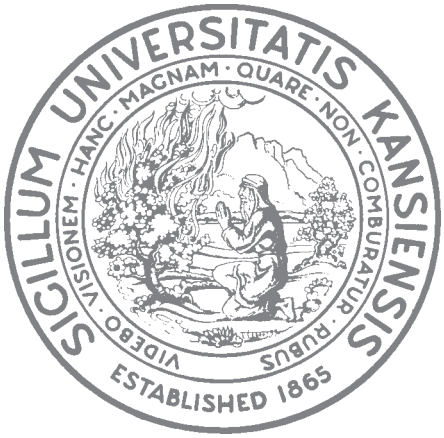
UNDERGRADUATE HANDBOOK

Electrical Engineering
Computer Engineering
Computer Science

For students admitted to the EECS Program in Fall 2004

The Department of Electrical Engineering and Computer Science
School of Engineering
The University of Kansas
1520 West 15th Street
2001 Eaton Hall
Lawrence, Kansas 66045-7621
Phone: 785/864-4620
Fax: 785/864-3226
Website: www.eecs.ku.edu



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School of Engineering

Stuart Bell, Dean
Robert Sorem, Associate Dean of Undergraduate Studies
Glen Marotz, Associate Dean of Research and Graduate Studies
1 Eaton Hall
Phone: 785/864-3881
E-mail: kuengr@ku.edu
Website: www.engr.ku.edu

Is engineering for me?

To find out, ask yourself:

- Do I like to design and build things?
- Am I a creative thinker who likes to solve complex problems?
- Do I enjoy math and science?
- Am I curious about how things work?
- Am I precise in my work and study habits?
- Do I budget my time so I can finish all the work required of me?
- Do I have a history of performing well academically?
- Am I ready to enter a demanding curriculum?

What degrees are offered?

The School of Engineering offers the Bachelor of Science (BS) in engineering with majors in 10 disciplines. They are aerospace engineering, architectural engineering, chemical engineering, civil engineering, computer engineering, computer science, electrical engineering, engineering physics, mechanical engineering, and petroleum engineering.

What can I do with an engineering degree?

Whatever your engineering major, you will find many job opportunities. Most KU graduates earn more than the national average starting salary. Many companies and governmental agencies are aware of the high quality of KU graduates, so they are eager to hire them and pay premium salaries. The School's Career Services Center will help put you in touch with potential employers. The Center schedules interviews and conducts workshops on resumes, interviewing, and searching for either permanent or summer jobs.

What is the faculty like?

Engineering faculty members are nationally recognized leaders in education and research. KU faculty members are leaders in many engineering societies. Their work is widely published in professional journals. You will get the chance to interact with faculty members outside the classroom and lab. Engineering faculty members participate in a variety of activities with students. For example, civil engineering faculty, join annually with students to build and race concrete canoes in an American Society of Civil Engineers competition.

Why is there an engineering fee?

As an engineering student, you will pay a special fee in addition to regular tuition and fees for engineering courses. The fee, calculated at a rate of $15 per credit hour of engineering courses you take, helps the School maintain and operate lab equipment and computers. Because you will take more engineering courses each semester as you advance, the engineering fee you pay will increase each year. Throughout your four years as an undergraduate, you will pay approximately $1000 in engineering fees.

How do I get into the School?

First-year students may enter the School of Engineering, but admission is selective. Applications are judged on several factors, including but not limited to, high school record, scores on national tests, academic record at college or

university level, and trend of grades. High school transcripts and ACT scores are required. Equivalent SAT scores may be substituted.

You must have graduated in the top half of your high school class and have a mathematics score of 28 or higher on the ACT exam (or be otherwise eligible to take Math 121) to be directly admitted into the EECS Department. Take a standard college-preparatory curriculum in high school, including courses in chemistry, economics, English, physics, and mathematics (through trigonometry). If you already have some college credits and you have a cumulative grade-point average of 2.5 or higher, you may qualify to transfer in to the School of Engineering .

Transfer Admission Standards

All applications from transfer students either from other KU units or from other institutions are evaluated on a case-by-case basis.

In general, students with grade-point averages under 2.5 are not considered for admission. Students must submit mathematics ACT or SAT scores or proof of competence in calculus for consideration.

Can I get a scholarship?

The School of Engineering offers scholarships to incoming freshman and transfer students with outstanding academic credentials. There are no scholarship forms to complete. Each student admitted to the School of Engineering is reviewed for scholarships. The deadline for consideration is January 15.

The Engineering Diversity Program also makes scholarships available to female and minority engineering students. Call the Diversity director at 785/864-3620 for more information.

For more information about grants, loans, and other need-based financial aid, write or call the University of Kansas Office of Student Financial Aid, 50 Strong Hall, Lawrence, KS 66045-1920, 785/864-4700 or visit their website at www.ku.edu/~osfa/.

Where can I get more information?

Write or call the University of Kansas, School of Engineering, Robert Sorem, Associate Dean, 1520 West 15th Street, 1 Eaton Hall, Lawrence, KS 66045, 785/864-3881; or visit the website at www.engr.ku.edu.

With so many engineering programs in the country, why should I choose KU?

- **Program Quality**

KU's undergraduate engineering programs are accredited by the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology (EAC/ABET). The computer science program is accredited by the Computing Accreditation Commission of ABET.

- **Your Overall Education**

The overall quality and breadth of your education is one great reason for coming to KU. The College of Liberal Arts and Sciences offers hundreds of courses and has excellent teachers. You will meet many international students and teachers who bring a cultural richness to campus and who will expose you to the diverse viewpoints and customs so important to your undergraduate education.

- **Student Organizations**

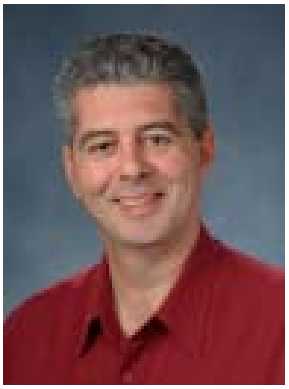
Engineering students can supplement and advance their academic programs by participating in student chapters of national engineering societies. The School has active support groups for women and minority students, and all student groups can participate in the annual Engineering Exposition, creating exhibits that describe areas of engineering and demonstrate engineering processes.

- **Research Opportunities**

Undergraduates can participate in KU's top-flight research programs in computer-aided aircraft design, architectural lighting and visibility, enhanced oil recovery, structural mechanics and stress analysis, telecommunications and information systems, computer-integrated manufacturing, automatic control systems, and other fields.

The Department of Electrical Engineering and Computer Science

Costas Tsatsoulis, Chair



The technological advances that have made our modern society what it is today are due largely to the efforts of electrical engineers, computer engineers, and computer scientists. Among these advances are radio, television, telephones, wireless communications, cellular telephones, personal computers, workstations, mainframe computers, aircraft avionics, satellite electronics, automobile electronics, office machinery, medical electronic equipment, video games, electric power generation and distribution systems, telecommunications, computer networks (including the Internet), home entertainment products, radar, defense electronics, artificial intelligence, and a wide variety of computer software.

The EECS Department offers three Bachelor of Science degrees: Electrical Engineering (BSEE), Computer Engineering (BSCoE), and Computer Science (BSCS). Each features a firm grounding in fundamentals of mathematics, basic science, and computer science and/or engineering science, and advanced studies in the theory and design of systems of various kinds, as well as hands-on experience. All degree programs are accredited.

Electrical engineers work with a broad range of electrical and electronic devices and systems. Electrical engineers may work in the areas of circuit design, electronic devices, electrical and optical communications, control and automation, electromagnetics, instrumentation, energy and power, or signal processing. While computers are involved in many of these areas, either as components or as design/analysis tools, an electrical engineer's work often extends beyond the computing aspects of a problem or system.

Electrical engineers find professional opportunities in a multitude of environments and locations both in this country and abroad. Many opportunities are obvious, such as the telecommunications and computer industries, but there are many other employers who need electrical engineers. For example, industries using technology seek the expertise of electrical engineers for developing microelectronic integrated circuits, electrical and electronic consumer products, electrical power generation and distribution, industrial instrumentation and control systems, and radar. Electrical engineers also provide expertise for incorporating equipment for communication, computer-aided manufacturing, control, and data acquisition.

Computer engineers focus on all aspects of computational devices and systems, including both hardware and software. Wherever computers can be found, computer engineers are needed. In addition to the computer system aspects of the electrical engineering and computer science areas listed, computer engineers may work in the areas of computer elements and architectures, very large scale integrated (VLSI) circuits for data processing and storage, embedded and real-time computer systems, or computer networking.

Computer engineering graduates can expect to find jobs in digital hardware design, software engineering, computer communications, the integration of hardware and software, and in developing microprocessors, personal computers, workstations, mainframe computers, software, and computer networks. As more industries come to rely on computers to carry out office automation, communications, manufacturing and robotics, process control, computer-aided design, and computer manufacturing, the demand for engineers to design and implement such systems will continue to rise.

Computer scientists focus on the theory and practice of computing. They may pursue the design, analysis, and implementation of computer algorithms, study the theory of programming methods and languages, or design and develop new programming languages and software systems. Computer scientists may also work in the areas of artificial intelligence, database systems, parallel and distributed computation, human-computer interaction, computer graphics, operating systems, or computer systems analysis.

Computer science graduates find jobs in a variety of industrial and governmental settings. As computer hardware and communications technologies have advanced, an explosive demand has emerged for software systems to exploit the ever-increasing potential. The need for software system design, development, and maintenance is not restricted to those companies whose main business is software development. Virtually every major company and governmental agency has found the need to develop and maintain specialized software for specific purposes. This trend is sure to continue in the future.

Career opportunities for electrical engineers, computer engineers, and computer scientists are available in many areas of specialization, in many industrial, commercial, academic, and government environments, and in many geographic locations in this country and abroad. Expertise in electrical engineering, computer engineering, and computer science is of vital importance to any high technology organization. Many such organizations actively recruit majors in all three disciplines. In addition, a bachelor of science degree in one of these three areas prepares a student for continued studies in graduate school or in other professional schools such as medicine or law.

The pages that follow outline the degree requirements for the BSEE, BSCoE, and the BSCS degrees.

Vision

The Vision of the EECS Department is to provide a stimulating and challenging intellectual environment:

- to have our classes populated by outstanding students
- to be world-class in an increasing number of selected areas of research
- to have faculty with high visibility among their peers

Mission

The Mission of the EECS Dept. is:

- to educate the next generation of electrical engineers, computer engineers and computer scientists
- to discover, apply and disseminate knowledge
- to be an asset to the community and to society

Common Degree Requirements

Science Electives

Courses satisfying science electives for CS and CoE Majors must be chosen from the following list: ASTR 291, BIOL 150, BIOL 152, CHEM 184, CHEM 188, GEOG (104 + 105), GEOG 304, or GEOL 101. If selected GEOG 104 and GEOG 105 must both be taken and together they count as one elective.

General Electives

All majors may choose classes from the following list of approved technical, scientific, and professional classes:

- EECS: Any course except EECS 100, EECS 128, EECS 138, EECS 498, and EECS 603.
- Engineering: Any course from any Engineering Department numbered 200 or above, except for ENGR 300, ENGR 504, ME 328 and CE 390.
- Natural Science: Any course designated as NB, NE, or NP by CLAS except PHSX 111, PHSX 112, PHSX 114, PHSX 115, PHSX 212 and CHEM 125 (if CHEM 184 or its equivalent was taken for Basic Science). If a science course used for the science elective exceeds the required science elective hours, then excess hours will be considered general elective hours.
- Math: Any MATH course numbered 500 or above, except MATH 701.
- Business: Any course from the School of Business, except statistics and computing.

Humanities/Social Science Electives

H/SS Electives must be selected from the list of *Principal Courses* (or Honors *Principal Courses*) in the *Humanities* and the *Social Sciences*. This list is found in the College of Liberal Arts and Sciences section of the *Undergraduate Catalog*. Any course designated "H" (humanities) or "S" (social sciences) which has a principal course as a prerequisite is also acceptable. Foreign language courses (other than English or a student's native language) may be used for up to 3 credit hours. Additionally, all western civilization (HWC) courses and non-western culture courses (see Undergraduate Catalog) can count as humanities (H) courses.

Senior Electives

EE and CoE majors may choose any EECS course 400 or above, excluding EECS 603. Under unusual circumstances other courses can be considered, but only with an accompanying petition.

For CS Majors, EECS 638, 647, 649, 663, 665, 672, 690 and any EECS course 700 or above. Under unusual circumstances other courses can be considered, but only with an accompanying petition.

Departmental Honors

A student may graduate with departmental honors in electrical engineering, computer engineering or computer science by satisfying the requirements below. Most of the requirements for graduation with Departmental Honors are completed during the final two semesters of a student's undergraduate program.

1. Upon entrance to the Departmental Honors program, a student must achieve and maintain until graduation a minimum overall GPA of 3.25 and minimum engineering GPA of 3.5 while maintaining full-time status.
2. The student must file an application to graduate with Departmental Honors during the semester preceding the student's final two semesters. This must be done prior to enrolling in any EECS 498 course. These forms are available in the EECS Office in 2001 Eaton Hall.
3. The student must enroll in EECS 498: Honors Research for one credit hour for his/her last two semesters under the supervision of a faculty member willing to serve as an honors advisor. These credits are in addition to those required for the degree.
4. The student must complete an independent research project paper and oral presentation to a panel of three judges approved by the undergraduate director. This panel makes the recommendation concerning graduating with honors.

Electrical Engineering

Electrical engineers work with a broad range of electrical and electronic devices and systems. Electrical engineers may work in the areas of circuit design, electronic devices, electrical and optical communications, control and automation, electromagnetics, instrumentation, energy and power, or signal processing. While computers are involved in many of these areas, either as components or as design/ analysis tools, an electrical engineer's work often extends beyond the computing aspects of a problem or system.

Objectives of the Electrical Engineering program are to produce graduates who:

1. Have an understanding of the fundamental concepts in basic sciences and mathematics, and can apply them to the solution of electrical engineering problems.
2. Are proficient in the use of laboratory and test equipment, computer aided design tools, computer software, and other tools used in engineering practice.
3. Can design components, experiments, and complex systems to meet specific requirements.
4. Have a broad education with exposure to humanities, professional ethics and responsibilities, and the role of engineer in global society.
5. Have the skills necessary to function in multidisciplinary, diverse and changing engineering environments.

Requirements for the Bachelor of Science in Electrical Engineering Degree

A total of 128 credit hours is required for the BSEE degree, as follows:

Electrical Engineering (63 credit hours)

EECS	211	Circuits I	3
EECS	212	Circuits II	4
EECS	240	Introduction to Digital Logic Design	4
EECS	258	Programming I	4
EECS	312	Electronic Circuits I	3
EECS	360	Signal & System Analysis	4
EECS	388	Computer Systems & Assembly Language	4
EECS	412	Electronics Circuits II	4
EECS	420	Electromagnetics II	4
EECS	443	Digital Systems Design	4
EECS	444	Control Systems	3
EECS	470	Electrical Devices & Properties of Materials	3
EECS	501	Senior Design Laboratory I	3
EECS	502	Senior Design Laboratory II	3
EECS	562	Introduction to Communication Systems	4
Senior electives			9

Mathematics (18 credit hours)

MATH	121	Calculus I	5
MATH	122	Calculus II	5
MATH	250	Mathematics of Engineering Systems	5
EECS	461	Probability and Statistics	3

Basic Science (17 credit hours)

CHEM	184	Chemistry I	5
PHSX	211	Physics I	4
EECS	220	Electromagnetics I	4
PHSX	313	Physics III*	4

***** Starting Fall 2005, the Physics III lab will become a separate course so students must take both PHSX 313 (becomes 3 hours) and PHSX 316 (1 hour lab).

General Electives (6 credit hours)

General Electives			6

English (6 credit hours)

ENGL	101	Composition	3
ENGL	102	Composition and Literature	3

Communications Elective (3 credit hours)

One of the following courses:			3
ENGL	362	Professional Writing: Technical Writing	
COMS	130	Speaker-Audience Communications	

Humanities/Social Science (15 credit hours)

Economics Elective::			3
ECON	142	Principles of Microeconomics (preferred) or	
ECON	144	Principles of Macroeconomics	
Political Science Elective:			3
POLS	110	Introduction to US Politics or	
POLS	150	Introduction to Comparative Politics or	
POLS	170	Introduction to International Politics	
Ethics Elective:			3
PHIL	365	Moral Issues in the Professions or	
PHIL	375	Moral Issues in the Computer Technology	
H/SS Elective 4			3
H/SS Elective 5			3

Electrical Engineering Suggested Course Sequence

FALL	*1st Semester*
ENGL 101	3
MATH 121	5
CHEM 184	5
H/SS 1	3
	16 hrs.

SPRING	*2nd Semester*
ENGL 102	3
MATH 122	5
PHSX 211	4
H/SS 2	3
	15 hrs.

FALL	*3rd Semester*
EECS 211	3
EECS 240	4
EECS 258	4
MATH 250	5
	16 hrs.

SPRING	*4th Semester*
EECS 212	4
EECS 220	4
EECS 388	4
H/SS 3	3
	15 hrs.

FALL	*5th Semester*
EECS 312	3
EECS 360	4
PHSX 313(& 316)	4
General Elective 1	3
H/SS 4	3
	17 hrs.

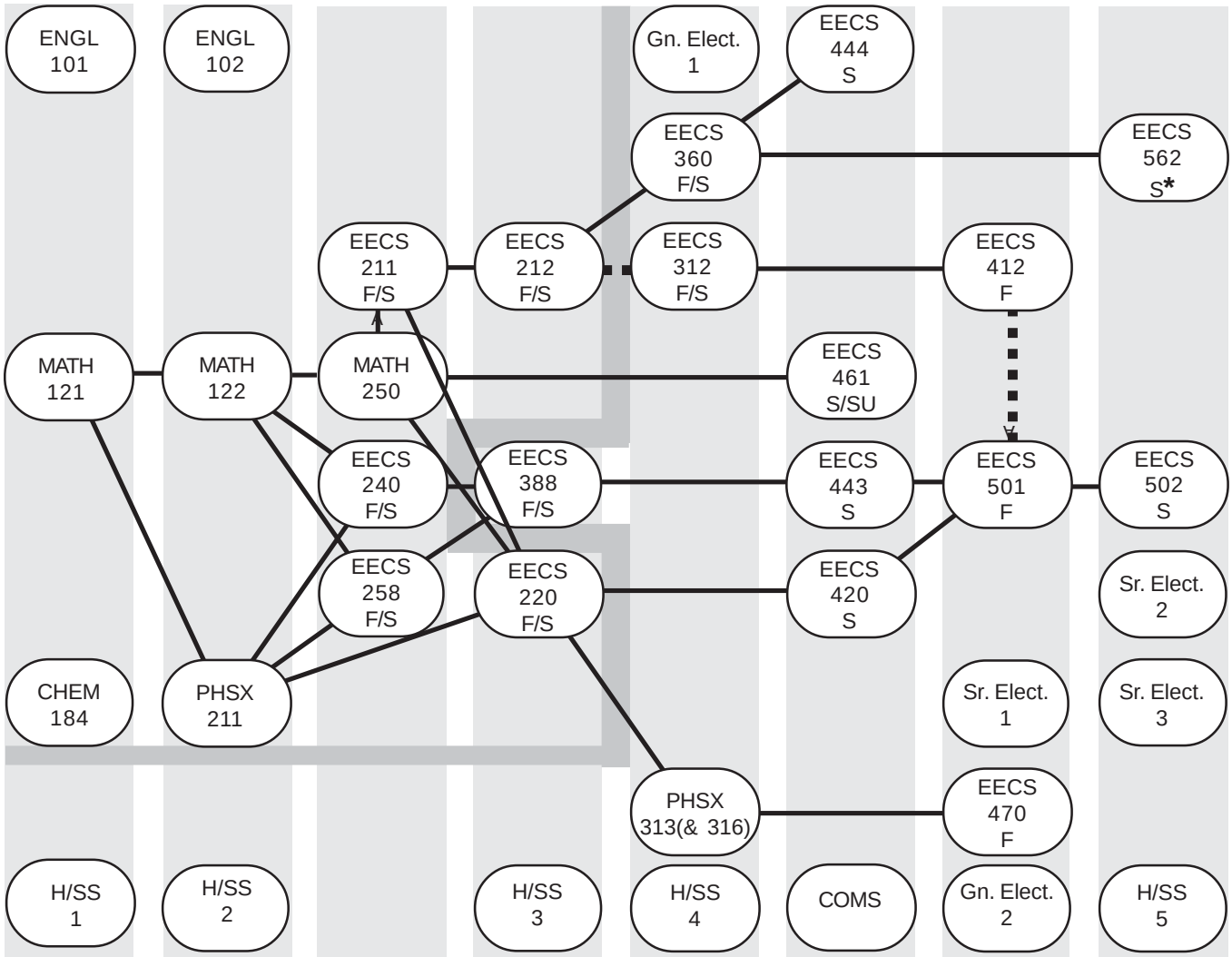
SPRING	*6th Semester*
EECS 420	4
EECS 461	3
EECS 443	4
EECS 444	3
COMS Elective	3
	17 hrs.

FALL	*7th Semester*
EECS 412	4
EECS 470	3
EECS 501	3
Sr. Elective 1	3
General Elective 2	3
	16 hrs.

SPRING	*8th Semester*
EECS 502	3
EECS 562*	4
Sr. Elective 2	3
Sr. Elective 3	3
H/SS 5	3
	16 hrs.

Electrical Engineering Course Flow Chart

The following flow chart shows the prerequisite relationships among the technical portions of the BSEE program. This chart, the latest catalog, and your advisor should be consulted if deviations from the suggested course sequence are contemplated.



**EECS 562 offered only in Fall through Fall 2005, then only in Spring starting Spring 2006.*

Eligibility Established — Prerequisite — Corequisite

BSEE Requirements Checklist

Name: _____

Advisor: _____

COURSE		SEM.	GRADE	MATH.	SCIENCE	ENGINEERING TOPICS	GENERAL EDUCATION	OTHER	TOTAL HOURS
Computer & Engineering Science & Design (63)									
EECS 211	Circuits I	_____	_____			3			3
EECS 212	Circuits II	_____	_____			4			4
EECS 240	Intro to Digital Logic Design	_____	_____			4			4
EECS 258	Programming I	_____	_____			4			4
EECS 312	Electronic Circuits I	_____	_____			3			3
EECS 360	Signal & Systems Analysis	_____	_____			4			4
EECS 388	Computer Systems & Assembly Lang.	_____	_____			4			4
EECS 412	Electronic Circuits II	_____	_____			4			4
EECS 420	Electromagnetics II	_____	_____			4			4
EECS 443	Digital Systems Design	_____	_____			4			4
EECS 444	Control Systems	_____	_____			3			3
EECS 470	Elect. Devices and Prop. of Materials	_____	_____			3			3
EECS 501	Senior Design Lab I	_____	_____			3			3
EECS 502	Senior Design Lab II	_____	_____			3			3
EECS 562	Intro to Communication Systems	_____	_____			4			4
Senior Electives (3 classes, 9 hrs.)									
EECS____	_____	_____	_____			3			3
EECS____	_____	_____	_____			3			3
EECS____	_____	_____	_____			3			3
Mathematics (18)									
MATH 121	Calculus I	_____	_____	5					5
MATH 122	Calculus II	_____	_____	5					5
MATH 250	Mathematics of Engineering Systems	_____	_____	5					5
EECS 461	Probability & Statistics	_____	_____	3					3
Basic Science (17)									
CHEM 184	Chemistry I	_____	_____		5				5
PHSX 211	General Physics I	_____	_____		4				4
EECS 220	Electromagnetics I	_____	_____		4				4
PHSX 313	General Physics III(including lab 316)	_____	_____		4				4
General Electives (6 hrs. total)									
_____	_____	_____	_____					3	3
_____	_____	_____	_____					3	3
English, Comms., Humanities & Social Science (24)									
ENGL 101	Composition	_____	_____				3		3
ENGL 102	Composition & Literature	_____	_____				3		3
_____	Communications Elective	_____	_____				3		3
ECON 14_	_____	_____	_____				3		3
POLS____	_____	_____	_____				3		3
PHIL____	_____	_____	_____				3		3
He&SS Electives 4 & 5 (2 classes)									
_____	_____	_____	_____				3		3
_____	_____	_____	_____				3		3
	TOTALS			18	17	63	24	6	128

For students admitted Fall 2004

Computer Engineering

Computer engineers focus on all aspects of computational devices and systems, including both hardware and software. Wherever computers can be found, computer engineers are needed. In addition to the computer system aspects of the electrical engineering and computer science areas listed, computer engineers may work in the areas of computer elements and architectures, very large scale integrated (VLSI) circuits for data processing and storage, embedded and real-time computer systems, or computer networking.

Objectives of the Computer Engineering program are to produce graduates who:

1. Have an understanding of the fundamental concepts in basic sciences and mathematics, and can apply them to the solution of computer engineering problems.
2. Are proficient in the use of laboratory and test equipment, computer aided design tools, computer software, and other tools used in engineering practice.
3. Can design components, experiments, and complex systems to meet specific requirements.
4. Have a broad education with exposure to humanities, professional ethics and responsibilities, and the role of engineers in global society.
5. Have the skills necessary to function in multidisciplinary, diverse and changing engineering environments.

Requirements for the Bachelor of Science in Computer Engineering Degree

A total of 130 credit hours is required for the BSCoE degree, as follows:

Computer Engineering (64 credit hours)

EECS	211	Circuits I	3
EECS	212	Circuits II	4
EECS	240	Introduction to Digital Logic Design	4
EECS	258	Programming I	4
EECS	268	Programming II	4
EECS	312	Electronic Circuits I	3
EECS	360	Signal & System Analysis	4
EECS	368	Programming Language Paradigms	3
EECS	388	Computer Systems & Assembly Language	4
EECS	443	Digital Systems Design	4
EECS	448	Software Engineering I	3
EECS	541	Computer Systems Design Laboratory I	3
EECS	542	Computer Systems Design Laboratory II	3
EECS	645	Computer Architecture and Networks	3
EECS	663	Introduction to Communication Networks	3
EECS	678	Introduction to Operating Systems	3
Senior electives			9

Mathematics (22 credit hours)

MATH 121	Calculus I	5
MATH 122	Calculus II	5
MATH 250	Mathematics of Engineering Systems	5
EECS 210	Discrete Structures	4
EECS 461	Probability and Statistics	3

Basic Science (15 credit hours)

PHSX 211	Physics I	4
EECS 220	Electromagnetics I	4
PHSX 313	Physics III *	4
Science Elective		3

*Starting Fall 2005, the Physics III lab will become a separate course, so students must take both PHSX 313 (becomes 3 hours) and PHSX 316 (1 hour lab).

General Electives (5 credit hours)

General Electives	5

English (6 credit hours)

ENGL	101	Composition	3
ENGL	102	Composition and Literature	3

Communications Elective (3 credit hours)

One of the following courses:			3
ENGL	362	Professional Writing: Technical Writing	
COMS	130	Speaker-Audience Communications	

Humanities/Social Science (15 credit hours)

Economics Elective:			3
ECON	142	Principles of Microeconomics (preferred)	
ECON	144	Principles of Macroeconomics	
Political Science Elective:			3
POLS	110	Introduction to US Politics	
POLS	150	Introduction to Comparative Politics	
POLS	170	Introduction to International Politics	
Ethics Elective:			3
PHIL	365	Moral Issues in the Professions	
PHIL	375	Moral Issues in the Computer Technology	

H/SS Elective 4	3
H/SS Elective 5	3

Computer Engineering Suggested Course Sequence

FALL	*1st Semester*
ENGL 101	3
MATH 121	5
Nat. Science	3-5
H/SS 1	3
	14-16 hrs.

SPRING	*2nd Semester*
ENGL 102	3
MATH 122	5
PHSX 211	4
H/SS 2	3
H/SS 3	3
	18 hrs.

FALL	*3rd Semester*
EECS 211	3
EECS 258	4
EECS 240	4
MATH 250	5
	16 hrs.

SPRING	*4th Semester*
EECS 210	4
EECS 212	4
EECS 220	4
EECS 268	4
	16 hrs.

FALL	*5th Semester*
EECS 312	3
EECS 360	4
EECS 368	3
EECS 388	4
H/SS	3
	17 hrs.

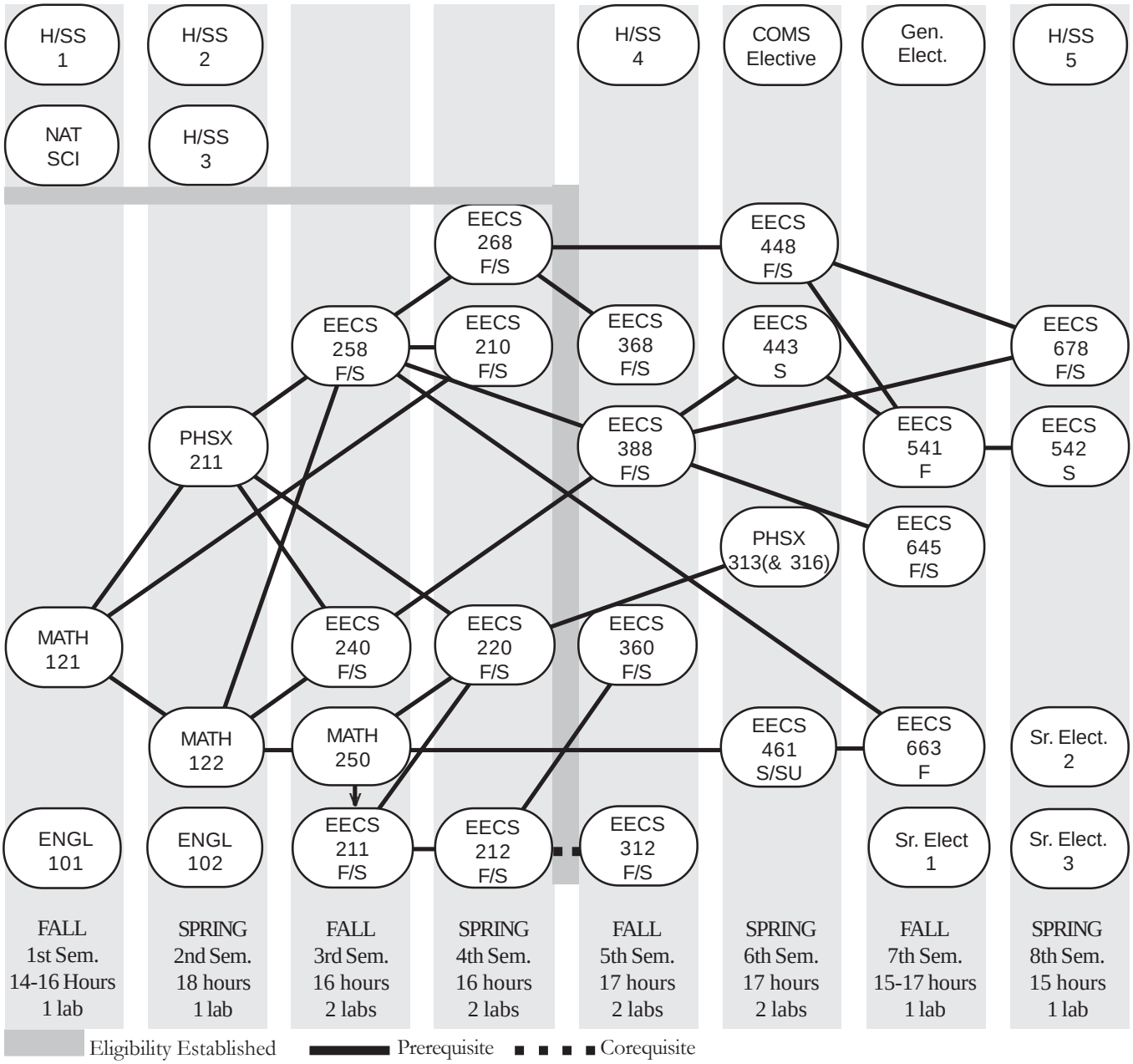
SPRING	*6th Semester*
EECS 443	4
EECS 448	3
EECS 461	3
PHSX 313(& 316)	4
COMS Elective	3
	17 hrs.

FALL	*7th Semester*
EECS 541	3
EECS 645	3
EECS 663	3
Sr. Elective 1	3
Gen. Elective	3-5
	15-17 hrs.

SPRING	*8th Semester*
EECS 542	3
EECS 678	3
Sr. Elective 2	3
Sr. Elective 3	3
H/SS 5	3
	15 hrs.

Computer Engineering Course Flow Chart

The following flow chart shows the prerequisite relationships among the technical portions of the BSCoE program. This chart, the latest catalog, and your advisor should be consulted if deviations from the suggested course sequence are contemplated.



BSCoE Requirements Checklist

Name: _____

Advisor: _____

COURSE	SEM.	GRADE	MATH.	SCIENCE	ENGINEERING TOPICS	GENERAL EDUCATION	OTHER	TOTAL HOURS
Computer & Engineering Science & Design (64)								
EECS 211 Circuits I	_____	_____			3			3
EECS 212 Circuits II	_____	_____			4			4
EECS 240 Intro to Digital Logic Design	_____	_____			4			4
EECS 258 Programming I	_____	_____			4			4
EECS 268 Programming II	_____	_____			4			4
EECS 312 Electronic Circuits I	_____	_____			3			3
EECS 360 Signal & Systems Analysis	_____	_____			4			4
EECS 368 Programming Language Paradigms	_____	_____			3			3
EECS 388 Computer Systems & Assembly Lang.	_____	_____			4			4
EECS 443 Digital Systems Design	_____	_____			4			4
EECS 448 Software Engineering I	_____	_____			3			3
EECS 541 Computer Systems Design Lab I	_____	_____			3			3
EECS 542 Computer Systems Design Lab II	_____	_____			3			3
EECS 645 Computer Architecture and Networks	_____	_____			3			3
EECS 663 Introduction to Communication Networks	_____	_____			3			3
EECS 678 Introduction to Operating Systems	_____	_____			3			3
Senior Electives (3 classes, 9 hrs.)								
EECS____ _____	_____	_____			3			3
EECS____ _____	_____	_____			3			3
EECS____ _____	_____	_____			3			3
Mathematics (22)								
MATH 121 Calculus I	_____	_____	5					5
MATH 122 Calculus II	_____	_____	5					5
MATH 250 Mathematics of Engineering Systems	_____	_____	5					5
EECS 210 Discrete Structures	_____	_____	4					4
EECS 461 Probability & Statistics	_____	_____	3					3
Basic Science (15)								
PHSX 211 General Physics I	_____	_____		4				4
EECS 220 Electromagnetics I	_____	_____		4				4
PHSX 313 General Physics III(including lab 316)	_____	_____		4				4
_____ Natural Science	_____	_____		3				3
General Electives (5 hrs. total)								
_____ _____	_____	_____					5	5
English, Comms., Humanities & Social Science (24)								
ENGL 101 Composition	_____	_____				3		3
ENGL 102 Composition & Literature	_____	_____				3		3
_____ Communications Elective	_____	_____				3		3
ECON 14_ _____	_____	_____				3		3
POLS____ _____	_____	_____				3		3
PHIL____ _____	_____	_____				3		3
He&SS Electives 4 & 5 (2 classes)								
_____ _____	_____	_____				3		3
_____ _____	_____	_____				3		3
TOTALS			22	15	64	24	5	130

For students admitted Fall 2004

Computer Science

Computer scientists focus on the theory and practice of computing. They may pursue the design, analysis, and implementation of computer algorithms, study the theory of programming methods and languages, or design and develop software systems. Computer scientists may also work in the areas of artificial intelligence, database systems, parallel and distributed computation, human-computer interaction, computer graphics, operating systems, or computer systems analysis and administration.

Objectives of the Computer Science Program

Our program seeks to ensure that our graduates have the solid preparation necessary for a successful career or entry into a graduate degree program. To this end our objectives are to provide the student with:

1. An understanding of the fundamental concepts in basic sciences and mathematics and how these concepts can be applied to the solution of science and engineering problems,
2. Meaningful studies in the humanities and social sciences, including an appreciation of ethical issues in the use of technology,
3. A solid foundation in oral and written communications,
4. Experience with the design, maintenance and implementation of software systems,
5. An understanding of computer hardware and software architectures and the ability to design software systems that run efficiently on conventional computing systems

Requirements for the Bachelor of Science in Computer Science Degree

A total of 126 credit hours are required for the BSCS degree, as follows:

Computer Science (52 credit hours)

EECS	240	Introduction to Digital Logic Design	4
EECS	258	Programming I	4
EECS	268	Programming II	4
EECS	368	Programming Language Paradigms	3
EECS	388	Computer Systems & Assembly Language	4
EECS	448	Software Engineering I	3
EECS	510	Introduction to the Theory of Computing	3
EECS	560	Data Structures	3
EECS	645	Computer Architecture	3
EECS	660	Fundamentals of Computer Algorithms	3
EECS	662	Programming Languages	3
EECS	678	Introduction to Operating Systems	3
Senior Electives			12

Mathematics (22 credit hours)

MATH	121	Calculus I	5
MATH	122	Calculus II	5
MATH	250	Mathematics of Engineering Systems or	5
MATH	123	Linear Algebra & Multivariable Calculus	
EECS	210	Discrete Structures	4
EECS	461	Probability and Statistics	3

Basic Science (14 credit hours)

PHSX	211	Physics I	4
PHSX	212	Physics II	4
Science Electives (two courses)			6

General Electives (5 credit hours)

General Electives			5

English (9 credit hours)

ENGL	101	Composition	3
ENGL	102	Composition & Literature	3
ENGL	362	Professional Writing: Technical Writing or	3
ENGL	2XX		

Professional Writing: Technical Writing (ENGL 362) is strongly recommended as the third course when enrollment is possible.

Communications (3 credit hours)

COMS	130	Speaker-Audience Communication	3

Humanities/Social Science (21 credit hours)

Ethics Course:			3
PHIL	375	Moral Issues in Computer Technology	
Three courses from Humanities			9
(from at least two different departments)			
Three courses from Social Sciences			9
(from at least two different departments)			

Computer Science Suggested Course Sequence

FALL	*1st Semester*
ENGL 101	3
MATH 121	5
Science Elective 1	3-5
H/SS 1	3
	14-16 hrs.

SPRING	*2nd Semester*
ENGL 102	3
MATH 122	5
PHSX 211	4
H/SS	3
	15 hrs.

FALL	*3rd Semester*
EECS 258	4
PHSX 212	4
MATH 250 or 123	5
H/SS	3
	16 hrs.

SPRING	*4th Semester*
EECS 210	4
EECS 240	4
EECS 268	4
PHIL 375	3
ENGL 362	3
	18 hrs.

FALL	*5th Semester*
EECS 368	3
EECS 388	4
EECS 448	3
COMS 130	3
H/SS 3	3
	16 hrs.

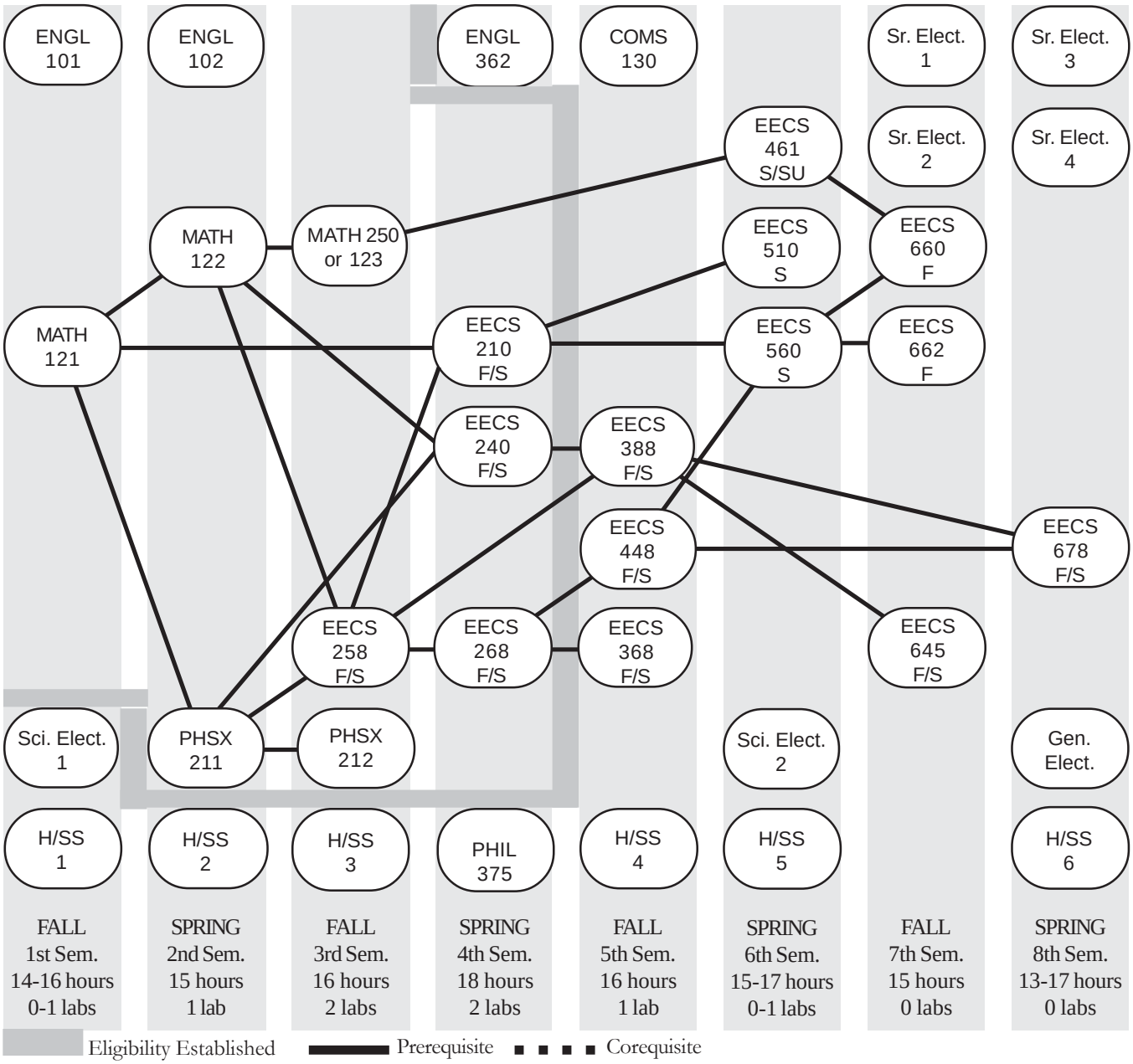
SPRING	*6th Semester*
EECS 461	3
EECS 510	3
EECS 560	3
H/SS 4	3
Science Elective 2	3-5
	15-17 hrs.

FALL	*7th Semester*
EECS 645	3
EECS 660	3
EECS 662	3
Sr. Elective 1	3
Sr. Elective 2	3
	15 hrs.

SPRING	*8th Semester*
EECS 678	3
Sr. Elective 3	3
Sr. Elective 4	3
H/SS 6	3
Gnrl. Elective	1-5
	13-17 hrs.

Computer Science Course Flow Chart

The following flow chart shows the prerequisite relationships among the technical portions of the BSCS program. This chart, the latest catalog, and your advisor should be consulted if deviations from the suggested course sequence are contemplated.



BSCS Requirements Checklist

Name: _____

Advisor: _____

ENROLLED	GRADE		COURSE	HOURS	THEORET FOUNDATNS	ALGORITHMS	DATA STRUCTURES	SOFTWARE DESIGN	PROGRAM CONCEPTS	COMPUTER ARCHITEC
Core Computer Science Classes 22 hrs. total)										
_____	_____	EECS 240	Intro. to Digital Logic Design	4						4
_____	_____	EECS 258	Programming I	4		1	.5	1	1.5	
_____	_____	EECS 268	Programming II	4		1	2		1	
_____	_____	EECS 368	Functional Programming	3		.5	.5		2	
_____	_____	EECS 388	Cmptr Systms & Assembly Lang.	4		1			1	2
_____	_____	EECS 448	Software Engineering	3				3		
Total Core Accreditation Minima (16-24 hrs. required)				22		3.5	3	4	5.5	6
Advanced Computer Science Classes (30 hrs. total)										
_____	_____	EECS 510	Intro to Theory of Computing	3	3					
_____	_____	EECS 560	Data Structures	3		1	2			
_____	_____	EECS 645	Computer Architecture & Networks	3						3
_____	_____	EECS 660	Fundamentals of Cmptr Algorithms	3		3				
_____	_____	EECS 662	Programming Languages	3					3	
_____	_____	EECS 678	Intro. to Operating Systems	3		.5		.5		2
Senior Electives (4 classes, 12 hrs)										
_____	_____	EECS___	_____	3						
_____	_____	EECS___	_____	3						
_____	_____	EECS___	_____	3						
_____	_____	EECS___	_____	3						
Total Advanced Accreditation Minima (16-24 hrs. required)				30	3	4.5	2	.5	3	5

ENROLLED	GRADE		COURSE	HOURS	MATH	SCIENCE	GENERAL	OTHER
Mathematics (22 hrs. total)								
_____	_____	MATH 121	Calculus I	5	5			
_____	_____	MATH 122	Calculus II	5	5			
_____	_____	MATH___	123 or 250	5	5			
_____	_____	EECS 210	Discrete Structures	4	4			
_____	_____	EECS 461	Probability and Statistics	3	3			
Science (14 hrs. total)								
_____	_____	PHSX 211	Physics I	4		4		
_____	_____	PHSX 212	Physics II	4		4		
_____	_____	_____	Natural Science	3		3		
_____	_____	_____	Natural Science	3		3		
Humanities, Social Science, English, and Communications (33 hrs. total)								
_____	_____	ENGL 101	Composition	3			3	
_____	_____	ENGL 102	Composition & Literature	3			3	
_____	_____	ENGL___	362 or 200 level	3			3	
_____	_____	PHIL 375	Moral Issues in Computer Technology	3			3	
_____	_____	COMS 130	Speaker-Audience Communication	3			3	
H&SS Electives (6 classes, 18 hours)								
_____	_____	_____	_____	3			3	
_____	_____	_____	_____	3			3	
_____	_____	_____	_____	3			3	
_____	_____	_____	_____	3			3	
_____	_____	_____	_____	3			3	
_____	_____	_____	_____	3			3	
General Electives (5 hrs. total)				5				5
_____	_____	_____	_____					
_____	_____	_____	_____					
_____	_____	_____	_____					
			TOTALS	74	22	14	33	5

For students admitted Fall 2004

Departmental Academic Policies

This section details department policies and procedures concerning completion of the curricula. In addition, each student is responsible for seeking out and complying with policies of the School of Engineering and the University. These are contained in the current Undergraduate Catalog of the University, or in sources referred to therein.

Transfer Credits

The University accepts and will place on the student's permanent KU record credits for all academic courses taken at an accredited college or university. Vocational and remedial courses are excluded.

Not all courses accepted by the University will apply toward a degree in engineering. A student will not receive engineering degree transfer credit for:

a. Courses in which the grade was lower than C, or which were graded credit/no-credit or pass/fail.
b. More than 64 hours from community or junior colleges.
c. Courses in advanced engineering sciences or engineering design unless they were taken in an engineering program accredited by ABET or CSAB.

To clearly document the application of engineering transfer course credits toward a specific degree in engineering, there is a "transfer contract" form, to be completed by the student and submitted for approval by the appropriate Department and School representatives. Copies of this form are available in the Department or School office. This process should normally be completed no later than the student's first semester in the Department.

In cases where it appears that a strong case can be made for transferring freshman or sophomore-level courses from a foreign school, or other school from which credits are not routinely accepted by the School of Engineering, a process called "Advanced Standing Credit by Validation" is available. Information about this process and the necessary forms are available from the Engineering Dean's office. All such validations should be petitioned during the student's first semester in the Department.

Academic Requirements

Progress through the curriculum requires not just passing all courses required for a particular degree, but passing them at certain levels or before certain key places in the curriculum.

Course Prerequisites and Co-requisites

All prerequisite courses for a given course must be passed **before** taking the follow-on course. Co-requisite courses may be taken concurrently.

Freshman-Sophomore Academic Requirements

All School of Engineering undergraduates are subject to certain academic requirements (detailed in the Undergraduate Catalog) which call for maintaining a GPA of 2.0 or better, and which provide for dismissal from the School for failure to do so. Students are expected to be familiar with these requirements.

In addition, EECS undergraduates are required to earn *Upper Level Course Eligibility* by attaining grades of C or better in each of the following courses:

EE Major
ENGL 101, 102
PHSX 211, CHEM 184
MATH 121, 122, MATH/ENGR 250
EECS 211, 212, 220, 240, 258
12 courses

CoE Major
ENGL 101, 102
PHSX 211
MATH 121, 122, MATH/ENGR 250
EECS 210, 211, 212, 220, 240, 258, 268
13 courses

CS Major
ENGL 101, 102
PHSX 211, 212
MATH 121, 122, MATH/ENGR 250 (or MATH 123)
EECS 210, 240, 258, 268
11 courses

Should less than a C be earned in any of the above listed courses, the student must repeat the course at the next available opportunity and must *not* take a course for which that course is a prerequisite. It is the *responsibility of the student* to contact his/her advisor *before beginning the new semester* regarding this required repetition and the associated "drops" and "adds."

Junior-Senior Academic Requirements

To enroll in *any* upper-level EECS course (numbered 300 and above), an EECS student must have fulfilled the *Freshman-Sophomore Academic Requirements* detailed above and thus acquired *Upper Level Course Eligibility*. Exceptions: EECS 312, EECS 368 and EECS 388 may be taken at the same time as you are completing your upper level eligibility. To preserve *Upper Level Course Eligibility*, a student must maintain a 2.0 grade point average for *all* required EECS courses. Should eligibility be lost because the grade point average drops below 2.0, the student must retake one or more required courses in the major in which a D or F was earned the last time the course was taken. Once the grade point average for all required courses in the major is raised to 2.0*, Upper Level Course Eligibility* status is reestablished. In the meantime, the student will not be allowed to take additional courses in the major.

Graduation Requirements

In addition to completing each of the required and elective courses listed in the curriculum, a student must:

1. Attain a cumulative grade-point average of at least 2.0 in courses applied toward the degree. A student must also have a KU cumulative grade-point average of 2.0 even if all courses are not being applied to the degree.
2. In addition to the requirements in item 1, attain a cumulative grade-point average of at least 2.0 in all courses taken in the School of Engineering, including courses not applied toward a degree.
3. Attain (if entering with advanced standing) a cumulative grade-point average of at least 2.0 in the resident courses applied toward the degree, and at least a 2.0 in all courses taken in the School of Engineering.
4. Take the last 30 hours of credit toward the degree at KU and be officially enrolled in the School of Engineering during this time.

Scheduling Your Time

Obtaining a degree in Electrical Engineering, Computer Engineering, or Computer Science requires a commitment to organization and planning, as well as dedicating a large portion of time to in-class work, lab-work, and home-work. The EECS Department suggests that students develop a plan of study. First you must select the EECS courses you wish to take and work out a schedule based on class prerequisites and when courses are offered.

Time is probably the most important factor when deciding how many classes to take each semester. Students with job commitments need to consider taking fewer courses in order to successfully proceed through the curriculum. The Department suggests planning for two- to three-hours out of class study time for every one-hour spent in the classroom. Students are strongly discouraged from violating the following "60-hour rule". (Total-credit-hours x 3) + weekly-employment-hours ≤ 60 hours.

Advising and Enrollment

Each entering freshman is encouraged to supply the School of Engineering with a final high school transcript and to attend the University's summer orientation program. At the summer orientation program, students are advised on course selection for the fall semester and given the opportunity to enroll. Students who cannot attend the orientation program confer with their advisors a day or two before enrollment for the fall semester. Similar orientation programs are offered in January.

Every EECS undergraduate is assigned a permanent faculty advisor with whom he/she is to consult at enrollment time and at any other time when questions or problems arise concerning their progress at the University.

All continuing EECS students are to enroll during the regular enrollment periods that occur about half way through a given semester for courses to be taken in the subsequent semester, i.e. in October/November for the following Spring semester, and in March/April for the following Summer session and Fall semester. Residual enrollment is only for new students and for continuing students who, for very good reasons, were unable to utilize the regular enrollment periods.

Each semester, a few days ahead of the start of enrollment itself, students see their faculty advisors to plan schedules and discuss other academic and career interests. Watch for department notices informing you of the days set aside for advising by the EECS department. Students sign-up on an appointment schedule available at their advisor's office. At the time of the appointment the student should arrive with definite notions (preferably written down so they will not be forgotten) about both (a) what he/she is sure of for the coming semester and about degree requirements in general, and (b) what he/she is unsure of and needs to discuss. This will make it possible for the student and advisor to deal effectively with whatever problems or concerns the student has.

Students are encouraged to call on their advisors any time during the school year if they wish to change their schedules or discuss other matters. Consultation with an advisor is required before making schedule changes.

There are a number of Department and School policies concerning course selection and enrollment in both engineering and non-engineering courses. Many of these are discussed below. For further information see the latest University catalog and check the EECS Department main bulletin boards at least weekly. The bulletin boards are located near 2001 Eaton Hall. Also, check regularly the EECS web site at www.eecs.ku.edu. Frequently notices are sent in mass to all EECS student email accounts. Make sure you check your EECS email account regularly.

Auditors

A person enrolled at KU may, with permission of the instructor of the course involved, audit a course. Auditors may not take examinations, submit daily assignments, or use laboratory equipment if a laboratory is part of the course. When auditing is allowed, students enroll and pay tuition, but not fees. No University credit is awarded.

Change of Advisor

If for good reason (change of major, extreme conflict) you need to change advisor, you must seek permission of the person with whom you wish to be assigned. The new advisor must inform the department undergraduate records staff of their acceptance of an existing student as a new advisee. This must be done by e-mail or signed note.

Change of Major

A student wishing to change majors within the School of Engineering must complete a Change of Major form available in the Engineering Dean's Office or the Electrical Engineering and Computer Science Department Office. Completed Change of Major forms should be turned in to the Engineering Dean's Office in 1 Eaton Hall.

Students wishing to change majors to something other than engineering need to complete a Change of School Application form. Forms are available in the Engineering Dean's Office. Completed forms should be turned in to the School in which you wish to change.

Curriculum Changes

When degree requirements are revised, students already admitted to that degree and making normal progress toward that degree generally have two options: (1) change to the revised curriculum, or (2) continue under the curriculum in effect when entering the degree program. If no additional time is needed for completion, it is generally advisable to choose the new curriculum.

Credit By Exam for EECS 258

Students who feel that they have a significant knowledge of programming and meet the requirements outlined below, may be issued, upon satisfactory completion of a comprehensive exam covering the materials for EECS 258, credit for the course.

Application Process

A student must apply to take the test and be granted permission by the EECS department and by the University Registrar. The first step is to complete an application form at the Registrar's Office in 123 Strong Hall. Application to the department will include the following criteria:

1. The student must meet the prerequisites for EECS 258, having received a "C" or better in each prerequisite course.
2. The student must demonstrate that they have direct programming experience in C++, Java or C (others may be allowed as well) but the test will assume fluency in C++, and the follow-on course (EECS 268) assumes C++ fluency. The demonstration of experience must be accomplished in at least one of the following ways:
   a. They must have taken one or more programming courses in high school.
   b. They must have job experience in programming.
   c. They must be able to show that they have learned programming skills on their own by showing us code that they have written and explaining its operation.
3. The student must not have been previously enrolled in EECS 138, EECS 258, or an equivalent course taken at KU or other post-secondary school.
4. The student is allowed to take the test once. If they do not pass, they will not be allowed to take the test again.

Official credit by exam application forms are available at the Office of the University Registrar in Strong Hall. It requires an endorsement by the department. Our endorsement will be given only if the criteria noted above are satisfied.

Frequency of Offering

The examination for credit in EECS 258 will be offered once immediately before the start of the fall and spring semesters. Students interested in taking the exam must take it at the single common time or wait until the next semester.

Test Contents and Structure

The test will be somewhat deeper than a comprehensive final examination over the entire contents of the EECS 258 course. It will be conducted in a lab with GTA proctors. Test questions will include:

- Several programming problems. This will be at least 60 percent of the total test points. Students will be required to read program specifications and then write, compile, and debug programs which meet the specifications.
- Definitions of key concepts.
- Short answers to questions.
- Multiple choice and true/false questions, if any, will not comprise more than 15 percent of the total test points.

Students will be allowed 3 1/2 hours to take the test.

Grading and Credit

The University allows either letter grades or credit ("CR") to be assigned. We will only award credit; we will not assign a letter grade. To receive credit, the student must earn an 80 percent score on the test.

Double Major in EECS

A student who wishes to double major (earn two of the three degrees) must fulfill all the requirements for the degrees in question. A student must take a minimum of 30 additional credit hours in required courses in order to earn the second degree.

Graduate Courses

Courses 700-999 are designed for graduate students. Undergraduates may NOT enroll in courses numbered 800-999. An undergraduate student may not enroll in an EECS course numbered 700-799 unless the student's engineering GPA is 3.0 or higher. In addition, it is strongly recommended that the student have a grade of B or higher in each prerequisite course.

Limitation on Enrollment in Engineering Courses

After the 14th calendar day from the beginning of classes, enrollment in a course offered by the School of Engineering is permissible only with approval of the instructor and special permission of the dean.

The School of Engineering reserves the right to deny admission to courses offered by the school to any student who is officially enrolled in another division of the university and who does not meet the standards established by the School of Engineering for admission or readmission.

Minimum and Maximum Enrollments

The maximum enrollment without the permission of the Dean of the School of Engineering is 19 hours in a semester and 9 hours in a summer session. There is no general minimum enrollment. However, for a particular student, a minimum enrollment requirement may be specified by the terms of a scholarship, student visa, or readmission agreement.

Substitutions

There are frequently times when it is necessary or desirable to make substitutions for a required course. This may occur when courses are transferred from another institution, or when there is a sound reason to substitute a course that lies outside the stated guidelines of the stated curriculum. Substitutions fall into one of the following five

categories. Specific forms for cases 2, 3, 4, and 5 are available from the Department.

Case 1:

Courses transferred from another institution that automatically fulfill a course requirement. This occurs when the "ARTS" (Academic Requirements Tracking System) form transcript shows this course with the necessary KU course equivalent number. These courses should also appear in the appropriate slots at the top section of the ARTS form, but if they don't, have your advisor get this straight with the Dean's office. (The ARTS form is a computer generated form that shows all courses for which KU gives you credit hours and other pertinent information to track your progress as a student at KU).

Case 2:

Technical courses transferred from another institution that clearly contained the appropriate course material for required courses, but did not appear on the ARTS form with the necessary KU course number. In this case, a *Transfer Contract* form should be filled out, signed by the advisor and then sent to the undergraduate director through the EECS Office.

Case 3:

Courses transferred from another institution or KU courses that contained the appropriate course material for required courses, but this equivalence is not obvious. In this case, a *Course Substitution Petition* should be filled out, signed by the advisor, and then sent to the undergraduate director through the EECS office. To the maximum extent possible these petitions are to be submitted for approval *before* the substituting courses are taken, and in any case at the earliest possible time.

Case 4:

Engineering courses which are not routinely transferred to the University of Kansas, but for which strong reasons can be advanced for their applicability toward degree requirements. In these cases, a petition for *Advanced Standing Credit by Validation* should be filled out. Case 4 applies only to 100- and 200-level courses.

Case 5:

Non-engineering courses which are not routinely transferred to the University of Kansas, but for which strong reasons can be advanced for their applicability toward degree requirements. These courses are handled by a petition for *Advanced Standing Credit by Validation.* To the maximum extent possible these petitions are to be submitted for approval *before* the substituting courses are taken, and in any case at the earliest possible time.

Dropping a Course

General Procedure:

1. Consult with the instructor and advisor as soon as possible (at least five days before the relevant deadline); get advisor's approval if dropping is truly the right action. Your advising folder will be needed during the consultation. You can pick it up in 2001 Eaton Hall.
2. Get Dean's stamp and go promptly to the enrollment center.

Your advisor's signature is always required on your enrollment form. This is to ensure that the student has consulted with his/her advisor and understands the various implications of enrollment. Other faculty members should not be asked to sign your enrollment materials. During the second and third period add/drop dates, the instructor's signature **is** needed on the add/drop cards.

Procedural Details:

Deadline dates and the latest information on dropping procedures and conditions for a given semester are available in the timetable in effect for that semester. In general the conditions have been:

1. During the first five weeks of the semester, dropping a course erases the enrollment from your permanent record.
2. During the second five weeks of the semester, the effect of dropping a course depends on what School or College in the University teaches the course. If the course is taught by the Engineering School, a "W" is recorded on the student's transcript.
3. During the third five weeks of the semester, in most parts of the university, withdrawal from a course is by petition only, such petition is accepted only under unusual circumstances, and is graded W/F (not automatic W) if the petition is granted.

Note: W means the student was earning at least a D at the time of dropping; the W has no effect on the GPA. F means the performance was not of passing quality; it is identical to an F at the end of the course and effects the GPA in precisely the same way.

During advising and enrollment students will be strongly discouraged from enrolling in more courses than they can realistically be expected to complete. The practice of over enrolling and dropping excess courses denies other students the opportunity to enroll in the first place. If a student is insistent about enrolling in more courses than the advisor believes is appropriate, the advisor may choose to approve 'with reservations', by recording these reservations in the student's folder. The advisor may then refuse to approve subsequent drops without very strong justification on the part of the student.

Readmission

Under various circumstances a student may leave the School of Engineering. Depending upon the reason for leaving and the student's current status, there are different procedures to be followed to be reconsidered for a major in the Electrical Engineering and Computer Science Department.

1. If a student left the School of Engineering and remained a student in good standing at the University of Kansas and then wished to return to the School of Engineering, the currently enrolled student should file an *Application for Change of School.* (Change of School Applications are available in the Engineering Dean's

Office, 1 Eaton Hall).

2. If a student left the School of Engineering and the University of Kansas and then wished to return to the School of Engineering, she/he should file an *Application for Readmission.* (Applications are available at the Admissions Office, KU Visitors Center, 1402 Iowa Street or the School of Engineering Dean's Office, 1 Eaton Hall).
3. A student who has been dismissed from the School of Engineering for poor scholarship must not only file the appropriate application mentioned in 1 or 2 above, but they must also file a *Petition for Reinstatement* to the School of Engineering. Petition forms are available from the School of Engineering Dean's office, 1 Eaton Hall. The signed petition must be turned in to the Dean's office, for review and decision.

If a student has completed additional course work since being dropped from the School of Engineering or leaving the University, the student will need to include an up-to-date transcript or a combination of a previous transcript and grade reports for all subsequent work.

University Course Repeat Policy

A student can replace up to five grades of D or F in their GPA calculation when the student repeats a course and meets all eight (yes, 8) of the following criteria:

- The **original course** (must be graded D or F) has to be taken Fall 2001or later at KU.
- The student must be an undergraduate.
- The original course must be taken in the student's first 60 credit hours attempted or, if the student has 60 or more attempted transfer hours, the original course must be taken in the student's first semester at KU.
- The student cannot have previously repeated the course.
- The original grade cannot be the result of recorded academic or disciplinary misconduct.
- The student cannot retake the course using the credit/no credit option.
- The student must retake the course at KU.
- The repeated course is not a prerequisite for a course already passed.

If you feel you meet the eight criteria you must file a course repeat petition form with the Engineering Dean's Office before the sixth week of classes. More information can be found at www.registrar.ku.edu/repeat.

Academic Misconduct

The EECS Department regards academic misconduct as a very serious matter. Students who violate conduct policies will be subject to severe penalties, up through and including dismissal from the School of Engineering. Please refer to the Student Handbook web site under Codes Policies, Laws & Guidelines at www.studenthandbook.ku.edu for specific guidelines about actions considered to be academic misconduct and the repercussions of such action.

These actions include, but are not limited to disruption of classes, threatening an instructor or fellow student in an academic setting; giving or receiving of unauthorized aid on examinations or in the preparation of notebooks, themes, reports or other assignments; knowingly misrepresenting the source of any academic work; unauthorized changing of grades; unauthorized use of University approvals or forging of signatures; falsification of research results; plagiarizing of another's work; violation of regulations or ethical codes for the treatment of human and animal subjects; or otherwise acting dishonestly in research.

Honors Program

University and School of Engineering Honors

The School of Engineering encourages all qualified students to participate in the Honors Program. Students must meet with an engineering advisor every semester and may also meet with an honors program advisor. See the Honors Program section in the General Regulations chapter in the College of Liberal Arts and Sciences catalog.

Departmental Honors

A student may graduate with departmental honors in electrical engineering, computer engineering or computer science by satisfying the requirements listed on page 6. Most of the requirements for graduation with Departmental Honors are completed during the final two semesters of a student's undergraduate program.

Frequently Asked Questions

a. Is it OK for a student to take the next course in a sequence, for example Math 122, at the same time he/she is repeating the prerequisite course, for example Math 121, to raise the grade to C or better?

Almost never -- for at least two reasons. First, the intent of the C-or-better policy is to get students to build solid foundations. This is not likely to happen if the student hasn't attained a C or better in the prerequisite course before taking the next course. Second, the student may have an impossible examination schedule. For the example cited, Math 121-122, the Math department frequently schedules exams for both courses at the same time. If, in some unusual case, the *academic facts* convince the advisor that it would be appropriate for the student to take the two courses at the same time, the student should obtain the permission of the department(s) teaching the courses.

b. When and for what classes is the Credit/No Credit Option allowed?

Not recommended. Although the credit/no credit option is allowed to fulfill English, humanities, social science, or oral communication courses, this option has the potential of lowering (not raising) the student's grade point average as applies to upper level course eligibility.

c. I would rather put off taking English until my senior year. Is that OK?

Definitely not! University regulations require that *all* students be *continuously* enrolled in English until the English requirements for their degree are completed.

For the BSEE, BSCoE and BSCS degrees this means completion of ENGL 101 and 102 *with grades of C or better* to be eligible to take junior-senior courses. In the case of international students whose primary language is not English, this includes continuous enrollment in courses specified by the Applied English Center (AEC), followed immediately by continuous enrollment in ENGL 101 and 102.

d. What is the ROTC policy for electrical engineering, computer engineering, and computer science majors?

Students who are in training for a commission as a regular or reserve officer in the Reserve Officers Training Corps (ROTC) may petition to apply credit earned in technical courses in aerospace studies, military science, or naval science for graduation. Up to six hours may be petitioned to count toward the general elective requirement.

e. I was exempt from the speech requirement. Do I need to make up these hours?

Yes. EE and CoE students may make up these hours by taking ENGL 362 (if they haven't already taken the course to satisfy other requirements) or any other communications course which lists COMS 130 as a prerequisite. CS students may make up these hours by taking any other communications course which lists COMS 130 as a prerequisite.

f. I was given permission to take a higher level English course because my English ACT score was greater than 30. Are there any special requirements? Yes. Students who have an ACT English score of 30 or higher can either take ENGL 102 (skipping ENGL 101) or ENGL 105 (honors equivalent of ENGL 102). Students choosing to follow this path will need to make up these 3 hours of English in a higher level English course.

g. Which library holds books and materials related to EECS? Books and materials related to EECS may be found either in the Spahr Engineering Library attached to Learned Hall or in the Anschutz Science Library. The general topic of the the item determines the particular library in which it is kept. The location of any particular item is included in the library's on-line information listing for that item.

Entry to the Profession

Job Search Assistance

The School of Engineering Career Services Center offers a comprehensive array of services to graduating students seeking permanent employment and to undergraduates seeking career-related summer or coop employment. These services include the on-campus interviewing program; a career fair each February and September; individual counseling and group workshops on resumes, interviewing, and job search strategies; resume-writing software; job postings from many employers not interviewing on campus; a library of employer and career literature; and mailing of student resumes to employers with job vacancies.

Although employment for engineering graduates depends on economic conditions, graduates from the KU School of Engineering consistently have been able to find responsible, high-paying positions in the profession. The Career Services Center does not guarantee employment to any graduate, but it makes every effort to help students who have initiated job searches. Services are available only to employers who support and implement the spirit and letter of state and federal laws in the matter of equal employment opportunity and nondiscriminatory practices.

Licensing

Formal study of engineering in an accredited engineering program is the principal means of becoming licensed to practice engineering in Kansas and other states. During the senior year, a student may take the state examination to become an "Engineering Intern." Following four or more years (licensing regulations vary among states) of practice satisfactory to the board, the student may take the examination to become a registered professional engineer.

Student Activities/Organizations

Students in the School of Engineering are encouraged to supplement their academic programs by participating in professional activities offered by the school's student organizations.

Engineering Student Council

The Engineering Student Council, composed of elected representatives of the engineering student body, sponsors an engineering exposition each year. Student groups and organizations plan and create exhibits that describe specialized areas of engineering and demonstrate engineering processes and resultant products. Awards are given for the best student displays.

Honor Societies

In their junior and senior years, outstanding engineering students may be invited to join one or more of the engineering honor societies on campus. These include Tau Beta Pi, all engineering disciplines; Eta Kappa Nu, electrical engineering and computer engineering; and Upsilon Pi Epsilon, computer science.

Minorities and Women

Two groups promote participation of women and minorities in engineering:

The **Engineering Diversity Program** encourages minority students to choose engineering as a career. It provides financial and academic support to its students, with retention as a main goal. Students may join chapters of the National Society of Black Engineers, American Indian Science and Engineering Society, or the Society of Hispanic Professional Engineers. For further information, contact the Engineering Diversity Program director, 785/864-3620.

The **Women's Engineering Program** works closely with the student chapter of the Society of Women Engineers to encourage and support women in pursuing engineering as a career. The program provides opportunities and activities for professional development, career guidance, mentoring, interaction with industry representatives, and social and academic support. Limited scholarships are available. For further information,

contact the Women's Engineering Programs director, 785/864-3881.

National Engineering Societies

Most national engineering societies have student chapters on campus. These include the American Institute of Aeronautics and Astronautics; American Institute of Chemical Engineers; American Society of Civil Engineers; American Society of Heating, Refrigeration, and Air-Conditioning Engineers; American Society of Mechanical Engineers; Association for Computing Machinery; Society of Petroleum Engineers; Institute of Electrical and Electronics Engineers; Society of Manufacturing Engineers; Society of American Military Engineers; Associated General Contractors of America; Illuminating Engineering Society; National Society of Architectural Engineers; Society of Automotive Engineers; Society of Women Engineers; National Society of Black Engineers; and Society of Hispanic Professional Engineers.

Student Publication

Students in the School of Engineering publish a magazine, the *Kansas Engineer*, for distribution on campus and to alumni who subscribe.

Catalog Description of Undergraduate Courses Offered by the EECS Department

EECS 128 Introduction to Computer-Based Information Systems (3). Acquisition of data and presentation of information. Algorithms, processes, and programming languages. Interacting with computers, internet and worldwide web. Binary numbers and logic. Organization and components of a computer. Programs, software, and operating systems. The computer as a general tool for handling and processing information. Concepts of data communications, distributed systems, and database management. Applications of computer-based information systems. Projects involving document preparation, spread sheets, databases, presentations, graphics, and other applications as well as an introduction to programming. Prerequisite: MATH 101 or MATH 104 or eligibility to enroll in MATH 115 or MATH 121.

EECS 138 Introduction to Computing: _____ (3). Algorithm development, basic computer organization, syntax and semantics of a high-level programming language, including testing and debugging. Concept of structure in data and programs, arrays, top-down design, subroutines and library programs. Abstract data types. System concepts such as compilation and files. Nature and scope of computer science. Not open to students who have taken EECS 805. Prerequisite: MATH 101 or MATH 104 or eligibility to enroll in MATH 115 or MATH 121.

EECS 210 Discrete Structures (4). Mathematical foundations including logic, sets and functions, general proof techniques, mathematical induction, sequences and summations, number theory, basic and advanced counting techniques, solution of recurrence relations, equivalence relations, partial order relations, lattices, graphs and trees, algorithmic complexity and algorithm design and analysis. Throughout there will be an emphasis on the development of general problem solving skills including algorithmic specification of solutions and the use of discrete structures in a variety of applications. Prerequisite: EECS 258 (or equivalent) and MATH 122.

EECS 211 Circuits I (3). Analysis of linear electrical circuits: Kirchoff's laws; source, resistor, capacitor and inductor models; nodal and mesh analysis; network theorems; transient analysis; Laplace transform analysis; steady-state sinusoidal analysis; computer-aided analysis. Co-requisite MATH 250.

EECS 212 Circuits II (4). Continued study of electrical circuits: Steady-state power analysis, three-phase circuits, transformers, frequency response, and two-port network analysis. Prerequisite: EECS 211.

EECS 220 Electromagnetics I (4). Vector analysis. Electrostatic and magnetostatic fields in a vacuum and material media. Electromagnetic fields and Maxwell's equations for time-varying sources. The relationship between field and circuit theory. Simple applications of Maxwell's equations. Prerequisite: MATH 250, PHSX 211, and EECS 211

EECS 240 Introduction to Digital Logic Design (4). An introductory course in digital logic circuits covering number representation, digital codes, Boolean Algebra, combinatorial logic design, sequential logic design, and programmable logic devices. Prerequisite: Grade of C or better in both MATH 122 and PHSX 211.

EECS 241 Introduction to Digital Logic: Honors (4). An introductory course in digital logic circuits covering number representation, digital codes, Boolean Algebra, combinatorial logic design, sequential logic design, and programmable logic devices. This course is intended for highly motivated students and includes honors-level assignments. Prerequisite: Grade C or better in both MATH 122 and PHSX 211, plus either acceptance into the KU Honors Program or consent of instructor.

EECS 258 Programming I (4). Problem solving using a high level programming language and object oriented software design. Fundamental stages of software development are discussed: problem specification, program design, implementation, testing, and documentation. Introduction to programming using an object oriented language: using classes, defining classes, extending classes. Introduction to algorithms and data structures useful for problem solving: arrays, lists, files, searching, and sorting. Students will be responsible for designing, implementing, testing, and documenting independent programming projects. Professional ethics are defined and discussed in particular with respect to computer rights and responsibilities. Prerequisite: Grade of C or better in both MATH 122 and PHSX 211.

EECS 259 Programming I: Honors (4). Problem solving using a high level programming language and object oriented software design. Fundamental stages of software development are discussed: problem specification, program design, implementation, testing, and documentation. Introduction to programming using an object oriented language: using classes, defining classes, extending classes. Introduction to algorithms and data structures useful for problem solving: arrays, lists, files, searching, and sorting. Students will be reponsible for designing, implementing, testing, and documenting independent programming projects. Professional ethics are defined and discussed in particular with respect to computer rights and responsibilities. This course is intended for highly motivated students and includes honors-level assignments. Prerequisite: Grade of C or better in both MATH 122 and PHSX 211, plus either acceptance into the KU Honors Program or consent of instructor.

EECS 268 Programming II (4). This course continues developing problem solving techniques by focusing on the imperative and object-oriented styles using Abstract Data Types. Basic data structures such as queues, stacks, trees, and graphs will be covered. Recursion. Basic notions of algorithmic efficiency and performance analysis in the context of sorting algorithms. Basic Object-Oriented techniques. An associated laboratory will develop projects reinforcing the lecture material. Three class periods and one laboratory period per week. Prerequisite: EECS 258.

EECS 312 Electronic Circuits I (3). Introduction to diodes, BJTs and MOSFETs, and their use in electronic circuits, especially digital circuits. Prerequisite: Upper-level eligibility. Co-requisite: EECS 212.

EECS 319 Electrical Circuits, Devices, and Systems (4). Introduction to electrical circuits, electronic devices, and electromechanical devices for nonelectrical engineering majors. Prerequisite: A course in differential equations and eight-hours of physics.

EECS 360 Signal and System Analysis (4). Fourier signal analysis (series and transform); linear system analysis (continuous and discrete); Z-transforms; analog and digital filter analysis. Analysis and design of continuous and discrete time systems using MATLAB. Prerequisite: EECS 212 and upper-level EECS eligibility.

EECS 368 Programming Language Paradigms (3) The course is a survey of programming languages: their attributes, uses and advantages and disadvantages. Topics include scopes, parameter passing, storage management, control flow, exception handling, encapsulation and modularization mechanism, reusability through genericity and inheritance, type systems. In particular, several different languages will be studied which exemplify different language philosophies (e.g., procedural, functional, object-oriented, logic, scripting). Prerequisite: EECS 268 and upper-level EECS eligibility.

EECS 388 Computer Systems and Assembly Language (4). Internal organization of microprocessor and microcontroller systems; programming in assembly language; input and output system; controlling external devices. The course will focus on one or two

specific microprocessors and computer systems. Prerequisite: EECS 240 and EECS 258 and upper-level EECS eligibility.

EECS 399 Projects (1-5). An electrical engineering, computer engineering, or computer science project pursued under the student's initiative, culminating in a comprehensive report, with special emphasis on orderly preparation and effective composition. Prerequisite: upper-level EECS eligibility and consent of instructor.

EECS 412 Electronic Circuits II (4). Discrete and integrated amplifier analysis and design. Introduction to feedback amplifier analysis and design. Introduction to feedback amplifiers. Prerequisite: EECS 312 and upper-level EECS eligibility.

EECS 420 Electromagnetics II (4). This course applies electromagnetic analysis to high frequency devices and systems where wave propagation effects cannot be neglected. Topics covered include transmission lines, space waves, waveguides, radiation, and antennas. Laboratory experiments include transmission line, waveguide, and antenna measurements and characterizations. Prerequisite: EECS 220 and upper-level EECS eligibility.

EECS 443 Digital Systems Design (4). The design of computer systems from the hardware point of view. The implementation of functional and control units. Introduction to VHDL, and its use in modeling and designing digital systems. Prerequisite: EECS 388.

EECS 444 Control Systems (3). An introduction to the modeling, analysis, and design of linear control systems. Topics include mathematical models, feedback concepts, state-space methods, time response, system stability in the time and transform domains, design using PID control and series compensation, and digital controller implementation. Prerequisite: EECS 212 and EECS 360.

EECS 448 Software Engineering I (3). This course covers the systematic development of software products. It first outlines the problems encountered in large software systems and their life cycle. It then concentrates on the methods and techniques for specification, design, and implementation of software: requirements analysis and specification; systems planning on design; software design and design documentation; implementation techniques, unit testing, and integration; validation and verification; early preparation of documentation including user manuals. Prerequisite: EECS 268 and upper-level EECS eligibility.

EECS 461 Probability and Statistics (3). Introduction to probability and statistics with applications. Reliability of systems. Discrete and continuous random variables. Expectations, functions of random variables, and linear regression. Sampling distributions, confidence intervals, and hypothesis testing. Joint, marginal, and conditional distributions and densities. Prerequisite: MATH 250 or MATH 123 and upper-level EECS eligibility.

EECS 470 Electronic Devices and Properties of Materials (3). An introduction to crystal structures, and metal, insulator, and semiconductor properties. Topics covered include the thermal, electric, dielectric, and optical properties of these materials. A significant portion of this course is devoted to the properties of semiconductors and semiconductor devices. Prerequisite: PHSX 313 and upper-level EECS eligibility.

EECS 498 Honors Research (1-2) Arranged to allow students to satisfy the independent research requirement for graduation with departmental honors. Prerequisite: Consent of instructor and upper-level EECS eligibility..

EECS 501 Senior Design Laboratory I (3). A lecture/laboratory course involving the design and implementation of prototypes of electrical and computer type products and systems. The project specifications require consideration of ethics, economics, manufacturing and safety. 2-hours lecture, 1-hour laboratory. Prerequisite: EECS 420 and EECS 443. Corequisite: EECS 412.

EECS 502 Senior Design Laboratory II (3). A lecture/laboratory course involving the design and implementation of prototypes of electrical and computer type products and systems. The project specifications require consideration of ethics, economics, health, manufacturing, and safety. Prerequisite: EECS 501.

EECS 510 Introduction to the Theory of Computing (3). Finite state automata and regular expressions. Context-free grammars and pushdown automata. Turing machines. Models of computable functions and undecidable problems. The course emphasis is on the theory of computability, especially on showing limits on computation. May not be taken for graduate credit. (Same as MATH 510.) Prerequisite: EECS 210 and upper-level eligibility.

EECS 512 Electronic Circuits III (3). Feedback amplifier circuit analysis, power amplifiers, analog IC op-amp techniques and analysis, filter approximation and realization, oscillators, wave generators and shapers. Prerequisite: EECS 412.

EECS 541 Computer Systems Design Laboratory I (3). A two semester lecture/laboratory course involving the specification, design, implementation, analysis, and documentation of a significant hardware and software computer system. Laboratory work involves software, hardware, and hardware/ software trade-offs. Project requirements include consideration of ethics, economics, manufacturing, safety, and health aspects of product development. Can be taken only during the senior year. Prerequisite: EECS 443 and EECS 448.

EECS 542 Computer Systems Design Laboratory II (3). A two semester lecture/laboratory course involving the specification, design, implementation, analysis, and documentation of a significant hardware and software computer system. Laboratory work involves software, hardware, and hardware/software trade-offs. Project requirements include consideration of ethics, economics, manufacturing, safety, and health aspects of product development. Can be taken only during the senior year. Prerequisite: EECS 541.

EECS 546 Integrated Circuit Design (3). The design, analysis, simulation, and layout of integrated circuit systems using CMOS technology. Students will carry out a design from initial concept through mask layout. The use of computer aided design tools is emphasized. Prerequisite: EECS 312 and EECS 470.

EECS 560 Data Structures (3) Abstract data types and concrete data structures including their associated algorithms. Topics include sets, graphs, trees, priority queues, heaps, mergeable heaps, balanced tree structures, and advanced data structures on trees. Application to problem solving including consideration of trade-offs incurred in the choice of implementation. Advanced sorting techniques. Efficiency of algorithms, big-oh, big-omega, worst case analysis, lower bounds on problem complexity. Basic techniques of algorithm design including divide and conquer, greedy, backtracking, and dynamic programming. Prerequisite: EECS 210 and EECS 448.

EECS 562 Introduction to Communication Systems (4). A first course in communications, including lectures and integrated laboratory experiments. After a review of spectral analysis and signal transmission, analog and digital communications are studied. Topics include: sampling, pulse amplitude modulation, and pulse code modulation; analog and digital amplitude, frequency, and phase modulation; frequency and time division multiplexing; noise performance of analog modulation techniques. Prerequisite: EECS 212 and EECS 360.

EECS 580 Electrical Energy Conversion (3). An introductory course on selected topics in electrical machinery and power electronics. Emphasis is placed on the principles underlying conversion of energy between electrical and mechanical domains. Types of electrical machinery covered include: dc motors and generators; transformers; induction motors and generators; and synchronous motors and generators. The appropriate application of these machines is considered in terms of the external operating characteristics. The operating characteristics of power electronic switching devices are related to electric power conversion: ac to dc, dc to ac, dc to dc, and ac to ac. There is an emphasis on safety as regards electrical systems. Prerequisite: EECS 220 and EECS 312.

EECS 603 Information Processing with C++ (3) Fundamental concepts of object-oriented programming and the development of abstract data types using C++. Case studies with applications to industry and the business world will also be included. *Not open for*

credit toward any EECS degree. Prerequisite: EECS 138.

EECS 611 Noise Reduction in Electronic Systems (3). A study of the sources of noise in electronic systems and how the effects of the noise can be reduced. Topics include: external and intrinsic noise sources, shielding, grounding, bypassing, filtering, contact protection, and active device noise. Prerequisite: EECS 220, EECS 312 and EECS 461.

EECS 622 Microwave and Radio Transmission Systems Introduction to radio transmission systems. Topics include radio transmitter and receiver design radiowave propagation phenomenology, antenna performance and basic design, and signal detection in the presence of noise. Students will design radio systems to meet specified performance measure. Prerequisite: EECS 420. Corequisites: EECS 461 and EECS 562.

EECS 625 Introduction to Radar (3). Basic radar principles. Radar range equation. Pulsed and cw modes of operation for detection, ranging, and extracting Dopplar information. Prerequisite: EECS 420, EECS 461 and EECS 562.

EECS 628 Fiber Optic Communication Systems (3). Description and analysis of the key components in optical communication systems. Topics covered include quantum sources, fiber cable propagation and dispersion characteristics, receiver characteristics, and system gain considerations. Prerequisite: EECS 220 and PHSX 313, or equivalent and upper-level EECS eligibility.

EECS 638 Fundamentals of Expert Systems (3). Basic information about expert systems: architecture of an expert system, building expert systems, uncertainty in expert systems, taxonomy of expert systems. Knowledge representation: first order logic, production systems, semantic nets, frames. Uncertainty in expert systems, one-valued approaches: probability theory, systems using Bayes' rule, and systems using certainty theory; two-valued approaches: systems using Dempster-Shafer theory and system INFERNO; set-valued approaches: systems using fuzzy set theory and systems using rough set theory.
Prerequisite: EECS 560 or consent of instructor.

EECS 644 Introduction to Digital Signal Processing (3). Discrete time signal and systems theory, sampling theorem, z-transforms, digital filter design, discrete Fourier transform, FFT, and hardware considerations. Prerequisite: EECS 360.

EECS 645 Computer Architecture (3). The structure and design of computing systems. Examination and analysis of computing systems. Examination and analysis of instruction set architectures, pipelined control and arithmetic units, vector processors, memory hierarchies, and performance evaluation.
Prerequisite: EECS 388.

EECS 647 Introduction to Database Systems (3). Introduction to the concept of databases and their operations. Basic concepts, database architectures, storage structures and indexing, data structures: hierarchical, network, and relational database organizations. Emphasis on relational databases and retrieval languages SQL, QBE, and ones based on relational algebra and relational calculus; brief description of predicate calculus. Theory of databases, normal forms, normalization, candidates keys, decomposition, functional dependencies, multivalued dependencies. Introduction to the design of a simple database structure and a data retrieval language. Prerequisite: EECS 448.

EECS 648 Software Engineering Tools (3). This course focuses on the software engineering tools and practices currently in use in the industry, supporting the complete software development lifecycle. The course provides hands-on experience with current software development tools. Topics include software engineering artifacts, team structure and roles, work contracts, requirements elicitation and analysis, specifications, supplementary specifications, use-case models, activity diagrams, use-case specifications, traceability, technical design, design review meetings, coding standards, code quality, code reviews, and modern software engineering tools. Prerequisite: EECS 448.

EECS 649 Introduction to Artificial Intelligence (3). General concepts, search procedures, two-person games, predicate calculus and automated theorem proving, nonmonotonic logic, probabilistic reasoning, rule based systems, semantic networks, frames, dynamic memory, planning, machine learning, natural language understanding, neural networks. Corequisite: EECS 368.

EECS 660 Fundamentals of Computer Algorithms (3). Basic concepts and techniques in the design and analysis of computer algorithms. Models of computations. Simple lower bound theory and optimality of algorithms. Computationally hard problems and the theory of NP-Completeness. Introduction to parallel algorithms. Prerequisite: EECS 560 and either EECS 461 or MATH 526.

EECS 662 Programming Languages (3) Formal definition of programming languages including specification of syntax and semantics. Simple statements including precedence, infix, prefix, and postfix notation. Global properties of algorithmic languages including scope of declaration, storage allocation, grouping of statements, binding time of constituents, subroutines, co-routines, and tasks. Run-time representation of program and data structures. Prerequisite: EECS 368 and EECS 388 and EECS 560.

EECS 663 Introduction to Communication Networks (3). An introduction to the principles used in communication networks is given in this course. Topics include a discussion of the uses of communications networks, network impairments, standards, the ISO reference model for organizing network functions. Telephone networks are introduced as well as emerging ISDN and B-ISDN systems. Switching and signaling within the telephone system are specifically addressed. Local Area Network technology and protocols are discussed. Link and network layer protocols are introduced. Basic concepts of network performance evaluation are studied, both analytical and simulation techniques are considered. Prerequisite: EECS 168 and EECS 461.

EECS 665 Compiler Construction (3). Compilation of simple expressions and statements. Organization of a compiler including symbol tables, lexical scan, syntax scan, object code generation, error diagnostics, code optimization techniques, and overall design. Compilation techniques and run-time structures in a block-structured language such as PASCAL or B. Use of compiler writing languages and boot-strapping. Prerequisite: EECS 368, EECS 448 and EECS 510.

EECS 670 Introduction to Semiconductor Processing (3). An overview of various processes to fabricate semiconductor devices and integrated circuits. Topics covered include crystal growth, oxidation, solid-state diffusion, ion implantation, photolithography, chemical vapor deposition, epitaxial growth, metalization, and plasma etching of thin films. (Same as C&PE 655) Prerequisite: senior standing in C&PE or EE, or consent of instructor.

EECS 672 Introduction to Computer Graphics (3). Foundations of 2D and 3D computer graphics. Structured graphics application programming. Basic 2D and 3D graphics algorithms (modeling and viewing transformations, clipping, projections, visible line/surface determination, basic empirical lighting and shading models), and aliasing. Prerequisite: EECS 448.

EECS 678 Introduction to Operating Systems (3). The purpose of the course is to provide the students with the concepts necessary to enable them to: (a) identify the abstract services common to all operating systems, and explore the many variations possible, (b) define the basic operating system components that carry out these machine independent abstractions, (c) understand how the entire system fits together, not merely how one or two important parts interact, and (d) understand the means by which fundamental problems in operating systems can be analyzed. Prerequisite: EECS 388 and EECS 448.

EECS 690 Special Topics: __ (1-3). Arranged as needed to present appropriate material to groups of students. May be repeated for additional credit. Prerequisite: Upper-level EECS eligibility and consent of instructor.

EECS 692 Directed Reading (1-3). Reading under the supervision of an instructor on a topic chosen by the student with the advice of the instructor. May be repeated for additional credit. Consent of the department required for enrollment.
Prerequisite: Upper-level EECS eligibility and consent of instructor.
EECS 700 Special Topics ___ (1-5). Courses on special topics of current interest in electrical engineering, computer engineering, or computer science, given as the need arises. May be repeated for additional credit. Prerequisite: variable.
EECS 713 High Speed Digital Circuit Design (3). Basic concepts and techniques in the design and analysis of high-frequency digital and analog circuits. Topics include: transmission lines, ground and power planes, layer stacking, substrate materials, terminations, vias, component issues, clock distribution, cross-talk, filtering and decoupling, shielding, signal launching. Prerequisite: EECS 312 and senior or graduate standing. EECS 420 recommended.
EECS 716 Formal Language Theory (3). Formal language generation by grammars, recognition by automata (finite and pushdown automata, Turing machines), and equivalence of these formulations; elementary containment and closure properties. Emphasis on context-free, deterministic context-free and regular languages. Prerequisite: EECS 510 or EECS 805 or equivalent.
EECS 720 Electromagnetics for Communications and Radar (3). Topics in electromagnetics relevant to wireless communications, optics and fiberoptics, radar and remote sensing. Subjects covered include space waves, guided waves, radiation and antennas, scattering, electromagnetic properties of materials, and optics. Prerequisite: EECS 420 or equivalent.
EECS 721 Antennas (3). Gain, Pattern, and Impedance concepts for antennas. Linear, loop, helical, and aperture antennas (arrays, reflectors, and lenses). Cylindrical and biconical antenna theory. Prerequisite: EECS 360, EECS 420, or EECS 720. Infrequently offered.
EECS 722 Mathematical Logic (3). Propositional Calculus. First order theories and model theory. Elementary arithmetic and Godel's incompleteness theorems. (Same as MATH 722) Prerequisite: MATH 765 or MATH 791, or equivalent evidence of mathematical maturity.
EECS 723 Microwave Engineering (3-4). Survey of microwave systems, techniques, and hardware. Guided-wave theory, microwave network theory, active and passive microwave components. The four-hour version of the course includes a laboratory. Prerequisite: EECS 420.
EECS 735 Automated Theorem Proving (3). Computer-based theorem-proving methods for selected domains such as plane geometry, symbolic integral calculus, and propositional calculus are reviewed. Mechanical theorem-proving procedures for the first-order predicate calculus are studied in depth. Includes resolution, semantic resolution, hyper-resolution, linear resolution, and paramodulation. Applications of these procedures to areas such as proofs of program correctness, deductive question answering, problem solving, and program synthesis. Prerequisite: EECS 730 and a knowledge of mathematical logic equivalent to that supplied by EECS 210. Infrequently offered.
EECS 740 Digital Image Processing (3). This course gives a hands on introduction to the fundamentals of digital image processing. Topics include: image formation, image transforms, image enhancement, image restoration, image reconstruction, image compression, and image segmentation. Prerequisite: EECS 672 or EECS 744.
EECS 741 Computer Vision (3). This course gives a hands-on introduction to the fundamentals of computer vision. Topics include: image formation, edge detection, image segmentation, line-drawing interpretation, shape from shading, texture analysis, stereo imaging, motion analysis, shape representation, object recognition. Prerequisite: EECS 672 or EECS 744.
EECS 742 Digital Video for Multimedia Systems (3). An introduction to digital video for multimedia systems. Topics include basics of digital video, capture and non-linear editing, video feature detection (temporal segmentation, motion estimation), content based video classification, video compression techniques and standards (MPEG-1, 2, 4, 7), video streaming, and multimedia applications. Digital video tools and techniques will be utilized in several programming projects. Prerequisite: EECS 740 or equivalent.
EECS 744 Digital Signal Processing I (3). Discrete fourier transforms, design of digital filters, fast fourier transform algorithms, and its application to signal processing, description of DSP chips and introduction to quantization error. Prerequisite: EECS 360.
EECS 745 High Performance Integrated Networks (3). Processing requirements for integrated networks and associated applications. Principles of VLSI architectures. Overview of selected network functions, including scrambling and descrambling, synchronization, cell switching, routing, bandwidth shaping and policing, encryption, and decryption. Implementation of network functions using high performance special-purpose architectures. Examples of processors for high speed networks. Prerequisite: EECS 663.
EECS 747 Mobile Robotics (3). Design, construction, and programming of mobile robots. Topics include computational hardware, designing and prototyping, sensors, mechanics, motors, power, robot programming, robot design principals, and current research in mobile robotics.
EECS 749 Knowledge Based Systems (3). General concepts of intelligent problem solving, rule-based systems, reasoning under uncertainty, associative networks, model-based reasoning blackboards, object-oriented systems, case-based reasoning, induction, neural networks. Students may not earn credit in both EECS 749 and CE 792. Prerequisite: EECS 649, EECS 730 or equivalent.
EECS 750 Operating System (3). An analytical treatment of the structures and theoretical foundations of operating systems and related systems, and of their design and implementation. Cooperating and distributed processes, memory and store management strategies, resource sharing and queuing, concurrency control, and system protection and security. Other topics such as design methodologies, fault tolerance, languages for distributed programming, and communication protocols will also be discussed. Prerequisite: EECS 678 and one of EECS 461, MATH 526, or MATH 627.
EECS 752 Concurrent Software Systems (3). Introduction to design and implementation of concurrent (multi-threaded, parallel, or distributed) software systems. The course examines problems and solutions common to all concurrent software, including interference, deadlock, consensus, resource allocation, coordination, global predicate evaluation, ways of expressing concurrency, concurrent I/O, debugging, fault tolerance, and heterogeneity. Prerequisite: EECS 448 and EECS 678.
EECS 753 Embedded and Real Time Computer Systems (3). This course will cover emerging and proposed techniques and issues in embedded and real time computer systems. Topics will include new paradigms, enabling technologies, and challenges resulting from emerging application domains. Prerequisite: EECS 645 and EECS 678.
EECS 755 System Requirements Modeling and Analysis (3). Modern software engineering techniques for modeling and analyzing software systems. Course coverage concentrates on pragmatic, formal modeling techniques that support predictive analysis.
EECS 761 Programming Paradigms (3). An investigation of alternative programming paradigms and their representative effect on programming expressiveness and style. Emphasis is on a comparative understanding of a spectrum of programming paradigms, with some facility in the use of at least one typical language representative of each paradigm studied. The course will review and investigate as appropriate imperative, functional, object-oriented, parallel, and logical programming paradigms, plus additional paradigms as relevant. Prerequisite: EECS 662 or EECS 807 or equivalent.
EECS 762 Programming Language Foundation (3).

Relationship between syntactic, static-semantic, and semantic structures. Attribute grammars as models for static-semantic information processing. Survey of formal semantic models, including operational, denotational, and axiomatic examples. Related static-semantic, semantic, and programming language issues. Prerequisite: EECS 662 or EECS 807 or equivalent.

EECS 764 Analysis of Algorithms (3). Models of computations and performance measures; asymptotic analysis of algorithms; basic design paradigms including divide-and-conquer, dynamic programming, backtracking, branch-and-bound, greedy method and heuristics; design and analysis of approximation algorithms; lower bound theory; polynomial transformation and the theory of NP-Completeness; additional topics may be selected from arithmetic complexity, graph algorithms, string matching, and other combinatorial problems. Prerequisite: EECS 660 or EECS 805 or equivalent.

EECS 767 Information Retrieval (3). The objective of this course is to give students a hands on introduction to information retrieval systems. Classic textual information retrieval systems are studied, followed by presentation of current research in the area. Topics include: file structures, term-weighting schemes, text preprocessing, World Wide Web search engines, multimedia retrieval systems, artificial intelligence applications. Prerequisite: EECS 647 or permission of instructor.

EECS 773 Advanced Graphics (3). Advanced topics in graphics and graphics systems. Techniques for scientific visualization and photorealistic rendering. Ray tracing; radiosity; volumetric rendering; antialiasing; animation. Specialized modeling tech-niques like particle systems and recursive constructions. Collaborative interaction and visualization. Prerequisite: EECS 672.

EECS 774 Geometric Modeling (3). Introduction to the representation, manipulation, and analysis of mathematical models of physical objects with applications to mechanical computer-aided design and manufacturing (CAD/ CAM). Basic geometric analysis tools. Implicit and parametric representations of curves and surfaces. Curve and surface design and display techniques. Curve and surface intersections. Solid modelling representations and algorithms. Boolean set operations on solid models and the boundary evaluation algorithm. Geometric modeling system architectures. Project developed in C. Prerequisite: EECS 672.

EECS 781 Numerical Analysis I (3). Finite and divided differences. Interpolation, numerical differentiation, and integration. Gaussian quadrature. Numerical integration of ordinary differential equations. Curve fitting. (Same as Math 781). Prerequisite: Math 320 and knowledge of a programming language.

EECS 782 Numerical Analysis II (3). Direct and interactive methods for solving systems of linear equations. Numerical solution of partial differential equations. Numerical determination of eigenvectors and eigenvalues. Solution of nonlinear equations. (Same as MATH 782) Prerequisite: EECS 781.