



Electrical Engineering  
Computer Engineering

# **Undergraduate Handbook**

Department of Electrical and Computer Engineering  
<http://www.ece.osu.edu>

**Autumn 2007**

# FOREWORD

Our faculty and staff welcome you to the Electrical and Computer Engineering major and hope to assist you in obtaining the maximum benefit from your college career.

The primary purpose of this handbook is to present you with a summary of academic requirements, policies, facilities, activities, and organizations of these programs. The handbook provides information supplementing that contained in other publications generally available to students at The Ohio State University.

The electrical and computer engineering curricula are very challenging ones. We expect our students to be actively involved in learning and devoted to advancing knowledge in electrical and computer engineering. Both faculty and students must work together to achieve these ends and ensure the quality of our educational program.

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# 1. ACADEMIC PROGRAM

## 1.1 Department Objectives

The Objectives of the Department of Electrical and Computer Engineering are as follows:

### **Electrical Engineering Program:**

- Graduates can apply electrical engineering principles to solve engineering problems and to address the technological challenges of the future based on a solid foundation in circuits, systems, electromagnetics and devices.
- Graduates can apply modern electrical engineering techniques, tools, and practices to create and apply technologies to meet the needs of society.
- Graduates have developed an appreciation for, and an ability to engage in, their life-long learning process. Graduates are also well prepared for graduate school to further their education.
- Graduates become effective engineers in the workplace of the future or otherwise use the foundation of their technical education to progress in their career.

### **Computer Engineering Program:**

- Graduates can apply computer engineering principles to solve engineering problems and to address the technological challenges of the future based on a solid foundation in circuits, systems and computer hardware and software.
- Graduates can apply modern computer engineering techniques, tools, and practices to create and apply technologies to meet the needs of society.
- Graduates have developed an appreciation for, and an ability to engage in, their life-long learning process. Graduates are also well prepared for graduate school to further their education.
- Graduates become effective engineers in the workplace of the future or otherwise use the foundation of their technical education to progress in their career.

## 1.2 Degree Structure

The programs of Electrical Engineering and Computer Engineering are administered by the Department of Electrical and Computer Engineering. The official major for all students in our department is Electrical and Computer Engineering (ECE). The degree awarded is Bachelor of Science in Electrical and Computer Engineering (BSECE), with the specialization of either Electrical Engineering or Computer Engineering annotated on the official transcript. Applications for Degree should be completed in the third quarter of enrollment prior to graduation. Students must first make an appointment to meet with the undergraduate Advisor in DL 227 to ensure the proper coursework schedule for final degree requirements.

There is sometimes confusion between Computer Engineering in the Department of Electrical and Computer Engineering, and the programs in the Department of Computer Science and Engineering. For a comparison of these see Appendix II.

### 1.3 Accreditation

The Electrical Engineering specialization in the BSECE degree is accredited according to the program requirements established by ABET (Accreditation Board for Engineering and Technology) for Electrical Engineering.

The Computer Engineering specialization in the BSECE degree is accredited according to the program requirements established by ABET for Computer Engineering.

### 1.4 Admission Requirements

Any student seeking the Bachelor of Science degree in Electrical and Computer Engineering must apply for acceptance into the degree program. A student becomes eligible to apply at the beginning of the quarter in which that student will complete the following ECE pre-major requirements:

#### Electrical Engineering Specialization

Mathematics 151, 152, 153, 254  
Physics 131, 132, 133  
Chemistry 121  
Engineering 181, 183  
Engineering Graphics 167\*, or equiv

#### Computer Engineering Specialization

Mathematics 151, 152, 153, 254  
Physics 131, 132, 133  
Chemistry 121  
Engineering 181, 183  
Engineering Graphics 167\* or CS&E 221†

All admission conditions, (conditions that may have been imposed when the student was admitted to OSU), must be completed before entering the major. English 110 must also be successfully completed prior to entry into the major. (If English Placement testing determines that 052, 053, 106, 107, 108.01, 109.01, 109.02 or 110W are required, these courses must also be successfully completed before the student enters the ECE major.)

An application to major, which is obtained from the Department's pre-major advisor or via the web site, must be completed and returned to that advisor **no later than the first week of the quarter** in which that student will complete these requirements.

For the acceptance-to-major selection process, OSU grades comprising both the Cumulative Point Hour Ratio (CPHR) and Secondary Point Hour Ratio (SPHR) are considered. The SPHR is the grade average of the pre-major courses listed above for each specialization (not including English 110)‡. Please note: Courses completed at other institutions do not count in the Special Point Hour Ratio (SPHR) at OSU, however, they may count toward degree requirements.

To be admitted, students must successfully complete the required pre-major courses. First, all students with a CPHR of 3.0 or better are admitted to the major. Then for students with a minimum CPHR of 2.0 we will base further admission by SPHR. At this time our statistics show that for this year, admitting all students with an SPHR of 2.0 and higher causes our quota to be filled. The admission SPHR may be adjusted in the future; however, it will not be lowered to less than 2.0 even if the quota is not filled.

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\* If taking En Graph 167 any section will count toward program requirement, however, En Graph 167C is preferred.

† En Graph 167 (En Graph 167C is preferred) or satisfactory placement exam score required as prereq for CS&E 221.

‡ Note: CS&E 221 is not included in SPHR if En Graph 167 (or its equiv) was taken for a grade.

The Department of Electrical and Computer Engineering may deny registration in electrical and computer engineering courses to those students who have not been admitted to the BSECE major or who do not have the written permission of the Department.

## 1.5 Degree Requirements for the Electrical Engineering Specialization

1. College Requirements—General	Credit Hours	
Mathematics 151, 152, 153, 254, 415	24	
Physics 131, 132, 133	15	
Chemistry 121	5	
Engineering 181, 183	6	
Engineering Graphics 167*	4	
		54
2. Department Requirements—Specific Technical Topics		
Mathematics 571 or 568	3	
Statistics 427 or Mathematics 530	3	
Electrical and Computer Engineering 331 (Material Science)	3	
Industrial and Systems Engineering 504 (Engineering Economics)	3	
		12
3. Department Requirements—Core Program		
ECE 205, 206, 209, 261, 265, 301, 311, 312, 323, 341, 351, 352, 432, 481, and 682 or 683		40
4. Selected Core†		3-9
5. Technical Electives‡		43-49
6. General Education Courses (GEC)—must include ECE 582§		<u>38</u>
	TOTAL .....	196

A sample time schedule for this specialization is shown in Table 1.

All students must successfully complete 48 hours of math and basic sciences.

All transfer students are required to fulfill all programmatic requirements for the B.S.E.C.E. They must also successfully complete a minimum of 45 hours of OSU ECE or CS&E course work at OSU.

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\* Any section of En Graph 167 will count toward program requirement, however, En Graph 167C is preferred.

† See more details on Selected Core on page 5.

‡ See more details on Technical Electives starting on page 5.

§ Transfer students should check with their advisor to verify they are using the correct GEC list.

TABLE 1

Time Schedule for the Electrical and Computer Engineering Major:

**Specialization in Electrical Engineering**

Yr	Autumn		Winter		Spring		
1	Math Chemistry Eng	151-5 121-5 181-3	Math Physics Eng GEC	152-5 131-5 183-3 5	Math Physics En Graph GEC	153-5 132-5 167*-4 5	50
2	Math Physics ECE Digital Circuits GEC	254-5 133-5 261-3 5	Math ECE Circuit Analysis ECE Digital Lab ECE Microprocessors GEC	415-4 205-3 206-1 265-3 5	Math 571 or 568 ECE Circuits/Elec Lab ECE Anlys/Dsgn in Circuits/Electronics ECE Energy Convrnsn GEC	xxx-3 209-2 301-3 341-3 5	50
3	Stat 427 or Math 530 ECE Elc Anlys/Dsn/Sim ECE Systems 1 Tech Elec/Select Core GEC	xxx-3 323-3 351-3 3 5	ECE Electromagnetics 1 ECE Materials ECE Systems 2 Tech Elec/Select Core GEC	311-3 331-3 352-3 3 5	ECE Electromagnetics 2 ECE Semiconduct Dvcs Tech Elec/Select Core	312-3 432-3 10	50
4	ECE Prof Practice ISE Eng Economics Tech Elec/Select Core	481-1 504-3 11	GEC (ECE 582) Tech Elec/Select Core	3 14	ECE Group Project <b>-or-</b> ECE Individual Studies Tech Elec/Select Core	682-3 683-3 11	46

\* Any section of En Graph 167 will count toward program requirement, however, En Graph 167C is preferred.

**Technical Electives / Selected Core:** Every undergraduate student specializing in electrical engineering is required to take 52 total credit hours of technical electives and selected core. The number of technical elective hours will vary between 43-49 depending on the number of selected core hours taken (minimum of 3 required, maximum of 9).

**Selected Core:** A minimum of 3 hours (maximum of 9 hours) MUST be from this list:

**Biology**—113 (5)

**Chemistry**—122 (5) or 125 (4), 231 (3) or 251 (3)

**Computer Science and Engineering**—230 (4), 541 (3) or **Mechanical Engineering**—250 (4)

**Geological Sciences**—Earth Sci (Geo Sci) 121 (5)

**Material Science Engineering**—401 (4) or **Mechanical Engineering**—500 (4)

**Math**—366 (3), 512 (3), 513 (3), 514 (3)

**Mechanical Engineering**—410 (4), 420 (4), 430 (4)

**Technical Elective criteria:** Of the 43-49 technical elective hours required:

- At least 37 hours of Technical Electives must be ECE (leaves up to 15 hours outside ECE, including “Selected Core”); and
- Must take a concentration of 11 hours in one of the areas of Communications and DSP, Electromagnetics, Circuits, Microelectronics & Photonics, Power, Control, or Computer, and must include at least one 700-level class; and
- Must take either: A second concentration of 11 hours in another of the above areas with at least one 700-level course, or additional concentrations of five hours in each of two other areas; and
- At least 7 hours of technical electives must be ECE labs.

Many technical electives must be taken in sequence and usually sequences are only offered once each year. Thus, a student must plan a technical elective program early to help assure that a desired set of courses will be available when needed. It is advised that such planning be undertaken while a student is taking ECE 323 in the core program. Because high tech courses are subject to frequent revisions, the latest University course catalog is not always accurate.\*

Any 500, 600, or 700-level ECE course is an acceptable technical elective. ECE 327 and ECE 447 will also be accepted. (All 800-level courses are reserved for graduate students.) As there are many such courses, you should study the guidelines, which are shown in Appendix I for each of the major areas within this department, and then talk to faculty members in potential areas of interest.

A student may wish to work on a project in a special area. This can be done for technical elective credit by taking either ECE 693 “Individual Studies” or ECE 699 “Undergraduate Research in Electrical and Computer Engineering”, under the supervision of a faculty member in that area. The number of credit hours given and the requirements to be satisfied are set by mutual agreement between that faculty member and the student. For students not pursuing an undergraduate distinction project, up to a total of 3 hours among 693, 699, or 793 can be used as a technical elective.

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\* The most current ECE course descriptions can be found at <http://www.ece.osu.edu/academics/courses.html>.

Students with a cumulative point hour ratio of 3.4 or better may receive their BSECE degrees with distinction (denoted on the diploma) by taking 6 hours of H783 credit (or 3 hours of H783 and 3 hours of 683) while working on a project approved by their faculty advisor, writing a formal report documenting their research, and defending the work in an oral examination before the advisor and another faculty member. Such a research project is usually conducted by the student during their senior year. Students doing a distinction project can count up to 6 hours as technical electives. Specifically 3 hours of H783 count as a technical elective and then up to 3 more hours of any combination of additional H783, 699, 693 or 793 hours can count as technical electives.

Rank 4 students with a CPHR greater than or equal to 3.0 may file a **Senior Petition** to have 600- or 700-level courses taken beyond those required for the undergraduate degree to be applied to graduate course work. There is a 15-hour limit on Senior Petitions. All coursework must be completed prior to receipt of the undergraduate degree. Contact the Graduate School, Room 247 University Hall, 230 North Oval Mall, for more details. **Senior Petitions must be returned to the Graduate School by the end of the first day of classes.**

There is a new program for graduating with honors in engineering (GHIE). Please visit: <http://www.engineering.osu.edu/currentstudents/pdf/GHIE.pdf> for details on the engineering honors program.

A combined BS and MS program is available to ECE students who qualify. This program allows students to count some technical elective courses for both the BS and MS degrees, thus reducing the total time to finish the two degrees. For more details visit your advisor or see our web site at [http://www.ece.osu.edu/academics/bs\\_ms.html](http://www.ece.osu.edu/academics/bs_ms.html).

The Bachelor of Science in Electrical and Computer Engineering degree can provide a basis for advanced, post-graduate study in a number of areas such as engineering, law, business, or medicine. Students with such interests should select elective courses accordingly. An undergraduate advisor can provide relevant advice.

**Approved Outside Technical Electives:** Some courses approved for this purpose are:

**Biomedical Engineering**—BIOMED E 500, 571, 600, 631, 686, 701, 721, 732, 733, 739, 741, 761, 763, 771.

**Business**—BUS-ADMIN 555, BUS-FIN 510, 590, and 620, BUS-MGT 630, BUS-MKTG & LOG 650, and BUS-MHR 590, 660, 701, and 795.02. See your advisor early in your program if you are thinking about completing a Business Minor or an Entrepreneurship Minor.

**Chemical and Biomolecular Engineering**—CHBE 769 (cross-listed with BIOMED E 761).

**Chemistry**—CHEM 251 through 255.

**Computer Science and Engineering**—CS&E 215, 230 or 502; or any 500-level or above course (excluding CS&E 548, 668, 675.01, 675.02, 676, or 779) that is not directly comparable to an ECE course.

**Evolution, Ecology, and Organismal Biology**—EEOB 232.

**Industrial and Systems Engineering**—IND ENG 311, 406, 534, 619, 620, 640, 682.

**Mathematics**—MATH 512; 513 or 551; 514 or 552; 566; 569 or 572; 601; 602. Note that you cannot double count a particular math course as both a selected core course and an outside technical elective.

**Mechanical Engineering**—Any 500-level or above course\* (excluding 571, 773, and 776) which is not directly comparable to an ECE course.

**Nuclear Engineering**—Any 500-level or above course. 505 is especially appropriate for students with power interests.

**Physics**—Any 500-level or above course (excluding 517, 525, 555, 596, 617, 656, 657, 670, and 795) that is not directly comparable to an ECE or other engineering course.

**Statistics**—STAT 428.

A student wishing to take courses not on this list must secure advance approval from the Department by means of a petition as described in Section 1.8 of this document. See your advisor about courses 593, 692, 693, 793, and 699 outside the ECE department.

**General Education Courses (GEC):** The last part of the Electrical and Computer Engineering Specialization is comprised of 38 hours as follows:

	Hours
English and Communication Skills	13
Social Sciences	5-10
Historical Study	5-10
Arts & Humanities	<u>5-10</u>
Total	38

One of the courses included in English and Communication skills is ECE 582, Electrical and Computer Engineering Design I, and is required of all ECE students. One of the GEC classes must also be a **Social Diversity** class (shown on the GEC list as underlined course numbers) and one of the GEC classes must also be an **Ethics** class. The GEC list is shown in the attachments at the end of the Handbook.

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\* May use up to 6 hours in Mech Eng 580, and up to 4 hours in Mech Eng 652.

## 1.6 Degree Requirements for the Computer Engineering Specialization

	Credit Hours	
1. College Requirements—General		
Mathematics 151, 152, 153, 254, 415	24	
Physics 131, 132, 133	15	
Chemistry 121	5	
Engineering 181, 183	6	
Engineering Graphics 167*	4	
		54
2. Department Requirements—Specific Technical Topics		
Statistics 427 or Mathematics 530	3	
Mathematics 571 or 568	3	
Electrical and Computer Engineering 331 (Material Science)	3	
Industrial and Systems Engineering 504 (Engineering Economics)	3	
		12
3. Department Requirements—Core Program for Computer Engineering		
ECE 205, 206, 209, 261, 265, 301, 323, 351, 352, 481, 561, 567, 662, and 682 or 683	36	
Math 366	3	
CS&E 221, 222, 321, 560, 660	20	
		59
4. Selected Core <sup>†</sup> (Computer Engineering students do not have to take any courses from this category but may take up to 9 hours.)		0-9
5. Technical Electives <sup>‡</sup>		
Of the 24-33 hours, 12 hours must be selected from a prescribed list of Technical Electives and 15 hours must be ECE (ECE courses taken from the prescribed list count toward this requirement as well).		24-33
6. General Education Courses (GEC)—must include ECE 582 <sup>§</sup>		<u>38</u>
	TOTAL .....	196

A sample time schedule for this specialization is shown in Table 2.

All students must successfully complete 48 hours of math and basic sciences.

All transfer students are required to fulfill all programmatic requirements for the B.S.E.C.E. They must also successfully complete a minimum of 45 hours of OSU ECE or CS&E coursework at OSU.

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\* En Graph 167 (any section of En Graph 167 will count toward program requirement, however, En Graph 167C is preferred) or satisfactory placement exam score required as prerequisite for CS&E 221.

† See more details on Selected Core starting on page 10.

‡ See more details on Technical Electives starting on page 10.

§ Transfer students should check with their advisor to verify they are using the correct GEC list.

TABLE 2

Time Schedule for the Electrical and Computer Engineering Major:

**Specialization in Computer Engineering**

Yr	Autumn		Winter		Spring		
1	Math Chemistry Eng GEC	151-5 121-5 181-3 5	Math Physics Eng En Graph	152-5 131-5 183-3 167*-4	Math Physics CS&E Math	153-5 132-5 221†-4 366-3	52
2	Math Physics CS&E GEC	254-5 133-5 222-4 5	Math CS&E ECE Circuit Analysis ECE Digital Circuits GEC	415-4 321-4 205-3 261-3 5	Math 571 or 568 ECE Digital Lab ECE Circuits/Elec Lab ECE Microprocessors ECE Anlys/Dsgn in Circuits/Electronics	xxx-3 206-1 209-2 265-3 301-3	50
3	Stat 427 or Math 530 ECE Elc Anlys/Dsn/Sim ECE Microrocessr Lab 1 Tech Elec/Select Core GEC	xxx-3 323-3 567-2 3 5	ECE Intro to Materials ECE Systems 1 ECE Digital Circuit Design Tech Elec/Select Core GEC	331-3 351-3 561-3 3 5	ECE Systems 2 ECE Digital Circuit Dsn CS&E Tech Elec/Select Core	352-3 662-3 560-5 3	47
4	ECE Prof Practice CS&E ISE Eng Economics Tech Elec/Select Core	481-1 660-3 504-3 6	GEC (ECE 582) Tech Elec/Select Core GEC	3 9 5	ECE Group Project <b>-or-</b> ECE Individual Studies Tech Elec/Select Core GEC	682-3 683-3 9 5	47

\* Any section of En Graph 167 will count toward program requirement, however, En Graph 167C is preferred.

† En Graph 167 (or equiv) or satisfactory placement exam score required as prereq for CS&E 221.

**Technical Electives / Selected Core:** Every undergraduate student specializing in computer engineering is required to take 33 total credit hours of technical electives and selected core. The number of technical elective hours will vary between 24-33 depending on the number of selected core hours taken (none required, maximum of 9).

**Selected Core:** 0-9 hours may be taken from this list:

- Biology**—113 (5)
- Chemistry**—122 (5) or 125 (4), 231 (3) or 251 (3)
- Geological Sciences**—Earth Sci (Geo Sci) 121 (5)
- Material Science Engineering**—401 (4) or **Mechanical Engineering**—500 (4)
- Mechanical Engineering**—250 (4), 410 (4), 420 (4), 430 (4)

**Technical Elective criteria:** Of the 22-33 technical elective hours required:

- 12 hours must be selected from this list; and
- 15 hours must be ECE (ECE courses taken from this list count toward this requirement as well).

**VLSI (Very Large Scale Integrated Circuits) and Computer-Aided Design**—ECE 720, ECE 721, ECE 761, CS&E 778

**Microprocessor Based Systems**—ECE 765

**Digital Design and Computer Architecture**—ECE 667, ECE 762, CS&E 775

**Computer Interfacing and Protocols, Computer Networks**—ECE 701, ECE 766, CS&E 677

**Robotics and Control for Automation**—ECE 551, ECE 755, ECE 757, ECE 763

**Neural Networks, Artificial Intelligence**—ECE 779, CS&E 630

**Digital Signal Processing/Image Processing**—ECE 600, ECE 609, ECE 700, ECE 706, ECE 707

**Semiconductors**—ECE 637, ECE 730

**Communication Theory**—ECE 501, ECE 702

**Numerical Analysis**—ECE 759, CS&E 541

Many technical electives must be taken in sequence and usually sequences are only offered once each year. Thus, a student must plan a technical elective program early to help assure that a desired set of courses will be available when needed. It is advised that such planning be undertaken while a student is taking ECE 323 in the core program.

If the student has met the 12 hours from the prescribed list and 15 ECE hours requirements, the remaining technical electives may be selected from any 500, 600, or 700-level ECE courses or from the list of approved outside technical electives found on the next page. (All 800-level courses are reserved for graduate students.) **ECE 311, 312, 327, 341, 432, and 447 also count as computer engineering technical electives.** As there are many such courses, you should study the guidelines, which are shown in Appendix I for each of the major areas within this Department, and then talk to faculty members in potential areas of interest.\*

A student may wish to work on a project in a special area. This can be done for technical elective credit by taking either ECE 693 “Individual Studies” or ECE 699 “Undergraduate Research in Electrical and Computer Engineering”, under the supervision of a faculty member in that area. The number of credit hours given and the requirements to be satisfied are set by mutual agreement

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\* The most current ECE course descriptions can be found at <http://www.ece.osu.edu/academics/courses.html>.

between that faculty member and the student. For students not pursuing an undergraduate distinction project, up to a total of 3 hours among 693, 699, or 793 can be used as a technical elective.

Students with a cumulative point hour ratio of 3.4 or better may receive their BSECE degrees with distinction (denoted on the diploma) by taking 6 hours of H783 credit (or 3 hours of H783 and 3 hours of 683) while working on a project approved by their faculty advisor, writing a formal report documenting their research, and defending the work in an oral examination before the advisor and another faculty member. Such a research project is usually conducted by the student during their senior year. Students doing a distinction project can count up to 6 hours as technical electives. Specifically 3 hours of H783 count as a technical elective and then up to 3 more hours of any combination of additional H783, 699, 693 or 793 hours can count as technical electives.

Rank 4 students with a CPHR greater than or equal to 3.0 may file a **Senior Petition** to have 600- or 700-level courses taken beyond those required for the undergraduate degree to be applied to graduate course work. There is a 15-hour limit on Senior Petitions. All coursework must be completed prior to receipt of the undergraduate degree. Contact the Graduate School, Room 247 University Hall, 230 North Oval Mall, for more details. **Senior Petitions must be returned to the Graduate School by the end of the first day of classes.**

There is a new program for graduating with honors in engineering (GHIE). Please visit: <http://www.engineering.osu.edu/currentstudents/pdf/GHIE.pdf> for details on the engineering honors program.

A combined BS and MS program is available to ECE students who qualify. This program allows students to count some technical elective courses for both the BS and MS degrees, thus reducing the total time to finish the two degrees. For more details visit your advisor or see our web site at [http://www.ece.osu.edu/academics/bs\\_ms.html](http://www.ece.osu.edu/academics/bs_ms.html).

The Bachelor of Science in Electrical and Computer Engineering degree can provide a basis for advanced, post-graduate study in a number of areas such as engineering, law, business, or medicine. Students with such interests should select elective courses accordingly. An undergraduate advisor can provide relevant advice.

**Approved Outside Technical Electives:** Often after students have completed 15 hours of ECE courses and 12 hours from the prescribed list of technical electives, there will be additional hours of the 24-33 hour requirement left. Some courses approved as outside technical electives are:

**Biomedical Engineering**—BIOMED E 500, 571, 600, 631, 686, 701, 721, 732, 733, 739, 741, 761, 763, 771.

**Business**—BUS-ADMIN 555, BUS-FIN 510, 590, and 620, BUS-MGT 630, BUS-MKTG & LOG 650, and BUS-MHR 590, 660, 701, and 795.02. See your advisor early in your program if you are thinking about completing a Business Minor or an Entrepreneurship Minor.

**Chemical and Biomolecular Engineering**—CHBE 769 (cross-listed with BIOMED E 761).

**Chemistry**—CHEM 251 through 255.

**Computer Science and Engineering**—any 500-level or above course (excluding CS&E 502, 548, 668, 675.01, 675.02, 676, and 779) that is not directly comparable to an ECE course. Note that CS&E 215, 230, and 502 do not count for outside technical electives in this specialization.

**Evolution, Ecology, and Organismal Biology**—EEOB 232.

**Industrial and Systems Engineering**—IND ENG 311, 406, 534, 619, 620, 640, 682.

**Mathematics**—MATH 512; 513 or 551; 514 or 552; 566; 569 or 572; 601; 602. Note that you cannot double count a particular math course as both a selected core course and an outside technical elective.

**Mechanical Engineering**—Any 500-level or above course\* (excluding 571, 773, and 776) which is not directly comparable to an ECE course.

**Nuclear Engineering**—Any 500-level or above course. 505 is especially appropriate for students with power interests.

**Physics**—Any 500-level or above course (excluding 517, 525, 555, 596, 617, 656, 657, 670, and 795) that is not directly comparable to an ECE or other engineering course.

**Statistics**—STAT 428.

A student wishing to take courses not on this list must secure advance approval from the Department by means of a petition as described in Section 1.8 of this document. See your advisor about courses 593, 692, 693, 793, and 699 outside the ECE department.

**General Education Courses (GEC):** The last part of the Computer Engineering Specialization is comprised of 43 hours as follows:

	Hours
English and Communication Skills	13
Social Sciences	5-10
Historical Study	5-10
Arts & Humanities	<u>5-10</u>
Total	38

One of the courses included in English and Communication skills is ECE 582, Electrical and Computer Engineering Design I, and is required of all ECE students. One of the GEC classes must also be a **Social Diversity** class (shown on the GEC list as underlined course numbers) and one of the GEC classes must also be an **Ethics** class. The GEC list is shown in the attachments at the end of the Handbook.

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\* May use up to 6 hours in Mech Eng 580, and up to 4 hours in Mech Eng 652.

## 1.7 Transfer Credit for the BSECE Degree

Transfer credit is initially evaluated by the Admissions Office, Lincoln Tower 340. Each admitted applicant receives an Admissions Notice which includes a preliminary evaluation of credit given for courses completed elsewhere. This evaluation is based on the transfer credit policy as described at the following web site:

[http://www.ureg.ohio-state.edu/ourweb/Transfer\\_Credit/TCPolicy.html](http://www.ureg.ohio-state.edu/ourweb/Transfer_Credit/TCPolicy.html).

However, all evaluated coursework, which appears in the Admissions Notice, may not apply to the degree requirements of the ECE program; therefore, it is essential that the student consult with their ECE academic advisor prior to registering. Each transfer student is responsible for obtaining further evaluation of the non-course specific credits [e.g., SPL, GEN, TECH, and DEF] by supplying additional information to the transfer credit coordinator of the appropriate academic departments (e.g., Math, Physics, Engineering Graphics). A list of transfer credit coordinators for the various OSU departments is available from the Admissions office. The most common OSU departments relevant to transferring ECE students can be found at

[http://www.ece.osu.edu/academics/undergrad/transfer\\_credit.html](http://www.ece.osu.edu/academics/undergrad/transfer_credit.html). All transfer credit should be evaluated by the end of the first quarter at OSU.

An eligible applicant can expect to receive equivalent quarter hours of credit for college-level electrical engineering course work successfully completed from universities or colleges accredited by the Accreditation Board for Engineering and Technology, provided that the course work corresponds directly to the existing ECE Programs in the Department. All transfer students should have such ECE courses evaluated the quarter they plan to enter the Electrical and Computer Engineering major. Instructions for having this evaluation performed are posted in ECE, can be obtained by an advisor, or at

[http://www.ece.osu.edu/academics/undergrad/transfer\\_credit.html](http://www.ece.osu.edu/academics/undergrad/transfer_credit.html).

Note: Coursework successfully completed at a non-OSU institution that is equivalent to our courses required at OSU will fully count as meeting the program course requirements for admission to OSU programs. However, you should be aware that entrance to major requires a satisfactory grade point average in both overall courses and the specific courses required by the program for admission. In calculating grade point averages, only OSU courses are used.

## 1.8 Petitions for the BSECE Degree

A student may wish to diverge from the set curriculum in some manner. One may wish to take more than the permitted maximum of 21 credit hours per quarter or to substitute certain courses for others. Any of these variations from the norm must be approved at two levels: the Department and the College. An official petition form may be obtained from the undergraduate advisors in Dreese 221 or 227 who will advise you on how to fill it out and whether similar patterns have been approved in the past. Petitions are not to be abused; they are intended to give flexibility to our curriculum and meet the needs of the wide variety of students we meet.

## 1.9 Academic Standards for Continuing Enrollment in the BSECE Degree Program

In order to graduate from one of the BSECE degree programs a student must have:

1. a cumulative point-hour ratio (CPHR) of 2.0 or above in all courses taken at The Ohio State University, and;
2. a major point-hour ratio (MPHR) of 2.0 or above in all major courses taken at The Ohio State University.

For students specializing in Electrical Engineering, major courses are all Electrical and Computer Engineering courses (excluding 300, 309, and 320).

For students specializing in Computer Engineering, major courses are the same as above plus these Computer Science & Engineering courses: CS&E 222, 321, all other 500-level and above (excluding 548, 675.01, 675.02, and 676.)

## 1.10 Special Action Probation for ECE Students (ECE SAP)

There are three forms of SAP for ECE students, namely, SAP for grades, SAP for lack of progress, and SAP after reinstatement.

### SAP for Grades

Condition for going on SAP for grades: If an ECE student has 6 or more hours in major classes and the MPHR is less 2.0, he or she is placed on SAP for grades. If a student has transfer credit for one or more major courses, he or she may be placed on SAP whenever their OSU MPHR is less than 2.0.

Conditions for continuing on SAP: Each student placed on SAP for grades will be given terms of probation. The terms are typically:

1. Reduce major deficiency points, normally by 5. If taking only 1 major class, reduce major deficiency points by 3; if taking no major classes, get quarter GPA of 2.0 or better;
2. Must not get Incompletes (I), missing grades (\*), W's, or drop classes without permission of advisor;
3. See advisor by the end of the 1<sup>st</sup> week of classes, during the 7<sup>th</sup> week, and additionally as specified.

If the student has met the terms but has not met the conditions for leaving SAP and returning to good standing, he or she will be continued on SAP.

If the student has not met the terms and has not met the conditions for leaving SAP and returning to good standing, he or she may also be continued on SAP based on special circumstances. Special circumstances include identified medical and family emergencies and other situations beyond the student's control. A student who shows improvement and progress, even if terms are not strictly met, may be continued.

Conditions for leaving SAP and returning to good standing: If the terms of probation are met and the MPHR is greater than or equal to 2.0, then the student is returned to good standing status.

**Conditions for being departmentally dismissed:** If the student does not meet terms of probation, and does not meet any of the conditions for special circumstances listed above, then the student is Departmentally Dismissed (DD).

A student dismissed three times from any combination of engineering departments or programs is not eligible to apply for reinstatement to any engineering department or program for at least 5 years. (After this time the University Fresh Start Rule applies.)

### **SAP for Lack of Progress**

**Condition for going on SAP:** An ECE student with sufficiently high grades not to go on SAP for Grades, will go on SAP for Lack of Progress for the following conditions:

1. Too many W's or I's;
2. Not taking any courses in the major for too many quarters;
3. Repeating the same class too many times or repeating too many total classes;
4. If student is taking no major classes, and quarter point hour ratio (QPHR)  $< 2$ ;
5. Not having completed English 110;
6. Grades falling or erratic, even if CPHR  $> 2$  and MPHR  $> 2$ .

**Conditions for continuing on SAP:** Each student put on SAP will be given terms of probation.

The terms are typically:

1. Address specific problem cited, i.e., if not completed English 110, must do so;
2. Grades must be satisfactory (QPHR  $> 2.0$ );
3. Don't drop class or get W's or Incompletes (I), or Missing Grades (\*) without permission of advisor;
4. See advisor by the end of the 1<sup>st</sup> week of classes, during the 7<sup>th</sup> week, and additionally as specified.

If the student has met the terms but has not met the conditions for leaving SAP and returning to good standing, he or she will be continued on SAP.

If the student has not met the terms and has not met the conditions for leaving SAP and returning to good standing, he or she may also be continued on SAP based on special circumstances. Special circumstances include identified medical and family emergencies and other situations beyond the student's control. Students who show improvement and progress, even if terms are not strictly met may be continued.

If a SAP for Lack of Progress student has sufficiently low grades that he or she meets the terms of SAP for grades, the student will be switched to SAP for grades.

**Conditions for leaving SAP and returning to good standing:** If the terms of probation are met and the MPHR is greater or equal to 2.0, then the student is returned to good standing status.

**Conditions for being departmentally dismissed:** If the student does not meet terms of probation, and does not meet any of the conditions for special circumstances listed above, then the student is Departmental Dismissed (DD).

A student dismissed three times from any combination of engineering departments or programs is not eligible to apply for reinstatement to any engineering department or program for at least 5 years. (After this time the University Fresh Start Rule applies.)

### **SAP after Reinstatement**

Students who are reinstated in the program are automatically placed on SAP After Reinstatement for three quarters. In addition to the specified conditions for the other two SAPs, the student is required to follow a prescribed set of courses, and limit work hours. A student reinstated with major deficiency points must also reduce major deficiency points as specified in his or her reinstatement letter.

## **1.11 Special Action Probation for Pre-ECE Students (Pre-ECE SAP)**

There are three forms of SAP for Pre-ECE students, namely, SAP for grades, SAP for lack of progress, and SAP after reinstatement.

### **SAP for Grades**

We monitor the following three conditions for pre-major students:

1. A cumulative point-hour ratio (CPHR) of 2.0 or above in all courses taken at The Ohio State University, and;
2. A secondary point-hour ratio (SPHR) of 2.0 or above in all pre-major courses taken at The Ohio State University.
3. A number of our major courses can be taken by pre-major students. If any major classes are taken by a pre-major student, a 2.0 must be maintained toward the MPHR (Major Point Hour Ratio).

For Pre-ECE students, the SPHR will be comprised of the following courses: Chemistry 121; Engineering 181 and 183; En Graph 167; Math 151,152,153, and 254; Physics 131,132, and 133; all courses equivalent to said courses will also be included.

**Conditions for going on Pre-ECE SAP:** If a Pre-ECE student's CPHR, SPHR, or MPHR is <2.0, he or she is placed on SAP for grades.

1. If CPHR<2.0, a student will be placed on Academic Warning for 14.9 or fewer deficiency points and Academic Probation for 15 or more deficiency points.
2. If CPHR>2.0 and SPHR<2.0, the student will be placed on SAP.
  - a. New first-quarter freshmen (NFQF) will not be placed on SAP until they have completed three quarters at OSU.
  - b. New transfer students will not be placed on SAP until they have completed two quarters at OSU.
3. If CPHR>2.0, SPHR>2.0, and major courses have been completed with MPHR<2.0, the student will be placed on Warning or SAP as specified for majors.
  - a. New first-quarter freshmen (NFQF) will not be placed on SAP until they have completed three quarters at OSU.
  - b. New transfer students will not be placed on SAP until they have completed two quarters at OSU.

**Conditions for continuing on Pre-ECE SAP:** Each Pre-ECE student placed on SAP will be given terms of probation. The terms are typically:

1. Reduce major deficiency points:

- a. If CPHR <2.0, cumulative deficiency points must be reduced by 5 if student is full-time.
  - b. If SPHR <2.0, SPHR deficiency points must be reduced. If taking no SPHR classes, must earn QPHR of 2.0 or better.
  - c. If registered for MPHR courses, must reduce deficiency points.
2. Must not get Incompletes (I), missing grades (\*), W's, or drop classes without permission of advisor;
  3. See advisor by the end of the 1st week of classes, during the 7<sup>th</sup> week, and additionally as specified.

If the Pre-ECE student has met the terms but has not met the conditions for leaving SAP and returning to good standing, he or she will be continued on SAP.

If the Pre-ECE student has not met the terms and has not met the conditions for leaving SAP and returning to good standing, he or she may also be continued on SAP based on special circumstances. Special circumstances include identified medical and family emergencies and other situations beyond the student's control. Students who show improvement and progress, even if terms are not strictly met may be continued on SAP.

**Conditions for leaving Pre- ECE SAP and returning to good standing:** If the terms of probation are met and the CPHR, MPHR, and SPHR are greater than or equal to 2.0, then the Pre-ECE student is returned to good standing status.

**Conditions on entering major on SAP:** Students entering the major with the MPHR <2.0 are placed on SAP according to the major policy.

**Conditions for being departmentally dismissed:** If the student does not meet terms of probation, and does not meet any of the conditions for special circumstances listed above, then the student is Departmentally Dismissed (DD).

A student dismissed three times from any combination of engineering departments or programs is not eligible to apply for reinstatement to any engineering department or program for at least 5 years. (After this time the University Fresh Start Rule applies.)

### **SAP for Lack of Progress**

**Condition for going on Pre-ECE SAP:** A Pre-ECE student with sufficiently high grades not to go on SAP for Grades, will go on SAP for Lack of Progress for the following conditions:

1. Too many W's or I's;
2. Not taking any courses towards our degree for too many quarters;
3. Repeating the same class too many times or repeating too many total classes;
4. Not making progress towards successful completion of English 110.
5. Grades falling or erratic, even if CPHR, MPHR, or SPHR >2.0.
6. If student has completed nearly all of the pre-major courses and their SPHR is not sufficiently high that they can enter the major, they can be put on SAP for Lack of Progress based on the number of courses they would have to re-take in order to raise their SPHR to enter the major.

**Conditions for continuing on Pre-ECE SAP:** Each Pre-ECE student put on SAP will be given terms of probation. The terms are typically:

1. Address specific problem cited, i.e., if not completed English 110, must do so;
2. Grades must be satisfactory (QPHR > 2.0);
3. Don't drop class or get W's or Incompletes (I), or Missing Grades (\*) without permission of advisor;
4. See advisor by the end of the 1<sup>st</sup> week of classes, during the 7<sup>th</sup> week, and additionally as specified.

If the Pre-ECE student has met the terms but has not met the conditions for leaving SAP and returning to good standing, he or she will be continued on SAP.

If the student has not met the terms and has not met the conditions for leaving SAP and returning to good standing, he or she may also be continued on SAP based on special circumstances. Special circumstances include identified medical and family emergencies and other situations beyond the student's control. Students who show improvement and progress, even if terms are not strictly met may be continued.

If a student on SAP for Lack of Progress has sufficiently low grades that he or she meets the terms of SAP for grades, the student will be switched to SAP for grades.

**Conditions for leaving Pre-ECE SAP and returning to good standing:** If the terms of probation are met and the CPHR, MPHR, and SPHR are greater than or equal to 2.0, then the student is returned to good standing status.

**Conditions for being departmentally dismissed:** If the student does not meet terms of probation, and does not meet any of the conditions for special circumstances listed above, then the student is Departmental Dismissed (DD).

A student dismissed three times from any combination of engineering departments or programs is not eligible to apply for reinstatement to any engineering department or program for at least 5 years. (After this time the University Fresh Start Rule applies.)

### **SAP after Reinstatement**

Students who are reinstated in the program are automatically placed on SAP After Reinstatement for three quarters. In addition to the specified conditions for the other two SAPs, the student is required to follow a prescribed set of courses, and limit work hours. A student reinstated with major deficiency points must also reduce major deficiency points as specified in his or her reinstatement letter.

## **1.12 Issues Common to both ECE and Pre-ECE SAP Policies**

### **Procedure for Student Appeal of Departmental Actions**

A student who feels that their performance may have been affected by special circumstances may petition in writing to the department Chair or his or her designee.

If a student finds this review unsatisfactory, he or she may appeal directly to the Academic Standards and Progress Committee (ASAP) through the college designee to this committee.

### **Notification of Departmental Policy for Academic Standards to Students**

Besides being stated in the Undergraduate Handbook, which is available to all pre-ECE and ECE students, the department's academic standards policy can be found as a handout in DL 205 and on the department's web page (<http://www.ece.osu.edu>). Transfer students will be given the Handbook when they first speak with one of our Advisors.

### **Reinstatement to the Major or Pre-Major**

A student dismissed from the department may petition to be reinstated typically after three academic quarters have elapsed. The academic advisor will receive the petition and forward it to the departmental reinstatement committee.

## **2. LOCATIONS OF INTEREST TO UNDERGRADUATES**

### **2.1 Dept. of Electrical & Computer Engineering, Main Office, DL 205**

Dreese 205 is the location of the office of the Chair, the administrative staff, and the mailboxes of all faculty members, graduate students, TAs and student organizations. Any faculty member may be contacted at this office through the receptionist by notices in his or her mailbox. The department web pages show how to contact faculty members by email.

### **2.2 Dept. of Electrical & Computer Engineering Student Advisors**

The undergraduate advisor, located in Dreese 227, advises all undergraduate students who have been accepted as ECE majors. The pre-major advisor, located in Dreese 221, advises all undergraduate students who are pre-majors and have indicated ECE as their desired major. The two advisors are assisted by a student advisor, located in Dreese 205, who also advises pre-major ECE students. Students may also see the Program Coordinator in Dreese 236 for assistance when unable to see their advisor. Advising office hours are posted inside Dreese 205 and outside individual offices. Students should remember that during the first week of classes the wait to see an advisor could be quite lengthy. Therefore, we recommend that for quick course additions through the first week of a quarter and quick course drops through the third week of a quarter, students use the on-line registration system whenever possible through the web at <http://buckeyelink.osu.edu/>. Students are also encouraged to use e-mail for basic advising questions at [ecadvisor@osu.edu](mailto:ecadvisor@osu.edu).

The advisors counsel students about degree requirements and each student's progress toward the satisfaction of those requirements. All class schedules are subject to his/her approval. Advice about the technical content of any courses is not given; instead the student is referred to the appropriate faculty members who are better able to give such advice. The department web page, <http://www.ece.osu.edu>, is also a useful source of course information. Current academic records are maintained of all undergraduate students registered in the Department. The advisors handle class permission forms, file applications for degrees, and oversee the disposition of petitions for changes from the normal curriculum occasionally requested by the student.

Our advisors are interested in students as people as well as scholars, and students are encouraged to drop by any time with questions, comments, complaints, advice or even matters of personal circumstances so that they can become sufficiently acquainted with individuals to give good counsel.

### **2.3 Dept. of Electrical & Computer Engineering Student Organizations**

The offices of Eta Kappa Nu (HKN), the Electrical and Computer Engineering honorary; the student branch of the Institute of Electrical and Electronic Engineers (IEEE) professional organization; and the Department of Electrical and Computer Engineering Student Council are located in Caldwell 274. Information about these student organizations is available there. Officers usually post their office hours for access by any student who may wish to contact them, and a nearby bulletin board serves as a communication link for students.

### **2.4 Dept. of Electrical & Computer Engineering Student Lounge**

The student lounge is located in Caldwell 271 and is available for student use. It is intended for between-class R and R, socializing with fellow colleagues, and studying. Students are strongly urged to use this room to help temper their academic responsibilities with a balancing social interest.

## **3. SPECIAL TOPICS OF INTEREST TO UNDERGRADUATES**

### **3.1 Co-Op and Internship Program**

The electrical and computer engineering department has a cooperative engineering and internship program through which students apply classroom learning with an industrial or government employer. Cooperative education opportunities involve two quarters per year of paid work experience with the same employer. Internships typically involve only one quarter per year, however, other schedules are possible. Beyond the considerable financial rewards of these experiences, the engineering experience obtained is invaluable. Practical experience helps students select areas of specialization, enriches the classroom experience, and provides useful job references and opportunities upon graduation. Experienced graduates are in greater demand in the job market and receive higher starting salaries and better positions than do those graduating without experience. Further information can be obtained from the Engineering Co-Op Office, 111 Hitchcock Hall, or from the web site: <http://career.eng.ohio-state.edu/>

### **3.2 Free Tutoring Service**

HKN volunteers offer a free tutoring service, available on a walk-in basis for students in ECE 205, 261 and 301. Hours are posted outside Caldwell 267 at the beginning of each quarter.

### **3.3 Scholarships**

The OSU Department of Electrical and Computer Engineering is privileged to have several endowed funds whose annual income provides full or partial scholarships to undergraduate students in the Electrical Engineering or the Computer Engineering specializations given by the Department. Each of these endowed funds was established for this purpose by the generous contributions of alumni, faculty and friends of the Department of Electrical and Computer Engineering.

Students who wish to apply for an undergraduate scholarship in the Department of Electrical and Computer Engineering can do so by either using the OSU Scholarship Application form (available in the Office of Student Financial Aid, 517 Lincoln Tower, 1800 Cannon Drive, Columbus OH 43210) OR using the College of Engineering Scholarship Application form available at the College of Engineering Office, 122 Hitchcock Hall, 2070 Neil Avenue, Columbus OH 43210.

The application deadline is March 1 for scholarships granted in the following academic year and should be turned into the College office. Students must reapply for these scholarships on an annual basis.

For current information regarding the various scholarships available to students, and the College of Engineering Scholarship Application form, please see the web page at:  
[http://www.ece.osu.edu/academics/undergrad/fin\\_aid\\_scholarships.html](http://www.ece.osu.edu/academics/undergrad/fin_aid_scholarships.html)

## **4. DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING STUDENT ORGANIZATIONS**

Students are encouraged to involve themselves in one or more of the organizations within the Department. Engineers are not machines—they are people and must interact with other people on various levels throughout their professional careers. Such interaction supplements the classroom experience. Part of this experience may be provided by the activities of these organizations, and they are recommended for the student as a balancing influence.

### **4.1 Eta Kappa Nu (HKN)**

HKN is the national electrical and computer engineering honor society. The chapter at Ohio State was the third established nationally, and was organized in 1907. The society's purpose is to recognize outstanding juniors and seniors in Electrical and Computer Engineering and to promote interaction between faculty and students. Membership is by invitation, based on academic excellence, with formal initiation banquets held Autumn and Spring quarters. HKN operates a tutor room as a free service to all beginning Electrical and Computer Engineering undergraduates. The society sponsors quarterly faculty/student coffee hours, presents the HKN/Fred H. Pumphrey Distinguished Teaching Award each Spring, and supports various Department social activities.

### **4.2 Institute of Electrical and Electronics Engineers (IEEE)**

IEEE is the major professional organization of electrical and computer engineering. Each school has a student branch which is intended to sponsor a social and professional program to familiarize the student with the parent organization, which is the second largest professional society in the world. Most students, upon leaving the University, become full members of the IEEE and receive its technical publications and journals. The student branch sponsors tours of various facilities on and off campus, intramural sports teams, etc. Members attend an IEEE Banquet hosted annually by the Columbus Chapter of the IEEE and receive a monthly magazine, *The Spectrum*, as well as reduced rates on other technical publications of special interest. Membership is open to all students in Electrical and Computer Engineering or Computer Science and Engineering curricula.

## 5. THE COLLEGE OF ENGINEERING

### 5.1 Engineering College, Main Office, Hitchcock 122

If you are ever unable to make contact with any of the ECE advisors and you have a **pressing deadline**, you may visit the college office or call 292-2651 during regular office hours and speak with one of their advisors. In addition, each week on Thursdays from 1-5pm, Kathleen Roca from the Financial Aid Office has walk-in hours in Hitchcock 122 (or phone her at 247-6829 during those hours) for any questions about financial aid you may have. More information about the College of Engineering can be obtained from the College web site at <http://engineering.osu.edu/>.

### 5.2 Engineering Career Services (ECS), Hitchcock 199

The objective of the ECS office is to prepare students for their job search and assist them in securing employment in their field following graduation. Students who are candidates for the BS, MS or PhD degree are encouraged to contact ECS one year prior to graduation to learn about the registration procedures and recruiting activities. For additional information visit the ECS web site at <http://career.eng.ohio-state.edu>.

### 5.3 Engineer-in-Training (EIT) Examination

Students who plan to make engineering their career should consider becoming a registered Professional Engineer (PE) by passing an examination somewhat akin to the medical board exam taken by medical students or the bar exam taken by law students. The examination comes in two parts—Fundamentals (FE) and Professional (PE). The Fundamentals exam is eight hours long and covers the entire undergraduate curriculum to include mathematics, statics, dynamics, fluid mechanics, thermodynamics, electrical theory, mechanics of materials, and economics. It is strongly advised that students take the FE exam in their senior year while these subjects are still fresh. We recommend taking Engineering 510 during your last Winter Quarter here. Information on preparing for the exam, such as an exam preparatory course, is available on the College of Engineering web site: <http://engineering.osu.edu/refreshercourse/index.php>. Be sure to check the National Council of Examiners for Engineering and Surveying web site at <http://www.ncees.org/> about 5 months before you plan to sit for the exam (<http://www.els-examreg.org/>) to assure that you register prior to the deadline. For students who graduate and go on to industry, the PE examination is given after the successful Engineer-in-Training has accumulated four years of work experience. It is an eight-hour written examination. Upon successful completion of this exam, the engineer is registered as a Professional Engineer in the state in which the exam is taken.

## 6. FOR THOSE INTERESTED IN ADVANCED DEGREES

### 6.1 Graduate School Admission Requirements

Selection for admission to graduate study is by the Departmental Graduate Committee. A Bachelor's degree in Electrical and Computer Engineering or a related field from an acceptable institution is required. Normally, a cumulative point-hour-ratio of 3.2 or higher is one of the admission requirements. For more detailed information see the Graduate Advisor in 227E Dreese Labs and view the Department web site at: <http://www.ece.osu.edu>

### 6.2 Degree Requirements

For specific degree requirements, please refer to the Department of Electrical and Computer Engineering Graduate Handbook, available from the department or via the department web page at: <http://www.ece.osu.edu/academics/gradpages/handbooks.html>

### 6.3 Combined BS and MS Program

This program allows students to count some technical elective courses for both the BS and MS degrees, thus reducing the total time to finish the two degrees. For more details, see our web site or pick up a handout in DL 205.

### 6.4 Financial Assistance

#### **Graduate Research Associate (GRA)** (50% time appointment)

A Graduate Research Associate participates in one of the many research programs within the Department. Stipends vary according to the Associate's experience. Academic fees and tuition are waived for all GRAs.

#### **Graduate Teaching Associate (GTA)** (50% time appointment)

Teaching assignments are commensurate with the student's experience, competence, and maturity. These appointments provide a monthly stipend plus a waiver of academic tuition and fees.

#### **Fellowships**

University Fellowships of both one year duration as well as multiple-year duration are available to qualified applicants on a competitive basis. To be eligible, the student must begin graduate work with no previous graduate credit and be working toward either an MS or a PhD degree. A University Fellowship provides a monthly stipend for twelve months plus remission of academic tuition and fees. In addition to University Fellowships, Departmental fellowships are available. Additional information in general and specific areas of research and study can be obtained from the Electrical and Computer Engineering Office.

## 7. MISCELLANEOUS

### 7.1 Web Site

The Department of Electrical and Computer Engineering consistently updates current information on its web site which is designed to be helpful in assisting students with a variety of information. At the site, students can find information about faculty, research projects, organizations, undergraduate and graduate program information, ECE course listings which are more current than those printed in the Course Offerings Bulletin, scheduling information and more. Students are also able to print out worksheets used in tracking coursework in either the Electrical Engineering or the Computer Engineering Specialization for the BSECE degree. Students may access the web site at: <http://www.ece.osu.edu>.

### 7.2 Computer Accounts

All students enrolled in Electrical and Computer Engineering courses are given accounts on the Electrical and Computer Engineering Unix and Windows systems. These accounts allow students access to their OSU email, online course materials via the web, and various applications that are necessary for their course work. Students who have ECE accounts also have keycard access to the ECE student computing labs, and both Dreese and Caldwell labs. The Department maintains a staff to administer and support the computing facilities, and has student consultants in the labs during posted hours.

### 7.3 Bulletin Boards

There are several bulletin boards in the Department which the student should consult frequently. The board of primary interest to undergraduates is in the hallway by the main ECE office, DL 205. This board gives the current class schedules, useful information on current and new course offerings, last minute scheduling changes and updates, and important dates and deadlines. An employment board is available on the third floor across from the elevators, a student activities board resides next to the Student Organizations Office, Caldwell 274; another is located outside the Student Lounge, Caldwell 271. Students are urged to acquire the habit of scanning these boards for anything new and informative.

### 7.4 Degree Audit Reports (DAR)

Degree Audit Reports allow you to view your major GPA, all grades in ECE and non-ECE courses you've taken, your secondary point hour ratio (SPHR), and learn what additional courses are needed to obtain your degree. You may retrieve your DAR via the web by utilizing "On-line Services" on the University Registrar's web page at: [http://buckeyelink.osu.edu/advising\\_degree.html](http://buckeyelink.osu.edu/advising_degree.html). Please note: DARS is attaining a level of accuracy that will soon make it the official document used for degree certification. Consequently, you need to check your degree audit once each quarter and report any discrepancies or errors to your advisor for reconciliation.

### 7.5 Lockers

Department of Electrical and Computer Engineering students may use the lockers on the third and fourth floors of Dreese Laboratory. The lockers are emptied each year during the first week of Autumn Quarter and are available on a first-come, first-served basis. You must provide your own lock and register the locker number in the Student Organization Office, Caldwell 274.

## 7.6 Faculty and Course Evaluations

At the end of each quarter, the students in every class are requested to complete one or more surveys evaluating the course, the instructor, and course materials/equipment. All surveys are anonymous and any surveys needing to be completed via paper will be typed prior to distribution. Results are not given to instructors until after the grade turn-in deadline.

The Student Evaluation of Instruction (SEI) is administered during class time at the end of each quarter. A student will be designated to hand out, collect, and turn in these surveys to the receptionist in the main office, DL 205, immediately after class.

The Department administers its own surveys for various purposes. Some of these are done through Carmen ([www.carmen.osu.edu](http://www.carmen.osu.edu)) and can be found on the course page titled “ECE Surveys *Qtr/Yr*” and some are done during class time at the end of each quarter. Surveys include the Lecture Course Survey, the Lab Course Survey, the Design Course Sequence (ECE 582 and 682/683) Survey; and the Course Objectives Survey.

All survey results are given to the individual instructors and to the department Chair for consideration and inclusion in the respective faculty member files for reference. Students are urged to use these evaluations, which have been employed for many years in our department, to give honest, well-considered feedback to the faculty, both criticizing and praising their performance in the course.

## 7.7 Suggestion Box

A suggestion box maintained by the Department of Electrical and Computer Engineering Student Council is located in the student lounge, Caldwell 271, for use by students regarding matters relative to the Electrical and Computer Engineering Department. Suggestions submitted are first screened then forwarded to the corresponding professor. A copy will also be sent to the Department Chair. Students may contact the ECE Student Council by sending email to: [eesc@ece.osu.edu](mailto:eesc@ece.osu.edu).

## 7.8 Colloquia and Seminars

Frequently the student will observe notices posted around the Department, primarily on the bulletin board across from the 2<sup>nd</sup> floor elevators, inviting attendance at colloquia given by guest speakers, usually from outside the University. These are also posted on the department web site at [http://www.ece.osu.edu/newsevents/seminars\\_colloquia.html](http://www.ece.osu.edu/newsevents/seminars_colloquia.html). As the student grows in sophistication, it is strongly recommended that he or she attend such colloquia, even though the topic may be slightly different from his or her interest or at a level above his or her level. Education as an engineer means becoming professional in outlook, and attending seminars is one additional method for staying current.

## APPENDIX I

### TECHNICAL ELECTIVES BASED ON AREAS

#### Faculty Undergraduate Advisors by Areas of Specialization

When choosing technical electives, students are encouraged to consult with any of several Undergraduate Advisors for Technical Affairs. These appointed faculty members advise students in technical aspects of the curriculum, such as course content, selection of technical elective courses, and the like. We have several undergraduate advisors to represent each of the areas in the department. The advisors for 2007-2008 are as follows:

#### Autumn 2007

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Circuits	M. Ismail
Communication	S. Bibyk
Computers	E. Ekici
Control	A. Serrani
Electromagnetics	R. Reano
Physical Electronics	P. Berger
Power	A. Keyhani

#### Winter 2008

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Circuits	P. Roblin
Communication	P. Schniter
Computers	D. Orin
Control	U. Ozguner
Electromagnetics	B.L. Anderson
Physical Electronics	L. Brillson
Power	L. Xu

#### Spring 2008

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Circuits	J. DeGroat
Communication	L. Potter
Computers	C. Klein
Control	S. Yurkovich
Electromagnetics	F. Teixeira
Physical Electronics	G. Valco
Power	D. Kasten

## CIRCUITS AND ELECTRONICS

Beyond the core requirements, circuits and electronics is available as an area of concentration. Desktop and embedded computers are only practical because of the advances in circuit design in integrated circuits. All electrical systems depend on electronic circuits that evolve to become smaller, faster, cheaper, and better.

Students interested in circuits and electronics can obtain more hands-on electronic experience in courses beyond what is required in the core. Students can study both analog and digital integrated circuits.

Microwave electronics is crucial in implementation of wireless systems. Power electronics deals with circuit elements used to regulate voltages in all electronic systems including actuator systems.

Elective courses in circuits and electronics are shown below. For more information consult any of the faculty in that area: Profs. Bibyk, Clymer, DeGroat, Ismail, Roblin, Schniter, Wang.

TABLE 3

### Guidelines for Technical Electives in Circuits and Electronics

Interest	Autumn	Winter	Spring
Electronics Lab	327 (lab)	327 (lab)	327 (lab)
Integrated Circuits	722	720	620 721
Microwave/RF Electronics for Wireless	*	723 (lab)	620

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\* See ECE 710 in Electromagnetics area.

## COMMUNICATIONS AND SIGNAL PROCESSING

Communication systems and signal processing are longstanding areas of interest for electrical engineers. Wireless systems, cellular telephones, computer networks, television broadcasting, transmission of images from space and computer processing of speech are but a few examples of today's communication and signal-processing technologies.

A full set of technical electives are available for further study in both disciplines. Some of these are system oriented and prepare the student for industry, while others are more theoretical and are recommended for preparation for graduate school.

Elective courses in Communications and Signal Processing are shown below. Students wishing more information should contact any of the faculty in the area: Profs. Bibyk, Clymer, Coifman, Ekici, El-Gamal, Eryilmaz, Koksal, Martinez, Moses, Potter, Schniter, and Shroff.

TABLE 4

### Guidelines for Technical Electives in Communications and Signal Processing

Interest	Autumn	Winter	Spring
Communications	501 508 (lab)	501 508 (lab)	702
Digital Signal Processing	600	600 700	609 (lab)*
Image Processing	706D	707	706, 706D
Communication Networks			701
Strong focus on Communication and Signal Processing	501 508 (lab) 600	501 508 (lab) 600	702 609 (lab)*
Preparation for advanced studies		700	702
Estimation	650†		
Data Processing for Transportation Applns.	675		

\* Not offered 07-08.

† ECE 650 hours may only be counted once in an area of concentration even though it appears in both the Communications and Control areas.

## COMPUTERS

Computer technology continues to be at the heart of the growth that is taking place in American industry. Its role remains strong in business and manufacturing while the consumer industry is increasingly affected by improvements in cost, size, and performance. Computers are a strong element in any Electrical Engineering program. The Computer Engineering program allows students to specialize in this important area and has more specific guidelines for technical electives (see page 10). A number of elective courses are available, both in the ECE program and in the CpE program. Many of the courses are design oriented and provide excellent preparation for a job in industry. Others provide a further development of the theory and are especially effective in preparation for graduate study in Computer Engineering.

Some guidelines for students considering computer electives are listed in the table below. Students are urged to consult with members of the Computer Engineering faculty for additional information: Profs. DeGroat, Ekici, Klein, Martinez, Orin, F. Ozguner, Shroff, and Zheng.

TABLE 5

### Guidelines for Technical Electives in Computers for Electrical Engineering Specialization\*

Interest	Autumn	Winter	Spring
Computer Design	561 567 (lab) 662 667 (lab) 761†	561 567 (lab) 667 (lab) 694A	561 567 (lab) 662 667 (lab) 762 764 (even years) †
Microprocessor Systems	765		
Computer Interfaces and Protocols, Networking		766	‡
Robotics	763 (odd years)		
Preparation for advanced studies	662 761†	§ 694A	662
Component Based Systems		668 (formerly 768)	

\* For information on technical electives for the Computer Engineering Specialization, see page 10.

† Not offered 07-08.

‡ See ECE 701 in the Communications and Signal Processing area.

§ ECE/CS&E 779 may also be considered by those interested in Computer although it is classified as a Communications/DSP course.

## CONTROL

Control is playing an increasingly essential role in many vital areas including space exploration, robotics, transportation, and manufacturing. With its emphasis on complex systems, analysis and design, and a wide range of hardware, students frequently find control a fascinating area of study.

Some of the control elective courses are design oriented and focused on preparing a student for entry into industry; others have a more theoretical perspective and are especially effective preparation for graduate study in control.

Some guidelines for students considering control electives are listed in the table below. Students are urged to consult with members of the control faculty, Profs. Coifman, Cruz, Hemami, U. Özgüner, Passino, Serrani, Utkin and Yurkovich, for additional information.

TABLE 6

### Guidelines for Technical Electives in Control

Interest	Autumn	Winter	Spring
Introduction to Feedback Control	551 557 (lab)	557 (lab)	551
Analog Control			752
Digital Control		755	757 (lab-even years)
Strong focus on Control		755 753.01 (odd years) 753.02 (even years)	752 757 (lab-even years)
Preparation for advanced studies	650* 750	754 755	752 757 (lab-even years)
Control Applications		753.01 (odd years) 753.02 (even years)	758 (lab-odd years) 757 (lab-even years)
Numerical Techniques	759		

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\* ECE 650 hours may only be counted once in an area of concentration even though it appears in both the Communications and Control areas.

## ELECTROMAGNETICS AND OPTICS

Electromagnetics is fundamental to all physics-based electrical engineering, such as antennas and propagation, photonics, solid state electronics and power systems. Antennas and optical devices are a central component in any wireless communication, radar or remote sensing system. For example, in addition to AM-FM radio and cellular antennas, future automobiles are predicted to have radar antennas for use with an automated highway system, tracking antennas for use with the Global Positioning System (GPS), communication antennas to receive information about road conditions, etc. A growing area of electromagnetics is electromagnetic compatibility, which involves the design of electronic equipment so that it neither produces, nor is it sensitive to, electromagnetic radiation. Magnetic Resonance Imaging (MRI) machines involve an antenna which must produce a very uniform magnetic field so as not to distort the image. Modern systems generally require antennas which are smaller and less expensive, and yet are able to perform multifunctions in different frequency bands.

To meet the demand for electrical engineers to work on these types of systems, the Department of Electrical and Computer Engineering offers a variety of technical electives in the electromagnetics area. Except for ECE 719, they are all practically oriented, and are designed for students entering industry or graduate school. Students interested in optics should also check courses in the Solid State Electronics and Photonics area.

For further information, students should consult with members of the electromagnetics and optics faculty: Profs. Anderson, Johnson, J. Lee, R. Lee, Reano, Rojas, Teixeira, and Volakis.

TABLE 7

### Guidelines for Technical Electives in Electromagnetics and Optics

Interest	Autumn	Winter	Spring
Electromagnetics Lab		517 (lab)	517 (lab)
Electromagnetic Compatibility			614
Microwave Circuits and Lab	710	*	710 <sup>†</sup>
Antennas and Radiation		711	
Radio Wave Propagation			713 (even years)
Radar Systems		714 (even years)	
Optics <sup>‡</sup>	716 (even years) 694 H (even years)		
Electromagnetic Field Theory	719		
Numerical Methods	715 (formerly 694Y)		

\* See ECE 723 from Circuits area.

<sup>†</sup> Not offered Sp08.

<sup>‡</sup> Also see ECE 732 (Au odd years), 737 (lab, Wi odd years), and 731 (Sp) from Microelectronics and Photonics area.

## SOLID STATE ELECTRONICS AND PHOTONICS

The future is leading to technologies involving a billion transistors on a chip, beyond megahertz logic to gigahertz logic, beyond gigahertz analog to terahertz analog, to new optoelectronic systems for processing information, even toward computational systems with billions of analog processors, comparable to the number of neurons in the human brain.

Solid State Electronics encompasses the study and design of the physical systems that allow these advances to be made. This ranges from the design of VLSI circuits to the study of the impact of a single layer of atoms on the electronic properties of a device; from the study of light emission from laser diodes to the design of processes for manufacturing integrated circuits.

Photonics combines physical electronics with light. Technical electives in photonics are listed both below and under Electromagnetics and Optics.

Some guidelines for students considering microelectronic electives are listed in the table below. Students are urged to consult with Profs. Anderson, Berger, Brillson, Lu, Ringel, Roblin and Valco.

TABLE 8

### Guidelines for Technical Electives in Microelectronics and Photonics

Interest	Autumn	Winter	Spring
Semiconductors for Microelectronics and Optoelectronics	730	736 (odd years)	
Integrated Circuit Processing	637 (lab)	735 (even years)	734 (odd years)
Photonics	* 732 (odd years)	737 (lab, odd years)	731
Nanofabrication & Nanomanufacturing	694L		

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\* See ECE 716 in Electromagnetics area.

## POWER

Since the electric power industry's modest origins in 1882, the technology to generate, transport, and use electricity has expanded and modernized at an astounding rate. Today the electric power industry is among the leaders in using high technology. It has grown from Thomas A. Edison's first electric power company, which provided energy to roughly a quarter-square-mile area, to the largest single industry in the United States.

Electric power engineers have a large choice of areas. For example, they are involved in system and component design, electric machines and control of machines, construction and installation, system operation and maintenance, management, system instrumentation and control, communication and data systems, and energy management. Power Electronics is a relatively new area in electric power engineering in which electric power is processed by solid state converters into many desirable forms. Additionally, there are many career options in each of the above general areas. Examples of these potential challenges include high-voltage applications, computer controls, alternative energy sources such as photovoltaic systems and fuel cells, and long-range planning. Research into new energy sources and their power electronics control will provide further opportunities for electric power engineers.

The Reliability in Electrical and Computer Engineering courses should also be of interest to students outside the power area.

Some guidelines for students considering electives are listed in the table below. Students are urged to consult with members of the power faculty, Profs. Kasten, Keyhani, Ringel, Xu, and Wang for additional information.

TABLE 9

### Guidelines for Technical Electives in Power

Interest	Autumn	Winter	Spring
Electric Power Systems	740	741	
Electric Machines, and Control of Machines	447 (lab) 643	447 (lab) 647 (lab)	447 (lab) 743
High Voltage Engineering		747 (incl lab)	
Industrial/Comm Power Systems			640
Power Electronics and Applications*	*	*	
Reliability in Engineering	776.01	776.02 776.03	

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\* See ECE 624 (Au), ECE 628 lab (Au), and ECE 724 (Wi), in the Circuits and Electronics area.

## APPENDIX II

### MISCELLANEOUS HELPFUL DOCUMENTS

#### Computer Degree Programs in the College of Engineering

There are two programs in the computing field through the College of Engineering: a Bachelor of Science in Electrical and Computer Engineering (BSECE) and a Bachelor of Science in Computer Science and Engineering (BSCSE). This document is designed to describe these programs, their admission requirements, and career related topics.

##### Program Description

##### Electrical and Computer Engineering ([www.ece.osu.edu](http://www.ece.osu.edu))

The BSECE is a comprehensive Electrical and Computer Engineering degree with a choice between a traditional Electrical Engineering program and a program in Computer Engineering. The Computer Engineering program is a balanced study of hardware and software as applied to practical computer systems.

The hardware studies cover the basics of electrical and electronic systems. Students learn the fundamentals of digital (discrete) and analog (continuous) circuits early in their program. They also study basic electronic devices, including transistors, and the materials used to make current and future innovative devices. Since computers are used in most high-tech systems, all students learn how to interface computers with hardware for all application areas. Studies in Systems and Communication concepts demonstrate how different subsystems can be integrated into a functional comprehensive whole.

For example, the development of audio compact disks and computer CD-ROMs required a working knowledge of all of these topics. An appreciation of both the materials field and wave control systems was necessary to guide the laser in reading the correct spot on a disk. Communication theory suggested alternatives which permitted dense information storage on the disc. Computer interfacing determined the optimal connection between the disc system and the rest of the computer.

The software studies include programming, operating systems and system software design, and numerical analysis (a study of how data can be accurately processed). Software is embedded in almost all new high-tech systems and therefore a Computer Engineering student with the BSECE receives a balanced overall set of skills for creating new technologies and meeting the current engineering needs of society.

##### Computer Science and Engineering ([www.cse.ohio-state.edu](http://www.cse.ohio-state.edu))

Computer Science is the study of the theory and methods for solving problems with the aid of computers. A computing professional must be able to develop and analyze the specifications of a problem and to design, evaluate, implement, and test solutions. It combines the study of both the hardware (physical components such as microprocessors and memory devices) and software (instruction or command sequences a computer processes to solve various kinds of problems).

The BSCE combines a rigorous computing program with exposure to many different areas of engineering and general education. Typical computing subjects of study include programming and software development, computer architecture, the design and analysis of algorithms and data structures, numerical methods, operating systems, databases and file design, programming languages, systems software design, computer networks, software engineering, artificial intelligence, computer graphics, the theory of computation and information security. The broad engineering background includes courses in electrical engineering (covering electronic circuits, devices, and controls), engineering economics, materials science, and mechanical engineering.

For example, to build the fastest multi-processor computer in the world requires involvement from multiple fields of computer science. First, hardware knowledge of inside a computer is needed to decide how to arrange the processors, memory and other systems to enable the maximum efficiency and output of all the hardware put into the system. Researchers of parallel computing are brought in to design the best way to distribute and transfer information among all these processors so that they can all work at full speed. Third, to make the system useful, operating systems have to be created or modified to fit the multi-processor system, new algorithms designed to exploit the extended ability of such a system, and new compilers designed to aid more people to make applications for this new system.

The Department of Computer Science and Engineering also offers computing programs in the Colleges of the Arts and Sciences (BS/CIS, BA/CIS) and supports the Fisher College of Business program in Information Science (BSBA).

### **Admission Requirements**

*Note:* All students applying to Engineering programs must complete English 110 and all admissions conditions (if any) before they are eligible for admission.

**Electrical and Computer Engineering:** Acceptance to the major is based on a numerical ceiling and the student's cumulative point-hour ratio (CPHR) and secondary point-hour ratio (SPHR) after completion of specified pre-major courses. The SPHR is computed after the completion of Math 254, Physics 133, Chemistry 121, Engineering 183, and Engineering Graphics 167 or CS&E 221. To be admitted, students must successfully complete the required pre-major courses. All students with a CPHR of 3.0 or better are admitted to the major. Then for students with a minimum CPHR of 2.0 we will base further admission by SPHR. At this time our statistics show that for this year admitting all students with an SPHR of 2.0 and higher causes our quota to be filled. The admission SPHR may be adjusted in the future; however, students with an SPHR of less than 2.0 will not be admitted even if the quota is not filled.

**Computer Science and Engineering:** Students must complete CS&E 221 and 222 with a minimum of a C- grade in both courses, and complete courses through English 110, Math 152 and Chemistry 121 and Physics 131, or Physics 131 and Physics 132. Students must establish a cumulative point hour ratio by completing at least 25 hours at Ohio State, and this ratio is used as a minimum for admission. The admission GPA is 2.0. Admission conditions must also be complete.

### **Career Related Topics**

**Co-op and Internship Programs:** Students are encouraged to pursue co-op and internship opportunities during their undergraduate careers. Career experience can assist students by solidifying their choice of programs, defining career interests, earning funds to supplement or support their education, and providing valuable experience that will significantly enhance job

prospects upon graduation. There are a significant number of opportunities for both programs. Phone: 614-292-8489. Web site: <http://career.eng.ohio-state.edu/ecip/student/index.html>

**Typical Job Titles:** Below is a listing of typical job titles for both programs:

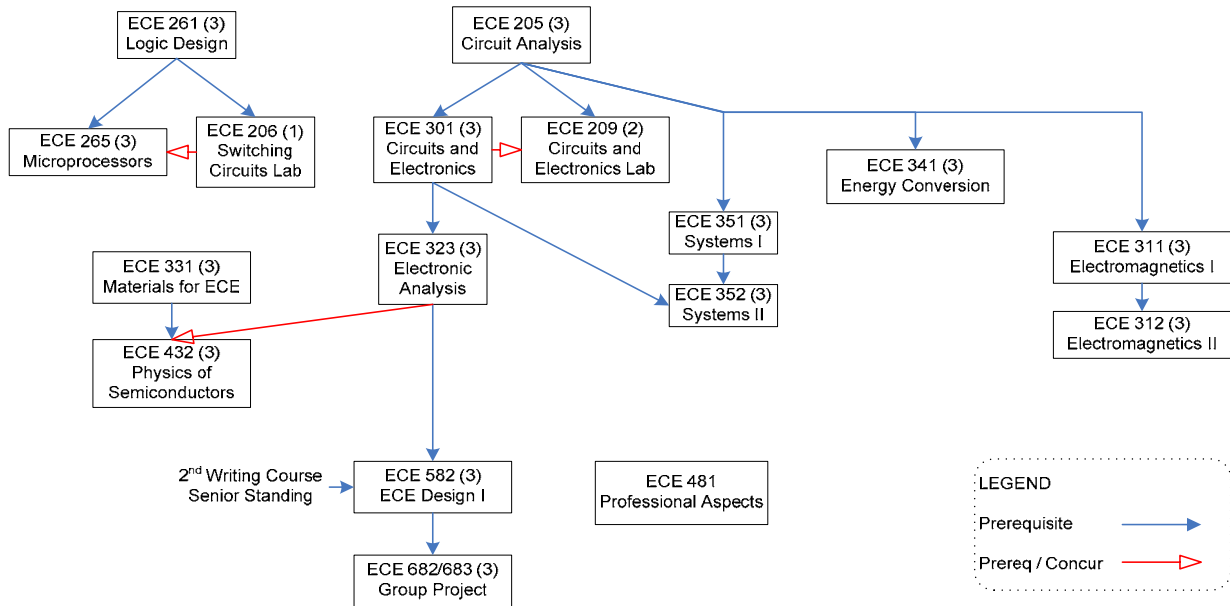
Applications/Field Service	Programming	Systems Analysis/Design
Consulting	Quality Control	Systems Engineering
Data Processing	Research & Development	Systems Programming
Hardware Design/Development	Sales/Technical marketing	Systems Security
Manufacturing and Production	Software Design/Development	Web Development
Product Engineering	Software Testing	

**Average Salaries:** Graduates from both programs earn significant entry-level salaries. The average starting salaries offered for 2006-2007 was approximately \$55,500 for ECE, and approximately \$52,500 for CS&E. Please note that this reflects not only the high demand for computing professionals in the current job market, but also the fact that most students have experience upon graduation, and therefore, usually receive higher salary offers.

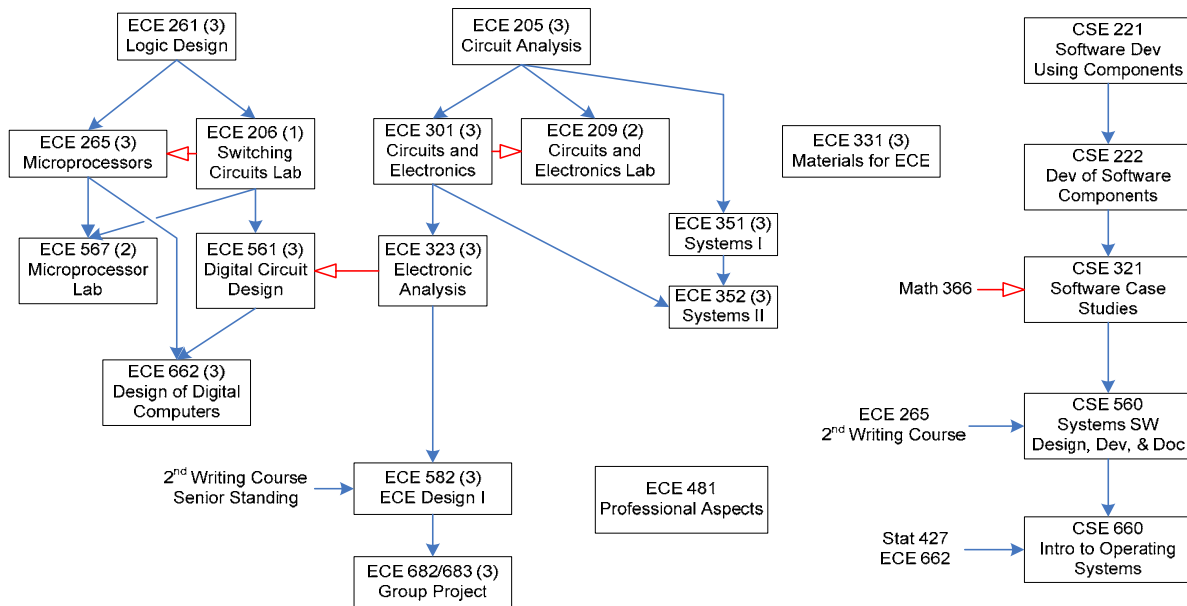
**Companies that Hire Graduates:** A large number of employers hire graduates from these programs, including small, medium, and large companies. Some of the most recognized names are Accenture, AT&T, Battelle, Dublin Technical Systems, AEP, IBM, Intel, Mettler Toledo, Marathon Ashland Petroleum, Microsoft, Motorola, Proctor & Gamble, Ross Labs, Silicon Graphics, and Texas Instruments.

# Core Courses Flowchart

## Electrical Engineering Specialization (EES)



## Computer Engineering Specialization (CES)



For more detailed course descriptions and sample syllabi: <http://www.ece.osu.edu/academics/courses.html>  
 For more information about areas of academic interest and technical elective concentration areas: <http://www.ece.osu.edu> (then pull-down Academics / Academic Areas / and choose which area you'd like to read about.)