UNDERGRADUATE HANDBOOK

Electrical Engineering
Computer Engineering
Computer Science

For students admitted
to the EECS Program in Fall 2003

The Department of Electrical Engineering
and Computer Science
School of Engineering
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Last updated 3/11/2003
Table of Contents

School of Engineering 3
Is engineering for me? 3
What degrees are offered? 3
What can I do with an engineering degree? 3
What is the faculty like? 3
Why is there an engineering fee? 3
How do I get into the School? 4
Transfer Admission Standards 4
Can I get a scholarship? 4
Where can I get more information? 4
Why should I choose KU? 4

The Department of Electrical Engineering and Computer Science 5

Electrical Engineering 6
  Program Objectives 6
  Requirements for BS 6
  Suggested Course Sequence 7
  Course Flow Chart 7
  BSEE Requirements Checklist 8

Computer Engineering 9
  Program Objectives 9
  Requirements for BS 9
  Suggested Course Sequence 10
  Course Flow Chart 10
  BSCoE Requirements Check List 11

Computer Science 12
  Program Objectives 12
  Requirements for BS 12
  Suggested Course Sequence 13
  Course Flow Chart 13
  BSCS Requirements Check List 14

Departmental Academic Policies 15
Transfer Credits 15
Academic Requirements 15
  Fresh.-Soph. Academic Requirements 15
  Junior-Senior Academic Requirements 15
  Graduation Requirements 15
Scheduling Your Time 16

Advising and Enrollment 16
  Auditors 16
  Change of Advisor 16
  Change of Major 16
  Curriculum Changes 17
  Credit by Exam for EECS 258 17
  Double major 17
  Graduate Courses 17
  Limitation on Enrollment 17
  Minimum and Maximum Enrollments 17
  Substitutions 17
  Dropping a Course 18
  Readmission 18
  Course Repeat Policy 19
  Academic Misconduct 19

Honors Program 19
  University and School of Engineering Honors 19
  Departmental Honors 19

Frequently Asked Questions 20
  a. Sequence Order for Completion of Class Requirements 20
  b. Credit/No Credit 20
  c. English 20
  d. ROTC Courses 20
  e. Speech Exemption 20

Entry to the Profession 20
  Job Search Assistance 20
  Licensing 20

Student Activities/Organizations 20
  Engineering Student Council 20
  Honor Societies 20
  Minorities and Women 20
  Engineering Diversity Program 21
  Women's Engineering Program 21
  National Engineering Societies 21
  Student Publication 21

Catalog Description of Courses Offered by the EECS Department 22

For students admitted Fall 2003
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 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 $14 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

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.
university level, and trend of grades. High school transcripts and ACT scores are required. Equivalent SAT scores may be substituted. Undergraduate enrollment quotas have been established for each department. Once a department quota or the school quota is met, admissions may be closed. The total number of out-of-state and international students is limited to 40 percent of enrollment.

You must have graduated in the top half of your high school class and have a mathematics score of 22 or higher (28 or higher for direct admission into the EECS department) on the ACT exam to be considered. 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 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.

For students admitted Fall 2003
The Department of Electrical Engineering and Computer Science

Costas Tsatsoulis, Acting Chair

The technological advances that have made our modern society what it is today are due in large part to the efforts of electrical engineers, computer engineers, and computer scientists. Among these technological advances are radio, television, telephones, 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, home entertainment products, radar, defense electronics, and computer software for home, government, and business.

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.

The mission of the Department of Electrical Engineering and Computer Science is to educate the next generation of electrical engineers, computer engineers, and computer scientists, to advance the state of knowledge through research, to strive to promote economic development for the state, and to engage in service to the public and the profession.

Electrical engineering involves the research, design, development, manufacture, and operation of electrical and electronic devices, components, and systems. Electrical engineering students can specialize in a variety of engineering design areas, including traditional analog electronics, communications systems, computer systems, digital electronics, microwave and radar systems, solid-state devices, and fiber optic systems.

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 engineering is related to both electrical engineering and computer science. Computer engineering involves the research, design, development, manufacture, and operation of computing products and systems. Computer engineering students get a solid foundation in math, chemistry, physics, the structure and design of computer systems, computer communications, and software design. Throughout, the concept of design is emphasized.

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 science involves the study of algorithms, computability, computer applications, and systems of computation. Subfields of computer science include programming languages, analysis of algorithms, operating systems, numerical analysis, artificial intelligence, graphics, database and information management, and networking. Students in computer science receive a well-balanced education in mathematics, natural sciences and liberal arts. The computer science curriculum balances the theory of computation with applied computer science. KU’s computer science curriculum emphasizes general problem-solving techniques and the use of abstraction. Early courses in the curriculum constitute a layer-by-layer approach to problem solving by computer. In parallel, theoretical models of computing principles are presented, and students gain a deep understanding of the nature, meaning and limits of computing.

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, 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.
Electrical Engineering

Electrical engineering involves research, design, development, manufacture and operation of electrical and electronic devices, components, and systems. Electrical engineering students can specialize in a variety of engineering design areas, including traditional analog electronics, communications systems, computer systems, digital electronics, microwave and radar systems, solid-state devices, and fiber optic systems.

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

Course List for Senior Electives:
Any EECS course 400 or above, except for EECS 603. Under unusual circumstances other courses can be considered, but only with an accompanying petition.

Requirements for EECS Honors (2 credit hours)
EECS 498 Honors Research 2
See page 19 for full details of the requirements to graduate with department honors.

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

General Electives (6 credit hours)

General Elective 1 3
General Elective 2 3

Two 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.

For students admitted fall 2003:

- Engineering: Any course from any Engineering Department numbered 200 or above, except for ENGR 300, ENGR 504 and ME 328.
- Natural Science: Any course designated as NB, NE, or NP by the 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).
- Math: Any MATH course numbered 500 or above, except MATH 701.
- Business: Any course from the School of Business, except statistics and computing.

English (6 credit hours)

ENGL 101 Composition 3
ENGL 102 Composition and Literature 3

Communications Elective (3 credit hours)
One of the following courses:
ENGL 362 Professional Writing: Technical Writing
COMS 130 Speaker-Audience Communications

Humanities/Social Science (15 credit hours)

One class from Set 1:
ECON 142 Principles of Microeconomics (preferred) or ECON 144 Principles of Macroeconomics

One class from Set 2:
POLS 110 Introduction to US Politics
POLS 150 Introduction to Comparative Politics
POLS 170 Introduction to International Politics

One class from Set 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

Electives 4 and 5 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 can count as humanities (H) courses.
For students admitted Fall 2003

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 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
- 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 Suggested Course Sequence

Eligibility Established  Prerequisite  Corequisite

H/SS  1
- FALL 1st Sem.  16 hours  1 lab

H/SS  2
- SPRING 2nd Sem.  15 hours  1 lab

H/SS  3
- FALL 3rd Sem.  16 hours  2 labs

H/SS  4
- SPRING 4th Sem.  15 hours  2 labs

H/SS  5
- FALL 5th Sem.  17 hours  2 labs

SPRING 6th Sem.  17 hours  2 labs

FALL 6th Sem.  16 hours  2 labs

SPRING 7th Sem.  16 hours  2 labs

FALL 7th Sem.  16 hours  2 labs

SPRING 8th Sem.  16 hours  2 labs

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.

ENGL 101  \rightarrow ENGL 102

MATH 121  \rightarrow MATH 122

CHEM 184  \rightarrow PHSX 211

H/SS 1  \rightarrow H/SS 2

EECS 312  \rightarrow EECS 360

EECS 211  \rightarrow EECS 212

EECS 240  \rightarrow EECS 388

EECS 258  \rightarrow EECS 220

EECS 211  \rightarrow EECS 360

EECS 212  \rightarrow EECS 312

EECS 240  \rightarrow EECS 220

EECS 258  \rightarrow EECS 420

EECS 211  \rightarrow EECS 312

EECS 240  \rightarrow EECS 312

EECS 258  \rightarrow EECS 420

EECS 360  \rightarrow EECS 412

EECS 388  \rightarrow EECS 444

EECS 312  \rightarrow EECS 412

EECS 420  \rightarrow EECS 412

EECS 443  \rightarrow EECS 501

EECS 444  \rightarrow EECS 502

EECS 420  \rightarrow EECS 502

EECS 312  \rightarrow EECS 502

EECS 470  \rightarrow Sr. Elect. 1

EECS 461  \rightarrow Sr. Elect. 2

EECS 501  \rightarrow Sr. Elect. 3

EECS 502  \rightarrow Sr. Elect. 3

H/SS 1  \rightarrow H/SS 2

H/SS 2  \rightarrow H/SS 3

H/SS 3  \rightarrow H/SS 4

H/SS 4  \rightarrow H/SS 5

COMS  \rightarrow Sr. Elect. 1

Gn. Elect. 1  \rightarrow Sr. Elect. 2

Sr. Elect. 1  \rightarrow Sr. Elect. 3

Sr. Elect. 2  \rightarrow Sr. Elect. 3

Sr. Elect. 3  \rightarrow Sr. Elect. 3

Gn. Elect. 2  \rightarrow Sr. Elect. 3

H/SS 5  \rightarrow Sr. Elect. 3

FALL 1st Semester

SPRING 2nd Semester

FALL 3rd Semester

SPRING 4th Semester

FALL 5th Semester

SPRING 6th Semester

FALL 7th Semester

SPRING 8th Semester

For students admitted Fall 2003
# BSEE Requirements Checklist

Name: _____________________________

Advisor: ___________________________

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<th>COURSE</th>
<th>SEM.</th>
<th>GRADE</th>
<th>MATH</th>
<th>SCIENCE</th>
<th>ENGINEERING TOPICS</th>
<th>EDUCATION</th>
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<th>TOTALS</th>
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*Senior Electives (3 classes, 9 hrs.)*

|                      |       |       | 3    | 3       |                     |           |       |        |

**Mathematics (18)**

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**Basic Science (17)**

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**General Electives (6 hrs. total)**

|                      |       |       | 3    | 3       |                     |           |       |        |

**English, Comms., Humanities & Social Science (24)**

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**TOTALS**

|                     | 18   | 17   | 63   | 24   | 6     | 128   |
Computer Engineering

Computer engineering involves the research, design, development, manufacture, and operation of computing products and systems; combining aspects of both electrical engineering and computer science. Computer engineering students get a solid foundation in math, chemistry, physics, the structure and design of computer systems, computer communications, and software design.

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:

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Senior electives 9

Course List for Senior Electives:

Any EECS course 400 or above, except for EECS 603. Under unusual circumstances other courses can be considered, but only with an accompanying petition.

Requirements for EECS Honors (2 credit hours)

EECS 498 Honors Research 2

See page 19 for full details of the requirements to graduate with department honors.

Mathematics (22 credit hours)

<table>
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Basic Science (17 credit hours)

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<td>EECS 220 Electromagnetics I</td>
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<td>PHSX 313 Physics III</td>
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<tr>
<td>NATURAL SCIENCE (Lab based)</td>
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General Electives (3 credit hours)

General Elective 3

One class 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 as long as it is 200 and above, except for ENGR 300, ENGR 504 and ME 328.
- Natural Science: Any course designated as NB, NE, or NP by the College of Liberal Arts and Sciences except PHSX 111, PHSX 112, PHSX 114, PHSX 115, PHSX 212 and CHEM 125 (if CHEM 184 or its equivalent was taken for Science).
- Math: Any MATH course numbered 500 or above, except MATH 701.
- Business: Any course from the School of Business, except statistics and computing.

English (6 credit hours)

<table>
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<td>ENGL 102 Composition and Literature</td>
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Communications Elective (3 credit hours)

One of the following courses: 3

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<td>ENGL 362 Professional Writing: Technical Writing</td>
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<tr>
<td>COMS 130 Speaker-Audience Communications</td>
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Humanities/Social Science (15 credit hours)

One class from Set 1: 3

<table>
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<td>ECON 144 Principles of Macroeconomics</td>
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One class from Set 2: 3

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<tr>
<td>POLS 150 Introduction to Comparative Politics</td>
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<td>POLS 170 Introduction to International Politics</td>
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</table>

One class from Set 3: 3

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<td>PHIL 365 Moral Issues in the Professions</td>
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<tr>
<td>PHIL 375 Moral Issues in the Computer Technology</td>
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</tbody>
</table>

H/SS Elective 4 3

H/SS Elective 5 3

Electives 4 and 5 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 courses designated “H” (humanities) or “S” (social sciences) which have a principal course as a prerequisite are 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 can count as humanities (H) courses.
Computer Engineering Suggested Course Sequence

For students admitted Fall 2003

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.

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

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

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

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

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

SPRING 6th Semester
EECS 443 4
EECS 448 3
EECS 461 3
PHSX 313 4
COMS Elective 3
Total 17 hrs.

FALL 7th Semester
EECS 541 3
EECS 645 3
EECS 663 3
Sr. Elective 1 3
Gen. Elective 3
Total 15 hrs.

SPRING 8th Semester
EECS 542 3
EECS 678 3
Sr. Elective 2 3
Sr. Elective 3 3
H/SS 5 3
Total 15 hrs.
# BSCoE Requirements Checklist

Name: _________________________________________

Advisor: ________________________________________

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<th>COURSE</th>
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<th>SCIENCE</th>
<th>ENGINERINGS</th>
<th>TOPICS</th>
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For students admitted fall 2003
Computer Science

Computer science involves the study of algorithms, computability, computer applications, and systems of computation. Subfields of computer science include programming languages, analysis of algorithms, operating systems, numerical analysis, artificial intelligence, graphics, database and information management, and networking.

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

1. Demonstrate a broad understanding of principles underlying all developments in modern computing and the competence to apply that knowledge in the real world.
2. Are educated in state-of-the-art techniques for application of the science to the needs of industry and society.

Requirements for the Bachelor of Science in Computer Science Degree

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

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Course List for Senior Electives:
EECS 638, 647, 649, 663, 665, 672, 690 (if so indicated in the course description and/or the timetable for that semester) and any EECS course 700 or above. Under unusual circumstances other courses can be considered, but only with an accompanying petition.

Requirements for EECS Honors (2 credit hours)
EECS 498 | Honors Research | 2 |
See page 19 for full details of the requirements to graduate with department honors.

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 | 5 |
EECS 210 | Discrete Structures | 4 |
EECS 461 | Probability and Statistics | 3 |

Basic Science (14-18 credit hours)
PHSX 211 | Physics I | 4 |
PHSX 212 | Physics II | 4 |

Science Electives (two courses) 6-10
(Courses satisfying science elective 1 and 2 must be chosen from the following list: ASTR 291, BIOL 150, BIOL 152, BIOL 413, CHEM 184, CHEM 188, GEOG 104, GEOG 304, GEOL 101.

General Electives (1-5 credit hours)
General elective hours plus basic science hours must be greater than or equal to 19. General elective hours must come from the following list of technical, scientific, and professional courses:

- EECS: Any course except EECS 100, EECS 128, EECS 138, EECS 498, and EECS 603.
- Western Civilization: Any course in Western Civilization.

- Non-Western Culture: Any Non-Western Culture course listed in Undergraduate Catalog (pages 57-58).
- Foreign Language (classes other than English or a student’s native language). The Dean’s Office can verify if the foreign language class being taken is one that can be used to help fulfill the General Electives Requirements.
- Engineering: Any course from any Engineering Department as long as it is 200 and above, except for ENGR 300, ENGR 504 and ME 328.
- Natural Science: Any course designated as NB, NE, or NP by the College of Liberal Arts and Sciences except PHSX 111, PHSX 112, PHSX 114, PHSX 115 and CHEM 125 (if CHEM 184 or its equivalent was taken for Science).
- Math: Any MATH course numbered 500 or above, except MATH 701.
- Business: Any course from the School of Business, except statistics and computing.

English (9 credit hours)
ENGL 101 | Composition | 3 |
ENGL 102 | Composition & Literature | 3 |
ENGL 362 | Professional Writing: Technical Writing | 3 |
ENGL 2XX | | |

Communications (3 credit hours)
COMS 130 | Speaker-Audience Communication | 3 |

Philosophy (3 credit hours)
PHIL 375 | Moral Issues in Computer Technology | 3 |
PHIL 365 | Moral Issues in the Professions | 3 |

Humanities/Social Science (18 credit hours)
Three courses from Humanities 9
(from at least two different departments)
Three courses from Social Sciences 9
(from at least two different departments)

These courses 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 and each semester’s offerings from this list are found in an appendix in that semester’s timetable. Any courses designated “H” (humanities) or “S” (social sciences) which have a principal course as a prerequisite are also acceptable. Additionally, all western civilization (HWC) courses can count as humanities (H) courses.
<table>
<thead>
<tr>
<th>FALL 1st Semester</th>
<th>SPRING 2nd Semester</th>
<th>FALL 3rd Semester</th>
<th>SPRING 4th Semester</th>
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<tr>
<td>ENGL 101 3</td>
<td>ENGL 102 3</td>
<td>EECS 240 4</td>
<td>EECS 210 4</td>
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<tr>
<td>MATH 121 5</td>
<td>MATH 122 5</td>
<td>EECS 258 4</td>
<td>EECS 268 4</td>
</tr>
<tr>
<td>Science Elective 1 3-5</td>
<td>PHSX 211 4</td>
<td>MATH 250 or 123 5</td>
<td>PHSX 212 4</td>
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<td>H/SS 1 3</td>
<td>H/SS 3 3</td>
<td>H/SS 3 3</td>
<td>PHIL ___ 3</td>
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<td>14-16 hrs.</td>
<td>15 hrs.</td>
<td>16 hrs.</td>
<td>ENGL 362 3</td>
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<tr>
<th>FALL 5th Semester</th>
<th>SPRING 6th Semester</th>
<th>FALL 7th Semester</th>
<th>SPRING 8th Semester</th>
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<tbody>
<tr>
<td>EECS 368 3</td>
<td>EECS 461 3</td>
<td>EECS 645 3</td>
<td>EECS 678 3</td>
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<tr>
<td>EECS 388 4</td>
<td>EECS 510 3</td>
<td>EECS 660 3</td>
<td>Sr. Elective 3 3</td>
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<tr>
<td>EECS 448 3</td>
<td>EECS 560 3</td>
<td>EECS 662 3</td>
<td>Sr. Elective 4 3</td>
</tr>
<tr>
<td>COMS 130 3</td>
<td>H/SS 4 3</td>
<td>Sr. Elective 1 3</td>
<td>H/SS 6 3</td>
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<td></td>
<td>15-17 hrs.</td>
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<td>13-17 hrs.</td>
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</table>

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.

Eligibility Established: Prerequisite, Corequisite

For students admitted Fall 2003
# BSCS Requirements Checklist

## Core Computer Science Classes (22 hrs. total)
- **EECS 240** Intro. to Digital Logic Design 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 Sysms & Assembly Lang. 4 1 1 2
- **EECS 448** Software Engineering 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
- **EECS 660** Fundamentals of Cmptr Algorithms 3 3
- **EECS 662** Programming Languages 3
- **EECS 678** Intro to Operating Systems 3 .5 .5 2

Senior Electives (4 classes, 12 hrs)
- **EECS**
- **EECS**
- **EECS**
- **EECS**

Total Advanced Accreditation Minima (16-24 hrs. required) 30 3 4.5 2 .5 3 5

## Mathematics (22 hrs. total)
- **MATH 121** Calculus I 5 5
- **MATH 122** Calculus II 5 5
- **MATH** 123 or 250 5 5
- **MATH**
- **EECS 210** Discrete Structures 4 4
- **EECS 461** Probability and Statistics 3 3

## Science (14-18 hrs. total)
- **PHSX 211** Physics I 4 4
- **PHSX 212** Physics II 4 4
- **PHSX**
- **PHSX**

## 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**
- **PHIL** Moral Issues in ________________
- **COMS 130** Speaker-Audience Communication 3 3

He&S Electives (6 classes, 18 hours)
- **COMS**
- **COMS**
- **COMS**
- **COMS**

## General Electives (1-5 hrs. total)
- **COMS**
- **COMS**

**TOTALS** 74 22 14-18 33 1-5

For students admitted Fall 2003
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
- MATH 121, 122, MATH/ENGR 250
- EECS 211, 212, 220, 240, 258, 268
- 13 courses

**CS Major**
- ENGL 101, 102
- MATH 121, 122, MATH/ENGR 250
- 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. Be officially enrolled in the School of Engineering while completing the last 30 hours of credit toward the degree.

**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 enroll-
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 approval by the EECS 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. Permission of the Graduate School is not required for courses numbered 700-799, but it is recommended that undergraduates consult with the instructor prior to enrolling if they do not have at least a B average, including a grade of B or better in each of the prerequisite courses.

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.
For students admitted Fall 2003

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 signature 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 required on all enrollment, add, and drop forms (not Change of Section forms). This is to ensure that the student has consulted with his/her advisor and understands the various implications of the drop. 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 AND your advisor’s signature are needed on the add/drop dates.

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.
   a. If the course is taught by the Engineering School, a “W” (withdrew passing) or “F” is recorded on the student’s transcript according to the instructor’s judgment of the student’s status in the class at the time of withdrawal.
   b. If the course is taught by Liberal Arts and Sciences, a W is recorded on the student’s transcript regardless of the student’s actual status in the course.
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 re-
mained 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 EECS Office, 2001 Eaton Hall, or 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 by the EECS Undergraduate Committee, followed by review and a decision from the Dean’s office.

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.

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 2001 or 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 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 have achieved 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.
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 a 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 senior 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.

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 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 organization plans 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 Courses
Offered by the EECS Department

EECS 100 Programming Short Course: _____ (1) U. Brief courses designed to provide the student with a working knowledge of a particular programming language. Several different languages may be taught including FORTRAN, C++, JAVA, and others as the need arises. Each section will treat only one of these languages. The student will write programs of moderate complexity in the given language. Prerequisite: EECS 138 or equivalent.

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 and MATH 121.

EECS 211 Circuits I (3). Analysis of linear electrical circuits: Kirchhoff’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: MATH 122 and PHSX 211.

EECS 250 Engineering Systems Analysis (2.5). Development of models for mechanical, electrical, and structural systems using linear differential equations. Solution of these systems of equations for students admitted Fall 2005.
EECS 40 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. Prerequisites: 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: EECS 220 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, 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...
For students admitted Fall 2005

EECS 625 Introduction to Radar (3). Basic radar principles. Radar range equation. Pulsed and cw modes of operation for detection, ranging, and extracting Doppler 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 644 Introduction to Digital Signal Processing (3). Discrete time signal and systems theory, sampling theorem, x-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 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 for students admitted Fall 2005. Given in this course. Topics include a discussion of the use 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 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 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.

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 800 Special Topics: ________** (1-5). Advanced 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 801 Directed Graduate Readings** (1-3). Graduate level directed readings on a topic in electrical engineering, computer engineering, or computer science, mutually agreed-on by the student and instructor. May be repeated for credit on another topic. Prerequisite: Consent of Instructor.

**EECS 802 EECS Colloquium** (2). A colloquium series featuring speakers from industry, government, other universities, and research organizations on the university campus presenting talks on various topics related to electrical engineering, computer engineering, and computer science. Course will be graded Satisfactory/Fail. No prerequisite.

**EECS 810 Principles of Software Engineering** (3) Practical concepts of software engineering with a focus on management issues as well as formalism; modern software development process models; project management, requirements analysis, specification, design, implementation, testing, maintenance; metrics and planning. This course is intended for EECS graduate students (focusing in software engineering or computer science) as well as others with a strong interest in software engineering methodologies. The course will be project-intensive and will serve as a preparation for other graduate software engineering courses. Prerequisite: EECS 448 and 560 or equivalent. Not open to students who have taken EECS 848.

**EECS 811 Software Project Management** (3) Process management in the context of software development; building productive teams; measuring performance; management issues in the creation, development, and maintenance of software. Various estimate techniques, planning, risk analysis, project administration and configuration management; fundamentals of software process modeling and definition; process improvement, frameworks for quality software, process properties and measurements, capability maturity evaluation, validation and verification, applications of TQM and SQA to software process improvement. Prerequisite: EECS 810.

**EECS 812 Software Requirements Engineering** (3) Objectives, processes, and activities of requirements engineering and requirements management; characteristics of good requirements; types of requirements; managing changing requirements; languages, notations and methodologies; formal and semiformal methods of presenting and validating the requirements; requirements standards; traceability issues. Prerequisite: EECS 810.

**EECS 814 Software Quality Assurance** (3) Software quality for students admitted Fall 2005 engineering as an integral facet of development, from requirements through deliver, maintenance, and process improvement; how to carry out inspections, manual and automated static analysis techniques, fundamental concepts in software testing, verification, validation, test case selection, testing strategies such as black-box testing, white-box testing, integration testing, regression testing, systems testing, acceptance testing, design for testability, fundamental concepts in software integration, configuration management, models for quality assurance; documentation; industry and government standards for quality. Prerequisite: EECS 810.

**EECS 816 Object-Oriented Software Development** (3) Abstract data types, objects and classes, class associations, modeling with objects, domain modeling, use case modeling, iterative and incremental development, object-oriented analysis and design, components, frameworks, UML and Unified Process, reusability, design patterns, object management, and CORBA. Prerequisite: EECS 810

**EECS 818 Software Architecture** (3) Design methodologies, software architectural qualities; architectural styles; architecture and design; common architectural patterns and reuse; domain specific architectures; tradeoff analysis, software architecture case studies, architectural styles; the analysis of an architecture. Prerequisite: EECS 810 and EECS 816.

**EECS 821 Adaptive Antenna Arrays for Communications and Radar** (3). Description and analysis of antenna arrays that have dynamically adjustable patterns. Topics include phased array antennas, digital beamforming in element and beam space; adaptive beamforming algorithms; error effects; relationship between multiple access schemes such as FDMA, TDMA, DCMA, and SDMA; mobile satellite, indoor, and radar applications; and current antenna, transceiver, and DSP technology. Prerequisite: EECS 420, EECS 461, and EECS 744 or equivalent.

**EECS 823 Microwave Remote Sensing** (3). Description and analysis of basic microwave remote sensing systems including radars and radiometers as well as the scattering and emission properties of natural targets. Topics covered include plane wave propagation, antennas, radometers, atmospheric effects, radars, calibrated systems, and remote sensing applications. Prerequisite: EECS 420 and EECS 622.


**EECS 828 Advanced Fiber-Optic Communications** (3). An advanced course in fiber-optic communications. The course will focus on various important aspects and applications of modern fiber-optic communications, ranging from photonic devices to systems and networks. Topics include: advanced semiconductor laser devices, external optical modulators, optical amplifiers, optical fiber nonlinearities and their impact in WDM and TDM optical systems, polarization effect in fiber-optic systems, optical receivers and high-speed optical system performance evaluation, optical soliton systems, lightwave analog video transmission, SONET & ATM optical networking and advanced multi-access lightwave networks. Prerequisite: EECS 628 or equivalent.

**EECS 830 Advanced Artificial Intelligence** (3). A detailed examination of computer programs and techniques that manifest intelligent behavior, with examples drawn from current literature. The nature of intelligence and intelligent behavior. Development of, improvement to, extension of, and generalization from artificially intelligent systems, such as theorem-provers, pattern recognizers, language analyzers, problem-solvers, question answerers, decision-makers, planners, and learners. Prerequisite: EECS 730.

**EECS 833 Neural Networks and Fuzzy Systems** (3). Fundamental theory of adaptive systems, Introduction to Artificial Neural Networks (ANN) and learning algorithms, neural computers, pattern classification, using neural networks, and hop-field networks.
Introduction to fuzzy sets and fuzzy relations, fuzzy-model-based classification and control, fusion of fuzzy models with neural networks, applications of fuzzy-neural networks in engineering problems. Prerequisite: Permission of the instructor.


EECS 844 Digital Signal Processing for Communications and Radar (3). This course focuses on the design and implementation of communication and radar systems using digital signal processing algorithms. Subjects include digital filters, modulation and demodulation algorithms, subsampling techniques, adaptive algorithms for filters and antennas, DSP microprocessors, and other software radio principles. Prerequisite: EECS 744 or permission of instructor.


EECS 848 Software Engineering II (3). This course is a continuation of the material presented in EECS 448 on the design and specification phase for production software. It includes a major project which will be carried out as a group effort. Students will be required to specify, design and document, and implement a major component of a combined project. Prerequisite: EECS 448 or equivalent. Not open to students who have taken EECS 810.

EECS 849 Multiagent Systems (3) In depth look at the area of multiagent systems (MAS). An intelligent agent is an autonomous software program that exists on a computing device or is embedded in a robot, acts on behalf of a user and has various degrees of the following attributes: reasoning, communication, learning, and mobility. A MAS is a collection of intelligent agents that may collaborate to solve a problem or set of problems, or may be in an adversarial relationship in areas of limited resources. Prerequisite: One class in Artificial Intelligence or permission of instructor.

EECS 861 Random Signal Theory (3). An extension of probabilistic modeling introducing random processes and spectral representation. Special emphasis on filtering and estimation including Wiener, Kalman, matched, pre and de emphasis filtering. Prerequisite: EECS 360 and EECS 461.

EECS 862 Principles of Digital Communication Systems (3). A study of communication systems using noisy channels. Principal topics are: information and channel capacity, baseband data transmission, digital carrier modulation, error control coding, and digital transmission of analog signals. The course includes a laboratory/computer aided design component integrated into the study of digital communication systems. Prerequisite: EECS 562. Co-requisite: EECS 861.

EECS 863 Analysis of Communication Networks (3). Modeling and analysis for performance prediction of communication networks. Topics include: an introduction to queueing theory; analysis of TDM systems; modeling and analysis of networks of queues; analysis of congestion and flow control algorithms; analysis of routing algorithms; analysis of bus and ring networks. Prerequisite: EECS 562 and EECS 861.

EECS 864 Multilwavelength Optical Networks (3). Introduce methodologies for multilwavelength optical network analysis, design, control and survivability. Prerequisite: EECS 663.

EECS 865 Wireless Communication Systems (3). The theory and practice of the engineering of wireless telecommunication systems. Topics include cellular principles, mobile radio propagation (including indoor and outdoor channels), radio links calculations, fading (including Rayleigh, Rician, and other models), packet radio, equalization, diversity, error correction coding, spread spectrum, multiple access techniques (including time, frequency, and code), & wireless networking. Current topics of interest will be covered. Corequisite: EECS 861.

EECS 868 Statistics of Random Processes (3)*. An introduction to the theory and practice of estimating the models and parameters of stochastic models used in communications and pattern recognition. Prerequisite: EECS 861. Infrequently offered.


EECS 888 Internet Routing Architectures (3). A detailed study of routing in IP networks. Topics include evolution of the Internet architecture, IP services and network characteristics, an overview of routing protocols, the details of common interior routing protocols and interdomain routing protocols, and the relationship between routing protocols and the implementation of policy. Issues will be illustrated through laboratories based on common routing platforms. Prerequisite: EECS 745.

EECS 891 Graduate Problems (0.5-3). Directed studies of advanced phases of electrical engineering, computer engineering, or computer science not covered in the regular graduate courses, including advanced laboratory work, special research or library reading. Prerequisite: Consent of Instructor.

EECS 899 Master's Thesis or Report (1-6). Group discussions of selected topics and reports on the progress of original investigations. Prerequisite: Consent of instructor.

EECS 962 Advanced Modulation and Coding (3). Study of coding subsytems and techniques within a digital communication system. Analysis of the effects of combined modulation and coding. Commercial and military applications of spread spectrum modulation for interference suppression. Prerequisite: EECS 862.

EECS 963 Integrated Telecommunication Networks (3). Description and analysis of telecommunication networks designed to integrate different types of traffic and provide different user services. Integrated Services Digital Network (ISDN), Broadband ISDN and Asynchronous Transfer Mode (ATM). “Fast packet” transport of speech, image, video. Source modeling, performance analysis, and congestion control techniques for integrated networks. Prerequisite: either EECS 863 or EECS 866.

EECS 964 Simulation of Communication Systems (3)*. This course will cover both fundamental and advanced concepts of simulation based analysis and design of communication systems. Monte Carlo simulation principles, modeling techniques, and performance estimation procedures will be discussed. Case studies in simulating satellite, optical and digital microwave links will be presented and the students will be exposed to state of the art simulation packages. Prerequisite: EECS 861 and EECS 862. Infrequently offered.

EECS 967 Mathematical Optimization with Communications Applications (3). A mathematical study of various methods for minimizing (or maximizing) functions. Optimization problem formulation. Linear, nonlinear, integer, dynamic programming. Conditions for optimal points. Convergence of algorithms. Stochastic optimization. Application to communications network design, error control coding, system modeling, etc. Prerequisite: Graduate standing in the School of Engineering and EECS 861. Infrequently offered.

EECS 969 Information Theory and Coding II (3) Advanced topics in information theory and coding. Current research trends. New developments in error correction coding, data compression, special channels, and combined modulation/coding. Applications from telecommunications, economics, computer science, physics, the biological sciences, and other areas. Lectures by the instructor. Class discussion. Readings from the literature. Student papers and presentations. Prerequisite: EECS 869.

EECS 998 Post-Master's Research (1-6).
EECS 999 Doctoral Dissertation (1-12).