COMPUTER SCIENCE AND ENGINEERING

Graduate Program Head: Chita Das
Program Code: CSE
Campus(es): University Park (Ph.D., M.S., M.Eng.)
Degrees Conferred: Doctor of Philosophy (Ph.D.)
Master of Science (M.S.)
Master of Engineering (M.Eng.)
Dual-Title Ph.D., M.S., and M.Eng. in Computer Science and Engineering and Operations Research

The Graduate Faculty View (https://secure.gradsch.psu.edu/gpms/?searchType=​fac&prog=CSE)

The department offers courses and is prepared to direct research in a variety of subfields of computer science and engineering, including VLSI, computer architecture, parallel/distributed processors and processing, multiprocessors, interconnection networks, pattern recognition and image processing, performance evaluation, reliability, fault tolerance, theory of computation, computer systems, numerical analysis and optimization, programming methodology, and analysis of algorithms.

Research and instruction are supported by extensive computing facilities within the University’s Information Technology Services and by the computer laboratories operated by the department.

Admission Requirements
Applicants apply for admission to the program via the Graduate School application for admission (http://gradschool.psu.edu/prospective-students/how-to-apply/). Requirements listed here are in addition to Graduate Council policies listed under GCAC-300 Admissions Policies (http://gradschool.psu.edu/graduate-education-policies/).

All applicants must provide a one-page statement of purpose and scores from the Graduate Record Examinations (GRE) Aptitude Test (verbal, quantitative, and analytical). A subject test in the GRE is not required, but the subject test in Computer Science is recommended.

The language of instruction at Penn State is English. English proficiency test scores (TOEFL/IELTS) may be required for international applicants. See GCAC-305 Admission Requirements for International Students (http://gradschool.psu.edu/graduate-education-policies/gcac/gcac-305-admission-requirements-international-students/) for more information.

Those students seeking an assistantship in Computer Science and Engineering are required to submit a Test of Spoken English (TSE) or the TOEFL iBT. A score of 26 on the speaking section of the TOEFL iBT is equivalent to passing the TSE. A lower score would require remedial English as a Second Language courses. For score reporting for TOEFL, the institution code is 2660 and the department code is 78.

Degree Requirements
Master of Engineering (M.Eng.)
Requirements listed here are in addition to Graduate Council policies listed under GCAC-700 Professional Degree Policies (http://gradschool.psu.edu/graduate-education-policies/).

A minimum of 30 credits at the 400, 500, or 800 level is required, with a minimum of 18 credits at the 500 or 800 level, and at least 6 credits at the 500 level.

Course Title Credits
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CSE 465 Data Structures and Algorithms 3
6 credits of the following: 6
CSE 443 Introduction to Computer and Network Security & CSE 431 Introduction to Database Management Systems
CSE 431 Introduction to Computer Architecture & CSE 472 and Microprocessors and Embedded Systems
3 credits of the following: 3
CSE 500 - CSE 589
CSE 597 Special Topics

Spring Semester
12 credits of the following: 12
CSE 500 - CSE 589
CSE 597 Special Topics

Summer Semester
CSE 820 Software & Hardware Project Management 3
CSE 594 Research Topics 3

Total Credits 30

The culminating experience for the program is a master’s paper completed while the student is enrolled in CSE 594.

Master of Science (M.S.)
Requirements listed here are in addition to Graduate Council policies listed under GCAC-600 Research Degree Policies (http://gradschool.psu.edu/graduate-education-policies/)

A minimum of 31 credits at the 400, 500, 600, or 800 level is required, with at least 18 credits at the 500 and 600 level, combined. Students may choose to complete a thesis or a scholarly paper. Students choosing to complete a thesis must complete at least 6 credits in thesis research (600 or 610). Students choosing to complete a scholarly paper must complete at least 18 credits in 500-level courses.

Required Courses

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<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>CSE 465</td>
<td>Data Structures and Algorithms</td>
<td>15-18</td>
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<tr>
<td>or CSE 565</td>
<td>Algorithm Design and Analysis</td>
<td>9</td>
</tr>
<tr>
<td>CSE 473</td>
<td>Operating Systems Design &amp; Construction</td>
<td></td>
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<tr>
<td>or CSE 511</td>
<td>Operating Systems Design</td>
<td></td>
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<tr>
<td>CMPEN 431</td>
<td>Introduction to Computer Architecture</td>
<td></td>
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<tr>
<td>or CSE 530</td>
<td>Fundamentals of Computer Architecture</td>
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<tr>
<td>CSE 590</td>
<td>Colloquium</td>
<td>1</td>
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</tbody>
</table>

Culminating Experience
Students who choose to complete a thesis must pass a thesis defense. The thesis must be accepted by the advisers and/or committee members, the head of the graduate program, and the Graduate School. If the student completes a scholarly paper, the paper must be accepted by the supervising faculty member(s) and the head of the graduate program. The scholarly paper is completed while the student is enrolled in CSE 594.

**Doctor of Philosophy (Ph.D.)**

Requirements listed here are in addition to Graduate Council policies listed under GCAC-600 Research Degree Policies. (http://gradschool.psu.edu/graduate-education-policies/)

Students applying for and gaining admittance to the Ph.D. program will not be permitted to switch to the master’s program at a later date, except under extenuating circumstances, at the discretion of the program.

To qualify for a Ph.D. degree, students who do not have an M.S. degree in Computer Science or Computer Engineering must take a minimum of 33 credits, including:

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<tr>
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<tr>
<td>CSE 591</td>
<td>Research Experience in Computer Science and Engineering</td>
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<tr>
<td>CSE 590</td>
<td>Colloquium</td>
<td>2</td>
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<tr>
<td>CSE 591</td>
<td>Research Experience in Computer Science and Engineering</td>
<td>1</td>
</tr>
<tr>
<td>CSE 565</td>
<td>Algorithm Design and Analysis</td>
<td>3</td>
</tr>
<tr>
<td>CSE 511</td>
<td>Operating Systems Design</td>
<td>3</td>
</tr>
<tr>
<td>CSE 530</td>
<td>Fundamentals of Computer Architecture</td>
<td>3</td>
</tr>
<tr>
<td>6 credits of the following:</td>
<td>6</td>
<td></td>
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<tr>
<td>9 credits of 400-, 500-, or 800-level courses in CSE/EE/MATH/STAT, or 500- or 800-level IST courses (which may include up to 3 credits of CSE 596)</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>CSE 590</td>
<td>Colloquium</td>
<td>2</td>
</tr>
<tr>
<td>Total Credits</td>
<td>33</td>
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Students admitted to the Ph.D. program with an M.S. degree in Computer Science or Computer Engineering must take a minimum of 21 credits, including:

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<tr>
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<td>Research Experience in Computer Science and Engineering</td>
<td>1</td>
</tr>
<tr>
<td>CSE 590</td>
<td>Colloquium</td>
<td>2</td>
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**Degree Requirements**

To qualify for the dual-title degree, students must satisfy the degree requirements for the degree they are enrolled in Computer Science and Engineering, listed on the Degree Requirements tab. In addition, students must complete the degree requirements for the dual-title in Operations Research, listed on the Operations Research Bulletin page (http://bulletins.psu.edu/graduate/programs/majors/operations-research/). The qualifying examination committee for the dual-title Ph.D. degree will be composed of Graduate Faculty from both Computer Science and Engineering and must include at least one Graduate Faculty member from the Operations Research program. Faculty members who hold appointments in both programs’ Graduate Faculty may serve in a combined role. There will be a single qualifying examination, containing elements of both Computer Science and Engineering and Operations Research. Dual-title graduate degree students may require an additional semester to fulfill requirements for both areas of study and, therefore, the qualifying examination may be delayed one semester beyond the normal period allowable.

In addition to the general Graduate Council requirements for Ph.D. committees (http://gradschool.psu.edu/graduate-education-policies/gcac/gcac-600/phd-dissertation-committee-formation/), the Ph.D. committee of a Computer Science and Engineering and Operations Research dual-title Ph.D. student must include at least one member of the Operations Research Graduate Faculty. Faculty members who hold appointments in both programs’ Graduate Faculty may serve in a combined role.
combined role. If the chair of the Ph.D. committee is not also a member of the Graduate Faculty in Operations Research, the member of the committee representing Operations Research must be appointed as co-chair. The Operations Research representative on the student’s Ph.D. committee will develop questions for and participate in the evaluation of the comprehensive examination.

Students in the dual-title program are required to write and orally defend a dissertation on a topic that is approved in advance by their Ph.D. committee and reflects their original research and education in Computer Science and Engineering and Operations Research. Upon completion of the doctoral dissertation, the candidate must pass a final oral examination (the dissertation defense) to earn the Ph.D. degree. The dissertation must be accepted by the Ph.D. committee, the head of the graduate program, and the Graduate School.

Minor
A graduate minor is available in any approved graduate major or dual-title program. The default requirements for a graduate minor are stated in Graduate Council policies listed under GCAC-600 Research Degree Policies (http://gradschool.psu.edu/graduate-education-policies/) and GCAC-700 Professional Degree Policies (http://gradschool.psu.edu/graduate-education-policies/), depending on the type of degree the student is pursuing:

- GCAC-611 Minor - Research Doctorate (https://gradschool.psu.edu/graduate-education-policies/gcac/gcac-600/gcac-611-minor-research-doctorate/)
- GCAC-641 Minor - Research Master’s (https://gradschool.psu.edu/graduate-education-policies/gcac/gcac-600/gcac-641-minor-research-masters/)
- GCAC-709 Minor - Professional Doctorate (https://gradschool.psu.edu/graduate-education-policies/gcac/gcac-700/gcac-709-professional-doctoral-minor/)
- GCAC-741 Minor - Professional Master’s (https://gradschool.psu.edu/graduate-education-policies/gcac/gcac-700/gcac-741-masters-minor-professional/)

Student Aid
Graduate assistantships available to students in this program and other forms of student aid are described in the Tuition & Funding (http://gradschool.psu.edu/graduate-funding/) section of The Graduate School’s website. Students on graduate assistantships must adhere to the course load limits (http://gradschool.psu.edu/graduate-education-policies/gsad/gsad-900/gsad-901-graduate-assistants/) set by The Graduate School.

Courses
Graduate courses carry numbers from 500 to 699 and 800 to 899. Advanced undergraduate courses numbered between 400 and 499 may be used to meet some graduate degree requirements when taken by graduate students. Courses below the 400 level may not. A graduate student may register for or audit these courses in order to make up deficiencies or to fill in gaps in previous education but not to meet requirements for an advanced degree.

Learning Outcomes
Master of Engineering (M.Eng.)
1. Graduates will be able to demonstrate understanding of advanced core principles and methods from selected sub-fields of Computer Science and Engineering at a depth consistent with their course of study.
2. Graduates will be able to apply their knowledge of selected sub-fields of Computer Science and Engineering to formulate and solve engineering problems.
3. Graduates will be able to analyze and synthesize knowledge within the field of Computer Science and Engineering to address a complex problem of practical relevance.
4. Graduates will be able to demonstrate proficiency in written communication appropriate to their discipline.
5. Graduates will be able to demonstrate an understanding of and a commitment to, the standards for professional practice within Computer Science and Engineering.

Master of Science (M.S.)
1. Graduates will be able to demonstrate understanding of advanced core principles and methods from selected sub-fields of Computer Science and Engineering at a depth consistent with their course of study.
2. Graduates will be able to apply their knowledge of selected sub-fields of Computer Science and Engineering to formulate and solve engineering problems.
3. Graduates will be able to analyze and synthesize knowledge within the field of Computer Science and Engineering to extend existing knowledge through a research experience or a course-based culminating experience.
4. Graduates will be able to demonstrate proficiency in oral and written communication appropriate to their discipline.
5. Graduates will be able to demonstrate an understanding of, and a commitment to, the standards of scholarship and research integrity within Computer Science and Engineering.

Doctor of Philosophy (Ph.D.)
1. Graduates will be able to demonstrate an understanding of advanced core principles and methods as well as modern research findings from selected sub-fields of Computer Science and Engineering (CSE) at a depth appropriate for a Ph.D. candidate.
2. Graduates will be able to apply their knowledge of selected sub-fields of Computer Science and Engineering in formulating and executing a research plan.
3. Graduates will be able to demonstrate the ability to analyze and synthesize appropriate literature to critically review their work in the context of the literature, and to formulate and defend conclusions based on their research that represent new scholarly contributions.
4. Graduates will be able to demonstrate high levels of proficiency in written communication.
5. Graduates will be able to demonstrate an understanding of and a commitment to, the standards for scholarship and research integrity.
## Contact

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<thead>
<tr>
<th>Campus</th>
<th>University Park</th>
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<tbody>
<tr>
<td>Graduate Program Head</td>
<td>Chitaranjan Das</td>
</tr>
<tr>
<td>Director of Graduate Studies (DGS) or Professor-in-Charge (PIC)</td>
<td>John Morgan Sampson</td>
</tr>
<tr>
<td>Program Contact</td>
<td>Jennifer Joy Houser</td>
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<td>Graduate Admissions</td>
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<td></td>
<td>W209 Westgate Building</td>
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<td><a href="mailto:jjh2@psu.edu">jjh2@psu.edu</a></td>
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<td>(814) 865-9186</td>
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Program Website: View [http://www.cse.psu.edu/prospective/graduate/](http://www.cse.psu.edu/prospective/graduate/)