave techniques and devices, and distributed circuit models of transmission lines. Radiation effects and occupational safety.

ELEN 321 Signals & Systems II: Discrete and Continuous-Time Systems (3) Lecture 3.
Prerequisites: ELEN 202, MATH 221. Fundamental concepts of continuous-time and discrete-time systems with emphasis on continuous-time. Classification of systems and basic properties. Solutions of n-th order differential and difference equations with engineering applications. Impulse response, frequency response, convolution, Laplace and Z-Transform. Introduction to state variable formulation. Basics of system modeling via MATLAB/SIMULINK. Applications in communications, signal processing, and control.

ELEN 332 Introduction to Communication Systems (3) Lecture 3.
Prerequisites: ELEN 220, ELEN 321. Introduction of the basic principles of analog and digital communication systems, modulation and demodulation techniques, probability and random processes, and analog and digital filter design methods.

ELEN 333 Introduction to Modern Power Engineering (3) Lecture 3.
Prerequisite: ELEN 202. An introduction to modern power engineering. with emphasis on single-phase transformers, and energy conversion devices including induction, synchronous and dc machines. Power flow analysis, economic dispatch, short circuit analysis, power system stability, reliability and control of power systems are introduced in this course.

ELEN 346 Introduction to Control Systems (3) Lecture 3.
Prerequisite: ELEN 321. Analysis and design of single input/single output control systems. System dynamics, stability, frequency domain methods, and state-space models and state feedback. Extensive use of MATLAB and SIMULINK.

ELEN 377 Elements of Electrical Engineering Lab (1) Laboratory biweekly.
Prerequisites: Sophomore standing in Mechanical Engineering. Laboratory component of ELEN 201 for Mechanical Engineering students. A set of experiments that explore basic circuit theory and measurements, network theorems, basic operational amplifier applications, transistor amplifier circuits, RLC circuits and characteristics, and induction motors.

ELEN 391 Electrical Engineering Laboratory II (2)
Laboratory 3.
Prerequisites: Credit for or registration in ELEN 303 and ELEN 321. A series of experiments or projects related to the electrical engineering courses in the junior year. Electronics, Signals and Systems, Physical Electronics, and AC Motors are considered.

ELEN 392 Electrical Engineering Laboratory III (2)
Laboratory 3.
Prerequisites: Credit for or registration in ELEN 303, ELEN 316, ELEN 321. A series of team projects related to electrical engineering courses in the junior year.

ELEN 401 Power Systems Analysis (3) Lecture 3.
Prerequisite: ELEN 333. A study of parameters and components of electric power systems. The development of equivalent circuits of systems under normal and abnormal conditions, applications of symmetrical components, power flow analysis, and power system stability are topics covered in this course.

ELEN 404 Power System Transients and Stability (3) Lecture 3.
Prerequisite: ELEN 401. A study of steady-state and transient stability of power systems. Topics covered include switching transients, electromagnetic phenomena of importance under transient conditions, effects of lightning, protection of power systems against transients.

ELEN 405 Power Electronics (3) Lecture 3.
Prerequisite: ELEN 304. An introduction to power semiconductor devices, their ratings and characteristics, and the analysis and design of circuits with power semiconductors and associated devices. Topics include power rectification, inversion, pulse-width modulation and pulse-frequency modulation, AC to DC power control, AC to DC power control, machine control, and protection aspects.

ELEN 412 Electronic Instrumentation (3) Lecture 3.
Prerequisite: ELEN 304. The application of analog and digital electronics to the measurement of electrical and non-electrical quantities. Transducers, filters, bridge circuits, phase detection, pseudo noise sources, radar techniques, function generation, analog and hybrid computation, noise reduction techniques, and microcomputer implementations are typical of topical coverage.

ELEN 425 Communication Theory and Techniques (3) Lecture 3.
Prerequisite: ELEN 332. Characteristics and performance of communication systems using analog modulation, pulse modulation, and digital modulation. Comparative performance in the presence of noise. Optimal filtering. Phase-locked loops and their applications. Special requirements of commonly used transmission channels.

ELEN 433 Digital Signal Processing I (3) Lecture 3.
Prerequisite: ELEN 321. The analysis of digital signals and systems in the time and frequency domain and the z-transform. Computer techniques are given for the design and implementation of digital filters. The use of the Fast Fourier Transform is discussed.

ELEN 434 Digital Signal Processing II (3) Lecture 3.
Prerequisite: ELEN 433. Techniques and applications of digital signal processing. Topics include optimal and adaptive filtering and model-based spectral estimation. A wide variety of applications are used to demonstrate advanced signal processing techniques.

ELEN 442 Introduction to Digital Control Systems (3) Lecture 3.
Prerequisite: ELEN 346. Sampling theory and Sampled Data Systems. Difference equations and Z-Transform techniques. Digital equivalents. Single-Input Single-Output Controller design using root locus. Stability. State-variable techniques. Extensive use of MATLAB and SIMULINK.

ELEN 445 Modern Control Systems (3) Lecture 3.
Prerequisite: ELEN 346. Canonical realizations of transfer functions. Concept of state, controllability, observability and Lyapunov stability. Controller/Observer design. The LQR problem and Kalman filtering. Extensive use of MATLAB and SIMULINK.

ELEN 481, ELEN 482 Senior Independent Studies (3).
Prerequisite: Senior standing in electrical engineering. Special courses for selected students who may wish to pursue an in-depth study in some area by selecting a suitable subject supervised by a member of the faculty.

ELEN 491 ELEN 492 Senior Design Project I, II (3, 3)
Seminar 2, Laboratory 3.
Prerequisite: Senior standing in electrical engineering. A two-semester sequence in which students apply their accumulated knowledge in designing and implementing a major project. Students will be graded on the basis of oral and written presentations dealing with their analysis and design as well as the quality of the project. A study of Engineering Economics is included in the first semester.

ELEN 601 Power Systems Analysis (3) Lecture 3.
Prerequisite: Graduate standing and departmental permission. Study of components and systems of electric power systems and the development of equivalent circuits of systems under normal and abnormal conditions, applications of symmetrical components, power flow analysis, and power system stability are topics covered in this course. Normally, three projects are conducted in the course.

ELEN 602 Power Systems: Optimization and Control (3) Lecture 3.
Prerequisite: Graduate standing and departmental permission. A study of current and traditional methods used in power system planning and operations. Topics covered include the following: economic dispatch, unit commitment, fuel scheduling, automatic generator control, optimum power flow, interconnected operations, production costing, power system security, and time permitting state estimation.

ELEN 604 Power System Transients and Stability (3)
Lecture 3.
Prerequisite: ELEN 601. Steady-state and transient stability of power systems. Switching transients, electromagnetic phenomena of importance under transient conditions, effects of lightning, protection of power systems against transients.

ELEN 605 Power Electronics (3) Lecture 3.
Prerequisite: Graduate standing and departmental permission. Overview of semiconductor switches (Power Semiconductor Devices). Generic power electronic circuits and PWM control techniques. Power supplies (SMPS). Drive applications of power electronics converters. Practical converter design considerations.

ELEN 606 Power System Planning (3) Lecture 3.
Prerequisite: Graduate standing and departmental permission Planning of utility financing and revenue requirements, reliability requirements, operating costs, and transmission constraints. In this course reliability computations are emphasized.

ELEN 612 Electronic Instrumentation (3) Lecture 3, laboratory assignments.
Prerequisite: Graduate standing and departmental permission. The application of analog and digital electronics to the measurement of electrical and non-electrical quantities. Transducers, filters, bridge circuits, phase detection, pseudo noise sources, radar techniques, function generation, analog and hybrid computation, noise reduction techniques, and microcomputer implementations are typical of topical coverage.

ELEN 625 Communication Theory and Techniques (3) Lecture 3.
Prerequisite: Graduate standing and departmental permission. Characteristics and performance of communication systems using analog modulation, pulse modulation, and digital modulation. Comparative performance in the presence of noise. Optimal filtering. Phase-locked loops and their applications. Special requirements of commonly used transmission channels.

ELEN 633 Digital Signal Processing I (3) Lecture 3.
Prerequisite: Graduate standing and departmental permission. The analysis of digital signals and systems in the time and frequency domain and the z-transform are presented. Computer techniques are given for the design and implementation of digital filters. The use of the Fast Fourier Transform is discussed.

ELEN 634 Digital Signal Processing II (3) Lecture 3.
Prerequisite: ELEN 633. Graduate standing and departmental permission. Techniques and applications of digital signal processing are considered. Topics include optimal and adaptive filtering and model-based spectral estimation. A wide variety of applications are used to demonstrate advanced signal processing techniques.

ELEN 642 Introduction to Digital Control Systems (3)
Lecture 3.
Prerequisite: Graduate standing and departmental permission. Sampling theory and Sampled Data Systems. Difference equations and Z-Transform techniques. Digital equivalents. Single-Input Single-Output Controller design using root locus. Stability. State-variable techniques. Extensive use of SIMIJL1NK and the MAT-LAB Control Toolbox.

ELEN 645 Modem Control Systems (3) Lecture 3.
Prerequisite: Graduate standing and departmental permission. Canonical realizations of transfer functions. Concept of state, controllability, observability and Lyapunov stability. Controller/Observer design. The LQR problem and Kalman filtering. Extensive use of MATLAB and SIMIULINK.

ELEN 646 Nonlinear Control (3) Lecture 3.
Prerequisite: Graduate standing and departmental permission. A self contained introduction to nonlinear feedback control design and analysis for continuous time, finite dimensional, uncertain sys tems. Differential geometric techniques are used to identify the class of nonlinear systems considered and to develop nonlinear design techniques when disturbances and unknown parameters are present. Several application examples from electric machines, power systems, robotics, spacecraft and aircraft control are included. Extensive use of MATLAB and SIMULINK.

ELEN 661 Energy and Environment Technology for Sustainable Development (3) Lecture 3.
Prerequisite: Graduate standing and departmental permission. This course will serve students with diversified backgrounds. Topics include a survey of environment-friendly energy conversion technology, environmental technology for energy conversion, energy system planning models and simulation, global climate changes and social-economic impacts, technology transfer, and global sustainable development.

ELEN 684 Reliability Engineering (3) Lecture 3.
Prerequisite: Graduate standing and departmental permission. Reliability terminology and measures, estimating the density functions from empirical data, probability distribution characteristics, static and dynamic reliability and maintainability models, maintainability, Markov chains, interference theory, time dependent models, design examples, reliability testing, Bayesian applications in design and testing, reliability/maintainability optimization with examples chosen in the fields of the students.