COMPUTER ENGINEERING
UNDERGRADUATE HANDBOOK

FOR THE COMPUTER ENGINEERING MAJOR IN THE

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

COLLEGE OF ENGINEERING

AT THE

PENNSYLVANIA STATE UNIVERSITY

Effective Summer, 2005

Department of Computer Science and Engineering:
342E Information Sciences and Technology Building
Phone: 865-9505
Hours: Monday - Friday; 8:00 a.m. - 5:00 p.m.
## (Some) University Park Offices and Phone Numbers

<table>
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<tr>
<th>College of Engineering:</th>
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<tr>
<td>Dean's Office, 101 Hammond</td>
<td>865-7537</td>
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<tr>
<td>Associate Dean of Undergraduate Studies, 101 Hammond</td>
<td>863-3750</td>
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<tr>
<td>International Engineering Programs, 205 Hammond</td>
<td>863-1032</td>
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<tr>
<td>Office of Student Services, 208 Hammond</td>
<td>863-1033</td>
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<td>Engineering Advising Center, 208 Hammond</td>
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<td>Assistant Dean for Student Services, 208F Hammond</td>
<td>865-7539</td>
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<tr>
<td>Multicultural Engineering Program, 208 Hammond</td>
<td>865-7138</td>
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<td>Women in Engineering Program, 208 Hammond</td>
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<td>Cooperative Education Program, 205 Hammond</td>
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<td>Adult Learner Services, 323 Boucke</td>
<td>863-3887</td>
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<td>Career Services, 101 MBNA Career Services Center</td>
<td>865-2377</td>
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<td>Information Technology Services (ITS) Help Desk – 215 Computer Building</td>
<td>863-2494</td>
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<td>Counseling and Psychological Services (CAPS), 221 Ritenour</td>
<td>863-0395</td>
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<td>Disability Services, 116 Boucke</td>
<td>863-1807</td>
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<td>Distance Education (correspondence courses), 207 Mitchell</td>
<td>865-5403</td>
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<tr>
<td>Division of Undergraduate Studies (DUS), 118 (lobby) Grange</td>
<td>865-7576</td>
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<tr>
<td>University Learning Resource Center, 220 Boucke</td>
<td>865-1841</td>
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<td>Office of Student Aid (financial), 314 Shields</td>
<td>865-6301</td>
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<td>Residence Life, 135 Boucke</td>
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<td>Schreyer Honors College, 10 Schreyer Honors College (Atherton Hall)</td>
<td>863-2635</td>
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<td>Veterans Programs, 325 Boucke</td>
<td>863-0465</td>
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<td>General Information, HUB Desk, First Floor Lobby</td>
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Sources of Information

This Handbook provides program information specifically for the undergraduate Computer Engineering major. It should be used as a supplement to the College of Engineering Undergraduate Programs Guide 2005-2006. The information in this Handbook pertains to students starting at the University Summer 2005, Fall 2005, or Spring 2006. Students who enrolled at the University in an earlier year should refer to the appropriate earlier version of the Computer Engineering Undergraduate Handbook. For information about the Computer Science degree, refer to the Computer Science Undergraduate Handbook. All of these documents are available in the department office, 342E Information Sciences and Technology Building. (If you are at a campus other than University Park, you should contact the College of Engineering representative at your location).

Although this Handbook lists all requirements for the Computer Engineering major, only those specific to Computer Engineering are described in detail. Other requirements are discussed only briefly with references to more comprehensive supporting documents. Hard copies of these documents can be obtained from a Dean's office or local bookstore. Many are available on-line through the World Wide Web or Gopher. A list of useful web resources is provided below. For easy reference, resource names are printed in bold throughout the Handbook.

- Semester Course Schedules
- DUS Advising Resource
- Department of Computer Science & Engineering
- Penn State University
- Engineering Advising Center
- Bulletin of Baccalaureate Degree Programs
- University Faculty Senate Policies for Students
- Student Guide to General University Policies and Rules
- Registrar's Schedule of Courses
- General Education & Cultural Diversity in the Curriculum
- eLion

For additional information, you can contact the Engineering Advising Center (208 Hammond, 863-1033), the Assistant Dean for Student Services (208F Hammond, 865-7539), or the Department of Computer Science and Engineering (342E Information Sciences and Technology Building, 865-9505). The structure in the Department of Computer Science and Engineering includes a Director of Academic Affairs and an Undergraduate Secretary, both of whom can provide information and guidance during your academic career.
The Computer Engineering Major*

The Department of Computer Science and Engineering was created in 1993 with the merger of the Computer Engineering Program and the Computer Science Department. The department offers B.S. degrees in both Computer Engineering (CMPEN) and Computer Science (CMPSC) through the College of Engineering.

The mission of the faculty of the undergraduate Computer Engineering program at Penn State is to provide students with the knowledge and experience needed to pursue a productive lifelong career in industry or to engage in further study at the graduate level. Students participate in a balanced program of instruction covering the basic principles of the design and application of computer systems. The program includes coverage in breadth and depth of basic science, engineering, and abstract concepts of information handling. Students specialize in, and are prepared for, careers in the design, analysis and use of hardware, software, and systems. The program is structured to ensure that graduates have a clear understanding of the design and the applications of computers, as well as the ability to apply this knowledge throughout their professional careers.

Specifically, graduates shall be able to:

- Apply principles of computer engineering to the design, implementation, analysis, and evaluation of computer systems.
- Articulate engineering designs effectively in both oral and written formats to both technical and non-technical audiences.
- Use state-of-the-art tools, technologies, and software to solve problems in such diverse areas as operating systems, hardware design and synthesis, compiler design, modern programming languages, database technologies, architectural simulation, knowledge representation, image processing, and computer vision.
- Work and think independently and participate in groups, including interdisciplinary groups, in an effective, professional and ethical manner.

During the first two years, students in Computer Engineering take many courses in common with other engineering majors, including courses in mathematics, physics, and chemistry. In addition, students take several specialized courses in the major, such as algorithms and programming, electrical engineering, digital systems and logic, and computational theory. From these courses, students gain experience using sophisticated software tools, working in a hardware laboratory, and completing individual and group projects. During the second two years, students complete a series of courses in both hardware and software systems. Students also select from numerous electives, which include at least one significant experience in hardware design, software design and intelligent information processing. Throughout the four years, students develop communication skills, including a senior year course in which students examine the complete design process and participate in a series of oral and written experiences similar to those that would be seen in industry.

Students who are interested in math and science and enjoy solving problems are excellent candidates for the Computer Engineering major. CSE 271 and CSE 103 (CMPSC 201C) are excellent introductions to this major. Job opportunities are virtually limitless; graduates are employed by all sectors of industry, government, and academic institutions. Because of the close relation to computer science, simultaneous degrees and dual majors in Computer Engineering and Computer Science are not permitted.

*Computer Engineering is accredited by the Engineering Accreditation Commission of ABET, Inc., 111 Market Place, Suite 1050, Baltimore, MD 21202-4012, telephone: 410-347-7700 or http://www.abet.org/.
Advising and Procedures for Major

If you are a first- or second-year student at University Park who is intending to major in Computer Engineering, you will see an adviser at the Engineering Advising Center (EAC), 208 Hammond Building, 863-1033. This office is open Monday through Friday, 8:00 a.m. to 5:00 p.m. (Walk-in advising is available but appointments are encouraged).

If you are a junior or senior who has been admitted into the computer engineering major or a University Scholar, you will be assigned a faculty adviser in the Computer Science and Engineering Department. If you do not know your assigned adviser’s name or office address, ask in the department office in 342E Information Sciences and Technology Building. This information is also available from eLion.

Required courses for the Computer Engineering major and a suggested schedule are given on the following pages. Information about all majors at Penn State are listed in the Bulletin of Baccalaureate Degree Programs. The Bulletin is updated yearly and should be used along with this Handbook. Exceptions to the Bulletin are noted here.

The final responsibility for selecting courses and meeting degree requirements is yours. The role of your adviser is to suggest, recommend, and remind you of the requirements of the major and rules of the University. (Two helpful references for University procedures on-line are: University Faculty Senate Policies for Students, and the Student Guide to General University Policies and Rules). When meeting with your adviser, always take a copy of your recent audits, grade reports, transcript, your present schedule, and your plan for at least the next semester’s courses.

Because computer engineering is such a rapidly changing field, adjustments in course content and/or course offerings should be expected. It will be to your advantage to keep abreast of new course offerings, current course enhancements, and allowable course substitutions through regular contact with your adviser and the department office.

Entrance to the major — The Computer Engineering major is under administrative enrollment controls. This means that only a limited number of students who have met specific requirements are admitted to the major. Available computing facilities, faculty and teaching assistants, and space constraints determine this limit. Currently, the combined limit for Computer Science and Computer Engineering is 190 students. Entrance to major is available to a student only once. For students entering Penn State in Summer 2005, Fall 2005, or Spring 2006, the only time you may enter the Computer Engineering major is Spring 2007.

To qualify for the Computer Engineering major,

1. You must complete MATH 140, MATH 141, CHEM 12, and PHYS 211 with a grade of C or better in each by the end of Spring semester, 2007.
2. You must be enrolled in the College of Engineering (ENGR major) or DUS (declared as heading toward an engineering major).
3. You should complete at least two full semesters of coursework appropriate to the major. You should be taking CSE 271, CSE 275, and EE 210 during your second year in order to make normal progress. Be sure you’re accumulating credits at a minimum rate of 30 credits per calendar year. Be aware that a deferred grade or withdrawal should be discussed with an adviser so that your schedule is not judged "inappropriate."
Students who meet the qualifications listed above will be selected for the Computer Engineering major starting with the student with the highest cumulative grade-point average and continuing down until the limit of 190 students has been reached. For the purpose of entrance to major, your grade-point average is evaluated after the Fall semester of your second year. So if your grade point average after Fall 2006 is in the highest 190 sophomore students selecting Computer Engineering or Computer Science as their major, you will be admitted to the major. Note, that if you have met the qualifications and your Fall 2006 cumulative grade-point average is 3.3 or greater, you are guaranteed entrance to major regardless of the student limit.

In summary, during your first two years, you must complete MATH 140, MATH 141, CHEM 12, and PHYS 211 with a grade of C or better in each. You must declare your intended major as Computer Engineering, schedule your courses wisely, and keep your grade point average up.

**Change of Major** – If you discover an interest in other areas of study or you are not admitted into Computer Engineering, you should explore other possible majors and alternatives at the [Engineering Advising Center](#) or the [DUS Advising Resource](#).

**Concurrent Major** – Concurrent majors will not be allowed in Computer Science and Computer Engineering.

**Registration** – Each semester, you register for classes by planning what you need to take (referring to this Handbook and the College of Engineering Undergraduate Programs Guide 2005 - 2006), by checking with your adviser, and then by following the instructions in the Schedule of Courses that is published each semester. (You can also find out what courses are still open, what courses have had sections added, etc., on-line at the [Registrar’s Schedule of Courses](#) website.

Re-ordering your course schedule will not necessarily delay graduation. The key to completing 126 credits over 4 years is to average approximately 16 credits per semester. Though many students do maintain this pace, it is not unusual for students to take lighter loads some semesters and to delay graduation. Experience has shown that the 5th semester has been difficult for many students; if you have doubts, it is a good place for a light load. Needed credits are often taken during the summer (not necessarily at University Park) or by independent learning. Some students will elect to attend for a 9th semester. Many courses are not offered every semester, so please be careful in your scheduling. This is especially true for co-op students.

**Schedule Changes** – Schedule adjustments (course adds/drops) may be made over the phone during the first 10 calendar days of each semester. Detailed instructions, costs, and deadlines are provided in the Schedule of Courses. After this time, you may still adjust your schedule, but any change is considered a late add or a late drop and requires an adviser’s signature. You have a limit of 16 late-drop credits, so consultation with your adviser is important. (REMEMBER: A student who has not yet been admitted to the major should seek advice at the [Engineering Advising Center](#); a student who has been admitted should see the assigned faculty adviser in Computer Science and Engineering).
**General Education** – All students at the University are required to complete 46 credits of General Education. A General Education course can be identified by its course suffix. You will partially meet these requirements by taking specific courses required for the Computer Engineering major, and by following the general guidelines below.

General Education consists of the following categories:

- first year seminar - at least 1 credit - courses with the designation PSU will fulfill this requirement, as will courses with the suffix FYS
- writing/speaking - 9 credits - course suffix of GWS
- quantification - 6 credits - suffix of GQ
- health and physical activity - 3 credits - suffix GHS
- natural sciences - 9 credits - suffix GN
- arts - 6 credits - suffix GA
- humanities - 6 credits - suffix GH
- social and behavioral sciences - 6 credits - suffix GS

College of Engineering students follow the University's General Education guidelines; refer to the **College of Engineering Undergraduate Programs Guide 2005 - 2006** and to the University's **Baccalaureate Degree Programs Bulletin** for a complete list of available courses.

Check with your adviser if you would prefer to develop a sequence of 9 credits in arts, humanities, or social and behavioral sciences by substituting 3 credits from one of the other 2 areas. Please note: students may take a level III language course and use it as one of the AHS courses, but it cannot be the only course in an area; thus, it can only be the second or third course of the 9-6-[not the 3] sequence in any of the AHS areas. It should also be noted that Engineering students must take ECON 2, 4, or 14 or ENNEC 100 as one of the courses in the social and behavioral sciences sequence. Petitions to use the 9-6-3-sequence option for meeting AHS requirements will be approved as long as the above requirements are met.

**Writing Requirement** – All Penn State students have a Writing Across the Curriculum graduation requirement. You must complete at least 3 credits of writing-intensive courses selected from "W" courses offered within the major or college of enrollment. The course in the Computer Engineering major that fulfills this requirement is 430W (Computer Engineering Project Design).

**Diversity Requirement** – Beginning summer 2005, the **Intercultural and International Competence (GI) requirement** has been replaced by a requirement in United States Cultures (US) and International Cultures (IL). Courses approved to fulfill this requirement will be designated as US, IL, or both US and IL. The **degree audit** will monitor the completion of the requirement for each student based on his/her program year.

Students admitted to baccalaureate or associate degree status before summer 2005 must complete a 3-credit course that is US, IL, or both US and IL. However, students who have fulfilled their Intercultural and International Competence requirement with a course designated as DF or GI are exempt from this requirement. Any semester- or year-long **Penn State-approved study abroad program** can be used to satisfy the requirement.
Students admitted to baccalaureate degree status after spring 2005 must complete 3 credits in US and 3 credits in IL. If a student takes a 3-credit course that is both US and IL, to complete the requirement, he/she must take another 3-credit course that is US, IL, or both US and IL. Associate degree candidates must complete a 3-credit course that is US, IL, or both US and IL. Education abroad courses and other credit-bearing experiences such as internships that meet this requirement will be designated as US, IL, or both US and IL.

A good reference, updated yearly, is the small blue booklet General Education and Cultural Diversity in the Curriculum. Education Abroad is another option for fulfilling the diversity requirement.

Sixth Semester Audit – During your sixth semester, the department will send you a copy of your transcript or a computer audit and a requirement checklist for the major. A copy of this checklist appears on page 15 of this handbook. You must fill out the requirement checklist and return it so that your progress can be checked and any problems resolved before graduation. If you have questions on your audit, it is your responsibility to talk to your adviser and/or to the undergraduate secretary (in 342E Information Sciences and Technology Building).

Graduation Requirements – To graduate from the University, every student must:

1. Complete the course requirements for his or her major;
2. Earn at least a 2.0 cumulative grade-point average for all courses taken at the University; and
3. Earn at least a C in each of these courses: CSE 103/CMPSC 201C, CSE 120, CSE 260, CSE 271, CSE 331, CSE 431, CSE 465, CHEM 12, E E 210, E E 310, E E 317, MATH 140, MATH 141, PHYS 211.

Credit Acquisition – In addition to taking courses at any Penn State campus, you can earn credit through Independent Learning (correspondence) or by transferring credits from another school. Before taking a course at another university, check with the Admissions office and your adviser to be sure the course will transfer usefully.

Cooperative Education Program – The cooperative education program provides work experience by alternating periods of academic study and full-time employment in industry or government. The program calls for entry at the beginning of the junior year, and for cumulative work experience of one year before graduation.

If you have interest in the co-op program, you should obtain advising no later than your fourth semester from the designated co-op adviser, who will help you plan work and study schedules. You may earn up to 3 credits toward graduation in the Department List requirements. If you are not a formal co-op student, you may still take related summer jobs; however, you may not claim co-op credits for jobs you arrange outside of the formal program.

Honors Program – Students in the Schreyer Honors College (Atherton Hall, 863-2635) have the option of pursuing an honors degree in Computer Engineering by participating in the Computer Engineering Honors Program. See an honors adviser if you are interested in finding out more about this program. (The department office, 342E Information Sciences and Technology Building, can identify the honors advisers for you).
Minors – A minor is a specialization of at least 18 credits that supplements a major. Some courses may concurrently meet the requirements of our major. Popular minors for students in our department include:

1) The Engineering Leadership Development Minor  
2) Management Information Systems Minor  
3) Mathematics Minor  
4) Geography Minor  
5) Business and Liberal Arts Minor

Other Issues – For additional information on minors, withdrawal, leaves of absence, simultaneous degrees, multiple majors, change of major, satisfactory/unsatisfactory credits, and other academic issues, refer to University Faculty Senate Policies for Students. For information on campus and community resources (parking, libraries, museums, etc.; referrals for returning adult students, minority students, veterans, women), refer to Easy Access, available during orientation and published by Student Life.

Any exceptions made in the degree requirements must be approved and documented, usually using a college petition form. Inquiries about exceptions and general degree requirements should be taken to the Computer Science and Engineering Department Office (342E Information Sciences and Technology Building), to your adviser, or to the Engineering Advising Center. (Note that such petitions will NOT be accepted during the semester that you plan to graduate).

Academic Integrity – Recognizing not only the value of integrity in the academic environment, but also its value for the practicing engineer and for society at large, we in the department urge you to act as a responsible professional while you are a student. Academic integrity is defined as follows in Faculty Senate rule 49-20:

"Academic integrity is the pursuit of scholarly activity free from fraud and deception and is an educational objective of this institution. Academic dishonesty includes, but is not limited to, cheating, plagiarizing, fabricating of information or citations, facilitating acts of academic dishonesty by others, having unauthorized possession of examinations, submitting work of another person or work previously used without informing the instructor, or tampering with the academic work of other students."

It is commonly accepted that people learn better if they can interact, discuss, and assist each other in solving problems and understanding concepts. Yet persons submitting identical homework papers overstep the bounds of beneficial interaction. You are encouraged to discuss homework assignments. You may discuss what you are supposed to do, the general algorithm and data structures that might be used. The furthest that cooperation is allowed is to assist another student in debugging their code. Do not, for any reason, show another student sections of your code or write sections of code for another student. Any collaboration that exceeds these guidelines will be considered cheating. Clearly, professionals share ideas but they should not use another’s work without clear acknowledgement of who did the work. Academic dishonesty in any form is not condoned or tolerated.
Engineering Design Experience – Design is incorporated into a majority of courses taught in the Computer Engineering Program. Many of the courses are split between engineering science and engineering design, so that the design experience is spread throughout the program.

At the sophomore level, in CSE 271 and 275, students design and build digital circuits consisting of combinational and sequential components. Students begin with analysis type projects, learning basic laboratory skills, problem specification, and project planning. Projects become increasingly more design oriented and open ended, culminating in a significant two- or three-week design effort, allowing the student to make choices and trade-offs between multiple design criteria.

During the junior year, students learn about computer organization in CSE 331 and CSE 431. Trade-offs in the design of a computer are examined.

The design experience culminates in the senior year, where students choose from a variety of system-level design courses in both hardware and software areas. Choices include laboratory design courses in microcomputer systems, VLSI, FPGA, software engineering, compilers, databases, and concurrent computing. Each of these courses involves the student in a significant design problem by the end of the course.

The final design course for most students is CSE 430W. Students experience the entire design process, starting from problem definition and requirements analysis to proposal preparation, to steps in the design review process, and finally, to design specification and implementation. Projects require students to consider a number of design factors including cost, size, human factors, reliability, power consumption, manufacturability, etc. The course is considered writing intensive and involves students in a number of technical writing experiences, as well as oral presentations.

Engineering Topics – Students achieve breadth in computer engineering through a series of required courses. Background in software related areas is gained through CSE 103 (Programming Techniques)/CMPSC 201C (Programming for Engineers), CSE 120 (Intermediate Programming), CSE 465 (Data Structures and Algorithms), CSE 428 (Programming Languages), and CSE 411 (Operating Systems). Background in hardware areas is gained through CSE 271 (Introduction to Digital Systems), CSE 275 (Digital Design Laboratory), CSE 331 (Computer Organization and Design), and CSE 431 (Introduction to Computer Architecture).

Depth is obtained in at least one area by the students’ selection of senior year electives. Students must select 15 credits from the Computer Engineering Electives (Select 9 credits from CSE 471, 472, 473, 477, 478, 447, 458, 485, 486, and EE 453, 456 and select 6 credits from any 400-level CSE course).

Issues related to the integration of hardware and software, and hardware-software tradeoffs are discussed in the required courses CSE 331, CSE 411, CSE 430W, and CSE 431, as well as some elective courses such as CSE 472 (Microprocessors and Embedded Systems) and CSE 473 (Microcomputer Laboratory).

Students receive appropriate introduction to various specialized mathematics topics in a sequence of required courses that include: CSE 260 (Discrete Mathematics for Computer Scientists), Stat 418 (Probability), and Math 220 (Matrices). A variety of methods for modeling computer processes and systems are introduced in the required courses CSE 465, CSE 331, CSE 411, and CSE 431.

Students learn to use a number of computer-aided design tools through the laboratory courses and in regular lecture courses. These include a digital schematic capture and simulation tool in CSE 271 and CSE 275; an analog simulation tool in EE 210; a hardware design language and a microprocessor emulation system in CSE 473; a hardware description language simulator in CSE 431; logic design CAD tools in CSE 431 and CSE 471; VLSI CAD tools in CSE 477; and various digital image processing and computer vision software tools in CSE/EE 485 and CSE/EE 486.
All students learn at least two programming languages, JAVA and C++. Assembly language is studied in CSE 472. In CSE 428, students are exposed to various language features associated with any programming language. Students make extensive use of the UNIX operating system in a large number of courses.

Program Requirement Summary Chart – On the next pages, you will find a semester-by-semester chart of what courses to take with notes describing any choices to be made or restrictions to be followed. Please realize that although all the courses listed are required for the degree, they need not be taken during the semesters shown in the charts. You should be sure to check course prerequisites before you deviate from the suggested schedule. **Care should be exercised to be sure core courses are taken in the proper sequence and in a time frame allowing you to meet entrance to major requirements.** A total of 126 credits are required for graduation.
### Suggested Schedule of Courses by Semester

#### SEMESTER 1
16 credits

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<th>Course</th>
<th>Credit</th>
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<tr>
<td>MATH 140 GQ* (Calculus I)</td>
<td>4</td>
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<tr>
<td>PHYS 211 GN* (Mechanics)</td>
<td>4</td>
</tr>
<tr>
<td>CHEM 12 GN* (Chemical Principles)</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 14 GN (Experimental Chemistry)</td>
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<tr>
<td>ENGL 15 or 30 GWS (Rhetoric &amp; Composition)</td>
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<tr>
<td>First Year Seminar*</td>
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#### SEMESTER 2
17 credits

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<tr>
<td>CMPSC 201C GQ* (Programming for Engrs)**</td>
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</tr>
<tr>
<td>MATH 141 GQ* (Calculus II)</td>
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<tr>
<td>PHYS 212 GN (Electricity &amp; Magnetism)</td>
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<td>Arts, Human, or Soc. Beh. Sci.viii or (ENGL 15/30)</td>
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<tr>
<td>Arts, Human, or Soc. Beh. Sci.viii</td>
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#### SEMESTER 3
16 credits

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<tr>
<th>Course</th>
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<tbody>
<tr>
<td>CSE 120* (Intermediate Programming)</td>
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<tr>
<td>CSE 271* (Intro to Digital Systems)</td>
<td>3</td>
</tr>
<tr>
<td>MATH 250 (Differential Equations)</td>
<td>3</td>
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<tr>
<td>MATH 220 GQ (Matrices)</td>
<td>2</td>
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<tr>
<td>PHYS 214 GN (Wave Motion &amp; Quantum Physics)</td>
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<tr>
<td>Health &amp; Physical Activityvi</td>
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#### SEMESTER 4
16 credits

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<tr>
<td>CSE 260* (Discrete Math for Computer Science)</td>
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<tr>
<td>CSE 275+ (Digital Design Lab)</td>
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</tr>
<tr>
<td>MATH 231 (Calculus of Several Variables)</td>
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<tr>
<td>E E 210* (Circuits and Devices)</td>
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<tr>
<td>ECON 2, 4, or 14 or ENNEC 100 (Social Science)viii</td>
<td>3</td>
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<tr>
<td>CAS 100 A/B (Effective Speech)</td>
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#### SEMESTER 5
16 credits

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<th>Course</th>
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<tbody>
<tr>
<td>CSE 331* (Computer Organization &amp; Design)</td>
<td>3</td>
</tr>
<tr>
<td>E E 317* (Signals &amp; Systems)</td>
<td>3</td>
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<td>E E 310* (Electronic Circuit Design)</td>
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<tr>
<td>STAT 418 (Probability)</td>
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<tr>
<td>Arts, Human, or Soc. Beh. Sci.viii</td>
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#### SEMESTER 6
15 credits

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<tr>
<td>CSE 431* (Intro to Computer Architecture)</td>
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<td>CSE 465* (Data Structures &amp; Algorithms)</td>
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<tr>
<td>CSE Computer Engineering Electiveii</td>
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<tr>
<td>ENGL 202C (Technical Writing)</td>
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</tr>
<tr>
<td>Arts, Human, or Soc. Beh. Sci.viii</td>
<td>3</td>
</tr>
</tbody>
</table>

#### SEMESTER 7
15 credits

<table>
<thead>
<tr>
<th>Course</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSE 428 (Programming Language Concepts)</td>
<td>3</td>
</tr>
<tr>
<td>CSE Computer Engineering Electiveii</td>
<td>3</td>
</tr>
<tr>
<td>CSE Computer Engineering Electiveii</td>
<td>3</td>
</tr>
<tr>
<td>CSE 400-level~</td>
<td>3</td>
</tr>
<tr>
<td>Department List* (General Elective)</td>
<td>3</td>
</tr>
</tbody>
</table>

#### SEMESTER 8
15 credits

<table>
<thead>
<tr>
<th>Course</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSE 411 (Operating Systems)</td>
<td>3</td>
</tr>
<tr>
<td>CSE 430W</td>
<td>3</td>
</tr>
<tr>
<td>CSE 400-level~</td>
<td>3</td>
</tr>
<tr>
<td>Department List* (General Elective)</td>
<td>3</td>
</tr>
<tr>
<td>Arts, Human, or Soc. Beh. Sci.viii</td>
<td>3</td>
</tr>
</tbody>
</table>

Superscripts in Roman numerals refer to the Graduation Requirements Notes on the following pages.

* A grade of C or better in these courses is required for graduation. (MATH 140, MATH 141, CHEM 12, and PHYS 211 require a C or better for entrance to the major). If a course requires a "C" or better and the course is a prerequisite for another course, a "C" is required to meet the prerequisite.

** While CMPSC 201C is listed as a required course for CMPEN majors, the department strongly recommends that students substitute CSE 103 instead.

+ At University Park, students are strongly encouraged to take CSE 271 prior to taking CSE 275. CSE 275 is taught with the assumption that students have already successfully completed the course materials in CSE 271.

~ Select 6 credits from any 400-level CSE course.
GRADUATION REQUIREMENTS NOTES

Many of the courses below have prerequisites; some prerequisites are shown in parentheses; others are given in the Bulletin.

I. Computer Science and Engineering (28 credits):
   - CMPSC 201C GQ (3) – Computer Programming for Engineers
     (prerequisite or concurrent: MATH 141)
     CSE 103 GQ (4) may be substituted, and it is recommended that you do so
   - CSE 120 (3) - Intermediate Programming
     (prerequisite: CMPSC 201C or CSE 103; MATH 140)
   - CSE 260 (3) - Discrete Mathematics for Computer Science
     (co-requisite: CSE 120)
   - CSE 271 (3) - Introduction to Digital Systems
     (concurrent: PHYS 212/202)
   - CSE 275 (1) - Digital Design Lab
     (concurrent or prerequisite: CSE 271)
     Note: Taking CSE 271 before CSE 275 is strongly recommended.
   - CSE 331 (3) - Computer Organization and Design
     (prerequisite: CSE 271; CMPSC 201C or CSES 103)
   - CSE 411 (3) - Operating Systems
     (prerequisite: CSE 465)
   - CSE 428 (3) - Applied Programming Languages
     (prerequisite: CSE 465)
   - CSE 431 (3) – Introduction to Computer Architecture
     (prerequisite: CSE 331)
   - CSE 465 (3) - Data Structures and Algorithms
     (prerequisite: CSE 260)

II. Additional CSE Courses [Computer Engineering Electives] (15 credits):
   Select 15 credits:
   - Select 6 credits from any 400-level CSE course.
   Some courses are NOT offered every semester or even every year.

III. Writing Intensive Course (3 credits):
   - CSE 430W (3) – Computer Engineering Project Design
     (prerequisite: CSE 331, CSE 465, ENGL 202C)

IV. Electrical Engineering (11 credits):
   - EE 210 (4) - Circuits and Devices
     (prerequisite: PHYS 212/202; concurrent: MATH 250)
   - EE 310 (4) - Introduction to Electron Devices and Circuits
     (prerequisite: EE 210)
   - EE 317 (3) - Signals and Systems: Continuous and Discrete-Time
     (prerequisite: CMPSC 201C or CMPSC 201F, EE 210, MATH 250)
V. Communications (9 credits):
ENGL 15 GWS (3) - Rhetoric and Composition
(ENGL 30 GWS may be substituted)
ENGL 202C GWS (3) - Technical Writing
CAS 100 A/B (3) – Effective Speech

VI. Quantification and Statistics (18 credits):
MATH 140 GQ (4) - Calculus with Analytic Geometry I
MATH 141 GQ (4) - Calculus with Analytic Geometry II
MATH 220 GQ (2) – Matrices
MATH 231 (2) - Calculus of Several Variables
MATH 250 (3) - Ordinary Differential Equations
STAT (MATH) 418 (3) – Probability

VII. Health Sciences and Physical Education (3 credits):
The Health Science/Physical Activity (ESACT) requirement can be met by taking one
3-credit course or various credit combinations (which can be taken in different semesters)
that total 3. The following are examples of some Health Science courses [GHS suffix],
and/or you can select any ESACT course(s) [GPE suffix]. The GHA suffix will be phased
in over the next three years.
FD SC 105
HL ED 3, 5, 13, 15, 19, 43, 44, 45, 46, 48, 57, 60, 303
NUTR 100, 115, 251
STS 105

VIII. Natural Sciences (14 credits):
PHYS 211/201* GN (4) - General Physics (mechanics)
PHYS 212/202* GN (4) - General Physics (electricity, magnetism)
PHYS 214/203* GN (2) - General Physics (wave motion and quantum physics)
CHEM 12 GN (3) - Chemical Principles
CHEM 14 GN (1) - Experimental Chemistry
*Preferred sequence is PHYS 211, 212, and 214, but may not be available at all campuses.

IX. Arts, Humanities, Social and Behavioral Sciences, Diversity (18 credits):
Six credits are required in each of the 3 categories: Arts (A), Humanities (H), and Social and Behavioral
Sciences (S), as listed under the University’s General Education Guidelines [see the University’s
Baccalaureate Degree Programs Bulletin]. See page 6 [this Handbook], General education, for an
explanation of the 9-6-3 sequence as it pertains to AHS courses. You may use one of your Arts,
Humanities, or Social or Behavioral Sciences selections to fulfill the University’s Diversity requirement (see
page 6 [this Handbook], Diversity requirement**). A work chart follows.

<table>
<thead>
<tr>
<th>Arts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Humanities</td>
</tr>
<tr>
<td>Social Sci.</td>
</tr>
<tr>
<td>ECON 2*, ECON 4*, or ECON 14* or ENNEC 100*</td>
</tr>
<tr>
<td>Diversity Focused Course</td>
</tr>
</tbody>
</table>

*Either ECON 2, 4, or 14 or ENNEC 100 is required for College of Engineering majors.

**For diversity-focused courses, see General Education and Cultural Diversity in the Curriculum
on-line and the Semester Courses Schedules.
X. Department List (General Elective) Guidelines (6 credits):
These 6 credits are sometimes called approved free electives or general electives, but restrictions apply as described below. These credits provide some flexibility and also allow inclusion of up to 6 credits of ROTC or up to 3 Cooperative Education credits. If your Diversity course was not an Arts, Humanities, Social or Behavioral Sciences course, it may be counted in this list. (For diversity focused courses, see the General Education and Cultural Diversity in the Curriculum booklet and the Schedule of Courses). We encourage, but do not require, the taking of technical electives in Computer Science, Engineering, Math or Physics in this category.

The following restrictions apply:
- no courses not satisfying minimum requirements for a baccalaureate degree program (see course descriptions in University Bulletin)
- no courses described as intended for non-science or non-technical majors in course descriptions in the University Bulletin (You may take non-technical courses, but look at the Bulletin to be sure the description doesn’t say “for non-science majors only”).
- no courses similar or remedial to a required course or course already taken (when in doubt, check with your advisor before scheduling the course).
- none of the following:
  Astronomy (ASTRO) 1, 10, 11, 120, 140
  Biological Science (BI SC) 1, 2, 3, 4
  Chemistry (CHEM) 1, 2, 6, 11
  Computer Science (CMPSC) 100, 203
  Earth and Mineral Sciences (EM SC) 150
  Earth Sciences (EARTH) 1
  English as a Second Language (ESL) 004
  Language and Literacy Education (LL ED) 5, 10
  Mathematics (MATH) 200, MATH below 140
  Philosophy (PHIL) 12
  Physical Science (PH SC) 7, 8
  Physics (PHYS) 215, 265, PHYS below 201
  Science, Technology, and Society (STS) 150
  Speech Communication (SPCOM) 126, 283
  Statistics (STAT/MATH) below 319
  Statistics (STAT/MATH) 401
- only 1 from the following set:
  STAT(MATH) 319, STAT(MATH) 415
- no more than 6 credits of ROTC
- no more than 3 additional credits of physical education
- no more than 3 credits of Cooperative Education
- no more than 2 credits of Engineering Internship
- no more than 3 credits of CHEM 17
- no more than 4 credits of MATH 140A

- IST courses are accepted with the following exceptions:
  IST 210 – (if the student has completed CSE 441W)
  IST 220 – (if the student has completed CSE 458)

XI. First Year Seminar (1 credit):
Small interactive classes that allow first-year students to meet faculty and alumni, explore different majors and career opportunities, or focus on hands-on projects and skill development.
### Graduation Requirements Checklist for B.S. Degree in Computer Engineering

[format is COURSE (grade,credits,semester): e.g., CMPSC 201 (A,3,Fa05)]

#### Computer Science and Engineering:

- CSE 103/CMPSC 201C GQ ( ,4/3, ), CSE 120 ( ,3, ),
- CSE 260 ( ,3, ), CSE 271 ( ,3, ), CSE 275 ( ,1, ),
- CSE 331 ( ,3, ), CSE 431 ( ,3, ),
- CSE 465 ( ,3, ), CSE 428 ( ,3, ), CSE 411 ( ,3, )

_______ (29/28)

#### Additional CSE Courses (Computer Engineering Electives):

- CSE ___________ ( ,3, ), CSE ___________ ( ,3, )
- CSE ___________ ( ,3, ), CSE ___________ ( ,3, )
- CSE ___________ ( ,3, )

_______ (15)

#### Writing Intensive Course:

- CSE 430W ( ,3, )

_______ (3)

#### Electrical Engineering:

- E E 210 ( ,4, ), E E 310 ( ,4, ), E E 317 ( ,3, )

_______ (11)

#### Communications:

- ENGL 15 GWS ( ,3, ), ENGL 202C GWS ( ,3, ),
- CAS 100 A/B ( ,3, )

_______ (9)

#### Quantification, Statistics:

- MATH 140 GQ ( ,4, ), MATH 141 GQ ( ,4, ),
- MATH 231 ( ,2, ), MATH 220 GQ ( ,2, ), MATH 250 ( ,3, ),
- STAT 418 ( ,3, )

_______ (18)

#### Health Sciences and Physical Activities:

- _______ ( , , ) _______ ( , , ) _______ ( , , )

_______ (3)

#### Natural Sciences:

- PHYS 211/201 DN ( ,4, ), PHYS 212/202 DN ( ,4, ),
- PHYS 214/203 DN ( ,2, ), CHEM 12 DN ( ,3, ), CHEM 14 DN ( ,1, )

_______ (14)

#### Arts, Humanities, Social & Behavioral Sciences, Diversity (indicate GA, GH, GS, & DF):

- ECON 2, 4 or 14 or ENNEC 100 ( ,3, )

_______ (18)

#### Department List (General Electives):

- _______ ( , , ) _______ ( , , )

_______ (6)

#### First Year Seminar:

- _______ ( ,1, )

_______ (1)

**TOTAL CREDITS** _______ (126+)

__________________________ (student name) is planning to graduate at the end of ________ Semester, 20___.

Advisor's signature ________________________________