

EECS Department

Undergraduate Handbook

Lawrence Campus Programs

Bachelor of Science Degrees in:

**Electrical Engineering
Computer Engineering
Computer Science
Interdisciplinary Computing**

For students admitted
to the EECS Department for

Fall 2014

Electrical Engineering and Computer Science

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Revised 12/5/14

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School of Engineering

Michael Branicky, Dean

Kyle Camarda, Associate Dean of Undergraduate Studies

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Is engineering or computer science 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 Bachelor of Science (BS) degrees in 13 disciplines. They are aerospace engineering, architectural engineering, chemical engineering, civil engineering, computer engineering, computer science, electrical engineering, information technology, engineering physics, environmental engineering, interdisciplinary computing, mechanical engineering, and petroleum engineering.



What can I do with an engineering or computer science degree?

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

What is the faculty like?

Engineering faculty members are nationally recognized leaders in education and research. KU faculty members are leaders in many engineering societies. Their work is widely published in professional journals. You will get the chance to interact with faculty members outside the classroom and lab. Engineering faculty members participate in a variety of activities with students.

Why is there an engineering fee?

You will pay a special fee in addition to regular tuition and fees for School of Engineering courses. The fee, which is on a per-credit-hour basis for all School of Engineering courses, helps the School maintain and operate lab equipment and computers and provide other student services. Because you will tend to take more School of Engineering courses each semester as you advance, the fee you pay will tend to increase each year.



How do I get into the School?

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

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

You must have graduated in the top half of your high school class and have a mathematics score of 28 or higher on the ACT exam (or be otherwise eligible to take Math 121) to be directly admitted into the EECS Department. You should 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 into 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. Entering first-year students should submit KU's Undergraduate Application for Admission and Scholarships, available online at www.admissions.ku.edu, to the University of Kansas Office of Admissions and Scholarships, KU Visitor Center, 1520 Iowa St., Lawrence, KS 66045, (785)864-3911. The office will see that applicants are considered for any scholarships for which they are eligible. The application deadline to be considered is November 1.

The Engineering Diversity Program also makes scholarships available to students who are African American, Hispanic American or Native American. 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, email, or call the University of Kansas School of Engineering, Kyle Camarda, Associate Dean, 1520 West 15th Street, 1 Eaton Hall, Lawrence, KS 66045, kuengr@ku.edu, (785)864-3881; or visit the website at www.engr.ku.edu.

With so many engineering and computer science programs available, why 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 (CAC) of ABET. Interdisciplinary Computing is also under the jurisdiction of CAC, but is not yet eligible for accreditation. The Information Technology program is also not yet eligible for accreditation.

❖ 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

Students can supplement and advance their academic programs by participating in student chapters of national engineering and computer science 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 and demonstrate principles of engineering and computer science.



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 science, radar remote sensing, computer-integrated manufacturing, automatic control systems, and other fields.

Electrical Engineering and Computer Science

Glenn Prescott, Chair



The technological advances that have made our modern society what it is today are due largely to the efforts of electrical engineers, computer engineers, and computer scientists. Among these advances are radio, television, telephones, wireless communications, cellular telephones, personal computers, workstations, mainframe computers, aircraft avionics, satellite electronics,

automobile electronics, office machinery, medical electronic equipment, video games, electric power generation and distribution systems, telecommunications, computer networks (including the Internet), home entertainment products, radar, defense electronics, artificial intelligence, and a wide range of computer software.

The EECS Department offers five Bachelor of Science degrees: Electrical Engineering (BSEE), Computer Engineering (BSCoE), Computer Science (BSCS), Interdisciplinary Computing (BSIC), and Information Technology (BSIT) which is offered on the Edwards campus. Each features a firm grounding in the fundamentals of mathematics, basic science, and computer science and/or engineering science, with advanced studies in the theory and design of systems of various kinds, as well as hands-on experience. The BSEE, BSCoE and BSCS degrees are accredited; the BSIC and BSIT degrees are not yet eligible for accreditation.

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

Electrical engineers can find professional opportunities in a multitude of environments. The telecommunications, computer, and power industries are obvious examples, but other 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.

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

Computer engineering graduates can expect to find jobs in digital hardware design, software engineering, and the integration of hardware and software in developing microprocessors, personal computers, workstations, mainframe computers, embedded systems, and computer communication networks. The demand for engineers to design and implement a wide variety of sophisticated computing systems will likely continue to rise.

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

Computer science graduates find jobs in many different industrial and governmental settings. 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.

Interdisciplinary computing couples a very strong computer science component with a thorough background in one of five concentrations: astronomy, biology, chemistry, geography, or physics. Graduates will apply their computing expertise to a variety of large-scale problems of scientific importance.

Interdisciplinary computing professionals are likely to collaborate with scientists or other professionals in industrial, government, or academic laboratories. The ever-increasing computational sophistication of scientific studies demands professionals who have computing expertise in addition to scientific training, which is exactly what Interdisciplinary Computing provides.

Career opportunities for graduates with electrical engineering, computer engineering, computer science, interdisciplinary computing degrees are available in many areas of specialization, in many industrial, commercial, academic, and government environments, and in many geographic locations in this country and abroad. Expertise in any of these areas is of vital importance to any high technology organization. In addition, a Bachelor of Science degree in one of these areas prepares a student for continued technical studies at the graduate level or in other professional schools such as medicine or law.

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

Vision

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

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

Mission

The Mission of the EECS Dept. is:

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

Common Degree Requirements

The KU Core

Effective Fall 2013, the KU Core is the university-wide curriculum that all incoming undergraduate students will complete as part of their degree requirements. The KU Core spans the undergraduate experience. It comprises three general education goals and three advanced education goals. Associated with each goal are one or more learning outcomes.

CODE	GOAL/OUTCOME	DESCRIPTION
GE11	Goal 1/Outcome 1	Critical Thinking
GE12	Goal 1/Outcome 2	Quantitative Literacy
GE21	Goal 2/Outcome 1	Written Communication (2 units)
GE22	Goal 2/Outcome 2	Oral Communication
GE3H	Goal 3/Outcome 1	Arts & Humanities
GE3N	Goal 3/Outcome 2	Natural Sciences
GE3S	Goal 3/Outcome 3	Social Sciences
AE41	Goal 4/Outcome 1	Diversity
AE42	Goal 4/Outcome 2	Culture
AE51 or AE52	Goal 5/Outcome 1	Social Responsibility & Ethics (course or practice)
AE61	Goal 6/Outcome 1/2	Integration & Creativity

Details of the KU Core goal and learning outcomes can be found at <http://kucore.ku.edu>.

Some required courses in the EECS curricula satisfy a KU Core goal and/or outcome. For these courses, the goal/outcome code is given in parentheses after the course on the following Degree Requirements pages. Where required courses do NOT specifically satisfy KU Core goals (Goals 2, 3 and 4) students must choose from a list of several means to satisfy the required goals. Information about satisfying the KU Core goals can be found at <http://kucore.ku.edu>.

Natural Science Electives

Courses satisfying natural science electives for CS majors must be chosen from the following list: ASTR 391, BIOL 150, BIOL 152, CHEM 130, CHEM 135, CHEM 150, GEOG (104+105), GEOG 304 or GEOL 101. To count as one elective both GEOG 104 and 105 must be taken.

Professional Electives

The intent of the Professional Electives is to allow students to prepare for a variety of professional careers (management, medical school, interdisciplinary, etc.). Courses are chosen from the following list (other courses may be petitioned):

- EECS: Any course except EECS 128, EECS 137, EECS 138, EECS 315, EECS 316, EECS 317, EECS 318, EECS 498 and 692. Also, EECS 645 may not be used by CoE majors, neither EECS 461 nor EECS 643 may be used by CS majors, and only one of EECS 643 and EECS 645 may be used to satisfy EE degree requirements.
- Engineering: Any course from any Engineering Department numbered 200 or above, except for AE 211, ENGR 300, ENGR 504, ME 208, ME 228 and any computing courses.
- Natural Science: Any course designated as GE3N except PHSX 111, PHSX 112, PHSX 114, PHSX 115, and PHSX 212. Also, you cannot use CHEM 125 if you have already taken (or will take) CHEM 130 or CHEM 150. If a course used for the natural science elective exceeds the required natural science elective hours, then excess hours will be considered Professional Elective hours.
- Math: Any MATH course numbered 500 or above, except MATH 701.
- Business: Any course from the School of Business that applies towards a Business major or minor, except for Statistics and Computing courses.

Senior Electives

EE and CoE majors may choose any EECS course 400 or above, excluding EECS 498 and EECS 692. Also, EECS 645 may not be used by CoE majors, and only one of EECS 643 and EECS 645 may be used to satisfy EE degree requirements. For CS majors, senior electives must be chosen from EECS 563, 565, 638, 647, 648, 649, 672, 690 and any EECS course 700 or above. Senior electives for IC majors are any of the CS senior electives plus EECS 645, EECS 660, EECS 662, and EECS 665.

Under unusual circumstances other courses can be petitioned as Senior Electives, subject to approval.

Electrical Engineering

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

Program Educational Objectives for Electrical Engineering

Graduates who have earned a Bachelor's Degree in Electrical Engineering, within a few years following graduation, will have demonstrated technical proficiency, collaborative activities, and professional development.

Technical Proficiency - Graduates will have achieved success and visibility in their chosen careers as shown by technical accomplishments in industry, government, entrepreneurial activities, or academia.

Collaborative Activities - Graduates will have exercised shared responsibilities through activities such as contributions to multi-person or multi-disciplinary technical projects, participation in professional society/organization functions, or performing collaborative research. In all such cases, graduates will have contributed to documentation of the collaborative activities.

Professional Development - Graduates will have demonstrated continual technical updating to extend their expertise and adapt to a changing environment through graduate studies; short courses, conferences, and seminars; or professional self-study. In addition, graduates will have demonstrated evidence of increasing technical and/or managerial impact.

Requirements for the degree of Bachelor of Science in Electrical Engineering

A total of 129 credit hours❖ is required for the BSEE degree, as follows:

Electrical Engineering (64 credit hours)	HRS	SEM	GRD	Professional Electives (6 credit hours) ❖	HRS	SEM	GRD
EECS 101 New Student Seminar (part of AE51)	1	_____	_____	Professional Elective 1	3	_____	_____
EECS 140 Intro to Digital Logic Design ♦	4	_____	_____	Professional Elective 2	3	_____	_____
EECS 168 Programming I ♦	4	_____	_____	Satisfy GE21: Written Communication (6 hours) ❖			
EECS 211 Circuits I	3	_____	_____	(Typically satisfied by ENGL 101 & 102)	3	_____	_____
EECS 212 Circuits II	4	_____	_____		3	_____	_____
EECS 312 Electronic Circuits I	3	_____	_____	Satisfy GE22: Oral Communication (3 hours) ❖			
EECS 360 Signal & System Analysis	4	_____	_____	(Typically satisfied by COMS 130)	3	_____	_____
EECS 388 Embedded Systems	4	_____	_____	Arts/Humanities/Social Science (9 hours)			
EECS 412 Electronic Circuits II	4	_____	_____	ECON 142 Principles of Microeconomics			
EECS 420 Electromagnetics II	4	_____	_____	(preferred) or			
EECS 443 Digital Systems Design	4	_____	_____	ECON 144 Principles of Macroeconomics (GE3S)	3	_____	_____
EECS 444 Control Systems	3	_____	_____	Satisfy GE3H: Arts/Humanities❖	3	_____	_____
EECS 470 Electrical Devices & Properties of Materials	3	_____	_____	Additional Arts/ Humanities/Social Science from GE3H or GE3S lists	3	_____	_____
EECS 501 Senior Design Lab I (part of AE51)	3	_____	_____	Satisfy AE41 and AE42: Diversity, Global Awareness (6 hours)❖			
EECS 502 Senior Design Laboratory II (AE61)	3	_____	_____		3	_____	_____
EECS 562 Intro to Communication Systems	4	_____	_____		3	_____	_____
Senior electives ❖	3	_____	_____		3	_____	_____
	3	_____	_____		3	_____	_____
	3	_____	_____				
Mathematics (18 credit hours)							
MATH 121 Calculus I (GE12)	5	_____	_____	♦ Students with even KUIDs take EECS 140 in fall and EECS 168 in spring. Those with odd KUIDs take EECS 168 in fall and EECS 140 in spring.			
MATH 122 Calculus II	5	_____	_____	❖ Means of satisfying KU Core Goals are chosen from a variety of options (see http://kucore.ku.edu). Hours listed are assuming the goals are satisfied with course work.			
MATH 220 Applied Differential Equations	3	_____	_____	❖ Six hours of Professional Electives are chosen from a list of engineering, math, natural science or business courses (see page 4).			
MATH 290 Elementary Linear Algebra	2	_____	_____	❖ Nine hours of Senior Electives are chosen from EECS courses at 400 level or above (see page 4).			
EECS 461 Probability and Statistics	3	_____	_____				
Basic Science (17 credit hours)							
CHEM 130/ General Chemistry I or CHEM 150 Chemistry for Engineers	5	_____	_____				
PHSX 210 General Physics I for Engrs (GE11)	3	_____	_____				
PHSX 216 General Physics I Lab (part of AE51)	1	_____	_____				
EECS 220 Electromagnetics I	4	_____	_____				
PHSX 313 General Physics III (GE3N)	3	_____	_____				
PHSX 316 Intermediate Physics lab 1	1	_____	_____				

Electrical Engineering Suggested Course Sequence

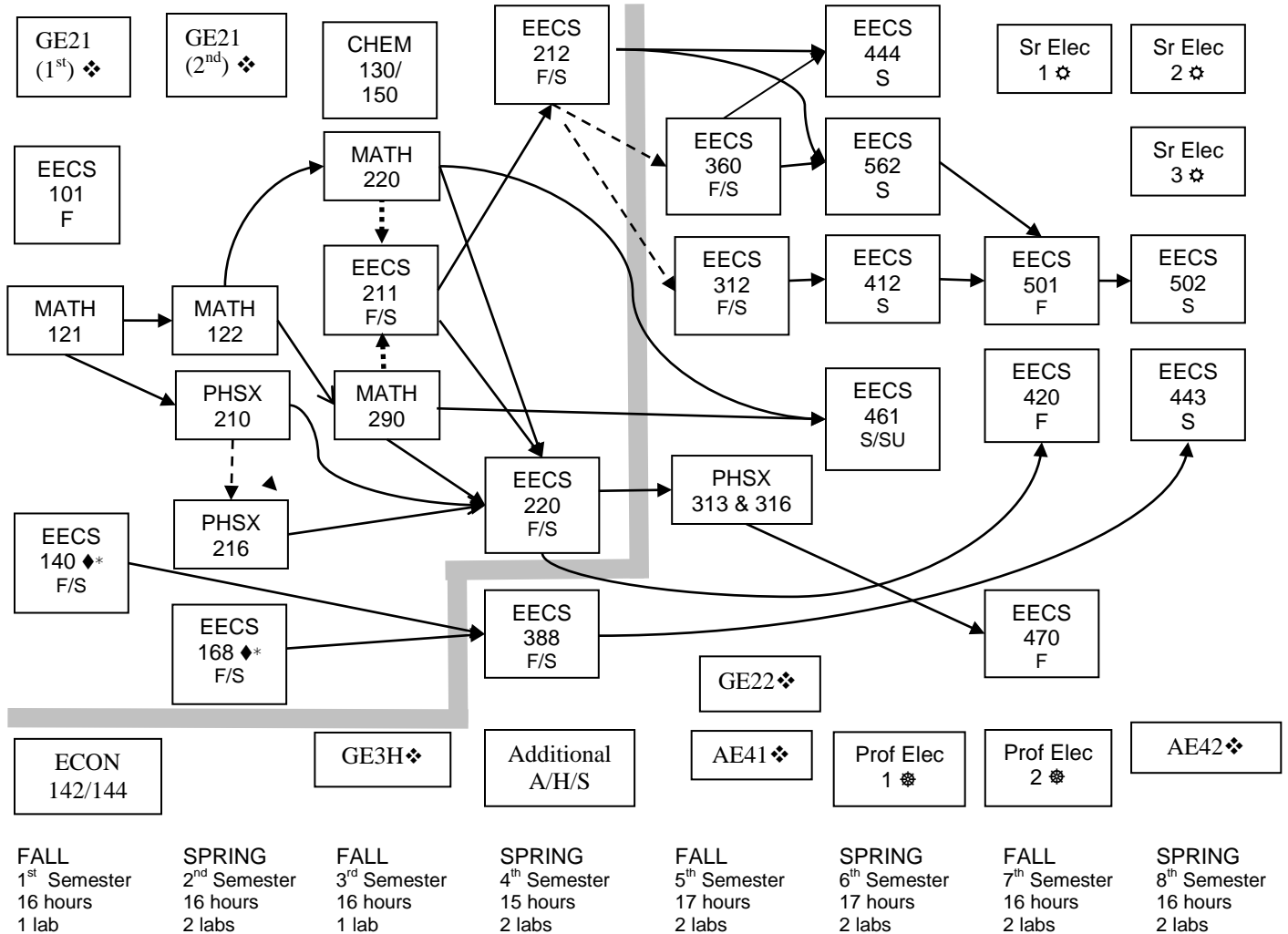
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Fall 1 st Semester	Spring 2 nd Semester	Fall 3 rd Semester	Spring 4 th Semester
EECS 101 1	GE21 (second)❖ 3	EECS 211 3	EECS 212 4
GE21 (first)❖ 3	MATH 122 5	MATH 220 3	EECS 220 4
MATH 121 5	PHSX 210 3	MATH 290 2	EECS 388 4
EECS 140 or 168 ♦ 4	PHSX 216 1	CHEM 130 or 150 5	Additional A/H/S 3
ECON 142/144 3	EECS 168 or 140 ♦ 4	GE3H❖ 3	
Total Hours 16	Total Hours 16	Total Hours 16	Total Hours 15

Fall 5 th Semester	Spring 6 th Semester	Fall 7 th Semester	Spring 8 th Semester
EECS 312 3	EECS 412 4	EECS 420 4	EECS 443 4
PHSX 313 & 316 4	EECS 444 3	EECS 470 3	EECS 502 3
EECS 360 4	EECS 461 3	EECS 501 3	Sr. Elective 2 ❖ 3
AE41❖ 3	EECS 562 4	Sr. Elective 1 ❖ 3	Sr. Elective 3 ❖ 3
GE22❖ 3	Professional Elective 1 ❖ 3	Professional Elective 2❖ 3	AE42❖ 3
Total Hours 17	Total Hours 17	Total Hours 16	Total Hours 16

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.



Computer Engineering

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

Program Educational Objectives for Computer Engineering

Graduates who have earned a Bachelor's Degree in Computer Engineering, within a few years following graduation, will have demonstrated technical proficiency, collaborative activities, and professional development.

Technical Proficiency - Graduates will have achieved success and visibility in their chosen careers as shown by technical accomplishments in industry, government, entrepreneurial activities, or academia.

Collaborative Activities - Graduates will have exercised shared responsibilities through activities such as contributions to multi-person or multi-disciplinary technical projects, participation in professional society/organization functions, or performing collaborative research. In all such cases, graduates will have contributed to documentation of the collaborative activities.

Professional Development - Graduates will have demonstrated continual technical updating to extend their expertise and adapt to a changing environment through graduate studies; short courses, conferences, and seminars; or professional self-study. In addition, graduates will have demonstrated evidence of increasing technical and/or managerial impact.

Requirements for the Bachelor of Science in Computer Engineering Degree

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

Computer Engineering (67 credit hours)				HRS	SEM	GRD	Professional Electives (3 credit hours) ✨			
EECS 101	New Student Seminar (part of AE51)	1					Professional Elective 1	3		
EECS 140	Intro to Digital Logic Design ♦	4					Satisfy GE21: Written Communication (6 hours) ❖			
EECS 168	Programming I ♦	4					(Typically satisfied by ENGL 101 & 102)	3		
EECS 211	Circuits I	3						3		
EECS 212	Circuits II	4					Satisfy GE22: Oral Communication (3 hours) ❖			
EECS 268	Programming II	4					(Typically satisfied by COMS 130)	3		
EECS 312	Electronic Circuits I	3					Arts/Humanities/Social Science 9 hours)			
EECS 360	Signal & System Analysis	4					ECON 142 Principles of Microeconomics			
EECS 368	Program. Language Paradigms	3					(preferred) or			
EECS 388	Embedded Systems	4					ECON 144 Principles of Macroeconomics (GE3S)	3		
EECS 443	Digital Systems Design	4					Satisfy GE3H: Arts/Humanities❖	3		
EECS 448	Software Engineering I	4					Additional Arts/ Humanities/Social Science			
EECS 541	Comp Sys Design Lab I (Part of AE51)	3					from GE3H or GE3S lists	3		
EECS 542	Comp Sys Design Lab II (AE61)	3					Satisfy AE41 and AE42: Diversity, Global Awareness (6 hours)❖			
EECS 563	Intro to Communication Networks	3						3		
EECS 643	Advanced Computer Organization	3						3		
EECS 678	Introduction to Operating Systems	4						3		
Senior electives ✨		3								
		3								
		3								
Mathematics (22 credit hours)										
MATH 121	Calculus I (GE12)	5								
MATH 122	Calculus II	5								
MATH 220	Applied Differential Equations	3								
MATH 290	Elementary Linear Algebra	2								
EECS 210	Discrete Structures	4								
EECS 461	Probability and Statistics	3								
Basic Science (12 credit hours)										
PHSX 210	General Physics I for Engrs (GE11)	3								
PHSX 216	General Physics I Lab (part of AE51)	1								
EECS 220	Electromagnetics I	4								
PHSX 313	General Physics III (GE3N)	3								
PHSX 316	Intermediate Physics lab 1	1								

- ♦ Students with even KUIDs take EECS 140 in fall and EECS 168 in spring. Those with odd KUIDs take EECS 168 in fall and EECS 140 in spring.
- ❖ Means of satisfying KU Core Goals are chosen from a variety of options (see <http://kucore.ku.edu>). Hours listed are assuming the goals are satisfied with course work.
- ✨ Three hours of Professional Electives are chosen from a list of engineering, math, natural science or business courses (see page 4).
- ❖ Nine hours of Senior Electives are chosen from EECS courses at 400 level or above (see page 4).

Computer Engineering Suggested Course Sequence

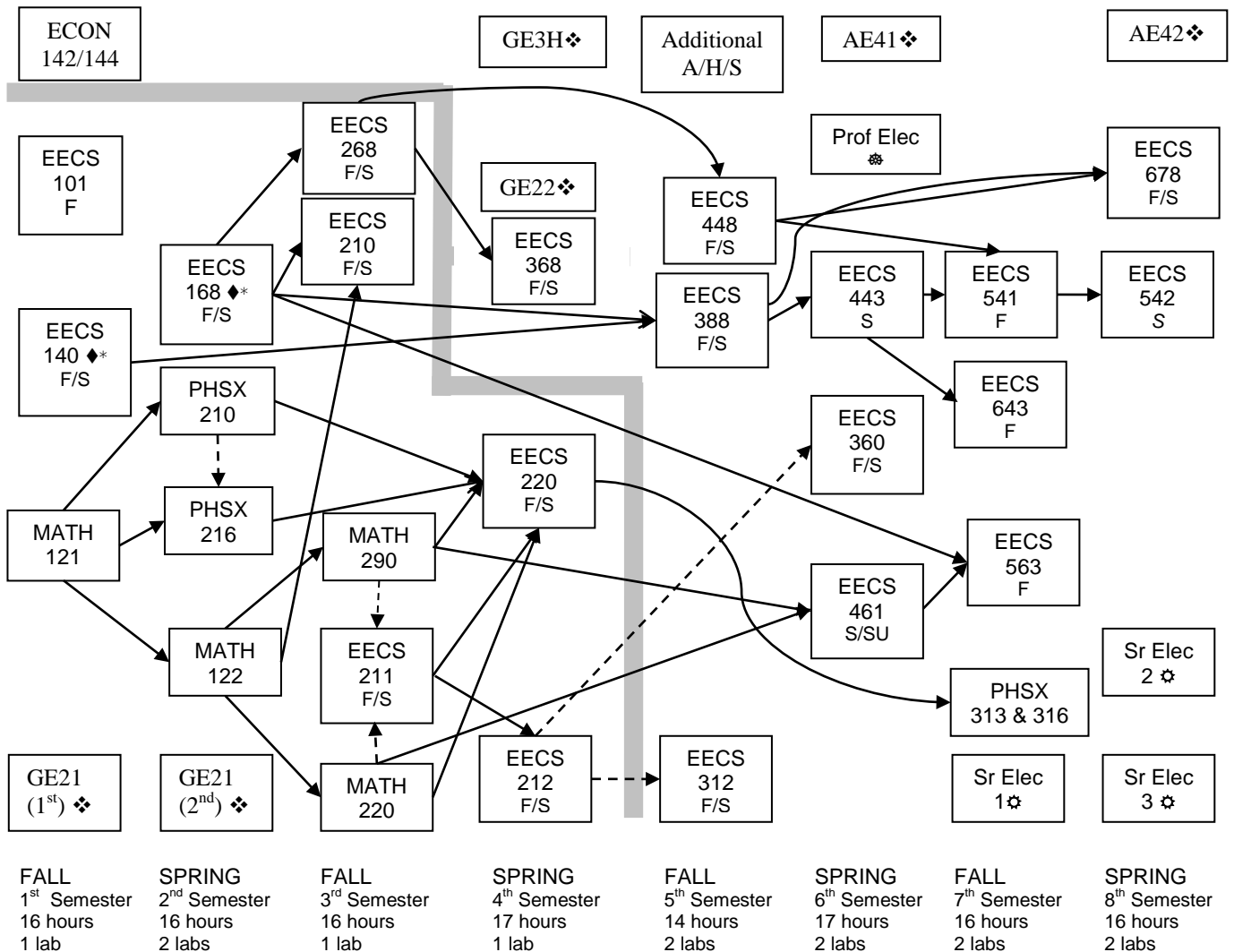
(Symbol key on previous page)

Fall 1 st Semester	Spring 2 nd Semester	Fall 3 rd Semester	Spring 4 th Semester
EECS 101 1	GE21 (second)❖ 3	EECS 210 4	EECS 212 4
GE21 (first)❖ 3	MATH 122 5	EECS 211 3	EECS 220 4
MATH 121 5	PHSX 210 3	EECS 268 4	EECS 368 3
EECS 140 or 168 ♦ 4	PHSX 216 1	MATH 220 3	GE22 ❖ 3
ECON 142/144 3	EECS 168 or 140 ♦ 4	MATH 290 2	GE3H❖ 3
Total Hours 16	Total Hours 16	Total Hours 16	Total Hours 17

Fall 5 th Semester	Spring 6 th Semester	Fall 7 th Semester	Spring 8 th Semester
EECS 312 3	EECS 360 4	EECS 541 3	EECS 542 3
EECS 388 4	EECS 443 4	EECS 563 3	EECS 678 4
EECS 448 4	EECS 461 3	EECS 643 3	Sr. Elective 2 ⚙ 3
Additional A/H/S 3	AE41❖ 3	Sr. Elective 1 ⚙ 3	Sr. Elective 3 ⚙ 3
	Professional Elective ⚙ 3	PHSX 313 & 316 4	AE42❖ 3
Total Hours 14	Total Hours 17	Total Hours 16	Total Hours 16

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.



*Assumes even KUID

Upper Level Eligibility Established
 Prerequisite
 Corequisite

F=course offered in Fall only; S=course offered in Spring only; F/S=course offered in Fall and Spring; S/SU=course offered in Spring and Summer

Computer Science

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

Program Educational Objectives for Computer Science

Graduates who have earned a Bachelor's Degree in Computer Science, within a few years following graduation, will have demonstrated technical proficiency, collaborative activities, and professional development.

Technical Proficiency - Graduates will have achieved success and visibility in their chosen careers as shown by technical accomplishments in industry, government, entrepreneurial activities, or academia.

Collaborative Activities - Graduates will have exercised shared responsibilities through activities such as contributions to multi-person or multi-disciplinary technical projects, participation in professional society/organization functions, or performing collaborative research. In all such cases, graduates will have contributed to documentation of the collaborative activities.

Professional Development - Graduates will have demonstrated continual technical updating to extend their expertise and adapt to a changing environment through graduate studies; short courses, conferences, and seminars; or professional self-study. In addition, graduates will have demonstrated evidence of increasing technical and/or managerial impact.

Requirements for the Bachelor of Science in Computer Science Degree

A total of 129 credit hours❖ is required for the BSCS degree, as follows:

Computer Science (66 credit hours)				Professional Electives (3 credit hours) ✨			
	HRS	SEM	GRD		HRS	SEM	GRD
EECS 101 New Student Seminar (part of AE51)	1	_____	_____	Professional Electives	3	_____	_____
EECS 140 Intro to Digital Logic Design ◆	4	_____	_____	Satisfy GE21: Written Communication (6 hours) ❖			
EECS 168 Programming I ◆	4	_____	_____	(Typically satisfied by ENGL 101 & 102)	3	_____	_____
EECS 268 Programming II	4	_____	_____				
EECS 368 Program. Language Paradigms	3	_____	_____	Satisfy GE22: Oral Communication (3 hours) ❖			
EECS 388 Embedded Systems	4	_____	_____	(Typically satisfied by COMS 130)	3	_____	_____
EECS 448 Software Engineering I	4	_____	_____				
EECS 510 Intro to Theory of Computing	3	_____	_____	Arts/Humanities/Social Science (12 hours)			
EECS 560 Data Structures	4	_____	_____	Satisfy GE3H: Arts/Humanities❖	3	_____	_____
EECS 581 CS Design I (part of AE51)	3	_____	_____	Satisfy GE3S: Social Science❖	3	_____	_____
EECS 582 CS Design II (AE61)	3	_____	_____	Additional Arts/Humanities from GE3H list	3	_____	_____
EECS 645 Computer Architecture	3	_____	_____	Additional Social Science from GE3S list	3	_____	_____
EECS 660 Fund of Comp Algorithms	3	_____	_____	Satisfy AE41 and AE42: Diversity, Global Awareness (6 hours)❖			
EECS 662 Programming Languages	3	_____	_____		3	_____	_____
EECS 665 Compiler Construction	4	_____	_____		3	_____	_____
EECS 678 Intro to Operating Systems	4	_____	_____				
Senior Electives ✨	3	_____	_____				
	3	_____	_____				
	3	_____	_____				
	3	_____	_____				
Mathematics (22 credit hours)							
MATH 121 Calculus I (GE12)	5	_____	_____	◆ Students with even KUIDs take EECS 140 in fall and EECS 168 in spring. Those with odd KUIDs take EECS 168 in fall and EECS 140 in spring.			
MATH 122 Calculus II	5	_____	_____	❖ Means of satisfying KU Core Goals are chosen from a variety of options (see http://kucore.ku.edu). Hours listed are assuming the goals are satisfied with course work.			
MATH 223 Vector Calculus ♣	3	_____	_____	✨ Three hours of Professional Electives are chosen from a list of engineering, math, natural science or business courses (see page 4).			
MATH 290 Elementary Linear Algebra ♣	2	_____	_____	⚙ Natural Science Electives (1 course, 3 hours) are chosen from a list of courses (see page 4). Excess natural science hours count as Professional Elective hours.			
MATH 526 Applied Mathematical Statistics I	3	_____	_____	⚙ Twelve hours of Senior Electives are chosen from a list of EECS courses (see page 4).			
EECS 210 Discrete Structures	4	_____	_____	♣ Honors MATH 143 is credited as both MATH 223 and MATH 290 and will satisfy these requirements.			
Basic Science (11 credit hours)							
PHSX 210 General Physics I for Engrs (GE11)	3	_____	_____				
PHSX 216 General Physics I Lab (part of AE51)	1	_____	_____				
PHSX 212 General Physics II (GE3N)	3	_____	_____				
PHSX 236 General Physics II, Lab	1	_____	_____				
Natural Science Elective (one course) ⚙	3	_____	_____				

Computer Science Suggested Course Sequence

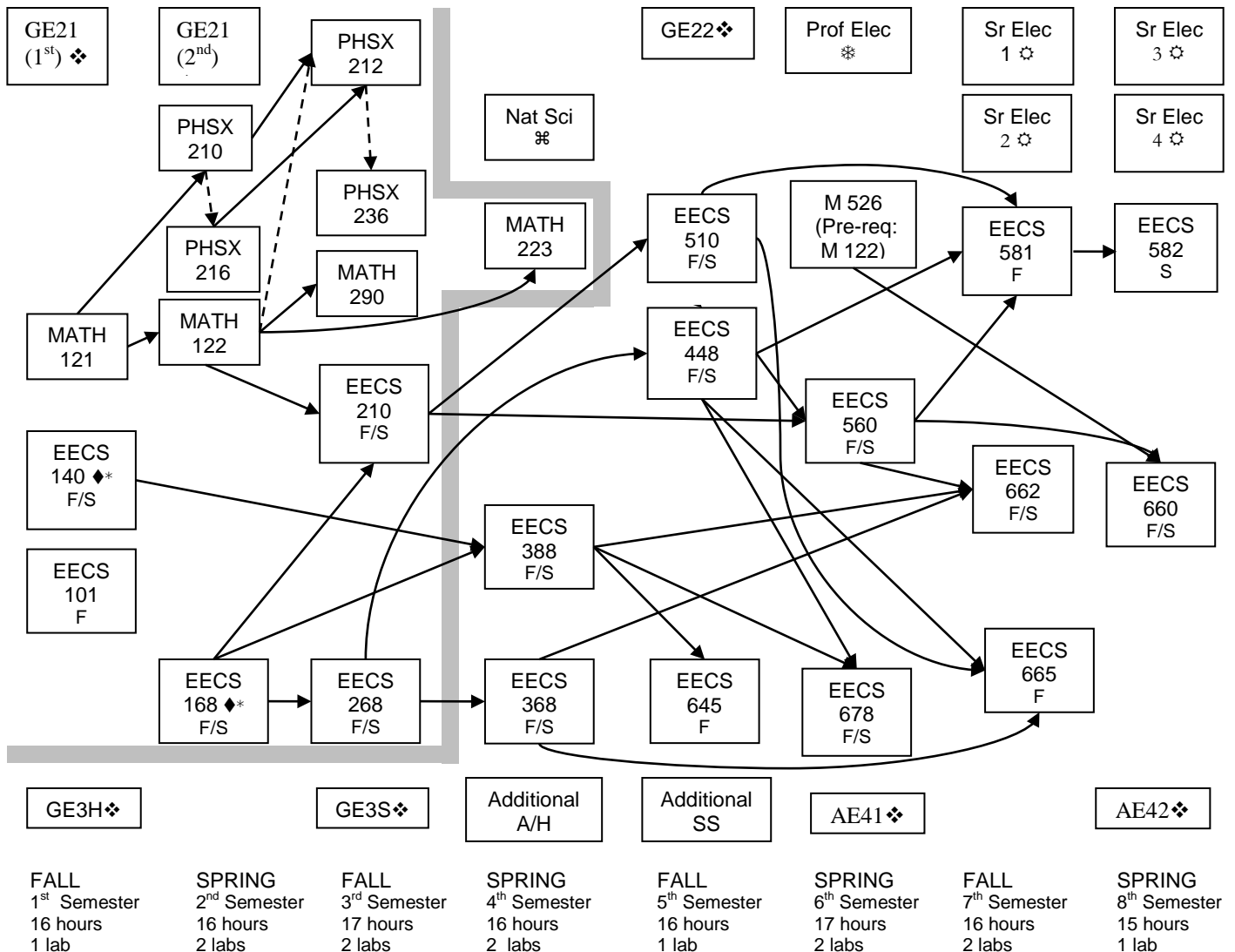
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Fall 1 st Semester	Spring 2 nd Semester	Fall 3 rd Semester	Spring 4 th Semester
EECS 101 1	GE21 (second)❖ 3	EECS 210 4	EECS 368 3
GE21 (first)❖ 3	MATH 122 5	EECS 268 4	EECS 388 4
MATH 121 5	PHSX 210 3	MATH 290 2	Math 223 3
EECS 140 or 168 ♦ 4	PHSX 216 1	PHSX 212 3	Natural Science ⌘ 3
GE3H❖ 3	EECS 168 or 140 ♦ 4	PHSX 236 1	Additional A/H 3
Total Hours 16	Total Hours 16	Total Hours 17	Total Hours 16

Fall 5 th Semester	Spring 6 th Semester	Fall 7 th Semester	Spring 8 th Semester
EECS 448 4	MATH 526 3	EECS 581 3	EECS 582 3
EECS 510 3	EECS 560 4	EECS 662 3	EECS 660 3
EECS 645 3	EECS 678 4	EECS 665 4	Sr. Elective 3 ⚙ 3
GE22❖ 3	Professional Elective ⚙ 3	Sr. Elective 1 ⚙ 3	Sr. Elective 4 ⚙ 3
Additional SS 3	AE41❖ 3	Sr. Elective 2 ⚙ 3	AE42❖ 3
Total Hours 16	Total Hours 17	Total Hours 16	Total Hours 15

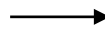
Computer Science Course Flow Chart

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

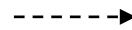


*Assumes even KUID.

Upper Level Eligibility Established



Prerequisite



Corequisite

F=course offered in Fall only; S=course offered in Spring only; F/S=course offered in Fall and Spring; S/SU=course offered in Spring and Summer

Interdisciplinary Computing-Astronomy

Interdisciplinary Computing graduates with a concentration in Astronomy are likely to collaborate with Astronomers, applying their computing expertise to large-scale Astronomy problems. However, the Interdisciplinary Computing degree also provides a very solid and broad foundation in computer science, preparing graduates for a wide variety of computing careers (see Computer Science).

Program Educational Objectives for Interdisciplinary Computing-Astronomy

Graduates who have earned a Bachelor's Degree in Interdisciplinary Computing, within a few years following graduation, will have demonstrated technical proficiency, collaborative activities, and professional development.

Technical Proficiency - Graduates will have achieved success and visibility in their chosen careers as shown by technical accomplishments in industry, government, entrepreneurial activities, or academia.

Collaborative Activities - Graduates will have exercised shared responsibilities through activities such as contributions to multi-person or multi-disciplinary technical projects, participation in professional society/organization functions, or performing collaborative research. In all such cases, graduates will have contributed to documentation of the collaborative activities.

Professional Development - Graduates will have demonstrated continual technical updating to extend their expertise and adapt to a changing environment through graduate studies; short courses, conferences, and seminars; or professional self-study. In addition, graduates will have demonstrated evidence of increasing technical and/or managerial impact.

Requirements for the Bachelor of Science in Interdisciplinary Computing (Astronomy) Degree

A total of 127 credit hours ❖ is required for the BSIC (Astronomy) degree, as follows:

Computer Science (50 credit hours)				HRS	SEM	GRD	Arts/Humanities/Social Science (6 hours) ❖				HRS	SEM	GRD
EECS 101	New Student Seminar (part of AE51)	1	_____	_____	_____	Satisfy GE3H: Arts/Humanities	3	_____	_____	_____			
EECS 140	Intro to Digital Logic Design ♦	4	_____	_____	_____	Satisfy GE3S: Social Science	3	_____	_____	_____			
EECS 168	Programming I ♦	4	_____	_____	_____	Satisfy AE41 and AE42: Diversity, Global Awareness (6 hours) ❖							
EECS 268	Programming II	4	_____	_____	_____								
EECS 368	Program. Language Paradigms	3	_____	_____	_____								
EECS 388	Embedded Systems	4	_____	_____	_____								
EECS 448	Software Engineering I	4	_____	_____	_____								
EECS 510	Intro to the Theory of Computing	3	_____	_____	_____								
EECS 560	Data Structures	4	_____	_____	_____								
EECS 581	CS Design I (part of AE51)	3	_____	_____	_____	Astronomy and Physics (31 credit hours)							
EECS 582	CS Design II (AE61)	3	_____	_____	_____	ASTR 391	Physical Astronomy, Honors	3	_____	_____	_____		
EECS 678	Intro to Operating Systems	4	_____	_____	_____	ASTR 503	Undergraduate Research	2	_____	_____	_____		
Senior Electives ✨		3	_____	_____	_____	ASTR 591	Stellar Astronomy	3	_____	_____	_____		
		3	_____	_____	_____	ASTR 592	Galactic & Extragalactic Astro	3	_____	_____	_____		
		3	_____	_____	_____	ASTR 596	Observational Astrophysics	2	_____	_____	_____		
		3	_____	_____	_____	ASTR Electives ★		3	_____	_____	_____		
								3	_____	_____	_____		
						PHSX 210	General Physics I for Engrs (GE11)	3	_____	_____	_____		
						PHSX 216	General Physics I Lab (part of AE51)	1	_____	_____	_____		
						PHSX 212	General Physics II (GE3N)	3	_____	_____	_____		
						PHSX 236	General Physics II, Lab	1	_____	_____	_____		
						PHSX 313	General Physics III	3	_____	_____	_____		
						PHSX 316	Intermediate Physics lab 1	1	_____	_____	_____		
						❖ Students with even KUIDs take EECS 140 in fall and EECS 168 in spring. Those with odd KUIDs take EECS 168 in fall and EECS 140 in spring.							
						❖ Means of satisfying KU Core Goals are chosen from a variety of options (see http://kucore.ku.edu). Hours listed are assuming the goals are satisfied with course work.							
						✨ Nine hours of Senior Electives are chosen from a list of EECS courses (see page 4).							
						♠ Honors MATH 143 is credited as both MATH 223 and MATH 290 and will satisfy these requirements.							
						★ Six hours of Astronomy electives are chosen from any Astronomy course numbered 500 or above, MATH 581, MATH 611, and PHSX 615.							
						Satisfy GE21: Written Communication (6 hours) ❖							
						(Typically satisfied by ENGL 101 & 102)	3	_____	_____	_____			
							3	_____	_____	_____			
						Satisfy GE22: Oral Communication (3 hours) ❖							
						(Typically satisfied by COMS 130)	3	_____	_____	_____			

Interdisciplinary Computing (Astronomy) Suggested Course Sequence

FOR STUDENTS ENTERING IN FALL OF **ODD YEARS**

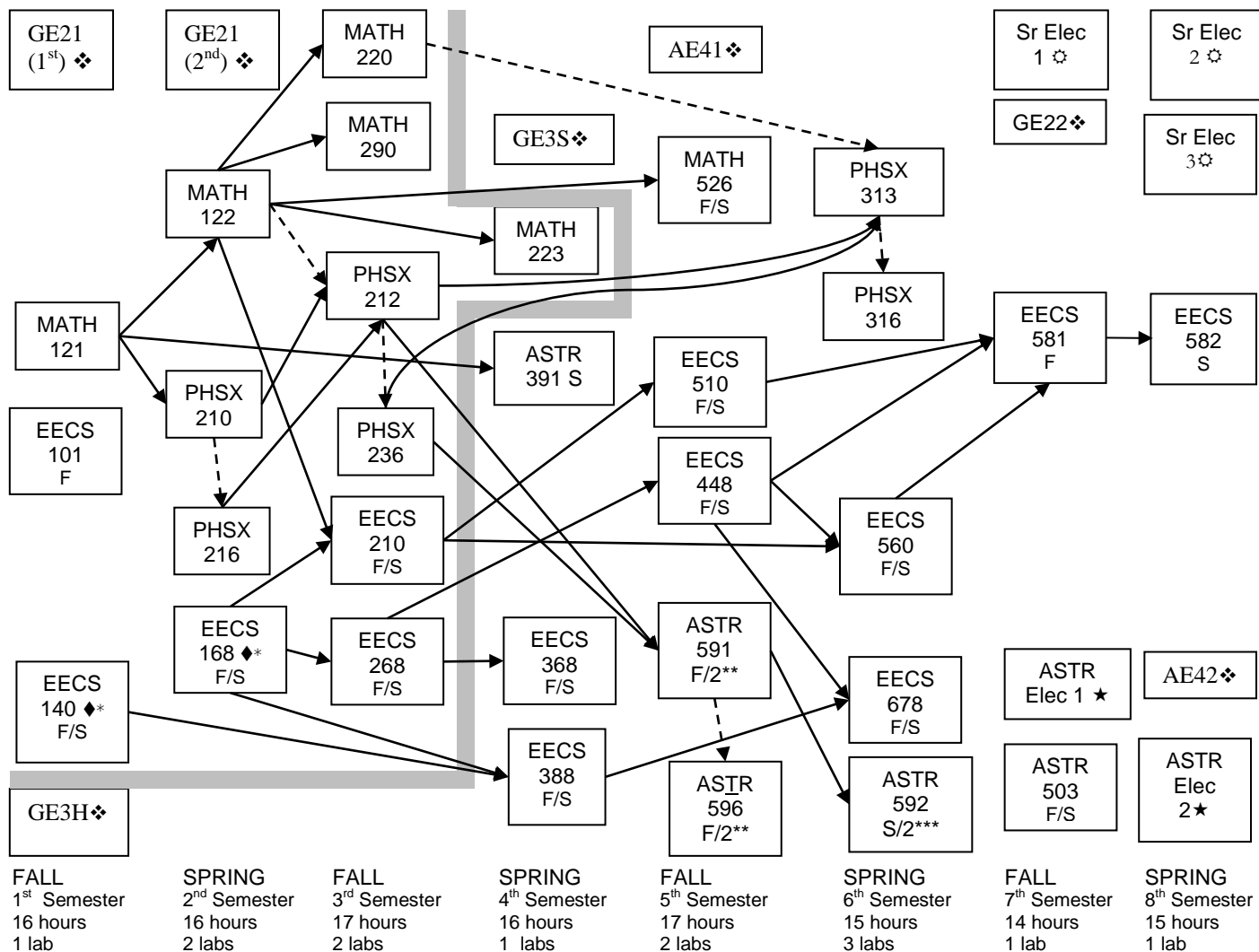
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Fall 1 st Semester	Spring 2 nd Semester	Fall 3 rd Semester	Spring 4 th Semester
EECS 101 1	GE21 (second)❖ 3	EECS 210 4	EECS 368 3
GE21 (first)❖ 3	MATH 122 5	EECS 268 4	EECS 388 4
MATH 121 5	PHSX 210 3	MATH 220 3	Math 223 3
EECS 140 or 168 ♦ 4	PHSX 216 1	MATH 290 2	GE3S❖ 3
GE3H❖ 3	EECS 168 or 140 ♦ 4	PHSX 212 3	ASTR 391 3
Total Hours 16	Total Hours 16	Total Hours 17	Total Hours 16

Fall 5 th Semester	Spring 6 th Semester	Fall 7 th Semester	Spring 8 th Semester
EECS 448 4	EECS 560 4	EECS 581 3	EECS 582 3
EECS 510 3	EECS 678 4	Sr. Elective 1 ☼ 3	Sr. Elective 2 ☼ 3
MATH 526 3	PHSX 313 3	ASTR Elective 1 ★ 3	Sr. Elective 3 ☼ 3
ASTR 591 3	PHSX 316 1	ASTR 503 2	ASTR Elective 2 ★ 3
ASTR 596 2	ASTR 592 3	GE22❖ 3	AE42❖ 3
AE41❖ 3			
Total Hours 18	Total Hours 15	Total Hours 14	Total Hours 15

Interdisciplinary Computing (Astronomy) Course Flow Chart

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



*Assumes even KUID. **Offered every other Fall Semester ***Offered every other Spring Semester
 Upper Level Eligibility Established → Prerequisite - - - - - Corequisite
 F=course offered in Fall only; S=course offered in Spring only; F/S=course offered in Fall and Spring; S/SU=course offered in Spring and Summer

Interdisciplinary Computing (Astronomy) Suggested Course Sequence

FOR STUDENTS ENTERING IN FALL OF EVEN YEARS

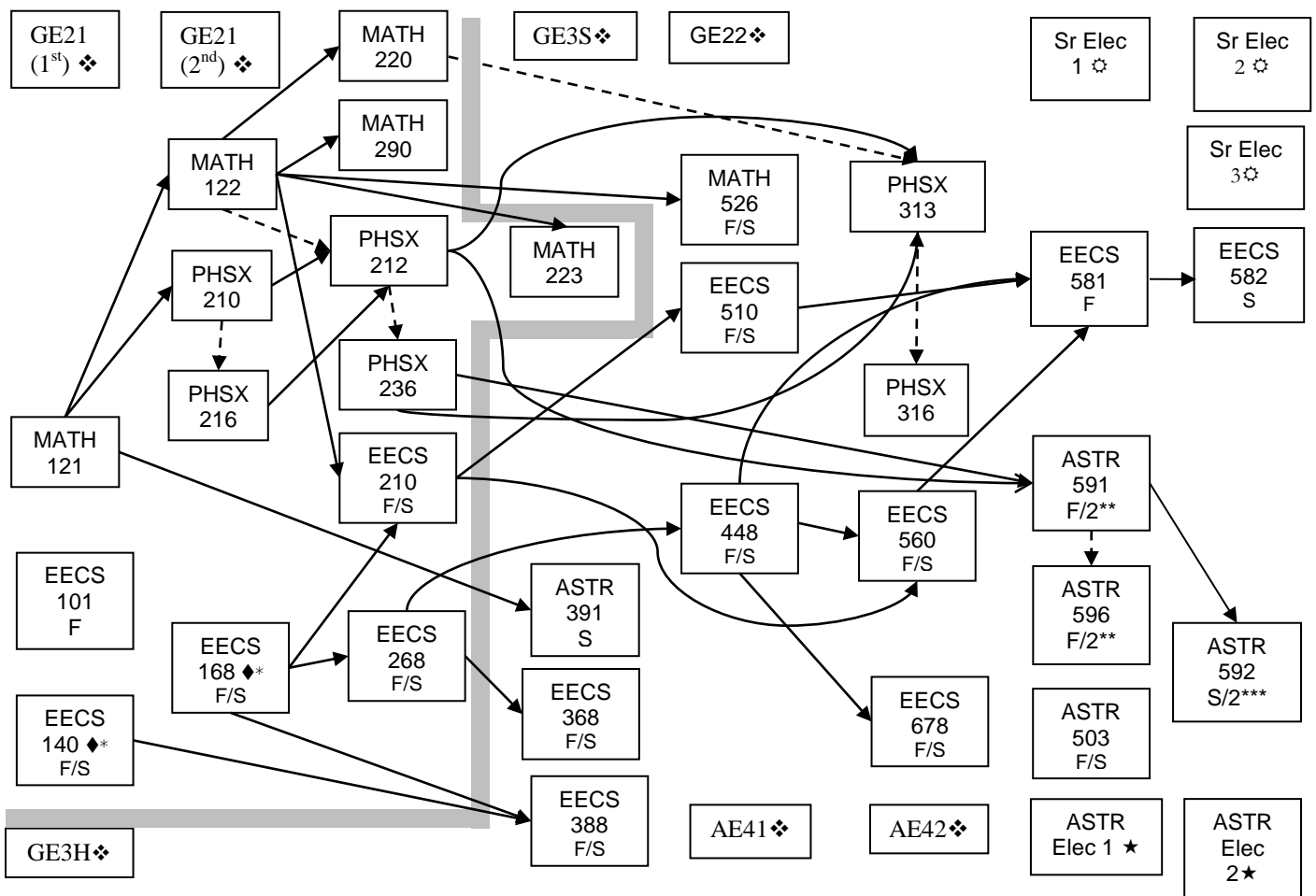
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Fall 1 st Semester	Spring 2 nd Semester	Fall 3 rd Semester	Spring 4 th Semester
EECS 101 1	GE21 (second)❖ 3	EECS 210 4	EECS 368 3
GE21 (first)❖ 3	MATH 122 5	EECS 268 4	EECS 388 4
MATH 121 5	PHSX 210 3	MATH 220 3	Math 223 3
EECS 140 or 168 ♦ 4	PHSX 216 1	MATH 290 2	GE3S❖ 3
GE3H❖ 3	EECS 168 or 140 ♦ 4	PHSX 212 3	ASTR 391 3
Total Hours 16	Total Hours 16	Total Hours 17	Total Hours 16

Fall 5 th Semester	Spring 6 th Semester	Fall 7 th Semester	Spring 8 th Semester
EECS 448 4	EECS 560 4	EECS 581 3	EECS 582 3
EECS 510 3	EECS 678 4	Sr. Elective 1 ✨ 3	Sr. Elective 2 ✨ 3
MATH 526 3	PHSX 313 3	ASTR 503 2	Sr. Elective 3 ✨ 3
GE22❖ 3	PHSX 316 1	ASTR 591 3	ASTR 592 3
AE41❖ 3	AE42❖ 3	ASTR 596 2	ASTR Elective 2★ 3
Total Hours 16	Total Hours 15	Total Hours 16	Total Hours 15

Interdisciplinary Computing (Astronomy) Course Flow Chart

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



FALL 1 st Semester 16 hours 1 lab	SPRING 2 nd Semester 16 hours 2 labs	FALL 3 rd Semester 17 hours 2 labs	SPRING 4 th Semester 16 hours 1 lab	FALL 5 th Semester 16 hours 1 lab	SPRING 6 th Semester 15 hours 3 labs	FALL 7 th Semester 15 hours 2 labs	SPRING 8 th Semester 15 hours 1 lab
---	--	--	---	---	--	--	---

*Assumes even KUID. ** Offered every other Fall Semester ***Offered every other Spring Semester

Upper Level Eligibility Established → Prerequisite - - - - -> Co-requisite

F=course offered in Fall only; S=course offered in Spring only; F/S=course offered in Fall and Spring; S/SU=course offered in Spring and Summer

Interdisciplinary Computing-Biology

Interdisciplinary Computing graduates with a concentration in Biology are likely to collaborate with Biologists, applying their computing expertise to large-scale Biology problems. However, the Interdisciplinary Computing degree also provides a very solid and broad foundation in computer science, preparing graduates for a wide variety of computing careers (see Computer Science).

Program Educational Objectives for Interdisciplinary Computing-Biology

Graduates who have earned a Bachelor's Degree in Interdisciplinary Computing, within a few years following graduation, will have demonstrated technical proficiency, collaborative activities, and professional development.

Technical Proficiency - Graduates will have achieved success and visibility in their chosen careers as shown by technical accomplishments in industry, government, entrepreneurial activities, or academia.

Collaborative Activities - Graduates will have exercised shared responsibilities through activities such as contributions to multi-person or multi-disciplinary technical projects, participation in professional society/organization functions, or performing collaborative research. In all such cases, graduates will have contributed to documentation of the collaborative activities.

Professional Development - Graduates will have demonstrated continual technical updating to extend their expertise and adapt to a changing environment through graduate studies; short courses, conferences, and seminars; or professional self-study. In addition, graduates will have demonstrated evidence of increasing technical and/or managerial impact.

Requirements for the Bachelor of Science in Interdisciplinary Computing (Biology) Degree

A total of 131 credit hours ❖ is required for the BSIC (Biology) degree, as follows:

Computer Science (50 credit hours)				HRS	SEM	GRD	Arts/Humanities/Social Science (6 hours) ❖				HRS	SEM	GRD
EECS 101	New Student Seminar			1	_____	_____	Satisfy GE3H: Arts/Humanities				3	_____	_____
EECS 140	Intro to Digital Logic Design ♦			4	_____	_____	Satisfy GE3S: Social Science				3	_____	_____
EECS 168	Programming I ♦			4	_____	_____	Satisfy AE41 and AE42: Diversity, Global Awareness (6 hours) ❖						
EECS 268	Programming II			4	_____	_____					3	_____	_____
EECS 368	Program. Language Paradigms			3	_____	_____					3	_____	_____
EECS 388	Embedded Systems			4	_____	_____					3	_____	_____
EECS 448	Software Engineering I			4	_____	_____					3	_____	_____
EECS 510	Intro to the Theory of Computing			3	_____	_____	Social Responsibility and Ethics (3 hours)						
EECS 560	Data Structures			4	_____	_____	PHIL 375/320/160 (AE51)				3	_____	_____
EECS 581	CS Design I			3	_____	_____	Biology and Chemistry (35 credit hours)						
EECS 582	CS Design II (AE61)			3	_____	_____	BIOL 150	Principles of Molecular and Cellular Biology (GE3N)			4	_____	_____
EECS 678	Intro to Operating Systems			4	_____	_____	BIOL 152	Principles of Organismal Bio			4	_____	_____
Senior Electives ✨				3	_____	_____	BIOL 350	Principles of Genetics			4	_____	_____
				3	_____	_____	BIOL 400/	Fund of Microbiology			3	_____	_____
				3	_____	_____	435	Intro to Neurobiology					
Mathematics (22 credit hours)							BIOL 408	Physiology of Organisms			3	_____	_____
MATH 121	Calculus I (GE12)			5	_____	_____	BIOL 412	Evolutionary Biology			4	_____	_____
MATH 122	Calculus II			5	_____	_____	Biology Electives ★				3	_____	_____
MATH 223	Vector Calculus ♣			3	_____	_____	CHEM 130	Foundations of Chemistry 1			5	_____	_____
MATH 290	Elementary Linear Algebra ♣			2	_____	_____	CHEM 135	Foundations of Chemistry 2			5	_____	_____
MATH 526	Applied Math Statistics I (GE11)			3	_____	_____	<ul style="list-style-type: none"> ♦ Students with even KUIDs take EECS 140 in fall and EECS 168 in spring. Those with odd KUIDs take EECS 168 in fall and EECS 140 in spring. ❖ Means of satisfying KU Core Goals are chosen from a variety of options (see http://kucore.ku.edu). Hours listed are assuming the goals are satisfied with course work. 🌟 Nine hours of Senior Electives are chosen from a list of EECS courses (see page 4). ♣ Honors MATH 143 is credited as both MATH 223 and MATH 290 and will satisfy these requirements. ★ Three hours of Biology electives are chosen from BIOL 413, BIOL 414, BIOL 416, BIOL 417, and BIOL 428. 						
EECS 210	Discrete Structures			4	_____	_____							
Satisfy GE21: Written Communication (6 hours) ❖													
(Typically satisfied by ENGL 101 & 102)													
				3	_____	_____							
				3	_____	_____							
Satisfy GE22: Oral Communication (3 hours) ❖													
(Typically satisfied by COMS 130)													
				3	_____	_____							

Interdisciplinary Computing (Biology) Suggested Course Sequence

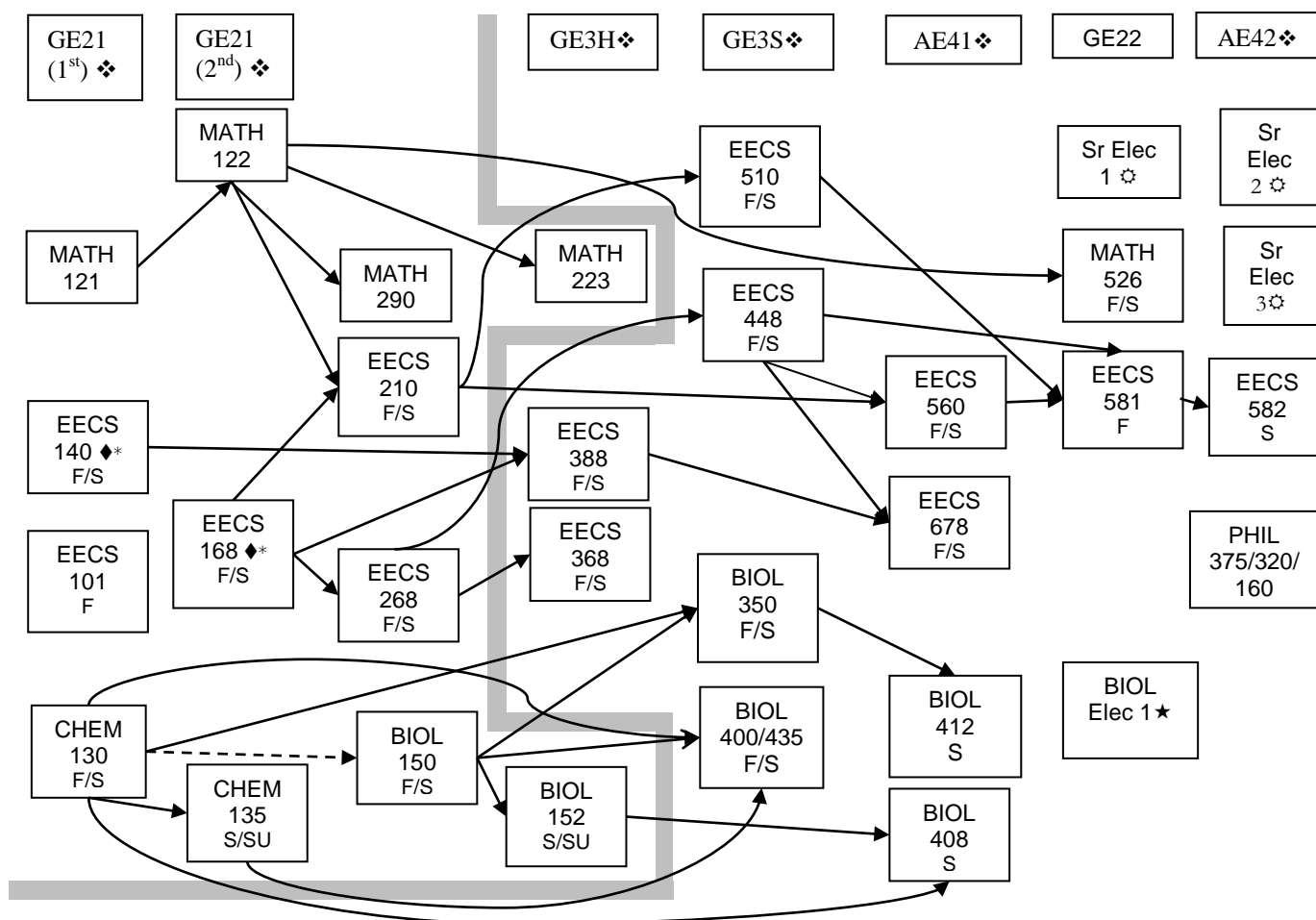
(Symbol key on previous page)

Fall 1 st Semester	Spring 2 nd Semester	Fall 3 rd Semester	Spring 4 th Semester
EECS 101 1			EECS 368 3
GE21 (1 st) ❖ 3	GE21 (2 nd) ❖ 3	EECS 210 4	EECS 388 4
MATH 121 5	MATH 122 5	EECS 268 4	Math 223 3
EECS 140 or 168 ♦ 4	EECS 168 or 140 ♦ 4	MATH 290 2	GE3H❖ 3
CHEM 130 5	CHEM 135 5	BIOL 150 4	BIOL 152 4
Total Hours 18	Total Hours 17	Total Hours 14	Total Hours 17

Fall 5 th Semester	Spring 6 th Semester	Fall 7 th Semester	Spring 8 th Semester
EECS 448 4	EECS 560 4	EECS 581 3	EECS 582 3
EECS 510 3	EECS 678 4	MATH 526 3	Sr. Elective 2 ☼ 3
GE3S❖ 3	AE41❖ 3	GE22❖ 3	Sr. Elective 3 ☼ 3
BIOL 350 4	BIOL 408 3	Sr. Elective 1 ☼ 3	PHIL 375/320/160 3
BIOL 400/435 3	BIOL 412 4	BIOL Elective 1★ 3	AE42❖ 3
Total Hours 17	Total Hours 18	Total Hours 15	Total Hours 15

Interdisciplinary Computing (Biology) Course Flow Chart

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



FALL	SPRING	FALL	SPRING	FALL	SPRING	FALL	SPRING
1 st Semester	2 nd Semester	3 rd Semester	4 th Semester	5 th Semester	6 th Semester	7 th Semester	8 th Semester
18 hours	17 hours	14 hours	17 hours	17 hours	18 hours	15 hours	15 hours
2 labs	2 labs	2 labs	2 labs	1 lab	2 labs	1 lab	1 lab

*Assumes even KUID.

Upper Level Eligibility Established ———> Prerequisite - - - - -> Co-requisite F=course offered in Fall only; S=course offered in Spring only; F/S=course offered in Fall and Spring; S/SU=course offered in Spring and Summer

Interdisciplinary Computing-Chemistry

Interdisciplinary Computing graduates with a concentration in Chemistry are likely to collaborate with Chemists, applying their computing expertise to large-scale Chemistry problems. However, the Interdisciplinary Computing degree also provides a very solid and broad foundation in computer science, preparing graduates for a wide variety of computing careers (see Computer Science).

Program Educational Objectives for Interdisciplinary Computing-Chemistry

Graduates who have earned a Bachelor's Degree in Interdisciplinary Computing, within a few years following graduation, will have demonstrated technical proficiency, collaborative activities, and professional development.

Technical Proficiency - Graduates will have achieved success and visibility in their chosen careers as shown by technical accomplishments in industry, government, entrepreneurial activities, or academia.

Collaborative Activities - Graduates will have exercised shared responsibilities through activities such as contributions to multi-person or multi-disciplinary technical projects, participation in professional society/organization functions, or performing collaborative research. In all such cases, graduates will have contributed to documentation of the collaborative activities.

Professional Development - Graduates will have demonstrated continual technical updating to extend their expertise and adapt to a changing environment through graduate studies; short courses, conferences, and seminars; or professional self-study. In addition, graduates will have demonstrated evidence of increasing technical and/or managerial impact.

Requirements for the Bachelor of Science in Interdisciplinary Computing (Chemistry) Degree

A total of 128 credit hours❖ is required for the BSIC (Chemistry) degree, as follows:

Computer Science (50 credit hours)				HRS	SEM	GRD	Arts/Humanities/Social Science (6 hours) ❖				HRS	SEM	GRD
EECS 101	New Student Seminar (part of AE51)	1	_____	_____	_____		Satisfy GE3H: Arts/Humanities	3	_____	_____		_____	_____
EECS 140	Intro to Digital Logic Design◆	4	_____	_____	_____		Satisfy GE3S: Social Science	3	_____	_____		_____	_____
EECS 168	Programming I◆	4	_____	_____	_____		Satisfy AE41 and AE42: Diversity, Global Awareness (6 hours)❖						
EECS 268	Programming II	4	_____	_____	_____			3	_____	_____		_____	_____
EECS 368	Program. Language Paradigms	3	_____	_____	_____			3	_____	_____		_____	_____
EECS 388	Embedded Systems	4	_____	_____	_____								
EECS 448	Software Engineering I	4	_____	_____	_____								
EECS 510	Intro to the Theory of Computing	3	_____	_____	_____								
EECS 560	Data Structures	4	_____	_____	_____								
EECS 581	CS Design I (part of AE51)	3	_____	_____	_____								
EECS 582	CS Design II (AE61)	3	_____	_____	_____								
EECS 678	Intro to Operating Systems	4	_____	_____	_____								
Senior Electives ❖		3	_____	_____	_____								
		3	_____	_____	_____								
		3	_____	_____	_____								
Mathematics (25 credit hours)							Chemistry and Physics (32 credit hours)						
MATH 121	Calculus I (GE12)	5	_____	_____	_____		CHEM 130	Foundations of Chemistry 1	5	_____	_____	_____	_____
MATH 122	Calculus II	5	_____	_____	_____		CHEM 135	Foundations of Chemistry 2	5	_____	_____	_____	_____
MATH 220	Applied Differential Equations	3	_____	_____	_____		CHEM 330	Organic Chemistry 1	3	_____	_____	_____	_____
MATH 223	Vector Calculus ♠	3	_____	_____	_____		CHEM 530	Physical Chemistry 1	3	_____	_____	_____	_____
MATH 290	Elementary Linear Algebra ♠	2	_____	_____	_____		CHEM 531	Physical Chemistry 1 Laboratory	2	_____	_____	_____	_____
MATH 526	Applied Mathematical Statistics I	3	_____	_____	_____		CHEM 535	Physical Chemistry 2	4	_____	_____	_____	_____
EECS 210	Discrete Structures	4	_____	_____	_____		CHEM 698	Undergraduate Research Problems	2	_____	_____	_____	_____
							PHSX 210	General Physics I for Engrs (GE11)	3	_____	_____	_____	_____
							PHSX 216	General Physics I Lab (part of AE51)	1	_____	_____	_____	_____
							PHSX 212	General Physics II (GE3N)	3	_____	_____	_____	_____
							PHSX 236	General Physics II, Lab	1	_____	_____	_____	_____
Satisfy GE21: Written Communication (6 hours) ❖							◆ Students with even KUIDs take EECS 140 in fall and EECS 168 in spring. Those with odd KUIDs take EECS 168 in fall and EECS 140 in spring.						
(Typically satisfied by ENGL 101 & 102)		3	_____	_____	_____		❖ Means of satisfying KU Core Goals are chosen from a variety of options (see http://kucore.ku.edu). Hours listed are assuming the goals are satisfied with course work.						
		3	_____	_____	_____		❖ Nine hours of Senior Electives are chosen from a list of EECS courses (see page 4).						
Satisfy GE22: Oral Communication (3 hours) ❖							♠ Honors MATH 143 is credited as both MATH 223 and MATH 290 and will satisfy these requirements.						
(Typically satisfied by COMS 130)		3	_____	_____	_____								

Interdisciplinary Computing (Chemistry) Suggested Course Sequence

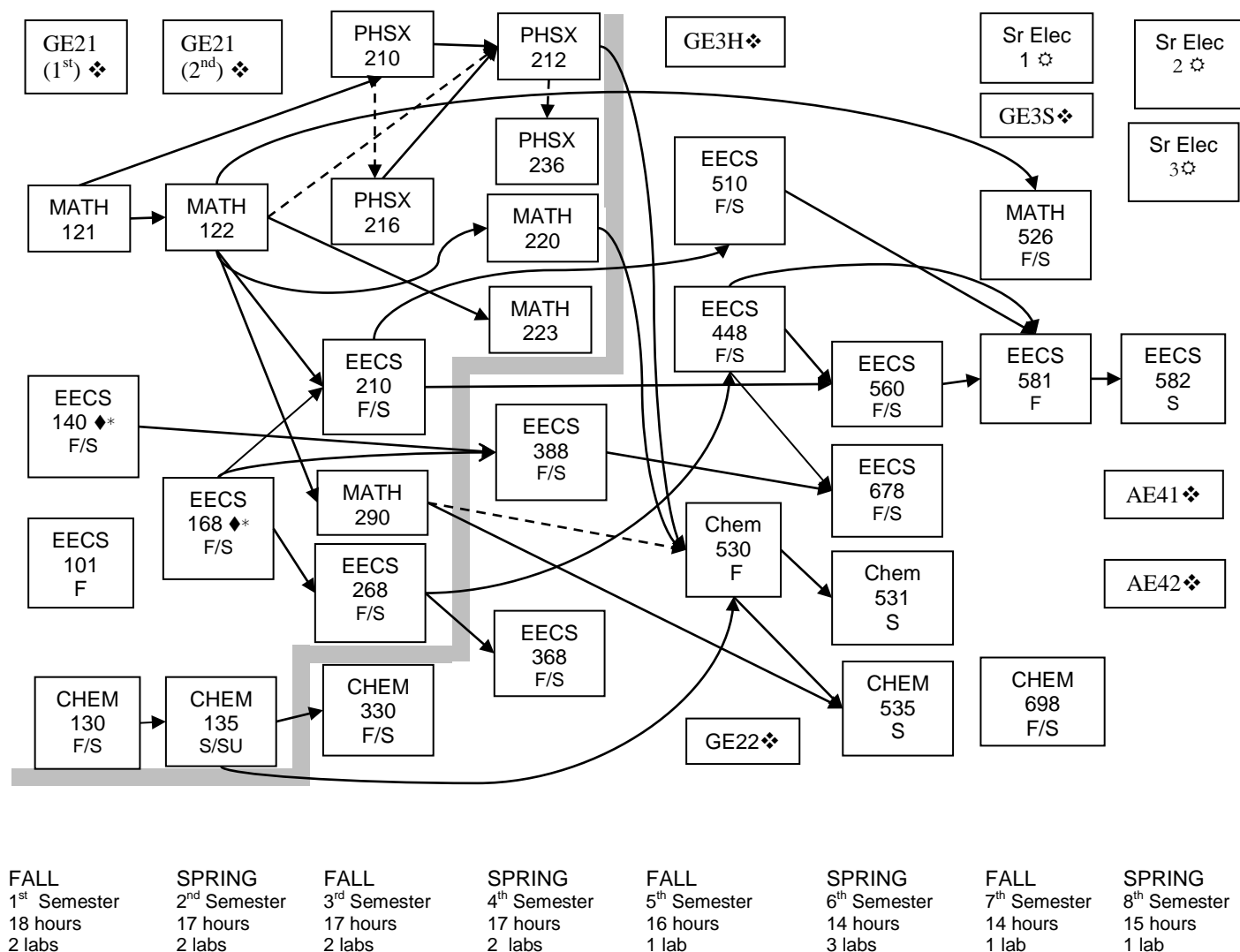
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Fall 1 st Semester	Spring 2 nd Semester	Fall 3 rd Semester	Spring 4 th Semester
EECS 101 1		EECS 210 4	EECS 368 3
GE21 (first)❖ 3	GE21 (second)❖ 3	EECS 268 4	EECS 388 4
MATH 121 5	MATH 122 5	MATH 290 2	MATH 220 3
EECS 140 or 168 ♦ 4	EECS 168 or 140 ♦ 4	PHSX 210 3	MATH 223 3
CHEM 130 5	CHEM 135 5	PHSX 216 1	PHSX 212 3
		CHEM 330 3	PHSX 236 1
Total Hours 18	Total Hours 17	Total Hours 17	Total Hours 17

Fall 5 th Semester	Spring 6 th Semester	Fall 7 th Semester	Spring 8 th Semester
EECS 448 4	EECS 560 4	EECS 581 3	EECS 582 3
EECS 510 3	EECS 678 4	MATH 526 3	Sr. Elective 2 ☼ 3
GE22❖ 3	CHEM 531 2	GE3S❖ 3	Sr. Elective 3 ☼ 3
GE3H❖ 3	CHEM 535 4	Sr. Elective 1 ☼ 3	AE41❖ 3
CHEM 530 3		CHEM 698 2	AE42❖ 3
Total Hours 16	Total Hours 14	Total Hours 14	Total Hours 15

Interdisciplinary Computing (Chemistry) Course Flow Chart

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



*Assumes even KUID.

Upper Level Eligibility Established

→ Prerequisite - - - - -> Co-requisite

F=course offered in Fall only; S=course offered in Spring only; F/S=course offered in Fall and Spring; S/SU=course offered in Spring and Summer

Interdisciplinary Computing-Geography

Interdisciplinary Computing graduates with a concentration in Geography are likely to collaborate with Geographers, applying their computing expertise to large-scale Geography problems. However, the Interdisciplinary Computing degree also provides a very solid and broad foundation in computer science, preparing graduates for a wide variety of computing careers (see Computer Science).

Program Educational Objectives for Interdisciplinary Computing-Geography

Graduates who have earned a Bachelor's Degree in Interdisciplinary Computing, within a few years following graduation, will have demonstrated technical proficiency, collaborative activities, and professional development.

Technical Proficiency - Graduates will have achieved success and visibility in their chosen careers as shown by technical accomplishments in industry, government, entrepreneurial activities, or academia.

Collaborative Activities - Graduates will have exercised shared responsibilities through activities such as contributions to multi-person or multi-disciplinary technical projects, participation in professional society/organization functions, or performing collaborative research. In all such cases, graduates will have contributed to documentation of the collaborative activities.

Professional Development - Graduates will have demonstrated continual technical updating to extend their expertise and adapt to a changing environment through graduate studies; short courses, conferences, and seminars; or professional self-study. In addition, graduates will have demonstrated evidence of increasing technical and/or managerial impact.

Requirements for the Bachelor of Science in Interdisciplinary (Geography) Degree

A total of 126 credit hours ❖ is required for the BSIC (Geography) degree, as follows:

Computer Science (50 credit hours)				HRS	SEM	GRD	Arts/Humanities/Social Science 6 hours ❖				HRS	SEM	GRD
EECS 101	New Student Seminar (part of AE51)	1	_____	_____			Satisfy GE3H: Arts/Humanities	3	_____	_____			
EECS 140	Intro to Digital Logic Design ♦	4	_____	_____			Satisfy GE3S: Social Science	3	_____	_____			
EECS 168	Programming I ♦	4	_____	_____			Satisfy AE41 and AE42: Diversity, Global Awareness (6 hours)❖						
EECS 268	Programming II	4	_____	_____				3	_____	_____			
EECS 368	Program. Language Paradigms	3	_____	_____				3	_____	_____			
EECS 388	Embedded Systems	4	_____	_____									
EECS 448	Software Engineering I	4	_____	_____									
EECS 510	Intro to the Theory of Computing	3	_____	_____									
EECS 560	Data Structures	4	_____	_____									
EECS 581	CS Design I (part of AE51)	3	_____	_____									
EECS 582	CS Design II (AE61)	3	_____	_____									
EECS 678	Intro to Operating Systems	4	_____	_____									
Senior Electives ❖		3	_____	_____									
		3	_____	_____									
Mathematics (22 credit hours)													
MATH 121	Calculus I (GE12)	5	_____	_____									
MATH 122	Calculus II	5	_____	_____									
MATH 223	Vector Calculus ♣	3	_____	_____									
MATH 290	Elementary Linear Algebra ♣	2	_____	_____									
MATH 526	Applied Mathematical Statistics I	3	_____	_____									
EECS 210	Discrete Structures	4	_____	_____									
Satisfy GE21: Written Communication (6 hours) ❖													
(Typically satisfied by ENGL 101 & 102)		3	_____	_____									
		3	_____	_____									
Satisfy GE22: Oral Communication (3 hours) ❖													
(Typically satisfied by COMS 130)		3	_____	_____									

- ♦ Students with even KUIDs take EECS 140 in fall and EECS 168 in spring. Those with odd KUIDs take EECS 168 in fall and EECS 140 in spring.
- ❖ Means of satisfying KU Core Goals are chosen from a variety of options (see <http://kucore.ku.edu>). Hours listed are assuming the goals are satisfied with course work.
- ❖ Nine hours of Senior Electives are chosen from a list of EECS courses (see page 4).
- ♣ Honors MATH 143 is credited as both MATH 223 and MATH 290 and will satisfy these requirements.
- ★★ Six hours of Geography are chosen from 300 level and above courses in categories defined in the Undergraduate Study in Geography and Atmospheric Science Handbook as: Physical Studies, Geographic Information Science, Human Studies, Regional Studies, and Atmospheric Science.
- ★ Seven hours of Geography electives are chosen from GEOG 513, GEOG 517, GEOG 560, GEOG 726, GEOG 758.

Interdisciplinary Computing (Geography) Suggested Course Sequence

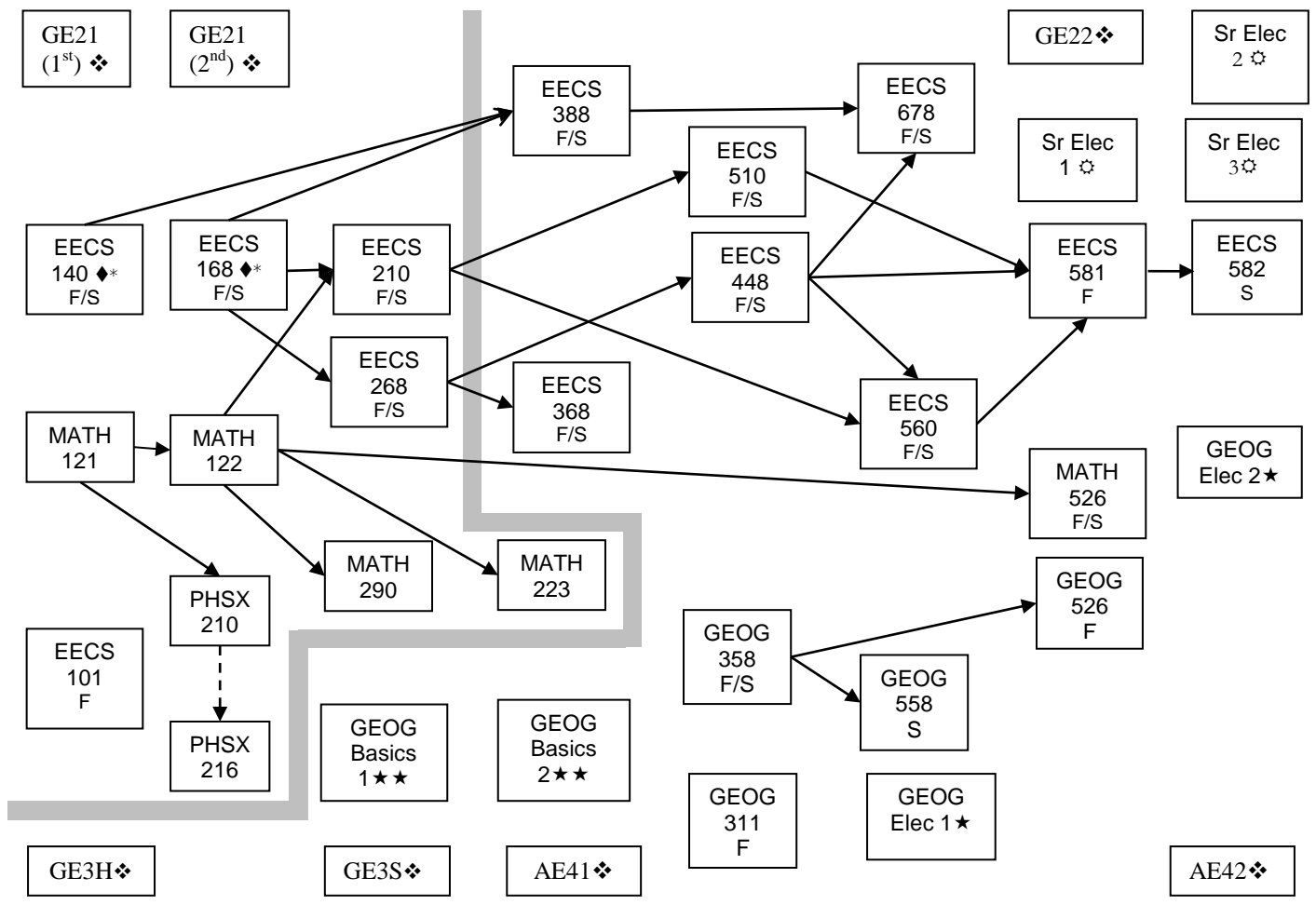
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Fall 1 st Semester	Spring 2 nd Semester	Fall 3 rd Semester	Spring 4 th Semester
EECS 101 1	GE21 (second)❖ 3	EECS 210 4	EECS 368 3
GE21 (first)❖ 3	MATH 122 5	EECS 268 4	EECS 388 4
MATH 121 5	EECS 168 or 140 ♦ 4	MATH 290 2	Math 223 3
EECS 140 or 168 ♦ 4	PHSX 210 3	GE3S❖ 3	AE41❖ 3
GE3H❖ 3	PHSX 216 1	GEOG BASICS 1★★ 3	GEOG BASICS 2★★ 3
Total Hours 16	Total Hours 16	Total Hours 16	Total Hours 16

Fall 5 th Semester	Spring 6 th Semester	Fall 7 th Semester	Spring 8 th Semester
EECS 448 4	EECS 560 4	EECS 581 3	EECS 582 3
EECS 510 3	EECS 678 4	MATH 526 3	Sr. Elective 2 ☼ 3
GEOG 311 4	GEOG Elective 1★ 3	GE22❖ 3	Sr. Elective 3 ☼ 3
GEOG 358 4	GEOG 558 4	Sr. Elective 1 ☼ 3	AE42❖ 3
Total Hours 15	Total Hours 15	Total Hours 16	Total Hours 16

Interdisciplinary Computing (Geography) Course Flow Chart

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



FALL 1 st Semester 16 hours 1 lab	SPRING 2 nd Semester 16 hours 2 labs	FALL 3 rd Semester 16 hours 1 lab	SPRING 4 th Semester 16 hours 1 lab	FALL 5 th Semester 15 hours 3 labs	SPRING 6 th Semester 15 hours 3 labs	FALL 7 th Semester 16 hours 2 labs	SPRING 8 th Semester 16 hours 1 lab
--	---	--	--	---	---	---	--

*Assumes even KUID.
 Upper Level Eligibility Established → Prerequisite - - - - - Co-requisite
F=course offered in Fall only; S=course offered in Spring only; F/S=course offered in Fall and Spring; S/SU=course offered in Spring and Summer;

Interdisciplinary Computing-Physics

Interdisciplinary Computing graduates with a concentration in Physics are likely to collaborate with Physicists, applying their computing expertise to large-scale Physics problems. However, the Interdisciplinary Computing degree also provides a very solid and broad foundation in computer science, preparing graduates for a wide variety of computing careers (see Computer Science).

Program Educational Objectives for Interdisciplinary Computing-Physics

Graduates who have earned a Bachelor's Degree in Interdisciplinary Computing, within a few years following graduation, will have demonstrated technical proficiency, collaborative activities, and professional development.

Technical Proficiency - Graduates will have achieved success and visibility in their chosen careers as shown by technical accomplishments in industry, government, entrepreneurial activities, or academia.

Collaborative Activities - Graduates will have exercised shared responsibilities through activities such as contributions to multi-person or multi-disciplinary technical projects, participation in professional society/organization functions, or performing collaborative research. In all such cases, graduates will have contributed to documentation of the collaborative activities.

Professional Development - Graduates will have demonstrated continual technical updating to extend their expertise and adapt to a changing environment through graduate studies; short courses, conferences, and seminars; or professional self-study. In addition, graduates will have demonstrated evidence of increasing technical and/or managerial impact.

Requirements for the Bachelor of Science in Interdisciplinary (Physics) Degree

A total of 125 credit hours ❖ is required for the BSIC (Physics) degree, as follows:

Computer Science (50 credit hours)				HRS	SEM	GRD	Arts/Humanities/Social Science (6 hours) ❖				HRS	SEM	GRD
EECS 101	New Student Seminar (part of AE51)	1	_____	_____	_____	Satisfy GE3H: Arts/Humanities	3	_____	_____	_____			
EECS 140	Intro to Digital Logic Design ♦	4	_____	_____	_____	Satisfy GE3S: Social Science	3	_____	_____	_____			
EECS 168	Programming I ♦	4	_____	_____	_____	Satisfy AE41 and AE42: Diversity, Global Awareness (6 hours) ❖							
EECS 268	Programming II	4	_____	_____	_____								
EECS 368	Program. Language Paradigms	3	_____	_____	_____								
EECS 388	Embedded Systems	4	_____	_____	_____								
EECS 448	Software Engineering I	4	_____	_____	_____								
EECS 510	Intro to the Theory of Computing	3	_____	_____	_____								
EECS 560	Data Structures	4	_____	_____	_____								
EECS 581	CS Design I (part of AE51)	3	_____	_____	_____								
EECS 582	CS Design II (AE61)	3	_____	_____	_____								
EECS 678	Intro to Operating Systems	4	_____	_____	_____								
Senior Electives ✨		3	_____	_____	_____								
		3	_____	_____	_____								
		3	_____	_____	_____								
Mathematics (25 credit hours)							Physics (29 credit hours)						
MATH 121	Calculus I (GE12)	5	_____	_____	_____	PHSX 210	General Physics 1 for Engrs (GE11)	3	_____	_____	_____		
MATH 122	Calculus II	5	_____	_____	_____	PHSX 216	General Physics I Lab (part of AE51)	1	_____	_____	_____		
MATH 220	Applied Differential Equations	3	_____	_____	_____	PHSX 212	General Physics 2 (GE3N)	3	_____	_____	_____		
MATH 223	Vector Calculus ♣	3	_____	_____	_____	PHSX 236	General Physics 2 Lab	1	_____	_____	_____		
MATH 290	Elementary Linear Algebra ♣	2	_____	_____	_____	PHSX 313	General Physics 3	3	_____	_____	_____		
MATH 526	Applied Mathematical Statistics I	3	_____	_____	_____	PHSX 316	Intermediate Physics Lab1	1	_____	_____	_____		
EECS 210	Discrete Structures	4	_____	_____	_____	PHSX 503	Undergraduate Research	2	_____	_____	_____		
						PHSX 511	Introductory Quantum Mechanics	3	_____	_____	_____		
						PHSX 521	Mechanics I	3	_____	_____	_____		
						PHSX 531	Electricity and Magnetism	3	_____	_____	_____		
						Physics Electives ★		3	_____	_____	_____		
								3	_____	_____	_____		
Satisfy GE21: Written Communication (6 hours) ❖													
(Typically satisfied by ENGL 101 & 102)		3	_____	_____	_____	♦ Students with even KUIDs take EECS 140 in fall and EECS 168 in spring. Those with odd KUIDs take EECS 168 in fall and EECS 140 in spring.							
		3	_____	_____	_____	❖ Means of satisfying KU Core Goals are chosen from a variety of options (see http://kucore.ku.edu). Hours listed are assuming the goals are satisfied with course work.							
Satisfy GE22: Oral Communication (3 hours) ❖													
(Typically satisfied by COMS 130)		3	_____	_____	_____	✨ Nine hours of Senior Electives are chosen from a list of EECS courses (see page 4).							
						♣ Honors MATH 143 is credited as both MATH 223 and MATH 290 and will satisfy these requirements.							
						★ Six hours of Physics electives are chosen from 600 level and above Physics courses.							

Interdisciplinary Computing (Physics) Suggested Course Sequence

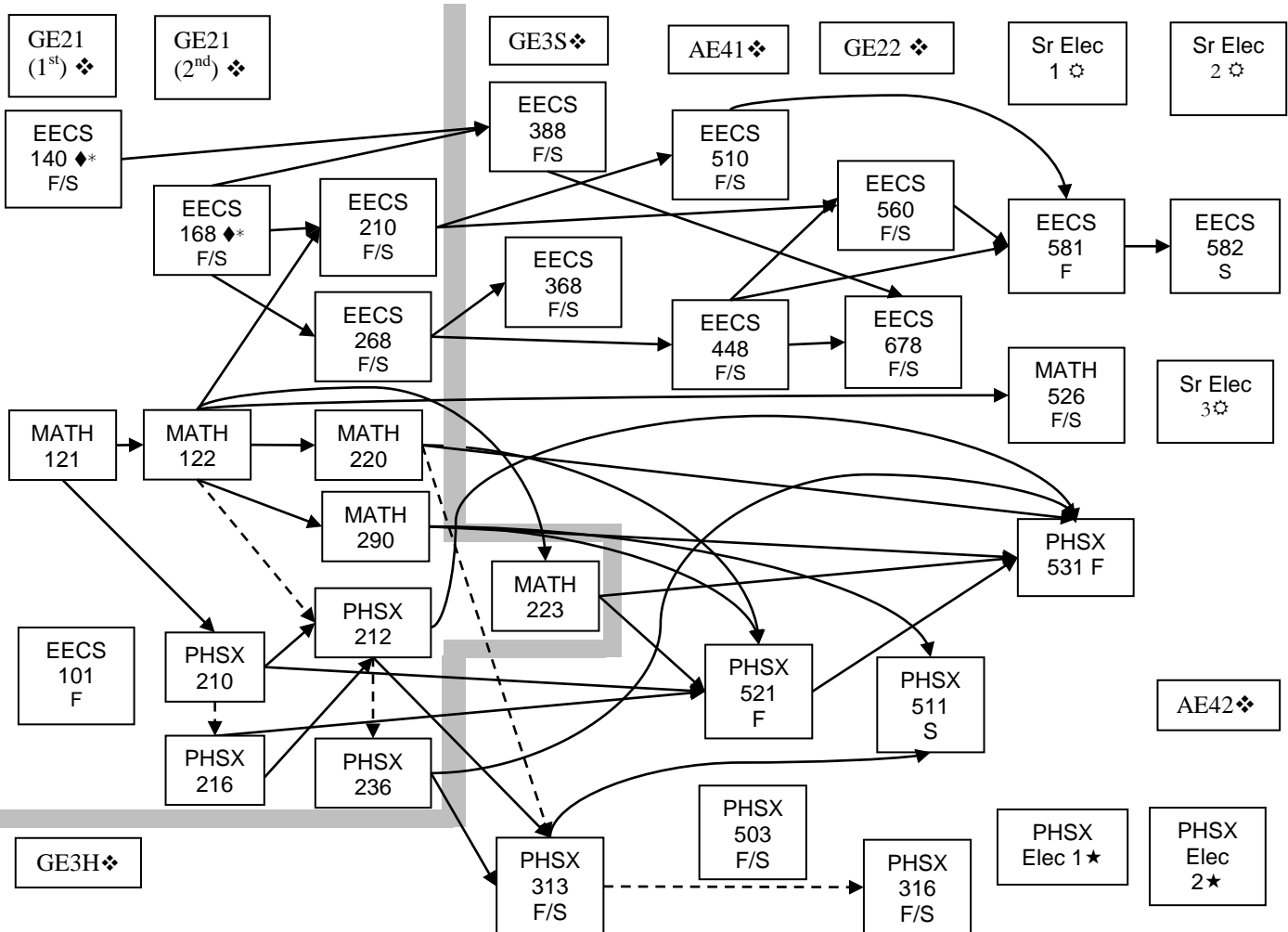
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Fall 1 st Semester		Spring 2 nd Semester		Fall 3 rd Semester		Spring 4 th Semester	
EECS 101	1	GE21 (second)❖	3	EECS 210	4	EECS 368	3
GE21 (first)❖	3	MATH 122	5	EECS 268	4	EECS 388	4
MATH 121	5	EECS 168 or 140 ♦	4	MATH 220	3	MATH 223	3
EECS 140 or 168 ♦	4	PHSX 210	3	MATH 290	2	GE3S❖	3
GE3H❖	3	PHSX 216	1	PHSX 212	3	PHSX 313	3
Total Hours	16	Total Hours	16	Total Hours	17	Total Hours	16

Fall 5 th Semester		Spring 6 th Semester		Fall 7 th Semester		Spring 8 th Semester	
EECS 448	4	EECS 560	4	EECS 581	3	EECS 582	3
EECS 510	3	EECS 678	4	MATH 526	3	Sr. Elective 2 ☼	3
AE41❖	3	GE22❖	3	Sr. Elective 1 ☼	3	Sr. Elective 3 ☼	3
PHSX 503	2	PHSX 316	1	PHSX 531	3	AE42❖	3
PHSX 521	3	PHSX 511	3	PHSX Elective 1★	3	PHSX Elective 2★	3
Total Hours	15	Total Hours	15	Total Hours	15	Total Hours	15

Interdisciplinary Computing (Physics) Course Flow Chart

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



FALL 1 st Semester 16 hours 1 lab	SPRING 2 nd Semester 16 hours 2 labs	FALL 3 rd Semester 17 hours 2 labs	SPRING 4 th Semester 16 hours 1 lab	FALL 5 th Semester 15 hours 1 lab	SPRING 6 th Semester 15 hours 3 labs	FALL 7 th Semester 15 hours 1 lab	SPRING 8 th Semester 15 hours 1 lab
---	--	--	---	---	--	---	---

*Assumes even KUID.

Upper Level Eligibility Established ———> Prerequisite - - - - -> Co-requisite

F=course offered in Fall only; S=course offered in Spring only; F/S=course offered in Fall and Spring; S/SU=course offered in Spring and Summer;

Departmental Academic Policies

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

Transfer Credits

The University accepts and will place on the student's permanent KU record credits for all academic courses taken at an accredited college or university. Vocational and remedial courses are excluded. Not all courses accepted by the University will apply toward a degree in engineering. A student will not receive engineering degree transfer credit for:

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

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 during the student's first semester in the Department.

Academic Requirements

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

Progress through the curriculum requires not just passing all courses required for a particular degree, but passing them at certain levels and/or in the proper sequence.

Course Prerequisites and Corequisites

You must pass (at the appropriate grade level) all prerequisite courses for a given course **before** taking the subsequent course. If Course A is a Corequisite for Course B, Course A must be taken in the same semester as Course B *or* be completed prior to taking Course B.

Upper Level Eligibility

In addition to prerequisites and co-requisites, 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

(15 courses)

GE21 (both)
PHSX 210 & 216
MATH 121, 122, 220, 290
EECS 101, 140, 168, 211, 212, 220
CHEM 130 or 150

CoE Major

(16 courses)

GE21 (both)
PHSX 210 & 216
MATH 121, 122, 220, 290
EECS 101, 140, 168, 210,
211, 212, 220, 268

CS Major

(15 courses)

GE21 (both)
PHSX 210 & 216, 212 & 236
MATH 121, 122, 223, 290
EECS 101, 140, 168, 210, 268

IC (Astronomy) Major

(16 courses)

GE21 (both)
PHSX 210 & 216, 212 & 236
MATH 121, 122, 220, 223, 290
EECS 101, 140, 168, 210, 268

IC (Biology) Major

(15 courses)

GE21 (both)
MATH 121, 122, 223, 290
EECS 101, 140, 168, 210, 268
CHEM 130, 135
BIOL 150, 152

IC (Chemistry) Major

(18 courses)

GE21 (both)
PHSX 210 & 216, 212 & 236
MATH 121, 122, 220,
223, 290
EECS 101, 140, 168, 210, 268
CHEM 184, 188

IC (Geography) Major

(13 courses)

GE21 (both)
PHSX 210 & 216
MATH 121, 122, 223, 290
EECS 101, 140, 168, 210, 268

IC (Physics) Major

(16 courses)

GE21 (both)
PHSX 210, 216, 212 & 236
MATH 121, 122, 220, 223, 290
EECS 101, 140, 168, 210, 268

If you earn less than a C in any of the above listed courses, you must repeat the course at the next available opportunity and you must **not** take a course for which that course is a prerequisite. It is *your responsibility* to contact your advisor *before beginning the new semester* regarding any required repetitions and the associated enrollment adjustments (drops and adds).

To enroll in *any* upper-level EECS course (numbered 300 and above), you must have fulfilled the *Upper Level Eligibility Requirements* detailed above. Exceptions: EECS 312, EECS 360, EECS 368 and EECS 388 may be taken in the same semester as

you are completing your upper level eligibility. You may also petition for a *Partial Waiver of Upper Level Eligibility Requirements* by completing the appropriate petition, found in the EECS office or at www.eecs.ku.edu.

Schedule of Course Offerings

The semester that courses are offered is indicated on the Suggested Course Sequence flow chart for each major (F=Fall only; S=Spring only; F/S=Fall and Spring; S/SU=Spring and Summer).

Graduation Requirements

In addition to completing each of the required and elective courses listed in the curriculum:

1. You must attain a cumulative grade-point average of at least 2.0 in courses applied toward the degree. You must also have a KU cumulative grade-point average of 2.0 whether or not all courses are being applied to the degree.
2. You must 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. If you entered with advanced standing (transfer credit), you must attain 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.
4. You must take the last 30 hours of credit toward the degree at KU and be officially enrolled in the School of Engineering during this time.

Departmental Honors

A student may graduate with departmental honors in any of the four majors by satisfying the requirements below. Most of the requirements for graduation with Honors are completed during the final two semesters of the undergraduate program.

1. The student must file an application to graduate with Departmental Honors during the semester preceding the student's final two semesters (a summer semester may count as one of these). This must be done prior to enrolling in any EECS 498 course (see step 3 below). These forms are available in 2001Eaton Hall. Applicants must have an overall GPA of 3.25 or higher and an engineering GPA of 3.5 or higher. Applicants must identify a research topic and obtain consent of a faculty member to supervise the Honors research.
2. Applicants who receive preliminary approval must remain enrolled full-time and must maintain the above minimum cumulative overall and engineering GPAs until graduation.
3. Applicants who receive preliminary approval must enroll in EECS 498: Honors Research for one credit hour for his/her last two semesters (a summer semester may count as one of these) under the supervision of the faculty member named in the Honors application. 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 faculty members, including the research supervisor. This panel makes the recommendation concerning graduating with honors.

Scheduling Your Time

Obtaining a degree in Electrical Engineering, Computer Engineering, Computer Science or Interdisciplinary Computing requires a commitment to organization and planning, as well as dedicating a large portion of time to in-class work, lab-work, and homework.

Time is probably the most important factor when deciding how many classes to take each semester. If you have job or family commitments, you 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". $(\text{Total-credit-hours} \times 3) + \text{weekly-employment-hours} \leq 60$ hours. If you are not closely following the Suggested Course Sequence for your degree, you should develop and keep current a complete plan of study for your chosen degree. This should be done at each semester's meeting with your faculty advisor (see below).

Advising and Enrollment

General Procedures

Each entering freshman or transfer student is encouraged to attend one of the University's summer orientation programs. 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 an orientation program confer with faculty advisors a day or two before the fall semester begins. Similar orientation programs are offered in January.

After the initial orientation advising, every EECS undergraduate is assigned a permanent faculty advisor. You should consult with your advisor at enrollment time and at any other time when questions or problems arise concerning your progress at the University or your professional future.

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

Each semester, a few days ahead of the start of enrollment itself, you are required to meet with your faculty advisor to plan your schedule and discuss other academic and career interests. You should watch for department notices informing you of the days set aside for advising by the EECS department. Prior to this advising period, you should sign up for an appointment on a sign-up sheet

available at your advisor's office or sign up on Blackboard. (You will be notified of which method of sign-up your advisor is using) At the time of the appointment you should bring an Academic Program Planning Form (available at the EECS office or at www.eecs.ku.edu) filled out with preliminary course selections. You should also arrive with definite notions (preferably written down so they will not be forgotten) about both (a) what you are sure of in terms of plans for the coming semester and about degree requirements in general, and (b) what you are unsure of that you need to discuss. This will make it possible for you and your advisor to deal effectively with whatever problems or concerns you have. You and our advisor must sign your Academic Program Planning Form before you will be allowed to enroll.

You are also encouraged to call on your advisor any time during the school year if you wish to change your enrollment or discuss any other school or career related matters. Consultation with an advisor is strongly encouraged before making enrollment changes.

There are a number of Department and School policies concerning course selection and enrollment in both engineering and non-engineering courses. Many of these are discussed below, and the latest University catalog may have more information on some topics. Also, you should regularly check the EECS web site at www.eecs.ku.edu. Important notices regarding advising and enrollment are sent to your EECS student email account; make sure you check your KU email account regularly or arrange to have your KU account email forwarded to another account that you check regularly.

Auditors

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

Change of Advisor

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

Change of Major

If you wish to change majors within the School of Engineering, you must complete a Change of Major form available in the Engineering Dean's Office or the EECS Office or at <http://enr.ku.edu/>. Completed Change of Major forms should be turned in to the Engineering Dean's Office in 1 Eaton Hall.

If you wish to change your major to something other than engineering, you need to complete a Change of School Application form. Forms are available in the Engineering Dean's Office or at www.registrar.ku.edu. Completed forms should be turned in to the School in which you wish to change.

Curriculum Changes

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

Double Major

If you wish to double-major (earn two degrees), you must fulfill all the requirements for the degrees in question. You must also consult the Engineering Dean's office and the department and/or school of the second major to find out if there are any additional requirements. If you wish to obtain two degrees offered by the EECS department, the following rule applies: a course that is required for one EECS degree program may not be used to satisfy a Senior Elective or General Elective requirement of another EECS degree program.

Graduate Courses

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

Limitation on Enrollment in Engineering Courses

After the 5th day 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 three categories. Specific forms for cases 2 and 3 are available from the EECS Office.

Case 1:

Courses transferred from another institution that automatically fulfill a course requirement. This occurs when the Advising Report in the KYou portal shows this course with the necessary KU course equivalent number. These courses should also appear on the DPR (Degree Progress Report), but if they don't, a *Course Substitution Petition* should be filled out, signed by the advisor, and submitted to the Undergraduate Committee who will then forward it to the Associate Dean of The School of Engineering. The DPR, Advising Report, and other information available in the KYou portal show all courses for which KU has given you credit hours and other pertinent information to track your progress as a student at KU.

Case 2:

Technical courses transferred from another accredited institution that clearly contain the appropriate course material for required courses, but do not appear on the DPR form with the necessary KU course number. In this case, a *Transfer Contract* form should be filled out, signed by the advisor and submitted to the Undergraduate Committee who will then forward it to the Associate Dean of The School of Engineering .

Case 3:

Courses transferred from another institution or KU courses that may contain 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 submitted to the Undergraduate Committee who will then forward it to the Associate Dean of The School of Engineering. If at all 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 Information:

Dropping courses should be avoided, since dropping almost always carries consequences of some sort; it is better to plan carefully. 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 on the Academic Program Planning Form.

Even with careful planning, however, you may at some point wish to drop a course that you have already enrolled in. Your advisor should always be consulted before making changes to your class schedule.

Procedural Details:

Deadline dates and the latest information on dropping procedures and conditions for a given semester are available in the University academic calendar (currently available at <http://www.registrar.ku.edu/calendar>) in effect for that semester.

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 EECS Department.

1. If you leave the School of Engineering but remain a student in good standing at the University of Kansas and then wish to return to the School of Engineering, you would file an *Application for Change of School*. (Change of School Applications are available in the Engineering Dean's Office, 1 Eaton Hall or at: www.registrar.ku.edu).
2. If you leave the School of Engineering and the University of Kansas and then wish to return to the School of Engineering, you would 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. If you have been dismissed from the School of Engineering for poor scholarship, you must not only file the appropriate application mentioned in 1 or 2 above, but you must also file a *Petition for Reinstatement* to the School of Engineering. Petition forms are available from the School of Engineering Dean's office, 1 Eaton Hall. The signed petition must be turned in to the Dean's office for review and decision.

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

University Course Repeat Policy

You can view the Course Repeat Policy at: <https://documents.ku.edu/policies/governance/USRR.htm#art2sect2>. The Engineering Dean's Office can provide answers to specific questions.

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 KU Policy Library website under Academic at <http://www.policy.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 Programs

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 website (<http://www.honors.ku.edu/>).

Frequently Asked Questions

a. How do I know when courses are offered?

The semester that courses are offered is indicated on the Suggested Course Sequence flow chart for each major (F=Fall only; S=Spring only; F/S=Fall and Spring; S/Su=Spring and Summer).

b. Is it OK for me to take the next course in a sequence, for example Math 122, at the same time I am 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 you to build solid foundations. This is not likely to happen if you haven't attained a C or better in the prerequisite course before taking the next course. Second, you 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 your advisor that it would be appropriate for you to take the two courses at the same time, you should obtain the permission of the department(s) teaching the courses.

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

Not recommended. Although the credit/no credit (CR/NC) option is allowed to fulfill: written and oral communications; arts, humanities, and social science courses; human diversity; and cultural and global awareness; this option has the potential of lowering (not raising) your grade point average, since CR/NC courses are not included in GPA calculations. Also, some schools, scholarship committees, and honorary societies do not accept this grading system and convert grades of No Credit to F when computing grade-point averages.

A Credit/No Credit option is available to all degree-seeking undergraduates. You may enroll in one course a semester under the option, if the course is not in your major or minor. For more information, visit the KU [Policy Library](#).

Warning: *Certain undesirable consequences may result from exercising the option. Some schools, scholarship committees, and honorary societies do not accept this grading system and convert grades of No Credit to F when computing grade-point averages.*

Credit/No Credit is allowed for courses used to fulfill KU Core GE 2.1 Written Communication, GE 2.2 Oral Communication, GE 3H Arts & Humanities, GE 3S Social Sciences, AE 4.1 Human Diversity, AE 4.2 Cultural & Global Awareness, and AE 5 Social Responsibility and Ethics requirements only. If an Engineering department recommends that certain course work be used to fulfill any of these requirements, those courses shall not be eligible for Credit/No Credit. Students should see their Engineering advisor.

d. What is the ROTC policy for electrical engineering, computer engineering, computer science and interdisciplinary computing 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 Professional Elective requirement.

e. ***How do I locate computer science books, journals and conference proceedings in the KU libraries?***

Print materials on computer science are housed in two different buildings at KU: **Anschutz Library**, 2nd floor (one floor below entry level), Call number QA 75.5-76.9. Anschutz covers mainly computer programming and software. Topics include general theory and application of computers, data processing, parallel processing, computer programming, programming languages, specific makes and models of computers and microprocessors, computer security, database and file management, etc. **Spahr Engineering Library**, 2nd floor, Call number TK 5100-7895. Spahr covers mainly computer engineering and hardware. Topics include telecommunication, signal processing, wireless, data transmission, computer networks, electronic circuits and apparatus, semiconductors, microelectronics, integrated circuits, microwaves, and computer hardware, components, and auxiliary equipment, etc. Sometimes there are materials on a topic in both Anschutz and Spahr.

f. ***What online publications are available?***

The Spahr Engineering Library's web site provides online access to many computer science publications. These include the ACM Digital Library, the IEEE Xplore journals and proceedings since 1998, and many other electronic journals and databases. Online publications are accessible from anywhere on campus. Regardless of location, all computer science books, journals, and conference proceedings are listed in the library's online catalog. The same is true of all library materials at KU in every field of engineering. The catalog gives the location of each and every item.

Entry to the Profession

Job Search Assistance

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

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

Licensing

Engineering licensure laws vary from state to state, but, in general, to become a Professional Engineer (PE) an individual must be a graduate of an engineering program accredited by the Accreditation Board for Engineering and Technology, pass the Fundamentals of Engineering exam (usually taken during a student's senior year), gain four years of experience working under a PE, and pass the Principles and Practice of Engineering exam.

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.

Student Activities/Organizations

Engineering Student Council

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

Honor Societies

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

Minorities and Women

The **Engineering Diversity Program** encourages minority and women 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, the Society of Hispanic Professional Engineers, and/or the Society of Women Engineers. For further information, contact the Engineering Diversity Program director, 785/864-3620.

National Professional Societies

Most national professional societies have student chapters on campus. In EECS, the primary societies are the Association for Computing Machinery (ACM) and the Institute of Electrical and Electronics Engineers (IEEE).

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 Open to Undergraduates Offered by the EECS Department

EECS 101 New Student Seminar (1)

A seminar intended to help connect freshmen and transfer EECS students to the EECS department, their chosen profession, and each other. Topics include overviews of the various disciplines, curricula and advising, ethics and professionalism, student organizations and extracurricular activities, senior projects, and career planning.

EECS 128 Foundations of Information Technology (3).

Introduction to information technology and computer science.

Topics include Internet tools (including browsers, search engines and web page construction), networking, computer organization, algorithms and programming, data representation and manipulation, computer components (including CPU, RAM and storage devices), arithmetic in other number bases, Boolean logic, system and application software, operating systems, databases, social and ethical issues in computing, privacy and information security, and mobile computing. Prerequisite: MATH 101 or MATH 104 or eligibility to enroll in MATH 115 or MATH 121.

EECS 137 Visual Basic for Engineers (3)

Introduction of computer-based problem solving techniques for engineering practice with emphasis on good programming practices and the integration of appropriate computational and related tools. Solutions are computed using Visual Basic, specifically VBA within Excel. Elementary numerical and statistical methods are applied to the solution of sets of linear and nonlinear algebraic equations, linear regression, and root finding. Microsoft Office is used with the computational tools to provide integrated report generation capability. Two lectures and weekly laboratory instruction. Prerequisite: MATH 104.

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. Prerequisite: MATH 101 or MATH 104 or eligibility to enroll in MATH 115 or MATH 121.

EECS 140 Introduction to Digital Logic Design (4). An introductory course in digital logic covering number representation, digital codes, Boolean Algebra, combinatorial logic design, sequential logic design, and programmable logic devices. Corequisite: MATH 104.

EECS 141 Introduction to Digital Logic: Honors (4). An introductory course in digital logic covering number representation, digital codes, Boolean Algebra, combinatorial logic design, sequential logic design, and programmable logic devices. This course is intended for highly motivated students and includes honors-level assignments. Corequisite: MATH 121 plus either acceptance into the KU Honors Program or consent of instructor.

EECS 168 Programming I (4). Problem solving using a high level programming language and object oriented software design. Fundamental stages of software development are discussed: problem specification, program design, implementation, testing, and documentation. Introduction to programming using an object oriented language: using classes, defining classes, and extending classes. Introduction to algorithms and data structures useful for problem solving: arrays, lists, files, searching, and sorting. Students will be responsible for designing, implementing, testing, and documenting independent programming projects. Professional ethics are defined and discussed in particular with respect to computer rights and responsibilities. Corequisite: MATH 104.

EECS 169 Programming I: Honors (4). Problem solving using a high level programming language and object oriented software

design. Fundamental stages of software development are discussed: problem specification, program design, implementation, testing, and documentation. Introduction to programming using an object oriented language: using classes, defining classes, extending classes. Introduction to algorithms and data structures useful for problem solving: arrays, lists, files, searching, and sorting. Students will be responsible for designing, implementing, testing, and documenting independent programming projects. Professional ethics are defined and discussed in particular with respect to computer rights and responsibilities. This course is intended for highly motivated students and includes honors-level assignments. Corequisite: MATH 121, plus either acceptance into the KU Honors Program or consent of instructor.

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 168 or 169 (or equivalent) and MATH 122.

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. Corequisites: MATH 220 and MATH 290.

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, and Maxwell's equations. Prerequisites: MATH 220, MATH 290, PHSX 211, PHSX 216, and EECS 211.

EECS 268 Programming II (4). This course continues developing problem solving techniques by focusing on the imperative and object-oriented styles using Abstract Data Types. Basic data structures such as queues, stacks, trees, and graphs will be covered. Recursion. Basic notions of algorithmic efficiency and performance analysis in the context of sorting algorithms. Basic Object-Oriented techniques. An associated laboratory will develop projects reinforcing the lecture material. Three class periods and one laboratory period per week. Prerequisites: EECS 168 or EECS 169.

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

EECS 315 Electric Circuits and Machines (3). Introduction to DC and AC electrical circuit analysis techniques, AC power calculations, transformers, three-phase systems, magnetic circuits, and DC and AC machines with a focus on applications. Not open to electrical or computer engineering majors. Prerequisite: A course in differential equations and eight hours of physics.

EECS 316 Circuits, Electronics and Instrumentation (3). Introduction to DC and AC electrical circuit analysis, operational amplifiers, semiconductors, digital circuits and systems, and electronic instrumentation and measurements with a focus on applications. Not open to electrical or computer engineering majors. Students may not receive credit for both EECS 316 and EECS 317. Prerequisite: A course in differential equations and eight hours of physics.

EECS 317 Electronics and Instrumentation (2). Introduction to operational amplifiers, semiconductors, digital circuits and systems, and electronic instrumentation and measurements with a focus on applications. Not open to Electrical or Computer Engineering majors. Students may not receive credit for both EECS 316 and EECS 317. Prerequisite: EECS 315.

EECS 318 Circuits and Electronics Lab (1). Laboratory exercises intended to complement EECS 316 and EECS 317. Experiments include DC circuits, analog electronics, and digital electronics. Not open to electrical or computer engineering majors. Corequisite: EECS 316 or EECS 317.

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

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

EECS 388 Embedded Systems (4). Internal organization of microprocessor and microcontroller systems; programming in assembly language; input and output system; controlling external devices. The course will focus on one or two specific microprocessors and computer systems. Prerequisite: EECS 140 or 141 and EECS 168 or 169 and upper-level EECS eligibility.

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

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

EECS 420 Electromagnetics II (4). This course applies electromagnetic analysis to high frequency devices and systems where wave propagation effects cannot be neglected. Topics covered include transmission lines, space waves, waveguides, radiation, and antennas. Laboratory experiments include transmission line, waveguide, and antenna measurements and characterizations. 3 hours lecture, 1 hour laboratory. Prerequisites: EECS 220 and upper-level EECS eligibility.

EECS 441 Power Systems Engineering II (3). A continuation of ARCE 640 that integrates system components into functional, safe, and reliable power distribution systems for commercial, industrial and institutional (CII) facilities. Service entrance design, distribution system layout and reliability, emergency and standby power system design, medium-voltage distribution systems, symmetrical fault analysis and special equipment and occupancies. (Same as ARCE 641.) Prerequisite: Either ARCE 640 or EECS 212, 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. Prerequisites: EECS 212 and EECS 360.

EECS 448: Software Engineering I (4). This course is an introduction to software engineering, and it covers the systematic development of software products. It outlines the scope of software

engineering, including life-cycle models, software process, teams, tools, testing, planning, and estimating. It concentrates on requirements, analysis, design, implementation, and maintenance of software products. The laboratory covers CASE tools, configuration control tools, UML diagrams, integrated development environments, and project specific components. Prerequisites: 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
Prerequisites: MATH 290, MATH 220 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. Prerequisites: PHSX 313 and upper-level EECS eligibility.

EECS 498 Honors Research (1-2). Arranged to allow students to satisfy the independent research requirement for graduation with departmental honors. Prerequisites: 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. Prerequisite: EECS 412 and EECS 562.

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 of computation. May be taken for graduate credit. (Same as MATH 510.) Prerequisites: EECS 210 and upper-level EECS 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. Prerequisites: 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 544: Electric Machines and Drives (3) Fall 2011
Introduction to electric machine theory, operation, and control. Electric machine covered include DC generators and motors, AC synchronous generators and motors, AC induction generators and motors, as well as fractional horsepower and special purpose motors. Motor starting and controls for both DC and AC machines are also

covered including as introduction to power electronics and variable frequency drives (VFD). (Same as ARCE 644). Prerequisite: Either ARCE 640 or EECS 212, and Upper-Level EECS Eligibility.

EECS 545: Electric Energy Production & Storage (3). An introduction to utility scale and small scale (distributed generation) electric energy production and storage systems. This course addresses the technical, operational, economic, environmental, and social characteristics associated with both traditional and nontraditional electric energy production systems along with associated grid integration, energy delivery, and regulatory issues. Traditional energy production systems covered include fossil fuel, hydroelectric, and nuclear power plants. Non-traditional energy production systems covered include fuel cells, photovoltaics (PV), concentrated solar power (CSP), wind, geothermal, and other emerging technologies. (Same as ARCE 645) Prerequisite: Either ARCE 640 or EECS 212, and Upper-Level EECS Eligibility.

EECS 547: Power System Analysis I (3). Introduction to the analysis of commercial, industrial, and utility power systems. Emphasis is placed on modeling system components which include transmission and distribution lines, transformers, induction machines, and synchronous machines and the development of a power system model for analysis from these components. System modeling will be applied to short-circuit studies and used to analyze symmetrical faults, to develop sequence networks using symmetrical components, and analyze unsymmetrical faults. (Same as ARCE 647.) Prerequisite: Either ARCE 640 or EECS 212, and Upper-Level EECS Eligibility.

EECS 548: Power System Analysis II (3). Continuation of EECS 547 that uses power system modeling developed in EECS 547 to analyze power system load flow, operation and economic dispatch, stability, and transient response. The impact of alternative energy sources, energy storage, DC transmission and interties, and other emerging technologies on power system operation and reliability will be addressed throughout the course. (Same as ARCE 648.) Prerequisites: Either ARCE 647 or EECS 547, and Upper-Level EECS Eligibility.

EECS 560 – Data Structures (4). Data abstraction and abstract data types. Topics include the design and implementation of dictionary, priority queues, concatenated queue, disjoint set structures, graphs, and other advanced data structures based on balanced and unbalanced tree structures. Special emphasis will be placed on the implementations of these structures and their performance tradeoffs. Both asymptotic complexity analysis and experimental profiling techniques will be introduced. Labs will be used to provide students with hands-on experience in the implementations of various abstract data types and to perform experimental performance analysis. 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. Prerequisites: EECS 212 and EECS 360.

EECS 563 Introduction to Communication Networks (3). An introduction to the principles used in communication networks is given in this course. Topics include a discussion of the uses of communications networks, network traffic, network impairments, standards, layered reference models for organizing network functions. Local Area Network technology and protocols are discussed. Link, network, transport layer protocols, and security are introduced. TCP/IP networks are stressed. VoIP is used as an example, throughout the course. Basic concepts of network performance evaluation are studied, both analytical and simulation techniques are considered. Prerequisite: EECS 168 and either EECS 461 or MATH 526.

EECS 565 Introduction to Information and Computer Security (3 hours). An introduction to the fundamentals of cryptography and information and computer security. Introduces the basic concepts, theories, and protocols in computer security. Discusses how to apply such knowledge to analyze, design and manage secure systems in the real world. Topic covered: the basics of cryptography, software security, operating system security, database security, network security, privacy and anonymity, social engineering, digital forensics, etc. Corequisite: EECS 678 and Prerequisite: Upper-Level EECS Eligibility.

EECS 581 CS Design I (3). The first semester of a two-semester, team-oriented lecture/laboratory course involving the specification, design, implementation, and documentation of a significant software system. The course includes the consideration of project management, ethics, economics, and technical writing. Can be taken only during the senior year. Pre-requisites: EECS 448, EECS 510, and EECS 560.

EECS 582 CS Design II (3). The second semester of a two-semester, team-oriented lecture/laboratory course involving the specification, design, implementation, and documentation of a significant software system. The course includes the consideration of project management, ethics, economics, and technical writing. Can be taken only during the senior year. Pre-requisite: EECS 581.

EECS 611 Electromagnetic Compatibility (3). A study of unwanted generation and reception of radio-frequency radiation from analog and digital electronic systems and how these emissions/receptions can be reduced. Topics covered include sources of radiation, grounding, shielding, crosstalk, electrostatic discharge, and practical design and layout schemes for reducing unwanted radiation and reception. Also covered are the major governmental electromagnetic compatibility (EMC) regulations and standards that apply to commercial electronic devices and systems. Prerequisites: EECS 220, and EECS 312.

EECS 622 Microwave and Radio Transmission Systems (3) Introduction to radio transmission systems. Topics include radio transmitter and receiver design, radiowave propagation phenomenology, antenna performance and basic design, and signal detection in the presence of noise. Students will design radio systems to meet specified performance measure. Corequisites: EECS 420 and EECS 461

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. Prerequisites: EECS 220 and PHSX 313, or equivalent and upper-level EECS eligibility.

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

EECS 643: Advanced Computer Organization (3). Principles and techniques of instruction level parallelism, Tomasulo's algorithm, branch prediction, reservation stations, recorder buffers, memory hierarchies. Parallel and scalable architectures, global directory caches, synchronization primitives, memory consistency, multithreading. Only one of EECS 643 and EECS 645 may be used to satisfy EECS degree requirements. Prerequisite: EECS 443

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

EECS 645 Computer Architecture (3). The structure and design of computing systems. Examination and analysis of computing systems. Examination and analysis of instruction set architectures, pipelined

control and arithmetic units, vector processors, memory hierarchies, and performance evaluation.

Prerequisite: EECS 388.

EECS 647 Introduction to Database Systems (3). Introduction to the concept of databases and their operations. Basic concepts, database architectures, storage structures and indexing, data structures: hierarchical, network, and relational database organizations. Emphasis on relational databases and retrieval languages SQL, QBE, and ones based on relational algebra and relational calculus; brief description of predicate calculus. Theory of databases, normal forms, normalization, candidates keys, decomposition, functional dependencies, multi-valued dependencies. Introduction to the design of a simple database structure and a data retrieval language. Prerequisite: EECS 448. Student cannot receive credit for both EECS 647 and EECS 746.

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

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

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

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

EECS 664 Introduction to Digital Communication Systems (3). An introduction to building digital communication systems in discrete time, including lectures and integrated laboratory exercises. Topics covered include signal spaces, base-band modulation, bandpass modulation, phase-locked loops, carrier phase recovery, symbol timing recovery, and basic performance analysis. Prerequisite: EECS 360 and 461. LBN

EECS 665 – Compiler Construction (4). Compilation of simple expressions and statements. Organization of a compiler including symbol tables, lexical analysis, syntax analysis, intermediate and object code generation, error diagnostics, code optimization techniques and run-time structures in a block-structured language such as PASCAL or C. Programming assignments include using tools for lexer and parser generator, and intermediate, and object code generation techniques. Laboratory exercises will provide hands-on experience with the tools and concepts required for the programming assignments. Prerequisites: EECS 368, EECS 448, 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, metallization, and plasma etching of thin films. (Same as C&PE 655) Prerequisite: senior standing in C&PE or EECS, 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, projects, visible line/surface determination, basic empirical lighting and shading models), and aliasing. Prerequisite: EECS 448

EECS 678 – Introduction to Operating Systems (4). The objective of this course is to provide the students with the concepts necessary to enable them to: a) identify the abstract services common to all operating systems, b) define the basic system components that support the operating system's machine independent abstractions on particular target architectures, c) consider how the design and implementation of different systems components interact and constrain one another, not merely how one or two important parts work in isolation, and d) understand the means by which fundamental problems in operating systems can be analyzed and addressed. Programming assignments address topics including process creation, inter-process communication, system call implementation, process scheduling and virtual memory. Laboratory exercises primarily focus on use of tools and concepts required for the programming assignments but include a small number of independent topics. Prerequisites: 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. Prerequisites: 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. Prerequisites: 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 710 Information Security and Assurance (3). This introductory security course covers a wide range of topics in the area of information and network security, privacy, and risk: the basic concepts: confidentiality, integrity and availability; introduction to cryptography; authentication; security models; information and database security; computer systems security; network security; Internet and web security; risk analysis; social engineering; computer forensics. Prerequisite(s): Graduate standing in EECS, or permission of the instructor. .

EECS 711 Security Management and Audit (3). Administration and management of security of information systems and networks, intrusion detection systems, vulnerability analysis, anomaly detection, computer forensics, auditing and data management, risk management, contingency planning and incident handling, security planning, e-business and commerce security, privacy, traceability and cyber-evidence, legal issues in computer security. Prerequisite: EECS 710.

EECS 712 Network Security and its Application (3). This course focuses on network-based information and communication systems, and examines network technologies and service applications to provide the students with a comprehensive introduction to the field of network security and its application. The course covers key concepts and critical network security services including authentication and access control, integrity and confidentiality of data, routing, firewalls, virtual private networks, web security, virus protection, and network security architecture and policy development. The students are expected to understand the technical vulnerabilities of networked systems and to develop methods to eliminate or mitigate those vulnerabilities. Prerequisite(s): EECS 710 and EECS 780, or the instructor's approval.

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 equivalent.

EECS 718 Graph Algorithms (3). This course introduces students to computational graph theory and various graph algorithms and their complexities. Algorithms and applications covered will include those related to graph searching, connectivity and distance in graphs, graph isomorphism, spanning trees, shortest paths, matching, flows in network, independent and dominating sets, coloring and covering, and Traveling Salesman and Postman problems. Prerequisite: EECS 560 or graduate standing with consent of instructor.

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, and EECS 420, or EECS 720 or permission of the instructor.

EECS 723 Microwave Engineering (3). 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 725 Introduction to Radar Systems (3). Basic radar principles and applications. Radar range equation. Pulsed and CS modes of operation for detection ranging, and extracting Doppler information. Prerequisite: EECS 360, EECS 420, EECS 461, EECS 622 recommended. LEC.

EECS 728 Fiber-Optic Measurement and Sensors (3). The course will focus on fundamental theory and various methods and applications of fiber-optic measurements and sensors. Topics include: optical power and loss measurements, optical spectrum analysis, wavelength measurements, polarization measurements, dispersion measurements, PMD measurements, optical amplifier characterization, OTDR, optical components characterization and industrial applications of fiber-optic sensor. Prerequisites: EECS 628 or equivalent. LEC

EECS 730 Introduction to Bioinformatics (3). This course provides an introduction to bioinformatics. It covers computational tools and databases widely used in bioinformatics. The underlying algorithms of existing tools will be discussed. Topics include: molecular biology databases, sequence alignment, gene expression data analysis, protein structure and function, protein analysis, and proteomics. Prerequisite: Data Structures Class equivalent to EECS 560, and Introduction to Biology equivalent to BIOL 150, or consent of instructor.

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 649 and a knowledge of mathematical logic equivalent to that supplied by EECS 210. Infrequently offered.

EECS 738 - Machine Learning (3). "Machine learning is the study of computer algorithms that improve automatically through experience" (Tom Mitchell). This course introduces basic concepts and algorithms in machine learning. A variety of topics such as Bayesian decision theory, dimensionality reduction, clustering, neural networks, hidden Markov models, combining multiple learners, reinforcement learning, Bayesian learning etc. will be covered. Prerequisite(s): Graduate standing in CS or CoE or consent of instructor.

EECS 739 Scientific Parallel Computing (3). This course is concerned with the application of parallel processing to problems in the natural sciences and engineering. State-of-the-art computing methodologies are studied along with contemporary applications.

The course takes a performance-oriented applied approach, with attention to parallel algorithms, parallel architecture, compilation issues, and system evaluation. Prerequisite: Graduate standing or consent of instructor and experience with C, C++, or FORTRAN.

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 - Static Analysis (3). This course presents an introduction to techniques for statically analyzing programs. Coverage includes theoretical analysis, definition and implementation of data flow analysis, control flow analysis, abstract interpretation, and type and effects systems. The course presents both the underlying definitions and pragmatic implementation of these systems. Prerequisite(s): EECS 662 or EECS 665 or equivalent

EECS 743 - Advanced Computer Architecture (3). This course will focus on the emerging technologies to build high-performance, low-power, and resilient microprocessors. Topics include multiprocessing, reliability-and-variability-aware computer architecture designs, energy-efficient computer systems, on-chip networks, 3D microprocessor designs, general-purpose computation on graphics processing units, and non-volatile computer memory. The course responds to VLSI technologies ability to provide increasing numbers of transistors and clock speeds to allow computer architects to build powerful microprocessors and computer systems and the challenges (e.g. resilience, energy-efficiency) that the growth in microprocessor performance is facing from the aggressive technology scaling. Prerequisite(s): Prerequisite: EECS 643 or EECS 645, or equivalent. A good understanding of C/C++ and having basic Unix/Linux skills is required.

EECS 744 - Communications and Radar Digital Signal Processing (3). The application of DSP techniques to specialized communications and radar signal processing subsystems. Topics include A-D converters, specialized digital filters, software receiver systems, adaptive subsystems and timing. Prerequisite(s): Prerequisites: An undergraduate course in DSP such as EECS 644.

EECS 745 Implementation of Networks (3). Laboratory-focused implementation of networks. Topics include direct link networks (encoding, framing, error detection, reliable transmission, SONET, FDDL, network adapters, Ethernet, 802.11 wireless networks); packet and cell switching (ATM, switching hardware, bridges and extended LANs); internetworking (Internet concepts, IPv6, multicast, naming/DNS); end-to-end protocols (UDP, TCP, APIs and sockets, RPCs, performance); end-to-end data (presentation formatting, data compression, security); congestion control (queuing disciplines, TCP congestion control and congestion avoidance); high-speed networking (issues, services, experiences); voice over IP (peer-to-peer calling, call managers, call signaling, PBX and call attendant functionality). Prerequisite: EECS 563 or EECS 780.

EECS 746 Database Systems (3). Introduction to the concept of databases and their operations. Basic database concepts, architectures, and data storage structures and indexing. Though other architectures are discussed, focus is on relational databases and the SQL retrieval language. Normalization, functional dependencies, and multivalued dependencies also covered. Culminates in the design and implementation of a simple database with a web interface. Prerequisite: EECS 448 or consent of instructor. Students cannot receive credit for both EECS 647 and EECS 746.

EECS 747 Mobile Robotics (3). Design, construction, and programming of mobile robots. Topics include computational hardware, designing and prototyping, sensors, mechanics, motors, power, robot programming, robot design principals and current

research in mobile robotics. Prerequisite(s): Knowledge of at least one modern programming language.

EECS 749 Knowledge Based Systems (3). General concepts of intelligent problem solving, rule-based systems, distributed AI, reasoning under uncertainty, case-based reasoning, subsymbolic techniques. Prerequisite: At least one class in Artificial Intelligence.

EECS 750 - Advanced Operating Systems (3). This course builds on the foundation established by an introductory course in operating systems concepts (e.g. EECS 678). Some previously covered topics are revisited in far greater detail, including code review of relevant portions of the Linux kernel source code. Examples include: computation representation by processes, system calls, interrupt processing and interrupt concurrency, process execution scheduling, and concurrency control methods.

Advanced topics, such as system performance analysis, time keeping, clock synchronization, virtualization, real - time implications for system design and scheduling, and device driver implementation are introduced for the first time. Approximately one- quarter to one- third of the class is devoted to reading, presenting and discussing conference and journal papers either illustrating classic breakthroughs in system architectures and methods or current research issues. Selection of the specific papers is done each semester, and students in the class are encouraged to suggest candidate topics and/or papers for consideration. Prerequisite(s): An undergraduate course in operating systems fundamentals. For example, EECS 678 or equivalent.

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 - Software Modeling and Analysis (3). Modern techniques for modeling and analyzing software systems. Course coverage concentrates on pragmatic, formal modeling techniques that support predictive analysis. Topics include formal modeling, static analysis, and formal analysis using model checking and theorem proving systems. Prerequisite(s): EECS 368 or equivalent.

EECS 761 - Programming Paradigms (3). An investigation of alternative programming paradigms and their representative effect on programming expressiveness and style. Emphasis is on a comparative understanding of a spectrum of programming paradigms, with some facility in the use of at least one typical language representative of each paradigm studied. This course will review and investigate as appropriate imperative, functional, object-oriented, parallel, logical, and scripting programming paradigms, plus additional paradigms as relevant. Prerequisite(s): EECS 662 or equivalent, or consent of instructor

EECS 762 - Programming Language Foundation I (3). This course presents a basic introduction to the semantics of programming languages. The presentation begins with basic lambda calculus and mechanisms for evaluating lambda calculus terms. Types are introduced in the form of simply typed lambda calculus and techniques for type inference and defining type systems are presented. Finally, techniques for using lambda calculus to define, evaluate and type check common programming language constructs are presented. Prerequisite(s): EECS 662 or equivalent.

EECS 763 - Introduction to Multiprocessor Systems on Chip (MPSoC) (3). This course covers the latest trends in advanced computer architecture for multiprocessor systems on chip for embedded and real time systems. Topics covered include multicore architectures, modeling abstractions, run time systems, and Hw/Sw co-design techniques. Prerequisite(s): EECS 645 and EECS 678 or equivalents

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(s): EECS 660 or equivalent

EECS 765 - Introduction to Cryptography and Computer Security (3). Comprehensive coverage to the fundamentals of cryptography and computer and communication security. This course serves as the

first graduate level security course, which introduces the core concepts, theories, algorithms and protocols in computer and communication security, and also prepares students for advanced security courses. This course first covers the mathematical foundation of cryptography and its applications in computer security. The course also covers a wide range of topics: information and database security, software and computer systems security, network security, Internet and web security. Prerequisite(s): EECS 678 and (EECS 780 or EECS 563), or the instructor's approval.

EECS 766 - Resource Sharing for Broadband Access Networks (3). Connections between network customers and the network come in many forms, wireless data systems, e.g., IEEE 802.16, wireless cellular systems, e.g. 3G, coax cable networks, e.g., DOCSIS, fiber optic communications systems, e.g., EPON, copper twisted pair, e.g., DSL, and powerline communications systems. All of these systems use various resource sharing strategies. The resource sharing strategy is matched to the necessities of specific systems as well as their operating environments. There are commonalities between these strategies as well as differences.

This course will look at resource sharing from a general perspective and then examine specific systems to underscore their commonalities and differences. Systems to be studied in detail include, DOCSIS, IEEE 802.16/Wi-Max, WCDMA, HSDPA/HSUPA, EV-DO, EPON, ZigBee/IEEE802.15.4, powerline networks. The use of cognitive radio communications technologies in future access networks will be introduced. Prerequisite(s): EECS 461, and EECS 563 or EECS 780.

EECS 767 - Information Retrieval (3). This class introduces algorithms and applications for retrieving information from large document repositories, including the Web. Topics span from classic information retrieval methods for text documents and databases, to recent developments in Web search, including: text algorithms, indexing, probabilistic modeling, performance evaluation, web structures, link analysis, multimedia information retrieval, social network analysis. Prerequisite(s): EECS 647 or permission of instructor.

EECS 768 Virtual Machines (3). Understand the fundamental principles and advanced implementation aspects of key virtual machine concepts. Topics include principles of virtualization, binary translation, process and system level virtual machines, JIT compilation and optimizations in managed environments, garbage collection, virtual machine implementation issues, and virtual machine security. Includes in-depth coverage of the latest developments and research issues in the field of virtual machines. Prerequisite(s): Prerequisites: EECS 665 and either EECS 643 or EECS 645 or consent of instructor

EECS 769 Information Theory (3). Information theory is the science of operations on data such as compression, storage, and communication. It is one of the few scientific fields fortunate enough to have an identifiable beginning - Claude Shannon's 1948 paper. The main topics of mutual information, entropy, and relative entropy are essential for students, researchers, and practitioners in such diverse fields as communications, data compression, statistical signal processing, neuroscience, and machine learning. The topics covered in this course include mathematical definitions and properties of information, mutual information, source coding theorem, lossless compression of data, optimal lossless coding, noisy communication channels, channel coding theorem, the source channel separation theorem, multiple access channels, broadcast channels, Gaussian noise, time-varying channels, and network information theory.. Prerequisite: EECS 461 or an equivalent undergraduate probability course.

EECS 773 - Advanced Graphics (3). Advanced topics in graphics and graphics systems. Topics at the state of the art typically selected from: photorealistic rendering; physically-based lighting models; ray tracing; radiosity; physically-based modeling and rendering; animation; general texture mapping techniques; point-based graphics; collaborative techniques; and others. Prerequisite(s): EECS 672 or permission of instructor.

EECS 774 - Geometric Modeling (3). Introduction to the representation, manipulation, and analysis of geometric models of objects. Implicit and parametric representations of curves and surfaces, with an emphasis on parametric freeform curves and surfaces such as Bezier and Nonuniform

Rational B-Splines (NURBS). Curve and surface design and rendering techniques. Introduction to solid modeling: representations and basic algorithms. Projects in C/C++ using OpenGL. Prerequisite(s): EECS 672 or permission of instructor.

EECS 775 – Visualization (3). Data representations, algorithms, and rendering techniques typically used in Visualization applications. The emphasis is on Scientific Visualization and generally includes topics such as contouring and volumetric rendering for scalar fields, glyph and stream (integral methods) for vector fields, and time animations.

Multidimensional, multivariate (MDMV) visualization techniques; scattered data interpolation; perceptual issues. Prerequisite(s): General knowledge of 3D graphics programming or permission of instructor.

EECS 776 Functional Programming and Domain Specific Languages

(3). An introduction to functional programming. Topics include learning how to program in Haskell; IO and purity in software engineering; functional data structures and algorithms; monads and applicative functors; parsing combinators; Domain Specific Languages (DSLs) and DSL construction; advanced type systems; making assurance arguments; testing and debugging. Prerequisite(s): Prerequisites: EECS 368 or equivalent or consent of instructor.

EECS 780 - Communication Networks (3). Comprehensive in-depth coverage to communication networks with emphasis on the Internet and the PSTN (wired and wireless). Extensive coverage of protocols and algorithms will be presented at all levels, including: social networking, overlay networks, client/server and peer-to-peer applications; session control; transport protocols, the end-to-end arguments and end-to-end congestion control; network architecture, forwarding, routing, signaling, addressing, and traffic management; quality of service, queueing and multimedia applications; LAN architecture, link protocols, access networks and MAC algorithms; physical media characteristics and coding; network security and information assurance; network management. Prerequisite(s): EECS 563 or equivalent or permission of instructor.

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

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

